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Welcome Message from Conference Chairs

On behalf of the organizing committee, we would like to welcome you to The Ninth International Conference on Electronic Business (ICEB 2009). The Department of Decision Sciences and Managerial Economics is proud of organizing this conference jointly with Li & Fung Institute of Supply Chain Management and Logistics, The Chinese University of Hong Kong and Faculty of Management and Administration, Macau University of Science and Technology. This is the third time The Chinese University of Hong Kong hosting the conference. However, this is the first time we are hosting a conference in Macau, a southern Chinese city with a lot of Portuguese accents. We have dedicated to this conference as usual and hoping you can enjoy it.

ICEB 2009 is an annual event supported by the International Consortium for Electronic Business that was initiated by The Chinese University of Hong Kong, Hong Kong; National Chiao Tung University, Taiwan; Tsinghua University, China; and National University of Singapore, Singapore in year 2000. The Consortium aims to be the leading forum for e-business knowledge and education in the world.

The aim of the conference is to foster the exchanges of research findings, innovative ideas and industrial practices in the area of e-business with special emphasis on “Ubiquitous e-Services in Digital Society”, since the growth of Internet has pushed the wave of e-Business adoption to all walks of life. ICEB 2009, has more than 160 papers submitted and we select around 140 papers to be included in the conference proceedings. The topics include Business Intelligence, Customer Relationship Management, e-Commerce: Theory and Applications Development, Information Management, Information Security, Interactive TV Service, Mobile Commerce, Service Innovation and Strategy, Virtual Community and others. We certainly hope this conference can provide a platform for exchanging findings and issues in e-business.

The conference would not be successful without your participations and dedications of many colleagues. We would like to express our sincere appreciation for the support of Faculty of Business Administration, Chung Chi College, Li & Fung Institute of Supply Chain Management and Logistics, The Chinese University of Hong Kong and Faculty of Business Administration, Macau University of Science and Technology for sponsoring and co-organizing this event. We would like to thank Professor Vincent Lai for the great effort on serving as the program chair, Professors Mika Hannula, Ravi Seethamraju, Irene Wang, Ja-Shen Chen, James Chin-Tarn Lee, Shin-Yuan Hung, Indranil Bose, Lee Schlenker, Namjae Cho, Ping Yi Chao, David C. Yen, She-I Chang, George Lin, Zhang Cheng, PengZhu Zhang, Hsin-Lu Chang, Gilbert Babin, Jinlong Zhang, Hong Zhou, Ming Dar Hwang, Kung-Jen Wang, Rua-Huan Tsaih, Kanliang Wang, Sophia Wang, Jao-Hong Cheng, Ting-Peng Liang, Patrick Chau, Benjamin Yen, Siriluck Rotchanakitumnuai, Ziqi Liao, Weiguo Fang, Wenyih Lee, Rebecca Yen, Anming Zhang, Xiande Zhao, Baoding Liu, Ludwig Chang for serving as the track chairs, Professor Eldon Y. Li for the support from International Consortium for Electronic Business, and many colleagues for serving as international committee members. Last but not least, we like to thank our colleagues who dedicate to the conference, including Elaine Chu, Maggie Leung, Cuby Lee, Ronney Chim, Joanna Choi, Xiaowei Chen and many others.
We sincerely hope you can enjoy the hospitality by Department of Decision Sciences and Managerial Economics, The Chinese University of Hong Kong, during your stay in Macau.

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Professor and Chairman  
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The Chinese University of Hong Kong

Timon Du  
Professor  
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THE USE OF SOCIAL MEDIA IN GATHERING AND SHARING COMPETITIVE INTELLIGENCE

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Abstract
Utilizing social media in the business context is an issue of growing interest. This article discusses how social media can contribute to information gathering and to information and knowledge sharing within a company in the context of competitive intelligence. The research is conducted as a systematic literature review. The results show that so far only a few journal articles have been published discussing these issues. They propose that social media applications can contribute to competitive intelligence activities more in sharing than gathering information and knowledge. The common benefit received from using different social media applications seems to be the added value compared to using more traditional knowledge sharing tools.

Keywords: Social Media, Competitive Intelligence, Identifying Information Sources, Information Gathering, Information Sharing, Knowledge Sharing

Introduction
Social media (sometimes referred to as web 2.0) is a hot topic in competitive intelligence. Competitive intelligence professionals are keen to find out ways to use Twitter, LinkedIn, Facebook, blogs and other social media applications to competitive intelligence purposes. [1] [2]

There seems to be two approaches to social media in the competitive intelligence context. First one is the information gathering approach. It considers how social media applications can advance information source identification and information gathering from the company’s external business environment. This is based on the basic default of having a competitive intelligence unit or suchlike centralized personnel responsible for the company’s competitive intelligence process. The focus is on how their work can be made more efficient with the use of social media.

The other perspective is the information sharing approach. It looks at social media as a means to share information and knowledge and enabler of collaborative competitive intelligence throughout the company. This approach sees competitive intelligence as a united effort of the whole organization: social media is considered as a way to empower employees and getting them to participate in the competitive intelligence process as information sources, refiners and users.

While companies can utilize social media according to either of the approaches described above, it is the authors’ understanding that the former way is more common. This is possibly due to the fact that the continuously increasing amount of available information creates additional pressures for companies to gather as much of this information as they possibly can in order to gain competitive edge over their competitors. While many social media applications, such as automated RSS feeds actually save time and effort when monitoring the competitive environment, the authors hypothesize that without an effective way to process or disseminate that knowledge to the workforce, the end result will be information overflow, or at least information that is not used to its full potential.

Therefore, harnessing the social media applications to share the captured information and knowledge throughout the company to the correct personnel is as imperative as capturing the information in the first place.

Since social media as a phenomenon is rather new [3], the academic literature on the subject is still relatively scarce. The authors conducted a systematic literature review on how both these approaches to social media have been utilized in the competitive intelligence context. Based on the reviewed literature, a set of potential benefits for utilizing social media as enhancer of information gathering and an enabler for internal information and knowledge sharing are derived.

Social media makes its way from leisure to business
Web 2.0 is a buzzword that has been increasingly hyped since its introduction in 2004 [3]. Although web 2.0 is often used as an adjacent term with social media, they are not synonyms. Web 2.0 refers to the technological features of the new generation of Internet, whereas social media is used to describe the actions enabled by web 2.0 applications. Social media is closely related to human interaction, social networking and publishing information. The term web 2.0 itself does not necessarily include the media aspect or any social activity [4].

Web 2.0 uses several technologies that enable
features referred to as SLATES, short for Search, Links, Authorship, Tags, Extensions, Signalling [5]. These features are the technological building blocks of social media and its activities listed in Table 1.

Table 1. Social media genres, activities and examples of their application. (Adapted from [4])

<table>
<thead>
<tr>
<th>Genre</th>
<th>Activity</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content creation and publishing tools</td>
<td>Production, publishing and dissemination</td>
<td>Blogs, wikis, podcasts (e.g. Blogger, Wikipedia, Flickr, del.icio.us, YouTube)</td>
</tr>
<tr>
<td>Social networks</td>
<td>Keeping up the old and building new social networks, self promotion etc.</td>
<td>Social network sites (e.g. LinkedIn, Facebook, MySpace)</td>
</tr>
<tr>
<td>Virtual worlds</td>
<td>Play, experience and live virtual environments</td>
<td>Virtual worlds (e.g. Second life, Warcraft)</td>
</tr>
</tbody>
</table>

People are accustomed to use social media in leisure activities. They are blogging about their hobbies, sharing vacation photographs in Flickr, updating their status in Facebook and uploading music videos in YouTube. Most of the young people entering job markets today can be called “digital natives”, people who have grown up with computers, internet and mobile phones [6]. For them digital technology is part and parcel of life, and it can be assumed that they are willing and even eager to adopt the use of social media also in the job context. This view is supported by a recent survey revealing that professional and work-related blogging is growing and that professional blogging has a positive impact on the career [7].

Companies are more careful with adopting social media. Social media is acknowledged to have potential in the business context, but companies do not quite seem to know how to realize the potential [8]. Marketing and communication departments have been the first functions in the frontiers of using social media in business. Despite the rather modest adoption rate of social media, the benefits of harnessing social media to promote products and reaching to customers and consumers are evident [9]. Other parts of business could benefit from social media as well, such as competitive intelligence.

**Using social media in competitive intelligence**

**Gaining competitive advantage from information**

Companies use information in generating their products and services. In addition to the know-how needed to produce them a company also needs to understand to whom, at what price, where, when and how the products and services should be sold in order to get the best possible profit. This understanding is built on experience and knowledge that already exists within a company, but in order to see the whole picture and new possibilities and threats a company also needs information from its external business environment.

Competitive intelligence is a process aimed to acquire this information, filter and refine it to a suitable form and deliver it to the users within the organization. The goal is to make sure that all the needed and useful information and knowledge regarding competitive issues makes its way to the users. At the same time another goal is to prevent excess and unreliable information from blurring the decision making process. Implicitly social media would seem to have potential to be a valuable aid helping competitive intelligence to reach these objectives. There are indications of social media already being used in competitive intelligence context (see e.g. [1]), and the following sections of this article will discuss the issue from two different viewpoints.

**Information source identification and information gathering**

The competitive intelligence process uses multiple sources and methods to gain the information needed in the organization. Some of the information is published and easy to reach either for free (e.g. companies’ statutory financial information) or against money (e.g. consultant reports). Some unpublished information may be very hard or even impossible to get (e.g. competitor’s plans of entering new market areas, possible upcoming changes in legislation), but finding the right sources might make it reachable. For example, a person working in a customer company may have valuable information concerning a certain competitor. Or an employee in a government department could be of assistance when pondering the impacts of a new regulation to the company.

How to identify these possible sources in order to contact them is often a difficult and time-consuming task. Social media can be of assistance in information source identification. Carpe [10] has listed and graded networking sites with information about people i.e. possible human sources of competitive intelligence. Sites such as LinkedIn, Wink.com and Jobster.com are examples of business social networks, where people list their professional information. This enables extensive searching for company employees, locations, organizational charts, titles and specialties. Making a search in such a professional social network may produce company...
specific information such as headcount, revenue, employees by function, direct phone numbers and email addresses [10]. The networks help to locate a possible information source and may even give his/her contact information. The information is given by the individuals using the network, and sometimes they upload company specific information that obviously should not be made public. This makes these networks even more interesting for a competitor’s competitive intelligence personnel, because in addition to helping to identify possible personal information sources the network site itself can also act as a primary information source.

Another resource consuming part of information gathering is searching information from internet and keeping up with constantly updating pages. Web 2.0 technology called RSS (i.e. Real Simple Syndicate or Rich Site Summary) enables filtered data delivery from selected web pages whenever the contents are changed or new content is added (see e.g. [11] [12]). Many web sites, blogs, news services and other online publications are increasingly offering RSS feeds. Using RSS feeds brings advantages to everyday information search and retrieval tasks regarding competitive intelligence. According to Johnson [13] these advantages are e.g. saving time and increasing productivity, lower information subscription and technology costs and fewer concerns on security issues. For example, subscribing feeds by using an RSS reader helps to access the updated contents of several sites in one place.

Information and knowledge sharing within the company

Competitive intelligence process does not end when the information has successfully been acquired. The information has to be shared within the company. The engaging employees in the competitive intelligence process as analyzers and sharers of information and knowledge adds value to the original intelligence process as analyzers and sharers of knowledge and adds value to the original intelligence process [14] [15] [16].

Liu and Liu [17] found that employees who have acquired knowledge from external sources are quite eager to share it to others in the company. They (ibid.) state that knowledge sharing is more efficient in small-group setting, because then it is possible for the source and the receiver to interact in a two-way manner. Face-to-face knowledge sharing is the most natural and often also preferred setting for interactive knowledge sharing. This however is not always possible, and even less so in a geographically dispersed company. When people are located in different places globally, the possibilities for face-to-face meetings are few. The prevailing economical recession has decreased the possibilities of face-to-face meetings between different locations from before by making companies to reduce or even ban internal business traveling altogether (see e.g. [18]). Therefore information and knowledge needs to be shared some other way, independent of geography and time zones.

Traditional groupware, such as video meetings and multi-participant phone meetings have become more popular, but they do not meet all the information sharing needs regarding competitive intelligence. One central problem is that only a limited amount of people are actually able to participate the meetings: the individuals having the best up to date knowledge concerning the issue discussed may not be in those meetings, or them being possible information sources in the issue may even not be known. Therefore it would be advantageous to have a medium via which all essential employees could share their information about competitive issues and accumulate the company’s competitive intelligence assets.

The potential of social media applications in enhancing information and knowledge sharing is implicit considering the purposes they are used in leisure: communicating, publishing information and networking [4]. Corporate blogs and management blogs are often focused on promoting corporate image for customers and other external parties [19], but they can also be used in internal communication. Siemens Information and Communication Networks Division pioneered in web-based knowledge sharing network already in 2002 [20], and since then the path towards collaboration in social networks and wikis has grown into a highway.

Systematic literature review

Despite the implicitly understood potential and thus growing interest of getting social media to support competitive intelligence activities in companies there seems to be quite little academic evidence of the issue. In order to find relevant academic research regarding the subject a systematic literature review was performed.

Systematic literature review is a useful method when the objective is to identify, assess, and synthesize all the essential studies of a given topic in order to get an overall picture of the studies and their indications. In addition the method minimizes the risk of bias caused by the human factors. [21] [22] The process of the systematic literature review is illustrated in Figure 1.

The aim of this systematic literature review was to study how social media has been utilized in information gathering and sharing information and knowledge in competitive intelligence context. The source of the reviewed articles was EBSCOHost Research Databases provided by EBSCO Information Services. The search was restricted in two databases in EBSCOHost: Academic Search Elite and Business Source Elite because they were
considered to hold the most relevant and good quality articles concerning the research topic. Restrictions had to be made in order to find articles of good quality and significance to the subject among the tens of thousands of articles within these databases. First the time scale of the articles was determined to start from January 2004. This time period was chosen because the term “Web 2.0” was first introduced in 2004 [3] and subsequently the wider discussion of social media was launched. The time period ends in August 2009 since the search was conducted in September 2009.

The academic quality of the research was enhanced by excluding all non-scholarly (i.e. not peer reviewed) articles. Another restriction aimed at enhancing the scientific credibility of the research was to take to account only those articles that were available in full text format. Abstracts do not always describe accurately the actual substance of the article and may therefore mislead the reader. Including only full text articles into this study made it possible for the authors to actually read through the articles in whole and thus determine whether they in fact were relevant to the study. These basic criteria of the search in EBSCOHost databases are summarized in Table 2.

**Figure 1. The process flow of systematic literature review. (Adapted from [21])**

**Figure 2. The set of key terms used in the systematic literature review.**
Table 2. The basic criteria of the search.

<table>
<thead>
<tr>
<th>Criteria of the search</th>
<th>Databases</th>
<th>Time scale</th>
<th>Articles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Academic Search Elite</td>
<td>January 2004–August 2009</td>
<td>Available in full text Peer reviewed In English</td>
</tr>
</tbody>
</table>

The search was refined by using relevant key terms. The key terms helped to filter articles discussing the issues of interest. The set of key terms is presented in Figure 2. Figure 2. The set of key terms used in the systematic literature review.

The key terms were used as combinations of several terms, Boolean operators AND and OR (marked with grey in Figure 2). Asterisk was used to truncate the search term where necessary.

Results

The search for using social media for information gathering and sharing in competitive intelligence context yielded altogether 143 results. 86 articles discuss the issue from information sharing point of view and 57 from information gathering point of view. When these results were checked for relevance, one notable fact emerged. The term “community” is rather commonplace in business literature, and many of the results did, in fact, discuss the roles of knowledge or learning communities or so-called communities of practice. Such communities may indeed have an important role in spreading or disseminating knowledge throughout the company. In most of these articles, however, social media applications were not discussed and therefore they were dropped from the results.

After the initial screening, 13 articles were found to discuss at least one social media application and its relationship to the business world. However, the focal point of this literature review is the competitive intelligence context, which means that the articles included in the final stage will have to discuss the impact of the social media application to knowledge gathering, analysing or distribution within the company.

The final examination of the articles produced five results that fit into the authors competitive intelligence schema categorized by the nature of the social media application. Four of the articles fell under the information sharing approach, and only one discussed social media from information gathering point of view. The occurrences of different social media applications discussed in the resulted articles is illustrated in Table 2. Wikis were discussed in one article, while blogs and social networks were both discussed two times.

Table 3. Social media applications discussed in the articles.

<table>
<thead>
<tr>
<th>Approach</th>
<th>Blogs</th>
<th>Wikis</th>
<th>Social networks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information gathering</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Information sharing</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Both of the blog-related articles emphasized the use of blogs in facilitating knowledge transfer, but also the issue of knowledge refining was evident. Wang and Wang [23] suggest that a blog-based knowledge-sharing model would improve the knowledge flow between companies’ data mining and business intelligence processes. Kaiser and Müller-Seitz [24] propose that software developers engage in writing blogs not only because of the actual knowledge transfer function, but because there are other intrinsic and extrinsic stimuli that provide added value. Such added value can be the feeling of having an impact, engaging in social exchange, signalling one’s competence, or getting support [24]. These examples suggest that blogs are not used just as extensions of traditional bulletin boards, but rather a tool that adds value to both the writer of the blog and the reader as well.

Wikis are a common and useful tool in teaching (see e.g. [25] [26]) that allow students to participate and collaborate on various educational projects. However, only one article considering the use of wikis emerged with the authors’ search criteria. McKelvie et al. [27] describe how a wiki-based system has been successfully implemented in a research company. The implementation of the wiki tool has been a success producing a vessel for delivering news articles, conference minutes, important emails or project notes. Basically, the same items could have been delivered through blogs or corporate Intranet as well, but they were rejected at the implementation stage for being too complex or hard to use. [27] Another benefit of the wikis was reported that the users were very satisfied with the fact that they could edit and add material to the system, thus having an individual impact on corporate knowledge creation.

The advantage the wikis seem to have over blogs is their centralized structure. With a wiki application, every user is using the same system, and
every user has the possibility to edit the articles the system contains. On the other hand in the blogosphere – a term used to describe the system of connected blogs – the structure is much more decentralized, as every blogger writes his/her own texts, which are linked to one another in a seemingly arbitrary fashion.

Social networks, such as MySpace, Facebook, or LinkedIn are being used in knowledge sharing all around the world for every minute of the day, every day. Sometimes the exchange is between colleagues within the same organization, and sometimes between different organizations. These activities usually take place because the individual users are doing it rather than because of a corporate policy. In fact, in many cases, organizations ban their employees from using social networks such as Facebook on company time (see e.g. [28]).

Cooke and Macfarlane [29] present an alternate view, where the social network/virtual world Second Life has been used while building communities of practice in training fresh market researchers, who can be seen as the people carrying out the competitive intelligence process. According to Cooke & Macfarlane (2008), four main benefits can be achieved by utilizing virtual worlds in such programs.

- developing personal skills
- recruiting talent
- starting new lines of businesses
- transferring best practices

Obviously, all four items are of great importance to any company, but only the last one fits within the realm of knowledge sharing. However, it can be argued that using social media in training market researchers also gives them knowledge on how to utilize social media in their competitive intelligence related work later on.

Once again, it seems that while the social media applications can and are being used to share information and knowledge within organizations, there is always the concept of added value that is linked to such activities compared with “traditional” knowledge sharing tools such as emails, company newsletters and bulletin boards.

The only article falling under information gathering approach discussed a virtual community: Casaló et al. [30] describe how a company can motivate its customers to participate virtual brand communities. They (ibid.) find that in addition to increasing consumer loyalty, product promotion and communication to customers, the advantages of such communities is better understanding customer needs and desires. [30] In other words, this kind of virtual community can produce vital information about customers that helps a company in developing and marketing products that satisfy their desires.

Conclusions

When person A informs person B of something, a transfer of knowledge has taken place. In a corporate setting, the number of such persons and their different combinations can be overwhelming. By utilizing user-generated content, social media applications try to facilitate knowledge transfer in a wider scale. The articles reviewed in this paper present clearly, how social media applications can enhance knowledge transfer activities within a company. However, the benefits of social media go beyond the basic setting of knowledge transfer (such as A telling B something).

The main added value of social media applications that was found in the reviewed articles was the fact that virtually anyone can act as knowledge provider and similarly anyone can act as knowledge receiver. This would result in a setting where there would no longer be employees who have to go through perilous crusades in order to find the one tiny bit of information that only one other employee is in possession of. In an ideal setting this would provide a situation where all the knowledge within a company could be harnessed to every employee in the company. Naturally, the authors realize that such a situation is a utopian one (not every employee would contribute to the corporate social media, some knowledge is hard to encode, some knowledge is for managerial personnel only…), but in theory, such a setting could be a possibility. Other benefits from using social media in CI context have been recorded as well in the reviewed articles (see Table 4.).

Table 4. Possible benefits of using social media in CI.

<table>
<thead>
<tr>
<th>Benefits by application</th>
<th>Blogs</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Enhance knowledge sharing between business processes.</td>
<td></td>
</tr>
<tr>
<td>- Provide added value for both writer and reader.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Wikis</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Beat intranet and blogs in delivering information.</td>
</tr>
<tr>
<td>- Enable employees to corporate knowledge creation</td>
</tr>
</tbody>
</table>
Even though the authors’ presumption was that there is so far rather little of academic research on the issue, the number of articles meeting the search criteria was even lower than anticipated. The relatively small amount of research articles published can be explained through the novelty of the phenomenon: the use of social media in other context than leisure and fun is yet rather unfocused. Companies understand that there may be synergy found in adopting social media in business, but for now they are still fumbling in the dark not quite sure of what they actually are trying to reach.

Since the companies actually using social media in competitive intelligence context (or at least the ones feeling confident enough to talk about it) are scarce, it is self-evident that empirical case research on the subject is consequently fairly lacking. The benefits of social media, as presented in this article, are nevertheless worthwhile and the overall diffusion of social media seems to go on indefinitely. At the same time the academic research on combining social media and competitive intelligence is almost a virginal area. In addition to practical experiences and case studies basic research on theoretical implications of how social media could benefit competitive intelligence is considered needed and desirable.

References
[18] The Chartered Institute of Personnel and Development. Employers experience budget cuts, escalation of workloads and higher stress levels to cope with recession, according to latest CIPD/KPMG quarterly survey (http://www.cipd.co.uk/pressoffice/_articles/LMOfocus23


UTILIZING BUSINESS INTELLIGENCE FRAMEWORK FOR LEVERAGING PRODUCT LIFECYCLE MANAGEMENT

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Abstract
Product lifecycle management is a concept for managing product related information. Besides product related information decision-makers urge processed information of other types as well. A solution for managing this kind of business information is business intelligence. In this paper is studied how business intelligence framework could be utilized in the context of product lifecycle management in order to refine information for better decision-making. The study is based on theoretical findings of business intelligence as a solution for product lifecycle information management challenges. As a conclusion the paper points out how business intelligence, and especially business intelligence tools, e.g. data warehousing and data mining, are efficient way to refine information products in order to support decision-making.

Keywords: product life cycle management (PLM), business intelligence (BI), information product, data warehousing, data mining

Introduction
PLM (Product Lifecycle Management) is a systematic and controlled concept for managing product related information and knowledge, and products, taking into consideration the whole product lifecycle (design, manufacturing, using, maintenance, recycling and disposal -cycle) [1]. The benefits gained by using PLM in the different separate phases of product lifecycle are proved by many sources, but utilizing product information together with other information types (like customer information) sets challenges for the lifecycle management (see e.g. [2]). Combining information from different sources is also a remarkable opportunity for organizations, for example, combining historical information of maintenance to predicted customer needs would ease the decisions of product customization. Besides the importance of utilizing customer information during the whole lifecycle, utilizing information from multiple different operational sources and the sharing of information to support the decision making are emphasized from product lifecycle management point of view.

In today’s highly networked business environment, various business functions are dispersed throughout different business units that many times cross organizational boundaries, forming complex and volatile relationships [3]. Product data management (PDM), and applications and functions, like enterprise resource planning (ERP) and customer relationship management (CRM), urge for a large amount of data, which presents many challenges to organisations’ information gathering and sharing [4]. Products generate large amounts of information through life cycle. There are several possible viewpoints to issue, e.g. intra organisational, extra organisational and life cycle viewpoints. Common themes to those views are the amount of information, crossing boundaries, form of information and collaboration between different phases of product lifecycle.

The purpose of this study is to find out how business intelligence framework could be utilized in the context of product lifecycle management in order to refine information for better decision making. The study is approached through theoretical consideration about central information management-related product lifecycle management and the challenges it faces and brings forward. One useful solution for problems of information management in PLM is business intelligence, especially BI solutions e.g. data warehousing and data mining. Based on the theory the study is expanded to consider the practical examples of PLM and BI complementing each others. These practices are studied from the business intelligence perspective. The main contribution by this study is to see how PLM information or PDM can be refined through BI process. Contribution is mainly theoretical, yet there are some empirical findings too. Authors seek to find new lines in the field of PLM research. Aim is to provide non-conclusive results.

This paper points out how information products could be processed from organisations’ operational systems to serve the information management in PLM. The research also indicates what type of business intelligence solutions could be utilized to ease the information management in PLM. The key finding in the paper is that business intelligence framework is a useful and novel concept when managing product lifecycle information. Especially, when sharing analyzed information to decision makers through different phases of product lifecycle management.
lifecycle. The paper gives, in addition to descriptive results, some practical points how BI can leverage PLM process.

**Generation of product lifecycle information**

The ultimate goal in managing product lifecycle information is to control and steer product-related information creation, handling, sharing and storing during the whole life cycle [1]. Managing product information is challenging, like stated above. One reason is the variety of the length of product life cycles within in the individual organizations. For example, in car industry product unit’s life cycle is generally longer than life cycle of product model, while in some services might be consumed in shorter time than the life cycle of product models are. In both cases demands for information management are exacting though the life cycle differs. In services the need for information is rapid and more ad hoc while in longer life cycles the accessibility of information years hence is relevant. Stark [5] elicits also challenges like large volumes of data, globalization, mass customization and personalization, knowledge management, new customer requirements, and the variety of different information system applications that all affect to the modern-day product and onward to containing the whole lifecycle.

Though the focus of the paper is on the challenges concerning the whole lifecycle it is essential to understand how product lifecycle is formed. Despite the variety of duration of product life cycles within in the individual organizations some equal phases of product lifecycles can be found. These phases are presented in the figure 1 which is one model of product lifecycle (c.f. [6]). The distinguished phases are design, manufacturing, packaging and distribution, use, service and maintenance, reuse and recycling and disposal. As concluded from the phases there could be many interfaces during product life cycle. For example, companies that manufacture mobile phones have multiple numbers of clients and many different interfaces to suppliers and subcontractors, but companies that prepare paper machines typically have only few clients who participate intensively in the whole manufacturing process.

As stated above, information is generated in each stage in product lifecycle. Information consists of two information modes. The first mode is related to product, i.e. how it is designed etc. The first mode can be documented in order to be passed forward or backward in life cycle, but some of it remains undocumented in each stage. First mode information accumulates in

![Figure 1. A Product life cycle (c.f. [6])](image-url)
from their existing and potential customer depositories to invent added value to their offerings. According to Sääksvuori and Immonen [1] and Stark [5] product lifecycle management is one solution for managing the information related to organisations’ offerings. But Stark [5] continues by saying that PLM is just product-focused, not the customer, or the supply chain, or the organisations’ information systems. Still, one important reason for managing business information is the linkage of the collected information and the business-critical systems and processes like ERP and CRM systems and also the tools to process the information. It seems that managing product lifecycle information needs a process alongside to manage the whole business information.

**Business intelligence framework**

Business intelligence (BI) is a one solution for managing the business information. Many authors, like Pirttimäki [8], define business intelligence as a dualistic concept. The concept refers to the refined information and knowledge, and the process. According to Pirttimäki [8] refined information and knowledge means information about organisation’s business environment, an organisation itself, and its state in relation to its markets, customers, competitors, and economic issues. The process, on the other hand, “produces refined information and knowledge (information products) for the management and decision-makers”. To put it brief BI can be defined as a framework for refining information to knowledge and a framework for refining data masses to information products utilized in operations and decision making.

Business intelligence is a wide concept which takes into account other viewpoints beside those related to product information. Business intelligence could be divided to fields like customer intelligence, marketing intelligence, competitive intelligence and counter intelligence [9] [10]. Competitive intelligence is the closest term if compared to business intelligence. It is continuous scanning of the environment, collecting outside information about competitors’ strategies, customer or supplier activities and market changes and analyzing information to provide refined information, information products, to decision-makers (see e.g. [10] [11]). Customer and marketing intelligence, on the other hand, refer to management of narrower type of information, like product information. Counter intelligence is about preventing other organizations to gather and collect intelligence of our organization [12].

Business intelligence does not have generally accepted conception and, besides above mentioned definitions, sometimes it has divided to discuss either organization’s internal or external information.

However, in this study the concept of business intelligence does not refer just to internal or external information, and neither to any specific information type. BI refers to the processes, techniques and tools which support faster and better decision-making. The main task of business intelligence processes and activities is to refine, analyze and manage large amounts of information related to business and business environment and provide the decision makers the easy access to processed information. Processed information is various types of information products, e.g. monthly sales reports, analysis of organisations’ market situation, analysis of customer needs, and information about subscriptions, product configurations and after-sales activities.

Business intelligence is a process which reduces the need of analysis and ease information sharing. An example of BI process and its phases is seen in the figure 2. Figure is based on many different sources, like Vitt et al. [13], Vuori [14], Gilad and Gilad [15], Choo [16]. The framework takes into account the both views stated above: refining information to knowledge and refining data masses to information products.

![Figure 2. Business information process](image)

The process starts with definition of information needs. Information needs composed of changes and uncertainties between organisation’s industry, strategy and operational environment have to be defined so the needs can be satisfied as well and efficiently as possible. Decision-making seek information and knowledge but false and unless information just harms decision-making. It is important to find out the proprietary information, focus on gathering, analyzing and sharing it in right form, to right people in right time.

Based on the definition of information needs the specified information sources act as a foundation for gathering the expedient information or data. Organisation’s information sources can be external, like competitors and customers, or internal, like operational databases. Based on scale and range of
needed information organizations must decide how tightly they want observe for example changes in markets or behavioral of customers and store the results to organisation’s depositories. From the perspective of product or life cycle information there is large variety of data or information sources. Each phase of lifecycle produces relevant, and especially irrelevant, information. Challenge is how to refine most essential out of relevant information. Moreover, each phase has unique requirements for type of information, e.g. design has different need compared to aftersales.

After information gathering the information must be analyzed and processed to some compact form. Collected information (mass) is assessed and connected to information that is already known. Analyzed information is formed by utilization of business intelligence solutions. During the phase information is generated to form of information products which are equivalent to needs of decision-makers. Though, existence of information and information products is not enough. To achieve decision-makers, information must be shared to satisfy the needs of decision-makers. For instance, sales needs detailed information on product versions to be passed forward to customers. Opposite information flow from customer needs to reach manufacturing and design as if there is something to be developed.

Information gets its final meaning when it is utilized. In the final phase of business intelligence process information is adapted to practice in problem solving and decision making situations. By utilizing information and knowledge is formed new information and understanding, and by adjusting operation of organizations the business intelligence cycle starts over. Business intelligence must be in connection with organizations other processes.

Common for all processes made by above mentioned authors is the result of the processes. The purpose is to produce insights, visions and knowledge for decision makers. In this study the authors emphasize the meaning of information products. Information products are the key elements of sharing relevant information for decision makers. Examples of information products are regular reports and announcements of organisation’s market situation, analysis of product offerings, strategic analyses of competitors and organisation’s intranets. Information products are important means in information sharing but they also act as information sources. Typical characteristics for good information products are ease of use, relevance of the information, flexibility and time and cost savings. The greatest benefit of information products, and of utilizing business intelligence, is gained when the right and qualified information is delivered for supporting decision-making [17].

Business intelligence must be connected to other business processes of organisations, because by separating it from every day operations high quality information, information products, do not bring value to decision-making. In the business intelligence process described above, data warehouses and the other tools, for example mining and analyzing tools, are in essential part in getting the right information to the right people. The tools, such as data warehouses, support the different stages of business intelligence as efficiently as possible. The tools are a part of the business intelligence process in which the data and information are processed into knowledge and intelligence based on the needs of the decision makers. Some authors, like Turban et al. [18] define business intelligence as an umbrella term that combines different tools, applications and methods.

**Business intelligence tools in refining product lifecycle information to the form of information products**

Nowadays business managers come face to face with the problem of having less and less time to make rational decisions with the over-abundance of the information available in various sources. BI solutions, e.g. search and reporting systems, online analytical processing, executive information systems, data warehousing and data mining, enable sharing the relevant and analyzed information through the product lifecycle for the whole personnel at the right time and at the proprietary way. Myllärniemi and Väisänen [19] indicate that organisations have needs to allocate the resources for facilitating information availability in decision making. There are also many examples in literature about different successful BI-solution implementation where organisations have gained remarkable benefits by allocating resources to support decision making, (see e.g. [18] [20] [21] [22]). Based on the literature the collaboration of concepts of product lifecycle management and business intelligence are not widely studied though, business intelligence as solution for resolving challenges of a single phase of product lifecycle is. In this paper, however, business intelligence is discussed as a solution for the challenges related to whole product lifecycle information management pointed out earlier on the text.

It is obvious that decision-makers need to know what their organisations’ problems are and what actions they need to do to solve those unwanted situations. But more important than to know what has happened is to know what will happen next. The evolution of business intelligence tools supports this kind of shift from reactive decision-making to proactive one. The evolution is from query and reporting towards data mining [23]. Efficient utilization of data mining tools coupled with
utilization of data warehouses, i.e. data warehousing, allows correctly and efficiently use of data to support organisations’ decision-making.

Data warehousing is a collection of different decision-supportive systems that help managers to structure and analyze this information better in order to make better and faster decisions. Data warehousing is based on the use of data warehouses (or databases) and a series of different tools to provide the right information for the decision makers [10]. While data warehousing contains the whole process of data handling in the organizations, data warehouses are more like repositories of data; solutions for many organizations for managing and storing their collected business information. Manning [24] describes data warehouse as a repository of current and historical data of potential interest collected from various sources for the purpose of providing management information.

It is important to notice that the data warehouses need to be capable of providing the data in an understandable form to various front-end tools for reporting and analysis. As stated above, data warehousing is more than just technical aspects of databases. Continental Airlines is an illustrative example of how both organizational and technical aspects of data warehousing must be taken into account when talking about successful data warehousing solutions. [21] Their real-time business intelligence solution implementation, which in their case was strongly related to data warehousing, has gained global visibility and recognition. Another good example of successful data warehousing implementation is Wal-Mart’s Collaborative Planning, Forecasting and Replenishment (CPFR) model [20]. The CPFR model allows Wal-Mart to share data and analyze it in collaboration with their suppliers providing added value to their supply chain management processes. These cases, among many others, support the importance of data warehousing in processing information products, and thus, our paper. Especially, the Wal-Mart case indicates data warehousing as a solution for breaking the boundaries between organization and its partners. More potential benefits of data warehousing is proposed by Watson et al. [25] and Myllärniemi & Väisänen [19] which are similar to characteristics of information products:

- Time savings for data suppliers and system users
- More and better information
- Better decisions
- Improvement of business processes
- Support for the accomplishment of strategic business objectives
- better information faster

From data warehouses the information is processed to the decision makers mainly by using information processing methods like OLAP and data mining [19]. OLAP is a fast, intuitive to use and easily decipherable ad hoc method enables users to create on-demand reports and queries [26]. It is one of the most commonly used information processing method among organizations, but it is not as analytical tool as, for example, data mining. One theoretical advantage of data mining over OLAP is the fact that the analyst does not necessarily have to have any kind of prior knowledge about the data. Still, the previous surveys indicated that managers prefer to conduct information processing with a more “human touch” instead of computer-generated algorithms. This calls for more flexible ways of viewing the data.

Earlier studies [19] [17] suggest that organizations are shifting from traditional information analysing methods towards faster and more multifunctional and -dimensional analysing tools, like data mining. Data mining is a process that utilizes statistical, mathematical and artificial intelligence techniques to extract and identify useful information from large databases. Data mining tools look for hidden patterns that can be used to predict future. [26], [27] It discovers previously unknown relationship among the data. For example, While OLAP answers only to questions you are certain to ask, data mining brings answers to unpredictable questions; to questions you would not think of asking [26].

Data mining tools and techniques are used to reach better understanding of customers and organisations’ own operations [26]. The point is to analyze massive amounts of data, for example customer information, to find out customer behavior and to identifying new products and features [28]. As a result of this kind of activity is mode of information, information products, that organizations apply to new customers, products, services or transactions to better understand how they should respond to them [27].

Data mining has been found useful in retailing and sales operations but also in manufacturing and production phases [26]. In the following cases of Credit Suisse and Highmark, Inc. data mining is utilized in forming information of organisations’ fairly large customer-related databases. Credit Suisse used data mining methods to determine their customer value and product buying probability. By data mining methods they generated knowledge about their customers buying a certain core products. This knowledge they utilized in product marketing campaign. [22] The success of Credit Suisse is based on utilization of data depositories and actively gathering the customer information. In Highmark,
Inc. case the use of data mining methods relates to the even massive amount of data gathered from their clients. Highmark, Inc. is a health care organization that exploits data mining in analyzing patient data for achieving cost savings and efficiency to their operations. [18]

When using data mining tools, or any other business intelligence tool, the absolutely value is not the location of used information. The most important is that the processed information supports decision-making. Decision-makers need relevant, real-time and coherent information like in the cases described above. In PLM concept the emphasis is on product information which narrows information sources and, thus, scale of information. In BI process information is processed by utilizing information from internal and external sources, like stated above. This is one of the most remarkable benefits of business intelligence compared to product lifecycle management; the information is not local. In the next figure information sources are linked to product lifecycle concept by utilizing business intelligence process. The figure summarizes the idea of the paper of linking business intelligence to product lifecycle management.

![Information processing - Information products](image)

Based on the discussion of the paper, it could be said that in traditional product lifecycle information management, for example, CRM is only concentrated to collecting information from phases like services. In this framework business intelligence is spread to all organization levels to contain the whole lifecycle. Information is processed in two levels: it is processed from operational databases, like PDM, and from business environment to support decision-making in phases of product lifecycle, but it is also processed from one product lifecycle phase to another. As a result from information processing, either from the depositories or between different phases, is an information product. Information products enable not just top management but also lower-stage employees to access and manage information. Business intelligence is a solution for transferring information from, for example, CRM systems to units that traditionally are not supposed to use that kind of information. Information products are expression of how information process, like BI process, is linked to product lifecycle management. Information product
can also seen as aided sense-making, i.e. analysis is already done.

Conclusions

Based on this research, it is obvious that business intelligence could leverage product lifecycle management. Especially, BI tools, like data warehousing and data mining, could offer remarkable benefits if compared to traditional product information management, for example, BI tools enable multiple ways to analyze and, more important, to process information. On the other hand, the tools enable sharing information products across the lifecycle. The tools discussed in this paper are not just for gathering and processing data and information for the needs of historical reporting. For example, data mining could be used in forecasting and simulating future potential.

As a conclusion, it could be stated that utilizing business intelligence tools organizations could integrate information management processes, like business intelligence process, to their lifecycle management. Besides product information, organizations generate multiple other types of information that need to be processed and shared to all phases of product lifecycle. As a result of business intelligence processes information products are the expression of this integration. Information products minimize discontinuation and migration of information.

Though the concept of business intelligence is emphasized lately and organizations have recognized the benefits business intelligence could offer, it is not a novel concept. Organisations have always gathered information about customers and products and used it for refining their offerings. But by more effective utilization of, for example, business intelligence tools, organizations could get more relevant and coherent information for decision-makers.

This paper presented the results of a theoretical study for future empirical researches about linkage of business intelligence and product lifecycle management. This study described how business intelligence framework could be utilized in the context of product lifecycle management in order to refine information for better decision making. This research brought up the issue of the underlying potential of data warehousing and data mining in product lifecycle information management. Though the study was mainly theoretical, the results show that there is a need for a larger research. The results indicate that the business intelligence and the tools are efficient in refining information and forming information products. Especially, in organizations where challenge is to process information from gathered data masses in order to, for example, provide better services to clientele utilizing business intelligence is a solution. The results motivate for a more pragmatic study of connecting these two concepts together. In further studies the authors aim to study how Finnish manufacturing companies actually use information processing methods in a product lifecycle management concept, and how business intelligence tools could intensify the forming of information products.

References

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INTENSIFYING PATIENT FLOW MANAGEMENT BY USING DATA MINING METHODS

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Abstract
Health care organizations need means to process the patient flow-related data into meaningful information in order to understand and manage complex patient flow networks. In this paper we present a theoretical framework of the patient flow management process and examine how this process could be intensified with the help of data mining methodology. Based on the empirical findings in a case organization, a Finnish special care hospital, the potential of suitable data mining methods, like sequence analysis, is evident. Using the data mining methodology, huge amounts of data could be processed into relevant and reliable information to support decision-making. As a result, the overall quality and effectiveness of the patient flow network would be improved.

Keywords: Health Care, Patient Flow, Patient Flow Network, Patient Flow Management, Data Mining, Sequence Analysis

Introduction
Throughout the world, the pressure for intensifying health care services is high. Demand for the services is increasing rapidly due to e.g. ageing, while even the current level of the health care costs is considered to be too high in many countries. \cite{1} Therefore, in future, more services should be offered with existing resources. Based on our previous researches concerning the health care network in Tampere, Finland \cite{2} \cite{3}, the health care related expenses could be efficiently controlled by intensifying the management of patient flows. The main function of a health care system is to provide patient flows, the functionality of which thus affects directly the cost of the system \cite{4}. Consequently, the intensified management of the patient flows could result in remarkable benefits.

Despite the importance of the matter, there is a lack of broad understanding when it comes to the formation of the whole health care network and its patient flows \cite{1}. Thus, the biggest challenge is to clarify the overview of the complex network formed by various organizations and units with different responsibilities and functions. It is claimed that instead of concerning the whole network, individual health care units currently develop their own operations usually separately from each other \cite{5}.

But how can the broader understanding of patient flow network be achieved in order to manage the service system better? It is found that health care organizations record huge amounts of patient flow-related data, but do not have the means to analyze and process it into relevant information for management and development purposes \cite{6}. Therefore, there is a need for analyzed information which could be utilized in the decision-making concerning the development of a whole health care system. It seems that data mining methods could be an efficient approach to tackle the challenge, as they are designed to process large amounts of data and find notable correlations among it \cite{7}. Regardless of this, the utilization of data mining in this field is not systematically studied \cite{8}.

In this paper, we consider patient flow management in Finnish health care environment and especially in Hatanpää hospital, which is the municipal special health care provider in the city of Tampere. The hospital serves citizens mainly in surgeries and orthopedics as well as in internal and infectious diseases. The hospital management has recognized challenges in the patient flow management. The challenges are related to both internal operations of the hospital but also to the whole health care network of Tampere. This paper concentrates on the challenges that could be resolved by processing the patient flow-related data into useful information more effective than today.

The paper is organized as follows. In the theoretical part, we form the concept of patient flow management based on the existent literature and our earlier research, as well as present the concept of data mining. After that, we examine the patient flow management practices in Hatanpää hospital; what kind of patient flow-related data is recorded and which are the current methods for analyzing it. Finally, we examine via an example how the use of data could be intensified with the help of data mining methods. To conclude, the point of interest of this paper can be stated as follows: how patient flow-related data is refined into information at the moment in order to manage processes that provide patient flows, and how this could be intensified by using data mining methods.

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Theoretical Framework

In this chapter, we examine the concepts of a patient flow and a patient flow network, and based on them, present a theoretical framework for intensifying the patient flow management. At the end of the chapter, we present the data mining methodology, which could be used when processing data into information in order to intensify the patient flow management.

Patient Flow Management

The term patient flow refers to the movement of patients between different operations of health care units. Four common characteristics are mutual to all patient flows: (1) an entrance, (2) an exit, (3) a path connecting the entrance to the exit, and (4) random health care elements along the path. So, between entrance and exit, there are a set of units that the patient may encounter and, at the same time, exploit units’ resources (e.g., beds, examining rooms, physicians, nurses, and medical procedures). This implies that patient flows can be depicted as a network. 

![Figure 1. Patient flow for patients at a family practice clinic](image)

It is important to dissect the whole network instead of separate units. To improve the flow, hospitals must view the problem in terms of an interdependent system rather than individual departments. The units that actually deliver the care in hospitals are tightly linked. Therefore, understanding patient flow requires looking at the whole care system, not just the isolated units. Any individual department that often improves flow by itself in its area in fact relegates the problem to other dependent departments. [5] So, it can be stated that understanding of patient flow is needed to manage a health care facility. Patient flow through different health care units is equivalent to the demand for services of these units [4]. Thus, an effective resource allocation and capacity planning are contingent upon the patient flows.

Studies reveal that it is a common but incorrect assumption that patient flows are a result of randomness. When analyzed, the variation caused by the structure of the service system itself is much bigger that the one caused by the randomness of patient arrivals and their diagnosis. [5]. Hence, once a health care organization has a grip of its patient flow network, the variation of demand can be managed. Consequently, quantitative tools, like forecasting and queuing models, can be used to help decision makers to estimate what resources (e.g. medical staff and equipment) will be required. [4] That is, resource allocation can be done much more accurately and flexibly when the operation is considered as a network of patient flows. [9]

It is now stated that the understanding of patient flow network is important, but how can this intellect be achieved? The concept of knowledge plays a key role in managing the health care services. Hence, one must have a wide knowledge about the system to steer it efficiently. [10] The term knowledge here refers to the outcome of human action which takes place in decision-making situations. This knowledge is acquired from information, which in turn is processed from data. [11] As mentioned earlier, a huge amount of data related to patient flows is recorded every day by the healthcare organizations, but this data seems to be used only for periodical simple reporting. Thus, the data should be processed into information and knowledge more efficiently than today.

At a general level, the data cultivation into information and knowledge is an iterative process [11] [12] [13]. Using this general theoretical framework as a basis, the authors have made a framework for intensifying the patient flow management in their earlier research [3]. This framework is illustrated in Figure 2. The intensification of patient flow management can be seen as an iterative process. This process proceeds as follows:

**Hospital resources (1.)** include all the tangible and intangible capital the hospital possesses. The former includes e.g. staff, facilities, equipment and materials. The latter means intellectual capital meaning e.g. the expertise and processes of the hospital. These resources make it possible to provide (2.) chosen care services for the customers, that is, produce patient flows including all the needed services. The amount and quality of the resources dictates how good the
patient flows can be arranged.

From an operational perspective, patient flows (3.) can be thought of as the movement of patients through a set of locations in a health care facility. Concerning the patient flows, a huge amount of data is recorded (4.). This data is related to things like sources and destinations of the patients, queuing, utilization of support services, and durations of different phases.

Data related to patient flows (5.) can be divided into two categories: operational data in operational IT systems and the data stored in different kinds of data warehouses in order to use it at a later date. To utilize the data in monitoring and management of the flows, it must be processed into (7.) information. This can be done by using various methods, including:
- Basic reporting using e.g. Microsoft Excel
- Measuring pre-defined key-figures
- Traditional mathematical and statistical methods
- Different kinds of data mining methods, e.g. clustering, segmentation and associate analysis
- Modelling and simulation methods.

Information related to patient flows (8.) can also be divided into two categories, though the difference between them is quite flexible. Operational information is related to daily processes and can be used to monitor and manage them. Strategic information for its part is used by the top management in order to make middle and long term strategic decisions. In other words, information related to patient flows supports the development of (9.) hospital resources. As stated earlier, effective resource allocation and capacity planning are contingent upon patient flows. As said, the understanding of the patient flow network offers many possibilities to develop the system. One can identify and fix the problems – like bottlenecks – of the current state of the system as well as forecast the future demand in order to anticipate what resources will be required [4]. So, the achieved information about the network helps decision makers to manage patient flows better, which lead to better flows. This comes with great significance, for potential benefits of better flows include better clinical outcomes, improved patient safety, greater patient and staff satisfaction, and improved financial performance [5].

Data Mining
Data mining is defined as “…the process of selection, exploration, and modeling of large quantities of data to discover regularities or relations that are at first unknown with the aim of obtaining clear and useful results for the owner of the database” [14]. Considering the definition above, data mining would seem to be a useful tool in examining patient flow related data for the following reasons:
- The amount of data in the patient flows is seemingly large (tens of thousands of observations)
- Considering the amount of different units and the total number of all possible patient flows, the data structure is rather complex
- The underlying patterns in such a large data mass are most likely unknown at first.

The advantage of data mining over any traditional statistical techniques is that in statistics, there is usually a hypothesis based on some kind of a priori knowledge, and this hypothesis is then tested on the data in order to conclude whether the hypothesis is true or not [15]. In data mining, no prior knowledge is needed [14], which does not restrict the user into dealing with assumptions or preconceptions that might not be known
beforehand in the first place. Therefore, the authors propose that different data mining techniques would provide significant improvement over traditional statistical techniques in step 7 of the Figure 2.

In the light of framework illustrated in chapter 2.1., the point of interest of this study can be stated as follows: How patient flow related data is refined into information in order to manage processes that provide patient flows, and how this could be intensified using data mining methods.

**Patient Flow Management in Hatanpää Hospital**

According to our research, patient flow management in Hatanpää hospital can be seen as an iterative process which is illustrated in Figure 3. The substantial content of the recorded data is described later in this chapter.

**The Overall Process**

According to our research, patient flow management in Hatanpää hospital can be seen as an iterative process which is illustrated in Figure 3. The substantial content of the recorded data is described later in this chapter.

**Challenges in Processing the Recorded Data into Strategic Information**

Many challenges and remarks related to the patient flow management process have been identified in Hatanpää hospital. Development is needed in every step presented in the model at figure 3. In this
paper we will focus on the step 3b, where data is processed into strategic information for the hospital management and administration. For understanding the challenges in this step, we first shortly describe the data the hospital records.

The substantial content of the recorded data related to patient flows is illustrated in figure 4. During the life cycle of a patient flow that typically starts from the entrance of a patient, the data is recorded into many different information systems. Though the data is mainly used in patients’ health care, it can also be used in managing the whole hospital. Besides collecting the basic parameters of the patient, such as age, gender and diagnosis, the hospital unit records all kind of the basic information about patient flows, like volumes of the patient groups, prices of care, durations of stays, and patients’ former and coming health care unit. This data is used to form some health care unit and patient group specific parameters. For example, average duration of stay is derived from patient specific parameters. On the other hand, some health care unit specific parameters are primary parameters, like bed counts, that are recorded for managing the operations of the hospital.

The health care unit specific parameters together with patient related parameters offer for the management a key to observe and manage the efficiency of the hospital. However, in the complex and turbulent environment with multiple changing parameters, it is difficult and challenging to gain the overall understanding of the service system the hospital offers. Thus, the transformation of the data into the strategic information for supporting the decision-making is a challenging task.

According to our research [3], Hatanpää hospital suffers of insufficient use of the patient flow-related information that is mainly caused by ineffective information utilizing methods. The decision-making is usually based on the simple periodical reports, which do not reveal the overall state of the system. Thereby, the hospital needs new methods and better means for decision-making in order to control and manage patient flows more efficiently. The hospital has indications, like huge data mass and the data warehouse, for optimization and even forecasting the operations, but so far data mining methods have not been used for achieving, for example, better understanding of patients’ behavior and hospital’s own operations. This has lead to problems, like un-optimized resource allocation and inefficient capacity utilization.

Challenges in the data processing are related to the hospital’s internal operation, but also to the inter-organizational activities in the health care network of Tampere. The organizations in the network share enormous amount of data and the shared data structure is so complex that the data processing with traditional methods, like Microsoft Excel, is almost impossible. [3] Limitations of data processing methods of the hospital together with the complex health care environment inflicted deficiencies of reporting and measuring the right things. In other words, there is a need of versatile and processed information as supporting the decision-making. One must analyze the patient flows and after that, optimize them by using the gathered information over them.

The current incapability of the process can be illustrated through the following example. When a patient enters the patient flow, patient-related data is being recorded into the Pegasos system (see Fig. 3). At this moment, the system generates pre-determined reports that examine the patient flow at unit-level. This means that the reports only reveal the patient flow parameters (e.g. the duration of the stay) in a specific unit, such as an x-ray unit or examination room, but they do not examine the dependencies between the parameters from separate units. The above setting is examined in the next chapter, in which a selected data mining method is used to examine the whole network instead of

![Figure 4. The substantial recorded data related to patient flows](image-url)
single units. This is done in order to optimize the entire system, not just single units separately.

**Potential of a Selected Data Mining Method in Hatanpää Hospital**

Currently, as mentioned, the pre-determined reports related to patient flows examine the patient flow only at unit-level. That is, they only reveal the patient flow parameters in a specific unit, but they do not examine the dependencies between the parameters from separate units. The authors propose utilizing a data mining method called **sequence analysis** to improve the usefulness of the patient flow data in order to help the hospital administration making better and more informed decisions in their management activities.

Sequence analysis is an extension of a popular association rules technique [16] where the analyst is faced with a task of finding which items occur together the most in a dataset. This technique is often referred to as market basket analysis as it is usually used in order to find out which items customers purchase in stores [14] [17]. A number of probabilistic figures can be used to gain more insight into the occurrences of the different combinations (rules) of items in a dataset. These probabilistic figures can be applied into sequence analysis techniques as well.

In its most simplistic form, an association rule is a logical statement between two occurrences, such as patient visiting the examination room and visiting the x-ray room [14]. More formally, we can write such a rule as follows:

\[
\text{examination} \rightarrow \text{x-ray}
\]

Most commonly used probabilistic figures describing association rules are support and confidence [14]. The support of a rule is the probability for that specific rule to occur in the dataset, which can be written as follows:

\[
\text{support} \{ \text{examination} \rightarrow \text{x-ray} \} = \frac{\text{Prob (examination)} \times \text{Prob (x-ray)}}{\text{Prob (examination) * Prob (x-ray)}}
\]

In the example above, support would reveal the proportion of the patients entering both the examination and x-ray rooms from all the patients recorded in the system. Confidence of a rule is the conditional probability of the event B if event A has occurred. By following the example above, we can write the confidence of a rule as follows:

\[
\text{confidence} \{ \text{examination} \rightarrow \text{x-ray} \} = \frac{\text{support} \{ \text{examination} \rightarrow \text{x-ray} \}}{\text{support} \{ \text{x-ray} \}}
\]

In this case, confidence would reveal the probability of a patient entering the x-ray room if he or she also enters the examination room during the hospital stay. By examining the confidences of items in a patient flow, the hospital management would be able to identify the most strained units that may act as bottlenecks in patient flows. By following our example above, the hospital administration could find out that there is a 90 % probability of a patient having a need to visit the x-ray room if the same hospital visit also includes a visit to the examination room. By utilizing such information the positioning and recruiting of the hospital personnel can be optimized by putting emphasis to the most loaded units.

Association rules, however, do not take into account the order in which the patient goes through the patient flow in the hospital. In order to optimize the patient flows, one first needs to describe them. To this end, the authors propose the use of sequence analysis. Sequence analysis takes into account the temporal order in which the items occur in the dataset [14]. In our example it is probable that the visit to the examination room precedes the visit to the x-ray room. By utilizing sequence analysis it is possible to describe the whole patient flow from the first event (entering the hospital) to the last (leaving the hospital). By using the support and confidence figures, it is possible to identify e.g. the most frequent patient flows by examining the binomial probability of entering into a certain unit or not entering it.

Once the most crucial patient flows have been identified and mapped, the next logical step would be optimizing the patient flows so that the operations of the hospital would better serve its customers. At this point the target hospital has yet to begin the patient flow identification, so any optimization activities are purely on a theoretical level, and is heavily dependent on the hospital management’s vision, but different data mining techniques could provide answers for the following patient flow-related issues:

- Predicting the patient flows of individual patients based on their symptoms, urgency, and demographic variables
- Identifying possible jams and blockages in patient flows in advance
- Identifying possible alternatives to patient flows for aforementioned situations
- Shorten any waiting periods during a patient’s stay in the hospital
- Decrease the cost of a single patient for the hospital.

**Conclusions and Future Research**

At the beginning of this paper, we showed the importance of understanding the health care system as a network of patient flows in order to manage it.
better. Then we presented a theoretical framework for intensifying the patient flow management. Besides, we presented the data mining methodology, which could be used to boost the step where the data is processed into information in order to intensify the management activities. In the empirical part of the paper we examined the patient flow management process in Hatanpää hospital through the presented theoretical framework. After that, we focused on the present challenges in processing the recorded data into strategic information, and brought into attention an example of the current, imperfect process. Finally, we proposed utilizing a data mining method called sequence analysis to improve the use of the patient flow data in order to help the hospital administration making better and more informed decisions.

Based on the literature and our earlier research, our hypothesis was that patient flow management could be intensified by using selected data mining methods. The example presented in chapter 4 revealed that data mining indeed could be a very suitable approach for processing huge amounts of patient flow-related data into useful information. This information helps to understand a complex service system and can, thereby, be used to support decision-making as well as the communication about the patient flow-related matters to all interest groups. As a result, the overall quality and effectiveness of the patient flow network would be improved. This means better clinical outcomes, improved patient safety, greater patient and staff satisfaction, and improved financial performance. On these grounds, we recommend that data mining methods would be more utilized in the referred field.

Despite the many opportunities of data mining in this field, there are also many challenges to conquer. One challenge is the ethicality of patient-related data that hinders the utilization of some data. Furthermore, one of the most common challenges is the quality of data. Insufficient and false records of data influence straightly to relevance and reliability of utilized information. One problem is also the organizational culture of the health care organizations. It has not risen to the level where patient flow-related information could be used effectively in developing the hospital activities.

The scientific contribution of this paper is the clarification of the theoretical concept of patient flow management process (Fig. 2) and its applicability to the real life process (Fig. 3), as well as the illustration of the potential of the data mining methods to intensify the process. The paper has also pragmatic significance as it propose a useful tool-set to the end-users for analyzing the actual data and consequently, new kind of processed information to support the decision-making. Although the study is conducted in a single hospital, the results can be well generalized to other hospitals.

Further research is, however, needed. In future research, the discovered advantages and also challenges of the presented sequence analysis method should be empirically tested. Also the potential offered by other data mining methods, such as neural networks, should be explored.

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MONITORING THE EVOLUTIONARY PATTERNS OF TECHNOLOGICAL ADVANCES BASED ON THE DYNAMIC PATENT LATTICE: A MODIFIED FORMAL CONCEPT ANALYSIS APPROACH

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Abstract
The strategic importance of monitoring changes in technology has been highlighted for achieving and maintaining firms’ competitive positions. In this respect, among others, patent citation analysis has been the most frequently adopted tool. However, it is subject to some drawbacks that stem from only consideration of citing-cited information and time lags between citing and cited patents. In response, we propose a modified formal concept analysis (FCA) approach to developing dynamic patent lattice that can analyze the complex relations among patents and evolutionary patterns of technological advances. The FCA is a mathematical tool for grouping objects with shared properties based on the lattice theory. The distinct strength of FCA, vis-à-vis other methods, lies in structuring and displaying the relations among objects in the amount of data. The FCA is modified to take time periods into account for the purpose of technology monitoring. Specifically, patents are first collected and transformed into structured data. Next, the dynamic patent lattice is developed by executing a modified FCA algorithm based on patent context. Finally, quantitative indexes are defined and gauged to conduct a more detailed analysis and obtain richer information. The proposed dynamic patent lattice can be effectively employed to aid decision making in technology monitoring.

Keywords: Technology monitoring, patent analysis, formal concept analysis, dynamic patent lattice.

Introduction
The recent decade has seen markets shifting rapidly and unlimited proliferation of technologies, resulting in product life cycles becoming ever shorter [1][2]. It has become the norm for successful companies to have consistently to innovate for survival [3]. Under such turbulent environment, the strategic importance of monitoring changes in technology has likewise been highlighted as the technology is reckoned as a critical asset for success. Technology monitoring has been defined in many different ways. According to the EIRMA [4], it is referred to identification and assessment of technological advances critical to the firm’s competitive position. Although variations may exist among researchers regarding to the definition and scope of technology monitoring, what the literature has in common is that it plays a crucial role in defending against potential threats and exploiting promising opportunities arising from technological environment [5]; consequently, there are rising attempts to formalize the technology monitoring process using suitable models, methods, and tools.

In this respect, patent documents are an ample source of technical and commercial knowledge for supporting the technology monitoring process [6][7]. Almost 80% of all technological information can be found in patent publications [8]. It can also be easily accessed through commercial and public databases. Patent analysis therefore has long been considered as a useful analytic tool for technology monitoring. An analysis of technological information in the patent documents is visualized as a patent map or network, allowing the complex patent information to be understood easily and effectively [9] and highlighting the crucial elements of knowledge on technologies, competitive positions [10][11], and infringement risk [12]. Moreover, it helps identify technological details and relationships, inspire novel industrial solutions reveal business trends, and decide investment policy [13][14].

A variety of methods for patent analysis have been introduced and among others, patent citation analysis has been the most frequently adopted tool. However, it is subject to some drawbacks as follows. Firstly, the scope of analysis and richness of potential information are limited since it takes only citing-cited information into account [15]. Secondly, regarding to the first problem, it has no capability of considering internal relationships among patents. Only existence or frequency of citations is taken into account, which may lead to superficial or even misleading analysis. Finally, it is difficult to grasp the up-to-date trends of technology because the time lags between citing and cited patents are more than ten years on average [16]. In order to overcome the limitations
mentioned above, keyword-based patent analysis has been proposed as an alternative of patent citation analysis. Despite all the possibilities offered by the keyword-based patent analysis, it also has some limitations because of the difficulties in monitoring the evolutionary patterns of technological advances as time goes on. Only simple methods such as cluster and co-word analysis have been utilized. The keyword-based patent map thus limited to visualizing the static view on current status of technology as a snapshot.

In response, the primary purpose of this study is to propose a modified formal concept analysis (FCA) approach to developing dynamic patent lattice that can analyze complex relations among patents and evolutionary patterns of technological advances. The FCA is a mathematical tool for grouping objects with shared properties based on the lattice theory. The distinct strength of FCA, vis-à-vis other methods, lies in structuring and displaying the relations among objects in the amount of data. For the purpose of technology monitoring, the FCA is modified to take time periods into account. Specifically, patents in a technology field of interests are first collected and transformed into structured data. Next, the dynamic patent lattice is developed by executing a modified FCA algorithm on the basis of patent context. Finally, some quantitative indexes are defined and gauged to conduct a more detailed analysis and obtain richer information.

The main contributions and potential utilities of this study are twofold. First and foremost, this study theoretically contributes to the technology monitoring research, by proposing an algorithmic approach that can structure, analyze, and visualize the evolutionary patterns of technological advancement. The proposed approach overcomes the drawbacks of patent citation analysis that stem from only consideration of citing- cited information and time lags between citing and cited patents. Second, this study is exploratory in that a modified FCA algorithm is first proposed, which can be utilized in many real world problems.

The rest of this paper is organized as follows. As an introductory statement, the general background of technology monitoring, patent analysis, and FCA is first reviewed in Section 2. The proposed approach is explained in Section 3. Finally, this paper ends with conclusions in Section 4.

**Background**

Put theoretically, FCA is integrated together with patent analysis under a systematic framework for the purpose of technology monitoring. They are used together only rarely, and thus most readers will be comfortable with one or some, but perhaps not all of them. We therefore touch briefly on what they are and how they are combined in this study.

**Technology monitoring**

Technology monitoring draws more attention in both theory and practice for establishment of technological forecasting and planning. The technology monitoring may reinforce the dominance of firms in the market or open up new one [17]. It is also widely recognized that an inadequate response to technological change may lead to the demise of established company [18]. The main reasons for business failure in the market are insufficient information on trends of technology and managerial incompetence [19]. Furthermore, previous research in different industries shows that the ability to monitor technological changes is one of crucial factors in managing the risk of organizational failure [20]. For these reasons, the decision makers endeavor to discover the current status of technology, and to anticipate future events critical to the firm’s competitive position [21], which is called technology monitoring.

A number of methods have been proposed to monitor the technological changes and forecast future events such as consensus method, Delphi method, structural models, and scenarios and technological vigilance. These methods can be grouped into three types: qualitative procedure, quantitative procedure, and combined procedure [22]. Firstly, the consensus method and Delphi method are qualitative procedures that primarily hinge on human intuition and individual experience. These may be distorted and biased due to the subjectivity [23][24]. Secondly, the quantitative procedure, such as structural model, may eliminate these subjective factors. This model isolates certain factors affecting the technology development process and mathematically explains some of the functional relationships among factors. However the procedures may tend to be abstractions. Omissions of certain factors that are not judged to be relevant for model construction may occur. Lastly, the combined procedure helps to identify threats and opportunities, but it requires time-consuming data collection work and is difficult to obtain objective information [19].

**Patent analysis**

Patent documents are as an ample source of technical and commercial knowledge [25]. The patent analysis provides a unique opportunity to satisfy the need for conceptual or qualitative analyses of technological change [26] and empirically explains most aspects of technological innovation [27]. Recent years thus have seen a huge increase in the use of patent analysis. The patent analysis has been employed for identification of economic effects of technological
innovation [28], assessment of national technological competitiveness [29] assessment of individual firms’ technological competitiveness [30][31], R&D activity prioritization [32], identification of technological change effects on performance [33], and identification of technological opportunity [7].

Patent data contain dozens of items for analyses, which can be grouped into two categories: structured and unstructured items [6]. The structured items are consistency in semantics and format across patent documents (e.g. patent number, filing date, inventors, and assignees) while the unstructured items are text of contents having different structures and styles (e.g. descriptions and claims). In the structured data analysis, the bibliographic fields of patent documents are utilized to explore, organize, and analyze a large amount of historical data in order that researchers can find hidden patterns to support their decision making. However, the scope of analysis and the richness of information are limited since the only bibliographic fields are employed, despite the potential utility of unstructured items. The unstructured data analysis is aimed at extracting and analyzing the technological information from the unstructured items of patent documents. Data mining techniques, especially text mining, have been widely employed for knowledge discovery from textual information.

Formal concept analysis

The FCA is a mathematical tool that can structure and visualize the relations among objects with shared properties to make them more understandable. The method was first proposed by Wille [34] based on the lattice theory of Birkoff [35]. The distinct strength of FCA, vis-à-vis other methods, lies in structuring and displaying the relations among objects in the amount of data. Recent years thus have seen a huge increase in the use of FCA for various problems such as ontology engineering [36], knowledge discovery in database [37], service engineering [38], collaborative recommendation [39], software engineering [40], and case-based reasoning [41].

The basic notations of FCA are summarized as follows. First, the formal context is defined as \( K=(G, M, I) \), where \( G \) is a set of objects, \( M \) is an set of attributes, and \( I \) is a binary relation of \( G \) and \( M \). The binary relation represents which attributes describe an object and vice versa. Second, the formal concept is referred to \( (O, A) \) which satisfies \( \text{intent}(O)=A \) and \( \text{extent}(A)=O \) where \( O \subseteq G \), \( A \subseteq M \) in a context \( (G, M, I) \). Finally, the concept lattice is developed by formal concepts and relations among concepts. The set of all the formal concepts of a context is denoted by \( B(G, M, I) \). The structure of \( B(G, M, I) \) is given by order relations between super- and sub-concept represented by \( \leq \) and defined as:

\[
(A_1, B_1) \leq (A_2, B_2) \quad \text{if} \quad A_1 \subseteq A_2 \quad \text{and} \quad B_2 \subseteq B_1
\]

Proposed approach

In this section, we examine the overall process of proposed approach, giving a brief explanation of each stage at the same time. The proposed approach is comprised of five stages, as shown in Figure 1. First, a technology field of interests is selected and related patent documents are collected. Second, the patent documents are transformed into structured data for further analyses. Third, patent context is constructed in terms of year of publication, patent number, and occurrence of keywords through using text mining technique. Fourth, the modified FCA algorithm is conducted to structure and visualize the evolutionary patterns of technological advances. Finally, some quantitative indexes are defined and gauged to conduct a more detailed analysis and obtain richer information.

Data collection and transformation

Patent documents in a technology field of interests are collected based on various search conditions from patent database. The patent documents need to be preprocessed because they are semi-structured data in the form of electronic documents, which are merely expressed in text
A structured patent database is constructed for further analyses. The database constructed includes not only structured items but also unstructured ones for structured and unstructured data analyses.

Development of patent context
A patent context is developed to be utilized as an input at the next stage. The patent context consists of three parts: year of publication, patent number, and occurrence of keywords. Repetitive trials between experts and computer-based approach are required to define the keyword list. Figure 2 explains steps to elicit the keywords from documents and to fill the patent context. Text mining is first conducted to find words with high frequency and then the words are refined based on the experts’ judgments. Finally, a set of final keywords are rearranged to consider the abbreviation, synonyms, singular, and plural forms of words. A patent context is exemplified in Table 1. The occurrence of keywords in a patent document is represented as a binary value. In the patent context, “V” means that the patent includes the corresponding keywords, while the blank means the patent does not.

Execution of modified FCA algorithm

A general lattice consists of nodes and arcs that link two nodes on the basis of order relations between super-concept and sub-concept. In this case, it only provides the current status of technology without time periods. The FCA is therefore modified to take time into account to analyze the evolutionary patterns of technological advances, as shown in Figure 3. The modified FCA algorithm is carried out by considering both publication year and similarity between patents in terms of the occurrence of keywords.

The basic concepts of modified FCA algorithm are summarized as follows. Firstly, by contrast to conventional FCA, patents published earlier than the target patent are only considered to develop the dynamic patent lattice. Secondly, the order relations are derived based on the cosine similarities among concepts as well as shared properties. There are three possible types of order relations: all new keywords, combination of new and existing keywords, and all existing keywords. A new concept is generated when the target patent consists of all new keywords without existing ones. If the target patent includes the existing keywords, it is linked with the concepts having the maximum

Table 1.
Example of patent context

<table>
<thead>
<tr>
<th>Year</th>
<th>Patent #</th>
<th>K1</th>
<th>K2</th>
<th>K3</th>
<th>K4</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>P1</td>
<td>V</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>P2</td>
<td>V</td>
<td>V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>P3</td>
<td>V</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>P4</td>
<td>V</td>
<td>V</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>P5</td>
<td>V</td>
<td>V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>P6</td>
<td>V</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>P7</td>
<td>V</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>P8</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
</tbody>
</table>
similarity and having the similarity greater than pre-defined threshold with the annotations of keywords changed (added and removed keywords). Thirdly, nodes in the dynamic patent lattice differ from one another with respect to types of concepts and number of patents in a concept. In more detail, concepts having new keywords are represented by colored circles while the concepts that only include the existing keywords are described by empty circles. The size of nodes is proportional to the number of patents that consists of a concept. Finally, regarding to the arcs, a solid line means that differences exist between concepts while a dotted line refers to the order relations between super- and sub-concepts.

Derivation of quantitative indexes

The suggested dynamic patent lattice is shown in Figure 4. The horizontal axis represents the time periods while the vertical axis shows the complexity of technology. In the dynamic patent lattice, the technological advances are divided into three types: improvement, convergence, and substitute. First, the “improvement” is exemplified in the relation between P1 and P3 that share same keywords. The P3 is an advanced version of P1, which may improve some aspects of P1. Second, the “convergence” is found in the relation between P1 and P2. The P2 includes K2 besides all the aspects of P1. Finally, the “substitute” is depicted in the relations between P2 and P4. K3 is added to P4 while K1 is removed from P2.

Figure 4.
Example of dynamic patent lattice

Table 2. Dimensions of analysis and related indexes

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Index</th>
<th>Object and definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degree of importance</td>
<td>Technology centrality</td>
<td>Measure the direct influences of a subjective technology to other technologies by gauging the density of direct linkages</td>
</tr>
<tr>
<td>Technology propagated centrality</td>
<td></td>
<td>Measure the direct and indirect influences of a subjective technology to other technologies</td>
</tr>
</tbody>
</table>

The proposed dynamic patent lattice shows intuitive knowledge on the patterns of technological advances and characteristics such as complexity of technology. To conduct a more detailed analysis and obtain richer information, quantitative indexes, however, need to be operationally defined and gauged. Among various indexes, three major dimensions and related indexes are proposed, as summarized in Table 2. Firstly, the “importance” dimension measures the contribution of a subjective technology to the technological advances. Specifically, the local importance implies the direct influences of a subjective technology to others while the global importance considers indirect influences as well as direct ones. Secondly, the “newness” refers to the status in life cycle of a subject technology by calculating the average publication year of directly linked technologies in the past. Finally, the “promise” measures the potential attractiveness of a subject technology by gauging the emerging and declining rates of keywords.
Conclusions
We proposed a modified FCA-based dynamic patent lattice that can analyze the complex relations among patents and evolutionary patterns of technological advances. Patent documents in a technology field of interests are first collected and transformed into structured data. Next, a modified FCA algorithm is executed based on patent lattice. Finally, quantitative indexes are defined and gauged to conduct a more detailed analysis and obtain richer information.

The proposed approach can be utilized together with the conventional citation-based patent map, as a technology monitoring and benchmarking tool. The dynamic patent lattice and quantitative indexes may enable in-depth analysis and thus aid decision making in technology monitoring. The main contributions and potential utilities of this study are twofold. First and foremost, this study theoretically contributes to the technology monitoring research, by proposing an algorithmic approach that can structure, analyze, and visualize the evolutionary patterns of technological advancement. The proposed approach overcomes the drawbacks of patent citation analysis that stem from only consideration of citing-cited information and time lags between citing and cited patents. Second, this study is exploratory in that a modified FCA algorithm is first proposed, which can be utilized in many real world problems.

Despite all the possibilities offered by this new and algorithmic approach to technology monitoring, this study still has some limitations that stand in the way of our future research plans. Firstly, this study only focuses on technology monitoring; how to make a strategic decision has not dealt with. To fill the missing link, the proposed approach can be integrated together with technology roadmapping. Secondly, automated supporting systems need to be developed to save the time and cost and increase the efficiency of proposed approach. These topics can be fruitful areas for future research. A case study will be also included in the future research show the feasibility and utilities of proposed approach.

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References


RELATIONSHIP AMONG CUSTOMER VALUE, SATISFACTION, AND LOYALTY OF SOCIAL NETWORK SERVICE

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Abstract
Social Network Service (SNS), is an innovative application and business model in recent years. It changes the development and communication of current social network and gathers tremendous viewers to create more business opportunities. However, what are the values that attract users to use SNS? This study focuses on the behaviors of SNS users in Taiwan by empirical research. From the customer point of view, satisfaction and loyalty could be relative to and affected by utilitarian value and hedonic value. Therefore, this study builds an applicable integrated model and uses Structural Equation Modeling to analyze the relations of constructs in the model.

We find the following. (1) The constructs of the model are supported. (2) The utilitarian value can be measured by factors of sociality, convenience, and information availability; hedonic value can be measured by factors of adventure, escapism, and affiliation. (3) The utilitarian value and hedonic value affect customer satisfaction; customer satisfaction affects word of mouth and repatronage intention. (4) The utilitarian value and hedonic value positively affect word of mouth and repatronage intention, but providing a good customer satisfaction can enhance word of mouth and repatronage intention. (5) The influence of hedonic value is higher than that of utilitarian value.

Keywords: Social Network Services (SNS), Utilitarian Value, Hedonic Value, Satisfaction, Word-of-Mouth, Repatronage Intention

Introduction
The invention of Internet not only influences human life, but also creates many business opportunities to promote the innovations and applications for business model. If one can understand and take full advantage of changes on Internet, one could facilitate enterprises to enhance competitive advantages [1]. Social Network Services (SNS) is an innovative business model and application in recent years. It changes the development and communication of current social network, and provides Internet users a channel to manage interpersonal relationship. Internet has become a good tool to link people without time and space limit as well. The website operation gathers tremendous viewers and also creates substantial business opportunities [2]. In the past two years, the number of websites has been increased 17% [2]. The fast growing SNS websites also indicates that it has become one of the major culture trends to connect many people at daily life. Some of the popular SNS websites, such as MySpace and Facebook, attract thousands of network users around the world to browse. This wave also hits Taiwan in establishing similar websites and/or providing similar related services. According to “Behavioral Analysis of Taiwan Network Entertainment” [3] by the Market Intelligence Center (MIC) of the Institute for Information Industry (III), 65.4% of network users in Taiwan have uploaded personal information on SNS websites, where most of them record and share their life (58.6%), display themselves (56.7%) and make friends online (54%) via webpage. Therefore, it is an important issue to understand SNS users requirements and provide better services to keep the users and attract new ones.

Even though SNS is getting more popular, fewer academic and marketing studies have been conducted especially on practical research [4]. It suggests that service studies on Internet should consider the customer motivation or cognition value [5]. Moreover, the value concept had been proved to influence satisfaction and loyalty [6]. However, almost these studies are studied based on retail shops and online shopping. These issues, including customer value constructs proposed in retail, service and marketing papers, are equally important in operating SNS.

In short, the purpose of this study is to verify the importance of customer value on SNS. Constructs in this study are based on the utilitarian and hedonic value to handle research problems according to user satisfaction and loyalty [word of mouth and repatronage intention] [4] [7], establish an explainable integrated model and then use
Structural Equation Modeling to analyze and verify the cause and effect relation among each construct in the model. Therefore, the main purposes in this study are to investigate the following: (1) Does the SNS utilitarian value include the factors of sociality, convenience and information accessibility? (2) Does SNS hedonic value include factors of adventure, escapism and attribution. (3) The relationship and influence of the SNS utilitarian and hedonic value to satisfaction, word of mouth and repatronage intention. (4) Based on the research results, the suggestions are given.

**Literature review and hypotheses**

**Social Network Service (SNS)**

Social Network Service (SNS) is an innovative application for web2.0. The service features include: providing to contacting friends, making friends and interact services via Internet platform. Each user may have his or her personal webpage, establish a list of friends and link them from the list, as well as facilitate users contacts via bulletin boards, activity, community and etc.[3]. Number of users usually increases one by one by Internet via friends, just like veins on the leaf [8]. Therefore, this kind of website is called vein website in China. It is defined [2] SNS as a kind of service based on network, allowing a user: establishing public or semipublic profiles(1); listing users of this user in that system and linking the lists shared by other users(2); searching or viewing other users in that system via list link shared by other users(3).

SNS is so special in that it not only allow users making new friends, but transferring social network from the real world to the virtual world [9]. In reality, many users in well known SNS websites do not have strong intention to make new friends, rather, they communicate with acquaintances and friends in the real world. These websites also emphasize that “pursuit of existing interpersonal relationship” is a major provided feature.

SNS mainly focuses on interpersonal relationship, differing from community websites based on interests [2]. Therefore, SNS not only differs from friend-making websites but also community websites. The service of friend-making website is to establish the relation with strangers. SNS is mainly based on existing interpersonal relationship to further extend social network. This is the difference that is easily confused.

Even though SNS’s are so worldwild popular, from the viewpoint of development and evolution, these websites don’t provide SNS [2] at the beginning. For example, QQ in China is real-time communication software when it started. LunarStorm in Sweden initiates to be a community website. Cyworld in South Korea originates from a network forum. Skyrock in France is a network blog before adding SNS features and so on. Although the initial development of these websites is not the same, they become SNS website as well after adding the features of social service.

Current wellknown SNSs, such as Myspace, Facebook, MSN spaces and so on, not only have a lot of users, but also can provide many business opportunities. In comparison, the related applications in Taiwan just began. From the successive establishment of the similar websites or related services to provide, such as Wretch, Youthwant, Atlaspost, meeya and so on, the SNS application has become a trend and the competition become more intensive. How can the operations of SNS create the customer value to keep competitive advantage and avoid customer leaving? This study, based on the definitions and features of SNS in literature, samples the appropriate SNS websites as research objects.

**Utilitarian and Hedonic value**

The past studies on customer value construct mainly focused on customers to weigh between product quality and price [10]. However, some researchers think value constructs are much more complicated. The other side of value should be taken into account by researchers and administrators [10] [12]. Regardless of consumption experience in reality or on Internet, the price felt by customers can be divided as utilitarian and hedonic value [7] [13] [15]. The utilitarian value indicates benefits related to functionality, tool and reality provided to customers during consumption. The hedonic value indicates benefits related to emotion, experience and delight provided to customers during consumption [13] [14] [16].

SNS could provide the utilitarian value, where interpersonal relationship works better than physical environment, for example, users are more in control, have more options and more information on this aspect. Not only SNS can provide functional benefit and interpersonal interaction, but also can provide hedonic value to meet users’ emotion need and further become a part of their life. Thus utilitarian value construct is categorized as convenience and information accessibility [17]. According to the characteristics of SNS, this study further includes one social construct, reflecting users via this service website to seek interaction of interpersonal relationship. Meanwhile hedonic value construct, according to [18] [19], is categorized as adventure, escapism and attribution. Therefore this study proposes first two hypotheses as follows:

H1a: SNS utilitarian value includes sociality, information accessibility and convenience.
H1b: SNS hedonic value includes adventure,
escapism and attribution.

**Relationship among Value, Satisfaction, and Loyalty**

Satisfaction is a level to reflect customer confidence, a combination of emotion and cognition decision [20]. Many researches on marketing have shown that the utilitarian, hedonic value and satisfaction are related [7] [13] [16] [21]. Therefore, this study proposes two hypotheses:

H2a: SNS utilitarian value will positively influence satisfaction.

H2b: SNS hedonic value will positively influence satisfaction.

The findings of [22] pointed out loyal customers can have stronger links with a website and spread it by word of mouth. This is also an important construct to weigh consumption. The theory pointed out word of mouth is a result reacted with emotion for consumption condition [23]. The generation of word of mouth is highly related to the scene experienced by customers. By sharing experience with other people, word of mouth can mentally comfort the pressure [24]. The studies have shown word of mouth is related to cognitive process, such as perceived value and fair estimate [23]. Therefore, this study proposes two hypotheses according to discussion above-mentioned:

H3a: SNS utilitarian value will positively influence word of mouth.

H3b: SNS hedonic value will positively influence word of mouth.

Repatronage intention reflects the possibility of re-consumption [25]. The utilitarian value should be related to repatronage intention. If customers think this website can provide more functions and utilitarian value, more repatronage intention will increase [17] [26]. Good consumer experience would make customers stay longer on the website and visit it frequently. Hedonic value may also affect repatronage intention because emotional experience during consumption could be an important factor to repurchase or no repurchase [27]. Some retail research has empirically supported this statement [28]. A study showed the utilitarian and hedonic value play a key role in predicting the repatronage intention of website [29]. Therefore, we propose the following hypotheses based on these researches:

H4a: SNS utilitarian value will positively influence repatronage intention.

H4b: SNS hedonic value will positively influence repatronage intention.

Customer satisfaction for the positive influence on loyalty has been widely supported by references related to marketing research [16] [30]. Satisfaction can be considered as a key to establishing and maintaining loyalty, and a foundation for customers to use website for a long period of time. High satisfaction can enhance the possibility of recommending service by customers [30] [31]. Thus, customer satisfaction is the key factor for enterprise operation and customer loyalty. Therefore, we propose the following hypotheses:

H5a: Customer satisfaction at SNS will positively influence word of mouth.

H5b: Customer satisfaction at SNS will positively influence repatronage intention.

**Research methodology**

This study aims to define each variable and establish the research model according to proposed hypotheses, and then design questionnaires to collect and analyze data in accordance with research model.

**Research model**

This research model is based on utilitarian and hedonic value as independent variables and customer satisfaction as an intermediate variable to investigate the impact of utilitarian and hedonic value on customer satisfaction, and then further affect word of mouth and repatronage intention through the intermediate effect of customer satisfaction. This research will empirically verify the proposed construct. The model is shown in Fig. 1.

**Questionnaire design**

This study makes use of self-report inventory questionnaires to collect data. The constructs include the utilitarian value [19] [17] [29], hedonic value [18] [7] [19] [4] [17] [29] [32], satisfaction [21] [33] [7], [20] [34] and loyalty [word of mouth and repatronage intention] [4] [29] [22]. These constructs come from previous researches; some measure items originate from online shopping researches, not SNS. According to the characteristics of SNS, some of the item meanings are modified to match the SNS scene and study
issues. The 7-point Likert Scale is used for measurement. If necessary, the questionnaire items can be provided.

**Study scope**
The study subjects are SNS website users in Taiwan. As far as the time, the cost, the definition of SNS, and the website traffic are concerned, SNS websites with high traffic like Wretch, Youthwant, MSN Space, Facebook and Myspace were selected as the target populations. In addition, this study also took 5 months to observe and operate SNS websites. In November and December 2008, the pretest and formal questionnaire surveys were conducted respectively.

**Data collection**
In order to make the data source closer and more related to the users of the target populations, online questionnaires were adopted to collect sample data. [35] also pointed out that when a study focused on the online consumer behavior, online questionnaire would be an appropriate way to collect data. There were 1250 questionnaires collected. After getting rid of some invalid responses, the study finally got 821 effective questionnaires in total. The effective response rate is 65.7%.

**Questionnaire pretest analysis**
The purpose of questionnaire pretest in this study is to confirm the clarification, homogeneity, and reliability of those questions in the questionnaire. We got 64 effective respondents out of 65 samples. After pretest, the validity and reliability of the questionnaire will be analyzed as the basis of establishing a formal questionnaire. For content validity, the questionnaire referred to some other related measures developed by foreign scholars. Therefore, the questionnaire should have content validity. Furthermore, two scholars and eight postgraduate students who have user experience in SNS were invited to examine the expressions of questions word for word, and provided opinions as the basis of scale modification. Consequently, this questionnaire should also have expert validity. For the item analysis, homogeneity check among each question was applied as the reference for modification. Pearson's correlation coefficient must be greater than 0.400; the modified items and coefficients related to total score must exceed 0.400. The outcome of the analysis showed the communities is 0.250 which means the extraction factors can explain over 25% of item variance. As a result, four questions need modifications. The values of Cronbach’s α in each construct through reliability analysis were all greater than 0.9, which indicates high internal consistency in each construct. After the inspections on the questionnaire, we modified several items for the follow-up questionnaire survey.

**Data analysis method**
This study not only analyzed the data by structural equation modeling to investigate the causal relations among model variables, but also estimated model parameter by maximum likelihood estimation (ML). According to suggestions from [36], the model was analyzed on two phases of measurement and structural model analysis, and the variables were reviewed prior to analysis. This study used SPSS 16.0 and AMOS 16.0 as sample encoding and analysis.

**Analysis and results**

**Sample characteristics**
According to demographic data, the female respondents are more than female respondents (55.9% to 44.1%); the respondents’ age ranged from 20 to 25 years old is the most part (35.1%). The majority group of educational background is university or college degree (47.5%). Most of the respondents are single (86.6%), showing the single youth prefers to use SNS. This is consistent with survey made by the Market Intelligence Center (MIC) of the Institute for Information Industry (III) in 2007[3]. Most of the respondents’ income is below NT$15000 [included] per month (41.5%), which relates to the occupations (33.5% students, 11.0% job seekers) in the sample respondents. The majority of respondents reside in the northern Taiwan (57.7%).

**Variables data review**
Many scholars think structural equation modeling must be applied with large sample size [37]. If samples are from model observed variable, the ratio of the sample size to the observed variables must be between 10:1 to 15:1 [38]. 37 observed variables are designed in this questionnaire. The ratio of the effective samples to the observed variables is about 22:1, complying with the requirement. The basic assumptions of maximum likelihood estimation includes: the observed data are drawn from matrix, drawn samples must be the probability maximum selected in all possible ones, and parameters must conform to the multivariate normal distribution [39]. Sampling in this study referred to the rank of browse traffic for Alexa website, and selected social service websites with larger browse traffic as sampling model; again, [39] indicates if the skewness coefficient is greater than 3 and the peak coefficient is greater than 8, the samples in the distribution of variable are not normal. The skewness and the peak of each variable can meet the standards. The data follows
the normal distribution.

**Measurement model analysis**

Conducting the confirmatory factor analysis, the measurement model fit must be evaluated. For the evaluation of model fit, external and interior quality of model should be included. According to [40], preliminary fit criteria, overall model fit and the fit of internal structure of model should be evaluated all together. In summary, the measurement model of each construct fit is acceptable after confirmatory factor analysis (CFA). When testing measurement model fit, measurement variables are also examined via CFA to confirm the reliability and validity of each construct. Therefore, in examining the measurement variable, we refer to six standards suggested by [40] as CFA screening standards of the measurement variables. With reasonable inference by referring to modification indices (MI) and modification model, we conducted multiple stages of CFA step by step. In such repeated analyses, eight measurement variables are deleted. Consequently, models reliability and validity were analyzed. The results meet our expectation. Each construct has good convergent and discriminant validity.

**Structural model analysis**

After the measurement model was examined, the structural model analysis is made. In the initial structure model, the evaluation results of overall model fit showed RMSEA = 0.092, GFI = 0.89 and AGFI = 0.85 didn’t fill the requirements [41]. It was found that two variables’ absolute values of standardized residual are greater than 2.58. After deleting two variables, 27 measurement variables are left. The final structural model and overall model fit can both meet the evaluation standards. The evaluation results of overall model fit are as shown in Fig. 2.

![Fig. 2 Structural model analysis](image1)

**Analysis and discussion of causal relations**

After verifying the applicability and rationality of the whole model, the estimate of the measurement and structural model can be further evaluated. By investigating the observed and potential variable as well as their relations, the structural relations of final overall model can be obtained. To summarize the evaluation standards, the theory models proposed in this study have reached the certain fit level to continuously verify the causal relations of the model. In the structural equation modeling, the causal relations among potential variables must be explained by estimated $\gamma$ [potential external variable $\rightarrow$ potential interior variable] and $\beta$ [potential interior variable $\rightarrow$ potential interior variable], which can be used to weigh the influences among potential variables. The relations among observed and potential variables must be explained by estimated $\lambda$. The structural equations determine each path coefficient of the model.
through maximum likelihood estimation, and then check the t-value. The results show λ, γ and β are significant. In Fig. 2, the causal relations among variables in this study are significant. Therefore, the hypotheses are supported.

The overall predicted effects of each predicted variable to customer satisfaction, word of mouth and repatronage intention are further discussed. The study results show the effects of the utilitarian (0.39) and hedonic (0.53) value on customer satisfaction. Both have the significant effects on satisfaction. The study results also verify there are relations among the utilitarian, hedonic value and satisfaction [7] [13] [16] [21]. The effect of the hedonic value on customer satisfaction is greater than the utilitarian value (0.53>0.39). This also reveals users have more preference for the hedonic value. Therefore, the hedonic value is more important to SNS. As for word of mouth, the direct effect of customer satisfaction is the highest (0.57). The second is the indirect effect of the hedonic value (0.30), influencing the extent of word of mouth up to 59% (0.30×0.51) of the total effect. The third is the indirect effect of the utilitarian value (0.22), sharing about 61% (0.22×0.36) of the total effect; in influencing repatronage intention, the direct effect of customer satisfaction is the highest (0.58). The second is the indirect effect of the hedonic value (0.31), influencing the extent of repatronage intention up to 66% (0.31×0.47) of the total effect. The third is the indirect effect of the utilitarian value (0.22), sharing about 59% (0.22×0.37) of the total effect. It shows because customer satisfaction has the high effect on word of mouth and repatronage intention to further trigger the indirect effects of the utilitarian and hedonic value on word of mouth and repatronage intention. In other words, both need customer satisfaction to display the indirect effect on word of mouth and repatronage intention. The intermediate effects show the possibilities of customers’ recommendation pointed by [30] [31] via satisfaction are consistent with the increasing repatronage intention. Although the direct effects of the utilitarian and hedonic value on word of mouth (0.14,0.21) as well as repatronage intention (0.15,0.16) are not higher than the direct and indirect effects of satisfaction, on the whole the effects of both values on word of mouth and repatronage intention reach the significant level (P<0.001), showing there is a certain influence. The study results supported the points proposed by [7] and [29]. For model explanation, while the combined effect of utilitarian and hedonic value achieved 69% of variance on customer satisfaction, word of mouth and repatronage intention by the utilitarian and hedonic value, and customer satisfactions are 72%, and 68% respectively to show that the extent of potential variable for the model is good.

Conclusions
Summary of findings and implications
The main contribution of this study is to prove attitude and behavioral results of using SNS and verify the effects of the utilitarian and hedonic value on satisfaction and loyalty. From utilitarian or hedonic viewpoint, it helps SNS administrators decide the allocations of website resources and how to manage the relation of network customers. Moreover, those views also carefully create a website environment so that consumers can have the better cognitive value, which includes a better website interface in compliance with social requirement, easily accessible information, and a reliable and comfortable network environment. All those factors above can strengthen customer loyalty (word of mouth and loyalty). The top five functions most used in SNS by customers are online log, bulletin board, photo upload, browsing and real-time message. It demonstrates that users have the needs of on-line friendship and interaction. These functions are indispensable in SNS.

The results in this study show, in using SNS, most users focus on existing interpersonal relationship. Such interpersonal relationship specially facilitates word of mouth. Word of mouth not only provides new users with more confidence and security in website use, but also can have more website exchanges and higher cognition among customers to further increase repatronage intention. Therefore, existing social relations facilitate word of mouth and repatronage intention for SNS. For example, classmates and club members through word of mouth can become registered members and voluntarily register to community so that registered members have the another sense of attribution to open an another window to attract new members. It differs from friend-making websites.

By way of word of mouth and exchanges, SNS produces the clustering effect to further develop the network effect, which promotes users’ dependence on Internet and finally generates the lock-in effect. By doing so, the switching cost of a user will be relatively enhance. Increasing the number of users will expand the website scale and develop many feasible commercial models. For example, members can make comments on commercial advertisements so that more members can share the ideas of the advertisement and further arouse more discussions. Those feedbacks will make advertisers more put more customized advertisements on website. The other example is members make comments on new film as talking subject so that more members have interests to see this movie. Therefore, it will provide exposures...
of on-line advertisement as well.

References


A FUNCTIONAL MODEL FOR DATA ANALYSIS AND RESULT VISUALIZATION
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Abstract
In several Web based applications (e-commerce, e-learning, digital libraries, etc.) one needs to display a dense array of information in a small amount of space (such as a screen) in a manner that communicates clearly and immediately. The information displayed is usually aggregates of results obtained through analysis of large amounts of data. We present a functional model that supports the data analysis and aggregation process, and a prototype that supports casual users in doing the following: (a) construct an analytic query visually, in an interactive manner, (b) visualize the aggregate result in a user selected mode (histogram, pie, etc.), (c) explore the query result by providing equivalent representations at different aggregation levels or for different parameter values selected by the user.

Keywords: Data Analysis, Analytic Query, Data Visualization, Visual Interaction

Introduction
In several Web based applications such as e-commerce, e-learning, digital libraries, etc. one needs to display a dense array of information in a small amount of space (such as a screen) in a manner that communicates clearly and immediately. The information displayed is usually aggregates of results obtained through analysis of large amounts of data. For example, consider the case of a digital library, allowing a community of users to share documents in digital form. Each document resides in its owner’s (local) database, and the digital library acts simply as a mediator allowing subscribers to access documents transparently. To access a desired document, a subscriber queries the library catalogue which stores each document’s URI together with a description of the document that is the values of the document’s attributes (language, topic, author, etc.). The catalogue can be seen as a table (see Figure 1), and a query against the catalogue is just a Boolean combination of elementary conditions of the form “$A = a$”, where $A$ is an attribute appearing in the column headings and $a$ is a value of that attribute; for example, referring to Figure 1, the following is a query asking for documents in French on Poetry: ($Language = \text{French}$) and ($Topic = \text{Poetry}$).

The digital library administration needs to perform usage analysis in order to plan the library’s activities. Such analysis usually concerns the ranking of documents along several dimensions (e.g. topic, author, language or any combination thereof) according to certain indicators (e.g. number of hits). However, the results of such analysis can be very large in size, and the only way to make sense out of big volumes of data is to create summaries and to display the summarized results to the analyst in an appropriate visualization mode - ideally, one selected by the analyst himself. Moreover, the analyst should be able to perform exploratory analysis on the visualized results by changing the summarization level or by viewing different, yet equivalent representations of the results that might reveal new, interesting information. There are several offerings today by software companies that allow analyzing large volumes of data and visualizing the results [1, 3], including some open source software [2]. However all these tools are closely related to the relational model and require some knowledge of the SQL constructs related to data analysis (such as grouping sets, cube, roll up etc.). In this paper, we present an approach that supports the data analysis and aggregation process visually, at a minimum effort by the user. More precisely, we present a simple data model allowing analysts to do the following:

1. construct an analytic query visually, in an interactive manner;
2. visualize the aggregate result in a user selected mode (histogram, pie, etc.);
3. explore the query result by viewing equivalent representations at different aggregation levels or for different parameter values selected by the user.

We also present the basic architecture of a prototype that implements the above functionalities. A prominent feature of our prototype is that the process of creating a query, receiving results, analyzing them and exploring them in several ways is well integrated, supported by intuitive actions: the entire process is very fluent and straightforward. In the remaining of the paper, we first give an informal overview of our data model; then define the formal model and give its mapping to the relational model. Next we give the description of a prototype interface under development, as well as the visual interaction between the user and the interface. We conclude with remarks and an outline of future work.

<table>
<thead>
<tr>
<th>URI</th>
<th>Language</th>
<th>Topic</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>French</td>
<td>drama</td>
<td>Dumas</td>
</tr>
<tr>
<td>2</td>
<td>Italian</td>
<td>poetry</td>
<td>Dante</td>
</tr>
<tr>
<td>3</td>
<td>English</td>
<td>poetry</td>
<td>Spenser</td>
</tr>
<tr>
<td>4</td>
<td>English</td>
<td>drama</td>
<td>Kipling</td>
</tr>
<tr>
<td>5</td>
<td>French</td>
<td>novel</td>
<td>Mérimeé</td>
</tr>
<tr>
<td>6</td>
<td>Spanish</td>
<td>drama</td>
<td>De Vega</td>
</tr>
</tbody>
</table>

Figure 1: A table, representing a catalog of a digital library.
Overview of the model

In this section we give an informal overview of our model using an example. Consider a digital library in which each document is identified by its URI and described by two attributes: Topic, whose values are keywords describing document content (e.g., drama, poetry, etc.) and Hits, whose values are integers representing the number of accesses to the document. Thus each document URI in the library is associated with one keyword (its topic description) and one integer (its number of hits).

Therefore we have two functional dependencies

\[ t : \text{URI} \rightarrow \text{Topic} \quad \text{and} \quad h : \text{URI} \rightarrow \text{Hits} \]

(we need the labels \( t \) and \( h \) for later reference).

We can describe this application by a graph, as shown in Figure 2.(a), where the attributes URI, Topic and Hits are the nodes and the functional dependencies \( t \) and \( h \) are the edges. This graph is a first, rudimentary example of what we call analytic schema (or simply “schema”). Its origin is the attribute URI which also happens to be a key (in this example). Roughly speaking, the origin of a schema represents the objects of interest, while all other nodes describe attributes of the objects.

In our approach, we interpret the edges \( t : \text{URI} \rightarrow \text{Topic} \) and \( h : \text{URI} \rightarrow \text{Hits} \) of the schema as function signatures and their extensions as the (current) database. Figure 2.(b) shows an example of (current) database. This database represents all documents accumulated so far in the library. It contains 9 document URIs, each associated with its topic and its number of hits through the functions \( t \) and \( h \) (for simplicity, we represent URIs as integers); for example, document 3 is associated with “Poetry” as topic and with 200 as number of hits (i.e. \( t(3) = \text{Poetry} \) and \( h(3) = 200 \)).

Suppose now that we want to analyze document usage, say by finding the total number of hits by topic, that is by evaluating the answer to the following query against the current database:

\[ Q_1 : \text{total number of hits by topic}. \]

In our approach, in order to answer this query we proceed in three steps as follows:

Grouping: we invert the function \( t \), thus grouping the URIs by topic;

Measuring: in each group, we apply the function \( h \) to each URI of the group to find the corresponding number of hits;

Aggregation: in each group, we sum up the results of measuring to have the total number of hits for that group.

The final result is shown in Figure 2.(c), and it is a function from Topic to a new attribute that we call TotalHits. This function associates each topic with the total number of hits for that topic. In other words the answer to \( Q_1 \) is the following function:

\[ \text{Ans}_{Q_1} : \text{Topic} \rightarrow \text{TotalHits}, \]  

such that \( \text{Ans}_{Q_1}(x) \) is the total number of hits, for each topic \( x \). For example, \( \text{Ans}_{Q_1}((\text{Drama})) = 300 \) and \( \text{Ans}_{Q_1}((\text{Poetry})) = 600 \).

This pattern of grouping a set of objects by inverting a function defined on them, then measuring a property in each group by applying a second function also defined on them, and finally aggregating the measures in each group by applying an operation on the measures constitutes the basic pattern of our approach.

It should be clear from the previous example that the specification of query \( Q_1 \) requires three parameters, a function such as \( t \) for classifying the URIs by topic, a function such as \( h \) for measuring the number of hits by URI, and an operation such as “sum” for aggregating the measured numbers of hits. Therefore \( Q_1 \) can be specified as a triple:

\[ Q_1 = (t, h, \text{sum}). \]  

Notice however that \( t \) and \( h \) have the origin of the schema as their common domain of definition, and that this condition is indispensable in order to compute the answer. Moreover, notice that the operation “sum” is an operation which is possible to apply over the range of \( h \) (i.e. over the integers), and that this condition is also indispensable in order to compute the answer.

In view of the previous discussion, in our approach, we define an analytic query over a schema to be a triple
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Figure 3: Adding Author and Nationality.

$Q = \langle c, m, op \rangle$, where $c$ and $m$ are edges of the schema having the origin as their common domain of definition, and $op$ is an operation which is possible to apply over the range of $m$. We refer to the function $c$ as the classifier or the grouping function of $Q$ and to the function $m$ as the measure.

It is interesting to note that, following the above definition, one can interchange the roles of $c$ and $m$ to obtain a different analytic query (provided of course that the operation in the resulting query is possible to apply over the range of the new measure). For example, one can interchange the roles of $t$ and $h$ in query $Q_1$ to obtain the query $Q'_1 = \langle h, t, \text{sum} \rangle$. However, this query is not well formed since the operation "sum" cannot be applied over the range of $t$ (i.e. over Topic, as topics can’t be summed). By the way, if one changes the operation from "sum" to "count" then one obtains a well formed query, namely

$$Q''_1 = \langle h, t, \text{count} \rangle,$$

(3)

asking for the number of topics by number of hits.

Continuing with our example, suppose now that, in addition to topic description and number of hits, each document is also associated with an author. Then we obtain a new schema as shown in Figure 3(a), where we added the edge $a : URI \rightarrow Author$. We can now formulate the following query, asking for the total number of hits per author:

$$Q_2 = \langle a, h, \text{sum} \rangle.$$

(4)

The answer will be a function from authors to integers: $AnsQ_2 : Author \rightarrow \text{TotHits}$ such that $AnsQ_2(a)$ is the total number of hits, for each author $a$.

Now, however, it makes sense to also ask the following query:

$Q_3$: “total number of hits by topic-author pair”.

This time the grouping of URIs will be done according to a function derived from $t$ and $a$, which associates each URI with a topic-author pair. This function is called the pairing of $t$ and $a$, it is denoted by $t \land a$, and it is defined as follows: $t \land a : URI \rightarrow Topic \times Author$ such that $(t \land a)(x) = \langle (t(x), a(x)) \rangle$.

During evaluation of $Q_3$, the pairing $t \land a$ will group together all URIs having the same topic and the same author, and the answer will associate each topic-author pair with a total number of hits. In other words, compared to $Q_1$, the only change is that the function $t$ of $Q_1$ is now replaced by the function $t \land a$; other than that, the evaluation of $Q_3$ proceeds in exactly the same way as for $Q_1$. Therefore, $Q_3$ is specified as follows:

$$Q_3 = \langle t \land a, h, \text{sum} \rangle.$$

(5)

And its answer will be a function from topic-author pairs to integers:

$$AnsQ_3 : Topic \times Author \rightarrow \text{TotHits},$$

(6)

such that $AnsQ_3((x, y))$ is the total number of hits, for each topic-author pair $(x, y)$.

As another example, suppose that we also add the nationality of each author. Then we obtain a new schema as shown in Figure 3(b). We can now ask the following analytic query:

$Q_4$: “total number of hits by author’s nationality”.

This time, during evaluation, the grouping of URIs will be done according to a function derived from $a$ and $n$ using functional composition. The composition of $a$ and $n$, denoted $n \circ a$, associates each URI with the corresponding author’s nationality. During evaluation of $Q_4$, the function $n \circ a$ will group together all URIs having the same author nationality; and the answer will associate each author nationality with a total number of hits. In other words, compared to query $Q_1$, the only change is that the function $t$ of $Q_1$ is now replaced by the function $n \circ a$; other than that, the evaluation of $Q_4$ proceeds in exactly the same way as for $Q_1$. Therefore $Q_4$ is specified as follows:

$$Q_4 = \langle n \circ a, h, \text{sum} \rangle.$$

(7)

And its answer will be a function from Nationality to TotHits:

$$AnsQ_4 : \text{Nationality} \rightarrow \text{TotHits},$$

(8)

such that $AnsQ_4(x)$ is the total number of hits, for each nationality $x$.

As a final example, we can ask the following analytic query over the schema of Figure 3(b):

$Q_5$: “total number of hits by topic-nationality pair”.

Again, all we have to do in order to evaluate this query is to replace the function $t$ of $Q_1$ by the function $c \land (n \circ a)$. Therefore $Q_5$ is specified as follows:

$$Q_5 = \langle c \land (n \circ a), h, \text{sum} \rangle.$$

(9)

And its answer will be a function from topic-nationality pairs to integers:

$$AnsQ_5 : Topic \times Nationality \rightarrow \text{TotHits},$$

(10)
such that $\text{Ans}_{Q_5}(x, y)$ is the total number of hits, for each topic-natinality pair $(x, y)$.

Notice that, in all the above examples of queries ($Q_1$ to $Q_5$), we can also restrict any of the functions involved to some desirable subset of its domain of definition, to form new analytic queries. In fact, the set of all operations on functions that we shall use to derive new functions from old constitutes what we shall call the functional algebra of a schema. These operations are quite elementary: composition, pairing, restriction and projection. Yet, as we shall see, they allow us to associate each schema with a powerful language of analytic queries.

The Formal Model

As we mentioned earlier, we view the schema as a set of function signatures and a database as a set of (finite) extensions, one for each function signature. In this section, we keep with this view and we define a language in which analytic queries can be formulated over the schema and evaluated over the database. We shall illustrate the concepts introduced by the following example that we shall use as our running example for the rest of the paper.

Running example

A big catering company delivers various products to retail stores over the whole country. The following data appears on each delivery invoice:

- the invoice number
- the date of delivery
- the store identifier
- a type of product (e.g. "Coca Light")
- and the number of items delivered (from that type of product)

These data are recorded in the database of the catering company, and accumulated over long periods of time with the purpose of analyzing them in order to improve the company’s delivery service. More specifically, the analyses performed are:

- by date and by month
- by store, by city and by region
- by supplier and by product category
- by combinations thereof, such as by date and store, or by month and region etc.

We assume that a supplier might supply products in two or more categories and that a product category might be supplied by two or more suppliers.

The schema concerning this application is shown in Figure 4, where $O$ stands for "invoice number", that is $O$ represents the set of all invoice numbers accumulated so far. We shall use this schema in order to introduce the basic concepts of the query language.

In our explanations we shall use the notation $f : X \rightarrow Y$ to denote an edge with label $f$, source $X$ and target $Y$; similarly, we shall talk of the source and the target of a path.

In our explanations we shall use the notation $f : X \rightarrow Y$ to denote an edge with label $f$, source $X$ and target $Y$; similarly, we shall talk of the source and the target of a path.

![Figure 4: The functional schema $S$ of the running example.](image)

Functional database

Given a schema $S$, a database over $S$ is a function $\delta$ that associates:

- each node $N$ of $S$ with a finite subset $\delta(N)$ of $\text{dom}(N)$, and
- each arrow $f : X \rightarrow Y$ of $S$ with a total function $\delta(f) : \delta(X) \rightarrow \delta(Y)$.

In order to simplify notation, we shall omit the symbol $\delta$ and we shall use the expression "function $f : X \rightarrow Y$" to mean "function $\delta(f) : \delta(X) \rightarrow \delta(Y)$".

We note that the fact that all functions in the database are total imposes the following constraint:

referential constraint : for every pair of functions of the form $f : X \rightarrow Y$ and $g : Y \rightarrow Z$ we must have $\text{range}(f) \subseteq \text{def}(g)$.

Roughly speaking, the schema is seen as a set of function signatures and the database stores their extensions.

Several remarks are in order here. First, in order to simplify the presentation, we adopt the following abuse of notation: we use an arrow label such as $f$ to denote both the arrow $f$ and the function $\delta(f)$ assigned to $f$ by $\delta$. Similarly, we use an attribute label such as $X$ to denote both the attribute $X$ and the finite set $\delta(X)$ assigned to $X$ by $\delta$. This should create no confusion, as more often than not the schema will resolve ambiguity. Second, the definition of a database requires that all functions assigned by the database $\delta$ to the arrows of $S$ be total functions. This restriction could be relaxed, by endowing each attribute domain with a bottom element $\bot$ (meaning “undefined”) and requiring that for any function $f : X \rightarrow Y$ we have (a) $f(\bot) = \bot$, that is “bottom can only map to bottom”, and (b) if $x \notin \text{def}(f)$ then $f(x) = \bot$. Under these assumptions, the functions can again be considered as total functions. However, the resulting theory would be more involved and would certainly obscure some of the important points that we would like to bring forward concerning analytic queries.
The Functional Algebra

In order to combine the function extensions in the database of a schema, we need a set of operations on functions that we call the functional algebra. The functional algebra comprises four operations. Each operation takes as input one or two functions and returns a new function as a result:

**Composition**: takes as input two functions, \( f \) and \( g \), such that \( \text{range}(f) \subseteq \text{def}(g) \), and returns a function \( g \circ f : \text{def}(f) \rightarrow \text{range}(g) \) defined by

\[
g \circ f(x) = g(f(x)), \text{ for all } x \in \text{def}(f).
\]  

**Pairing**: takes as input two functions, \( f \) and \( g \), such that \( \text{def}(f) = \text{def}(g) \), and returns a function \( f \land g : \text{def}(f) \rightarrow \text{range}(f) \times \text{range}(g) \) defined by

\[
f \land g(x) = (f(x), g(x)),
\]  

for all \( x \in \text{def}(f) \).

**Projection**: it’s the usual operation on the cartesian product of sets.

**Restriction**: takes as input a function \( f : X \rightarrow Y \) and a set \( E \subseteq \text{def}(f) \), and returns a function \( f/E : E \rightarrow Y \) defined by

\[
f/E(x) = f(x),
\]  

for all \( x \in E \).

The following proposition states an important property of the functional algebra.

**Proposition 1**

For every pair of functions \( f : X \rightarrow Y \) and \( g : X \rightarrow Z \), we have

\[
f = \pi_Y \circ (f \land g) \quad \text{and} \quad g = \pi_Z \circ (f \land g).
\]

**Nota**: \( \pi_Y() \) and \( \pi_Z() \) are the projection functions over \( Y \times Z \), defined by: \( \pi_Y(y, z) = y \) and \( \pi_Z(y, z) = z \), for all pairs \( (y, z) \in Y \times Z \).

**Path expressions**

Given a schema \( S \), a path expression over \( S \) is a well formed expression whose operands are arrows from \( S \) and whose operations are those of the functional algebra. Every path expression \( e \) is associated with a source and a target, defined recursively, based on the notions of source and target of the arrows in \( S \). For example, if \( e_1 = g_2 \circ g_1 \), then \( \text{source}(e_1) = \text{Store} \) and \( \text{target}(e_1) = \text{Region} \); similarly, if \( e_2 = (g_1 \circ g) \land f \) then \( \text{source}(e_2) = \text{O} \) and \( \text{target}(e_2) = \text{City} \times \text{Date} \) (for a formal definition of a path expression see [2]).

Given a path expression \( e \) and a database \( \delta \) over \( S \), the evaluation of \( e \) with respect to \( \delta \) is done in two steps, as follows:

1. replace each arrow \( f \) appearing in \( e \) by the function \( \delta(f) \) that the database \( \delta \) associates with \( f \)
2. perform the operations of the functional algebra as indicated in \( e \).

Note that the result of the evaluation is always a function; therefore we have a closure property as in the case of the relational algebra.

A particular kind of path expression will be of interest, namely the one that corresponds to projection over the empty set. To understand the nature of this projection, recall that, given a Cartesian product of \( k \) sets, say \( A_1 \times \ldots \times A_k \), there are as many projection functions as there are subsets of the set \( A_1, \ldots, A_k \). The projection function that corresponds to the empty set is the one that we call the empty projection function, hence we denote it by \( \pi_{\emptyset} \). Clearly, following the definition of a projection function, the function \( \pi_{\emptyset} \) is a constant function as it associates every tuple of \( A_1 \times \ldots \times A_k \) with the empty tuple; we shall denote the empty tuple by \( \lambda \). Therefore, \( \pi_{\emptyset}(t) = \{\lambda\} \), for all \( t \in A_1 \times \ldots \times A_k \) (assuming there is at least one such \( t \)). In view of our previous discussion, we introduce a particular path expression, the **empty path expression**, which will always be associated with the empty projection function, in any database \( \delta \). We denote the empty path expression by \( \varepsilon \), where \( X \) denotes the source of the empty path expression (its target being always interpreted as \( \{\lambda\} \)). The empty path expression with source \( O \) will be simply denoted by \( \varepsilon \).

**OLAP query**

Given a schema \( S \), an OLAP query over \( S \) is a triple

\[
Q = \langle c, m, \text{op} \rangle,
\]  

where:

- \( c \) and \( m \) are path expressions over \( S \) such that \( \text{source}(c) = \text{source}(m) \) and \( \text{op} \) is an operation among those authorized over the target of \( m \).

For example, in the schema \( S \) of our running example (Figure 4):

\[
Q = (g \land (h_2 \circ h), n, \text{sum})
\]  

is an OLAP query over \( S \), with

- \( c = g \land (h_2 \circ h) \), \( m = n \) and \( \text{op} = \text{sum} \) and we have \( \text{source}(g \land (h_2 \circ h)) = \text{source}(n) = O \), and \( \text{sum} \) is an authorized operation over the target of \( n \) (which is Number, with \( \text{dom}(\text{Number}) = \text{Int} \)).

Given an OLAP query \( Q = \langle c, m, \text{op} \rangle \), we call \( c \) the classifier, \( m \) the measure and \( \text{op} \) the operation (or the aggregator) of \( Q \). Moreover, we call the target of \( c \) the classification level (or the grouping level), and the target of \( m \) the measurement level. Note that the classification level, or the measurement level, might be composed of other simpler levels, as is the case in our previous example where \( \text{target}(c) = \text{Store} \times \text{Supplier} \).

**Evaluation of an OLAP query**

Given an OLAP query \( Q = \langle c, m, \text{op} \rangle \) and a database \( \delta \) over \( S \), the answer to \( Q \) with respect to \( \delta \) is a function \( \text{ansq}_\delta : \text{range}(c) \rightarrow \text{target}(\text{op}) \) computed in two steps, as follows:

1. Evaluate the path expressions \( c \) and \( m \) with respect to \( \delta \).
A Functional Model for Data Analysis and Result Visualization

\[Q = (e, m, op)\]  \hspace{1cm} (16)

During its evaluation, step 1 of the evaluation algorithm returns a constant function with \( \lambda \) as its only value; step 2.(a) (grouping) returns just one group \( c^{-1}(\lambda) = \{X\} \); step 2(b) (measurement) returns the images under \( m \) of all elements of \( X \); step 2.(c) (aggregation) applies the operation on all images to obtain a single result \( \text{Res}(\lambda) \); and step 2.(d) (answer) associates every element of \( X \) to \( \text{Res}(\lambda) \). Therefore, the answer \( \text{ans}_{Q, \delta} \), is itself a constant function.

As an example, the query

\[Q = (e, n, \text{Sum})\]  \hspace{1cm} (17)

will return the total number of items delivered (i.e. the total number of items present in the database).

When the target of the classifier \( e \) is a Cartesian product, say \( A_1 \times \ldots \times A_k \), then the representation of the answer \( \text{ans}_{Q, \delta} : \text{range}(c) \rightarrow \text{target}(op) \) by cross tabulation is usually called a “data cube”. Recall that two other representations of the answer are possible, by graph and by binary table, and several tools for “visualizing” and manipulating the answer are available today.

A final but important remark on the definition and evaluation of an OLAP query is in order here. As the classifier and the measure of an OLAP query \( Q = (e, m, op) \) both are path expressions, if we interchange them we obtain a different but valid OLAP query, possibly with a different operation \( op \). For example, consider the query \( Q = (g, n, \text{sum}) \), which asks for the total number of items delivered by store. If we interchange \( g \) and \( n \) and use \( \text{count} \) instead of \( \text{sum} \) then we obtain the query \( Q' = (n, g, \text{count}) \), which asks for the number of stores by number of units delivered (i.e. given a number of items, how many stores had this number delivered to them). Note that, in the query \( Q' \), we used “count” as an operation, since this is the only operation allowed on the target of the measure \( g \) (which is a set of store references).

Mapping to the relational model

The schema model that we presented in the previous section can certainly be used as is to model an application in order to perform data analysis. Moreover, a schema database can be implemented using available open source DBMS technology. For example, MonetDB [?] seems to fit quite well for this purpose as its basic structure is the binary table. However, given that the vast majority of transactional databases and data warehouses today are based on the relational model, it is important to have a way of mapping the functional model to the relational model. In this section we present a method for mapping the schema model to the relational model.

Our method uses three mappings as follows:

- Mapping a schema to a relational star schema
- Mapping a path expression to a relational expression
- Mapping an OLAP query to an SQL query

Mapping a schema to a relational star schema

Given a functional schema \( S \), there are several ways to map it into a relational schema \( \text{rel}(S) \). The simplest way is to represent each arrow of \( S \) by a binary table, and define the set of all binary tables to be the schema \( \text{rel}(S) \). However, the evaluation of OLAP queries will then require the frequent use of joins. A more efficient mapping is the one that produces a so called star schema. To simplify the presentation we shall assume that the functional schema is a tree (as in our running example). Under this assumption, here are the tables and constraints in the corresponding star schema:

**Tables:**

- Define a table \( FT \) containing the root of \( S \) and all its immediate successors as its attributes (these immediate successors are the base attributes). Call this table the fact table.
- For each base attribute \( B \), if there is at least one successor of \( B \), define a table \( B^T \) containing \( B \) and all its descendants as attributes. Call this table the \( B \)-table.

**Constraints:**
1. In each of the tables defined above, any arrow connecting two of its attributes becomes a functional dependency of that table (hence it might be that some tables are not in Boyce-Codd Normal Form).

2. There is a foreign key dependency from the fact table to every other table \( BT: \pi_B(FT) \subseteq \pi_B(BT) \).

**Example**

The star schema for our running example is the following (underlined attributes form the key of each table):

\[
\begin{align*}
FT(Q, Date, Store, Product, Num) \\
DateT(Date, Month) \\
StoreT(Store, City, Region) \\
ProductT(Product, Category, Supplier) \\
\end{align*}
\]

Note that the table \( StoreT \) is not in Boyce-Codd Normal Form, and that the table \( DateT \) is not necessary to store (as the month can be determined from the date).

**Mapping a path expression to a relational expression**

The following algorithm maps a path expression \( e \) over \( S \) to a relational expression \( rel(e) \) over the star schema \( rel(S) \):

**if** the target of \( e \) contains only base attributes

**then** \( rel(e) = \pi_{target(e)}(FT) \)

**else** \( rel(e) = \pi_{target(e)}(FT \bowtie T_1 \bowtie ... \bowtie T_k) \), where \( T_1, ..., T_k \) are all the tables each of which contains at least one non base attribute appearing either in the target of \( e \), or in the definition of a restriction.

**Example:**

The path expressions:

\[
\begin{align*}
e_1 &= g \land (h_2 \circ h) \\
e_2 &= n
\end{align*}
\]  
(18)

map to the following relational expressions:

\[
\begin{align*}
rel(e_1) &= \pi_{Store, Sup}(FT \bowtie ProductT) \\
rel(e_2) &= \pi_{Num}(FT).
\end{align*}
\]  
(19)

**Mapping an OLAP query to an SQL query**

To map an OLAP query \( Q = \langle c, m, op \rangle \) to a relational query \( rel(Q) \) it is sufficient to replace the path expressions \( c \) and \( m \) by \( rel(c) \) and \( rel(m) \), to obtain

\[
rel(Q) = \langle rel(c), rel(m), op \rangle.
\]  
(20)

The query \( rel(Q) \) is then evaluated using a “group by” instruction. This is possible if one observes that the “group by” instruction of SQL simply computes inverses of a special kind of functions, namely projections.

**Example:**

\[
Q = \langle g \land (h_2 \circ h), n, sum \rangle
\]  
(21)

maps to

\[
rel(Q) = \langle \pi_{Store, Sup}(FT \bowtie ProductT), \pi_{Num}(FT), sum \rangle
\]  
(22)

and \( rel(Q) \) is evaluated as follows:

\[
\text{select } Store, Sup, sum(Num) \text{ as TotNum from join}(FT, ProductT) \text{ group by } (Store, Sup)
\]

The previous SQL instruction computes the inverse of the projection function \( \pi_{Store, Sup} \) thus creating a partition of the table \( join(FT, ProductT) \) into sub-tables; then in each sub-table \( T \), it applies the function \( n \) to each tuple of the sub-table to find the corresponding number; and finally sums up the numbers found to return the total number for each sub-table.

**Result Visualization**

Interactive visualization is a powerful technique to slice a data set from various viewpoints using queries and to find interesting trends from visual representations of query results. To perform interactive OLAP visualization, we need to construct many OLAP queries and dynamically map query results to appropriate visual representations. For non-professional end users these tasks are not so easy.

In our prototype, we follow a template-based approach in the user interface to improve user’s experience with interactive analysis tasks. By interacting with visual components, called visualization templates, one can easily define both queries and visual representations of query results, simultaneously.

Moreover, our prototype also supports what we call result exploration that is the possibility of visualizing the query result at aggregation levels different than those specified in the query; or the possibility of creating a parametric representation of the result for better visualization.

**Visualization template**

Broadly speaking, a visualization template is an interactive component for defining a visual representation of a designated (data) function. Figure 6 illustrates a concept of visualization template. Visualization template \( T_{bar} \) defines a bar chart representation of a function \( f_{bar} : xcoord \rightarrow \text{length} \). The function \( f_{bar} \) is a variable and we can bind it to a designated function in a data schema or to the answer of a query (which is also a function).

Our prototype implements the following user interaction and automating mechanism to define a function binding. To bind \( f_{bar} \), our prototype requires attribute mappings from attributes in the data schema to the domain \( xcoord \) and the range \( \text{length} \) of \( f_{bar} \). For this purpose, \( T_{bar} \) has visible slots \( \{xcoord\} \) and \( \{\text{length}\} \) on its surface to map attributes to \( xcoord \) and \( \text{length} \). We can specify attribute mappings just by dragging attributes from the visualized data schema and dropping them into slots. When \( T_{bar} \) accepts attribute mappings \( \{A \rightarrow xcoord, B \rightarrow \text{length}\} \) with attributes \( A \) and \( B \) in data schema \( S \), \( T_{bar} \) automatically binds \( f_{bar} \) to a function retrieved by the following rule.
Parametric Visualization

If a schema function (or a derived function) \( f : A \rightarrow B \) exists in \( S \), \( T_{\text{bar}} \) binds \( f_{\text{bar}} \) to \( f \). (If more than one function of the form \( A \rightarrow B \) exist in \( S \), the system shows a dialog for choosing one of them.)

If no function of the form \( A \rightarrow B \) exists in \( S \), \( T_{\text{bar}} \) binds \( f_{\text{bar}} \) to a query \( Q(p_A, p_B, op) : A \rightarrow op(B) \) such that \( O \) is the root of \( S \), \( p_A : O \rightarrow A \) and \( p_B : O \rightarrow B \) are path expressions over \( S \), and \( op \) is an operation preset by users.

Our prototype provides a visualization template library containing a set of basic chart representations (bar chart, pie chart, etc.) and layouts of multiple charts (e.g., grid layout). We can interactively define both, queries and query result representations, by just choosing templates from the library and designing attribute mappings through drag-and-drop manipulation.

Changing the aggregation level of the result

The user interaction and the automating mechanism described above allow us to quickly change aggregation levels of the result. Consider for example the query “Q: Totals by Month”. Figure 5 shows the result of this query in the form of a bar chart. The user can explore this result further by asking the system to produce a visualization at levels different than those specified in the query, for example, by Date, by Product; or by Category; or by City, and so on, just by dragging an attribute for classifier and dropping it into the slot associated with the X axis of the bar chart.

When visualizing a result involving two or more aggregation levels, it is often convenient to make a series of small plots one for every category item. For example, consider a query whose result involves two dimensions, product category and city. We can make a series of plots showing totals by cities for each product category (as shown in Figure 7). This series of plots might convey easily information difficult to grasp from a single plot showing totals by product category and city. The underlying idea here is that, as the answer to \( Q \) has the signature \( \text{Category} \times \text{City} \rightarrow \text{Totals} \), we can produce an equivalent representation of the answer using the well known “curry operation”: \( (\text{Category} \times \text{City} \rightarrow \text{Totals}) \equiv (\text{Category} \rightarrow (\text{City} \rightarrow \text{Totals})) \), suggesting that we can use Category as a “parameter” for producing as many small plots \( \text{City} \rightarrow \text{Totals} \), as there are product categories. Alternatively, one can use City as a parameter for producing as many small plots \( \text{Category} \rightarrow \text{Totals} \) as there are cities. This kind of exploration is basically a repetition of a plot across a grid, where each plot has one variable which changes. In other words, it is a grid of multiple smaller plots driven around in a loop executing it once for every category item. Clearly, parametric visualization is not bound to a specific visualization mode: every basic visualization mode can be parameterized this way, whether it is scatter bar charts, heat maps, line charts, whichever.
belonging to the dropped template to cell. For instance, if we drop $T_{\text{bar}}$ with function $f_{\text{bar}} : xcoord \rightarrow length$ into [cell], $T_{\text{grid}}$ produces a grid layout of bar charts to represent function $f_{\text{gridOfBars}} : row \times column \rightarrow (xcoord \rightarrow length)$.

Parametric visualization provides yet another, important dimension of result exploration as the eye can grasp more detailed information when visualizing a set of simple plots, in addition to the information obtained from a single, higher dimensional (thus more complex) plot.

Concluding Remarks

We have seen a functional model for data analysis and an interactive interface (based on that model) that supports users in the following tasks:

- formulating an analytic query visually, in the form of a click stream;
- visualizing the query result in a user selected mode (histogram, pie, etc.);
- exploring the visualized result at different aggregation levels or for different parameter values selected by the user;

The prominent features of our model are that it is simple to grasp and easily amenable to visual interaction. We are currently investigating the use of our model in an important application area, namely log data analysis in the context of the European project "ASSETS: Advanced Search Services and Enhanced Technological Solutions for the European Digital Library".

The basic idea is to import log data in the form of a relational table with functional dependencies, and construct a functional schema in which the base attributes are those of the table, the analysis indicators (i.e., the non-base attributes) are provided by the analyst, and the edges are generated by the functional dependencies. We note that log data analysis is a useful activity in such areas as e-learning, collaborative work or digital libraries, as it provides valuable support to knowledge discovery from past user activity. Future work will address two main issues:

1. Combining change of aggregation level and parametric visualization. For example, one can visualize totals by product, at different aggregation levels, using different visualization modes for each store.

2. The application of our model to XML data warehouses for analyzing large collections of XML documents.

References

A FRAMEWORK FOR THE DESIGN OF SPEECH-ENABLED SELF-CARE E-HEALTH SYSTEMS

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Abstract

The Internet provides a wide range of health information and services which consumers access for self-care and to participate in a more informed way in their healthcare when they see their physician. This information and services are however, delivered in text form and therefore, does not cater for the needs of the non-computer literate, the visually impaired and the blind. This paper presents a framework for the design of speech-enabled self-care e-Health systems. Reasoning-induced disease diagnosis which existing speech-based disease screening systems lack has been incorporated into the framework to enable systems based on the framework diagnose more than one type of disease. Based on the framework, speech-based self-care e-Health system (SSeS) prototype application was developed. The originality of this framework is that it is speech-based. This takes care of the health needs of the category of people earlier identified and the underserved people, majority of those who are domiciled in Africa.

Keywords: Self-Care, Speech-Enabled, VoiceXML, e-Health, Health Information, Reasoning.

Introduction

Consumers seek health information to educate themselves for self-care and to participate in a more informed way in their healthcare when they see their physicians. As such, they search websites to get this information [1]. This activity is especially helpful in most African countries where healthcare is inadequate [2]. Mobile phone usage is however on the increase on the continent [3].

The information provided by these websites is delivered in text form and this does not cater for the needs of the non-computer literate, the blind as well as the people with visual impairment. Although several frameworks have been proposed for different features in e-Health systems, these frameworks however, do not address the issue of inadequacy of healthcare, visual impairment and non-computer literacy of some sections of the population.

This paper presents a framework for speech-enabled self-care e-Health system. The initiative makes health information and services for self-care available through speech for the categories of people that are underserved and those not taken care of through the graphical user interface (GUI) systems. It incorporates reasoning-induced disease diagnosis which the existing speech-based screening systems lack, to enable them diagnose more than one disease. It also serves as an e-Learning speech-enabled e-Health initiative that provides health information.

Previous Work

Previous related research efforts in the area of e-Health systems include the following: A framework for the creation, maintenance, and reuse of clinical document templates adhering to HL7 Clinical Document Architecture (CDA) and interoperability with middleware services of the health information infrastructure (HII) is proposed by [4]. The architecture and a prototype of a generic service platform for the provision of mobile healthcare services based on Body Area Networks (BANs) are discussed in [5]. The use of health BANs together with advanced wireless communications enables remote management of chronic conditions and detection of health emergencies whilst maximizing patient mobility. A composite device computing environment (CDCE) framework that can offer access to broad range of multimedia services across multitude of potential devices is proposed in [6]. CDCE needs to be sufficiently adaptive in order to exploit an ever-changing number and diverse range of available computing resources. A mechanism that supports the ubiquitous and efficient exchange of electronic medical records across multiple heterogeneous environments is provided in [7]. Mu-Jung and Mu-Yen proposed a framework for an integrated design of intelligent web-based Chinese Medical Diagnostic System (CMDS) for digestive health using ontology. CMDS used Web interface and expert system to diagnose a number of digestive system diseases [8]. Nsuangani and Pérez presented the result of a study conducted on college students’ online activities at health websites. It was found out that those who searched the sites were looking for health-related information, products, and services for self-help [1]. The information provided was however in text form. Medical Library Association listed some websites that people access for self-care, but the access is through GUI only [9]. Sherwani et al.
presented a report of speech-based access to health information by low-literate community health workers to assist them in their job. The information provided was in Urdu language of Pakistan and it was found out that speech technology could help the low-literate [10]. James et al. presented a report of Interactive Voice Response (IVR) developed for screening for early Dementia. A Clinical Dementia Rating Scale was used to assess 156 subjects aged 56 to 93 years. These subjects performed a battery tests administered by an interactive voice response system using standard touch-tone telephones. It was discovered that computer-automated telephone screening using either informant or direct assessment is feasible and that such systems could provide wide-scale, cost-effective screening, education and referral services to patients and care givers [11]. Mundt et al. extended the work presented by James et al. to include educating the callers on dementia disease and making referral services. Data gathered from the pilot testing showed the feasibility of using IVR for education purposes [12]. Kim et al. carried out a test to know the feasibility of using IVR to screen for depression among low-income, urban pregnant patients and to solicit their preferences for treatment. Consenting subjects used a phone in a private clinic room to complete an IVR version of the Edinburgh Postnatal Depression Scale (EPDS). The pilot study suggested the practicability of using an automated phone interview for screening [13]. Corkrey et al. described a pilot interactive voice response cervical cancer screening brief advice interface. The subjects used completed computer-assisted telephone interview (CATI) and the results obtained suggested that an IVR reminder might be useful to increase cervical screening rates [14]. A critical look at the existing speech-based disease screening systems shows that the approach employed by them is that of asking the callers stereotyped set of questions over and over again. There is no reasoning involved in arriving at the conclusion. Because of this limitation, they are mainly meant for diagnosing a particular type of disease and consequently cannot handle more than one disease.

**Materials and Methods**

**Methodology**

In developing the framework, the American Medical Library Association recommended websites were accessed to gather the features provided by the framework. Reasoning-induced disease diagnosis which existing speech-based disease screening systems lack has been provided as part of the features to enable systems based on the framework diagnose more than one disease. A prototype voice application was developed to provide functionalities based on the features of the framework using four types of fever prevalent in Africa as case diseases. VoiceObjects Desktop for Eclipse was used to develop, test and deploy the prototype application. Voxeo Prophecy was used as the media platform, and server-side Javascript was used to specify the rules with which the system reasons in diagnosing a disease using script objects. Logic objects were used to control the logic of the dialog flow. VoiceObjects embedded database was used to store the context of the problem domain, while the inbuilt rule engine within VoiceObjects determines which rule gets fired. X-Lite soft phone was used to call the application. These tools were chosen because they allow a developer to develop and test an application locally, eliminating the need to pick up a phone and dial a specific number each time the application is to be tested and debugged.

**Speech Technology**

Speech technology is a technology that is capable of catering for the needs of the categories of people that are blind, visually impaired and non-computer literate. Until recently, Internet applications have primarily been dependent on visual interfaces to provide access to information and services. Advances in speech recognition technology are however, allowing the creation of voice applications that users interact with by speaking to them through telephones rather than by using traditional input devices. All that is necessary for them is to obtain the information they require through voice. Driving this technology is Voice Extensible Markup Language or VoiceXML. VoiceXML is a standard language for building interfaces between voice recognition software and Web content. Just as HTML defines the display and delivery of text and images on the Internet, VoiceXML translates XML-tagged Web content into a format that speech recognition software can deliver by phone [15].

VoiceXML technology follows the same model as the HTML and Web browser technologies. Similar to HTML, a VoiceXML application does not contain any platform specific knowledge for processing the content. The platform specific processing capability is provided through the Voice Gateway that incorporates Automatic Speech Recognition (ASR) and Text-to-Speech (TTS) engines, along with a Voice Browser [17]. The Voice Gateway architecture is presented in figure 1. It uses the familiar client – server paradigm.

VoiceXML pages are served from a Web Server and is typically created dynamically within the framework of an Application Server. The Voice Browser is a telephone-based browser that renders VoiceXML pages audibly. The users interact with the Automatic Speech Recognition (ASR) engine and Text To Speech (TTS) voice synthesis and restitution
of pre-recorded audio files are the outputs the machine can use.

![Voice gateway architecture](Source: 16)

**Figure 1. Voice gateway architecture**

**e-Health**

e-Health is a term that is commonly used in relation to the use of technology in healthcare. Although there is no universally acceptable meaning of e-Health [17], it could be said to be the use of Information and Communication Technologies (ICT) to improve health and healthcare systems [18]. e-Health combines the use of electronic communication and information technology in the health sector, or is the use of digitally transmitted data that is stored and retrieved electronically for clinical, educational and administrative purposes both at a local site and remotely in the health sector [19].

**m-Learning and e-Learning**

According to Niall Winters [21], current perspectives on mobile learning generally fall into the following four broad categories:

1. Technocentric: Here, mobile learning is viewed as learning using a mobile device such as PDA, mobile phone, iPod, playstation portable, etc.
2. Relationship to e-learning: This perspective characterizes mobile learning as an extension of e-learning.
4. Learner-centered: Any sort of learning that happens when the learner is not at a fixed, predetermined location or learning that happens when the learner takes advantage of learning opportunities offered by mobile technologies. According to Parsons and Ryu, m-learning is broadly defined as the delivery of learning content to learners utilizing mobile computing devices [21], and according to Kambourakis G. et al., m-learning is the point at which mobile computing and e-learning intersect to produce an anytime, anywhere learning experience [22]. From the various definitions of m-learning, we can conclude that m-learning is a form of e-learning that involves any learning with the use of mobile device to produce an anywhere and anytime learning experience to cater for the needs of different learners and augmenting their formal learning experience.

On the other hand, there are various definitions of e-learning and one thing that is common to them all is the term ‘technology’. It involves a learner using a variety of computer and networking technologies to access training materials. It is education offered using electronic delivery methods such as CD-ROMs, video conferencing, websites and e-mails to facilitate and enhance learning through the use of devices based on computer and communications technology [23]. It covers a wide set of applications and processes such as Web-based learning, computer-based learning (CD-ROM), virtual classrooms, and digital collaboration [24]. In an overall definition, it is the use of electronic technology to support and enhance teaching and learning.

**The Architectural Framework for the Speech-Enabled Self-Care e-Health System (SSeS)**

Figure 2 below shows the architecture for the proposed framework.

![The architecture for the framework](Source: 16)
The architecture consists of the client layer, the middle layer and the data layer. The client layer consists of telephone either fixed or mobile with which the caller will interact with the middle layer. In the middle layer, the VoiceXML gateway is an operational platform on which VoiceXML services run. As a gateway, it bridges the world of telephony to other networks such as Internet and data networks. The Web server serves the VoiceXML pages and the service manager allows the caller to pick any of the services below:

**Alternative Therapy:** This provides alternative therapy to any disease the caller wants information about. This is especially useful in the context of some African nations like Nigeria where the National Agency for Food and Drug Administration and Control (NAFDAC) has registered some alternative therapy medicines.

**Hospital:** This service provides a list of hospitals in the caller’s proximity in case of the need to consult a doctor and in cases of emergency.

**Drugs:** This provides over-the-counter (OTC) drugs for specific diseases, which the caller can purchase for treatment.

**Diseases and Prevention:** The service provides information about diseases and how they can be prevented.

**Research Results:** It provides information about new results of researches related to treatment, prevention, how to live a healthy life, etc.

**Specialists:** This provides information about specialist doctors in the proximity of the caller in case of the need to consult one.

**Diagnosis:** This service allows the caller to diagnose the kind of disease he/she is suffering from.

**Fruit Therapy:** This provides information about fruits that can be used to treat and prevent certain diseases. This is especially useful for people in the rural areas in Africa where healthcare is inadequate and where the occupation of the entire populace is farming.

The data layer consists of the database that houses the information accessible through the middle layer including all the words and phrases which the user is expected to say.

---

**Speech-Based Self-Care e-Health System (SSeS) System Design**

Based on the framework provided above, Speech-Based Self-Care e-Health System (SSeS) prototype was developed. Figure 3 shows the control of flow diagram for SSeS.

![SSeS control flow diagram](image)

The system has a welcome message played to intimate the caller of the services it renders and the instruction on how to use the system. The caller is then given a choice of either diagnosing his/her fever or getting information about a select list of fever rampant in Africa (malaria fever, typhoid fever, lass fever and yellow fever). For each of the fever, the caller can get general information about the fever (e.g how it can be contacted, where it is prevalent, etc), how the fever can be prevented, how it can be treated using orthodox medicine, the symptoms of the fever, how the fever can be treated with fruits and alternative therapies available for the treatment of the fever. The system is able to diagnose more than one disease because of the reasoning introduced into it. This approach is an improvement over the existing speech-based disease screening systems that can only handle only one disease.

---

**Reasoning Model of Speech-Based Self-Care e-Health System (SSeS)**
The table below shows the symptoms associated with each of the four types of fever diagnosed by SSes.

<table>
<thead>
<tr>
<th>Malaria Fever</th>
<th>Lassa Fever</th>
<th>Typhoid Fever</th>
<th>Yellow Fever</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headache</td>
<td>Headache</td>
<td>Headache</td>
<td></td>
</tr>
<tr>
<td>Stomach pain</td>
<td>Stomach pain</td>
<td>Stomach pain</td>
<td>Stomach pain</td>
</tr>
<tr>
<td>Fever</td>
<td>Fever</td>
<td>Fever</td>
<td></td>
</tr>
<tr>
<td>Diarrhea</td>
<td>Diarrhea</td>
<td>Diarrhea</td>
<td>Vomiting</td>
</tr>
<tr>
<td>Vomiting</td>
<td>Vomiting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chill</td>
<td>Chill</td>
<td></td>
<td>Chill</td>
</tr>
<tr>
<td>Nausea</td>
<td></td>
<td></td>
<td>Nausea</td>
</tr>
<tr>
<td>Back pain</td>
<td>Back pain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fatigue</td>
<td>Fatigue</td>
<td>Fatigue</td>
<td></td>
</tr>
<tr>
<td>Muscle pain</td>
<td>Muscle pain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loss of appetite</td>
<td>Loss of appetite</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bitter taste</td>
<td>Chest pain</td>
<td>Rash</td>
<td>Bone pain</td>
</tr>
<tr>
<td>Sweating</td>
<td>Cough</td>
<td>Bloody stool</td>
<td>Bleeding</td>
</tr>
<tr>
<td>Joint pain</td>
<td>Swollen eyes</td>
<td>Red eyes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Swollen neck</td>
<td>Low urine</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Swollen face</td>
<td>Blood vomiting</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ringing in ears</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1 is divided into three sections. The symptoms from the first two sections are not sufficient to diagnose any of the four types of fever because the different types of fever have some of them in common. However, the symptoms from the third section, which is the last, are sufficient to diagnose each of the fever types because they are specific to the different types of fever. For instance, any of bitter taste, sweating and joint pain is enough to suggest malaria fever. If the caller mentions any three symptoms from any of the first, second or the first two sections, the system must carry out further interrogations to ascertain the kind of fever the caller is suffering from. The algorithm below shows the reasoning model used by SSes in diagnosing the particular type of fever a caller is suffering from:

Begin
1. Capture three symptoms from the caller.
2. If any of the symptoms is from bitter taste, sweating and joint pain, report malaria fever as the fever diagnosed.
3. Else if any of the symptoms is either rash or bloody stool, report typhoid fever as the fever diagnosed.
4. Else if any of the symptoms is from bone pain, bleeding, red eyes, low urine and blood vomiting, report yellow fever as the fever diagnosed.
5. Else if any of the symptoms is from chest pain, cough, swollen neck, swollen face and ringing in ears, report lassa fever as the fever diagnosed.
6. // Symptoms supplied by the caller are common to two or more of the fever types

Else interrogate the caller until the fever type is diagnosed.

End
In the algorithm above, the caller is expected to mention three symptoms through which SSes will determine the nature of the fever. If the caller mentions any symptom(s) specific to a particular kind of fever, the disease is diagnosed and reported to the caller. If however, the symptoms mentioned are common to two or more of the fever types, SSes will ask the caller questions in order to be able to determine the particular kind of fever.

Figure 4 below shows SSes being called using X-Lite soft phone.

Figure 4. Calling SSes using X-Lite soft phone

Conclusion
This paper has proposed a framework for the design of speech-enabled self-care e-Health systems to make health information and services available through speech and accessed by telephone. This will empower for self-care, the estimated 180,000,000 visually impaired and blind people worldwide [25], the non-computer literate, as well as the underserved people, majority of those who reside in places in Africa where healthcare is inadequate. The initiative will also aid their efforts in seeking healthcare. Reasoning-induced disease diagnosis which has been incorporated into the framework enables systems based on the framework to diagnose more than one
disease. This is an improvement over the existing speech-based disease screening systems which can only diagnose one disease.

References


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A CASE STUDY FOR EXPLORING DENTAL PATIENTS’ PREFERRED ROLES IN TAIWAN

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Abstract
The purpose of this study was to explore the dental patients' preferred roles in Taiwan. A convenience sample of 66 patients, 26 recruited from one dental clinic, and 40 from one medical center, were interviewed and their preferences for participation in treatment decision making were established using a measurement tool designed to elicit decision-making preferences. Patients’ preferences for participation in treatment decision making were established using Control Preference Scale (CPS) tool. In addition, Unfolding theory provided a means of analyzing the data so that the degree of control preferred by each patient could be established. This study found that nearly 70% clinic patients perceived passive role in treatment decision making whereas 50% patients in medical centre. Further, the collaborative role was most commonly preferred, but an active role was more commonly perceived in clinics than in medical centre. Finally, the implications of the results for patient participation are discussed.

Keywords: Control Preference Scale (CPS), Treatment decision making, Patients’ preferences

BACKGROUND
Prior to the 1980s, the most prevalent approach to treatment decision-making in the world was paternalistic with physicians assuming the dominant role. [1, 2] In recent years, providers of health care have moved away from a paternalistic approach to one that actively encourages patient autonomy and participation in treatment decision making. [3] A number of previous studies have suggested that patients have some opportunities to participate in medical decision-making, as a result both of entrenched physician paternalism and national characteristics of dependency and passivity. Even some elements of the physician-patient relationship, notably satisfaction, have been explored. This work is now dated. Therefore, this study is to evaluate Taiwanese patients’ preference for participating in medical decision making. The study will compare dental patients’ decision making role between clinic and medical center and explore what differences of patients’ preferred and perceived dental treatment decision making roles in both organizations.

RESEARCH DESIGN AND METHODS

Aims of the study
The aims of this study were:
- The first one is to evaluate Taiwanese patients’ preference for participating in medical decision making.
- The second is to compare dental patients’ decision making role between clinic and medical center and explore what differences of patients’ preferred and perceived dental treatment decision making roles, respectively.

Data collection
Prior to the interview, all patients were asked to provide written consent before being involved in the study and each patient was given an information sheet outlining the purpose of the study and assured of the confidentiality of their responses. The introductory section of the questionnaire covered socio-demographic information, including age, sex, marital status, employment status, and education distribution.

A convenience sample of 66 patients was recruited to the study from Chung Shan Medical University Hospital (40), and Yuan-zoe dental clinic (26) who over a 2-month period in 2009. No individuals declined to take part in the study and no individuals were excluded. The overall proportions
of respondents were a broad age range and the
gender distribution was fairly even.

Study design and method
Patients’ preferences for participation in treatment
decision making were established using Control
Preference Scale (CPS) tool, a set of sort cards
outlining five decisional roles (active, semi-active,
collaborative, semi-passive, passive)(see figure 1).
[10] The CPS cards were shuffled at the outset and
presented in a random order by face-to-face
interview. Patient were present with the cards in
subsets of two and were asked to state a preference
between the two cards, depending on which role
they ideally would like to play in treatment
decision making. Once the role preference
hierarchy had been obtained, the patients were
asked to pick one card (see fig 2) and give a
rationale for their perceived role after the physician
treatment. Rationale for choice of preferred role
was recorded verbatim. Frequency description and
unfolding theory were conducted to provide a
means of analyzing the data so that the degree of
control preferred by each patient was established.
In addition, Unfolding theory provided a means of
analyzing the data so that the degree of control
preferred by each patient could be established. [9,
11]

Figure 1 Contents of five sort cards used to explore
expected role

<table>
<thead>
<tr>
<th>Active role options</th>
<th>Collaborative role options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Card A: I prefer to make the final decision about which treatment I will receive.</td>
<td></td>
</tr>
<tr>
<td>Card B: I prefer that my doctor and I share responsibility for deciding which treatment is best for me.</td>
<td></td>
</tr>
<tr>
<td>Card C: My doctor makes the final decision about which treatment I will receive, but seriously considers my opinion.</td>
<td></td>
</tr>
<tr>
<td>Card D: My doctor makes the final decision about which treatment will be used, but seriously considers my opinion.</td>
<td></td>
</tr>
<tr>
<td>Card E: I leave all decisions regarding my treatment to my doctor.</td>
<td></td>
</tr>
</tbody>
</table>

Source: Chapple et al., 2003 [10]

Figure 2 Contents of five sort cards used to explore
perceived role

DATA ANALYSIS

Among all of the patients, the ratios of preferences
for patient participation in treatment decision
making have show in figure 3. Both of the clinic
and hospital have 0% of patients chose A as the
most preferred role. Patients of the clinic prefer C
as the collaborative role and patients of the hospital
prefer D as the semi-passive role.

In the hospital, more respondents selected the
passive role (card D, approximate 40%) as most
preferred than any other role. Respondents who
chose B trust in the dentist ordinary, have fully of
knowledge about the subject, feel lack of time for
discussion and common of the consumerist stance.
The patients who chose C are lack of trust in the
dentist, have lack of knowledge about the subject,
feel ordinary of time for discussion and common of
the consumerist stance. The patients who chose D
are fully of trust in the dentist, have ordinary of
knowledge about the subject, feel ordinary of time
for discussion and common of the consumerist stance. In the clinic, more respondents selected the collaborative role (card C, approximate 50%) as most preferred than any other role. Patients who chose C are fully of trust in the dentist, have ordinary of differences about knowledge of the subject, feel fully of time for discussion and satisfied of the consumerist stance. The patients who chose D are fully of trust in the dentist, have vague of differences about knowledge of the subject, feel fully of time for discussion and satisfied of the consumerist stance. There is no one selected Card A, the fully active role, as their most preferred. In the clinic, most preferred roles were collaborative role (50.0%), whereas at the hospital site the active role type (20.0%) was less commonly preferred than the collaborative (32.5%) or passive types (47.5%).

Figure 4 have shows the distribution of least preferred roles in the sample. Both of A and E are least preferred of the patients ether in clinic or hospital. There are 76.9% patients of the clinic and 50% of the hospital least prefer A. The patients of clinic dislike active role and almost a half of patients in hospital dislike passive role.

Figure 4 Distribution of least preferred roles in treatment decision making

Table 1 shows the preference orders for the total sample. There was a range of preference orders, from the most active (ABCDE) to the most passive (EDCBA), but in our research didn’t have the ABCDE preference order. In the clinic sample, the most common preference order was CDEBA, a ‘collaborative-passive’ preference order. By contrast, the Hospital sample, the most common preference order was CBDAE, a ‘collaborative-active’ preference order.

This result didn’t have the preference order (ABCDE), also didn’t show that all 11 transitive orders present and mirror image orders. However both of the two sites passed the standard of 50%+1.

By the way, clinic is over 73.0% to fit in with 50%+1.

Table 1 Decisional role preference orders for the sample

<table>
<thead>
<tr>
<th>Preference order</th>
<th>Clinic (N=26)</th>
<th>Hospital (N=40)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABCDE</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>RACDE</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>BCDAE</td>
<td>22.0%</td>
<td>3</td>
</tr>
<tr>
<td>BCBAB</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>BCDEA</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>BDECA</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CBBAB</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>CBBAE</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>CBDEA</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>CBDBA</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>CBEBA</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>CDEBA</td>
<td>46.1%</td>
<td>1</td>
</tr>
<tr>
<td>CDEB</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CDEBA</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>CDBBA</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>CDBB</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 2 Extent to which Coomb’s goodness of fit criteria were met

<table>
<thead>
<tr>
<th>Patient group</th>
<th>All 11 transitive orders present</th>
<th>Mirror image orders (ABCDE/EDCBA)</th>
<th>50%+1 of preference orders are transitive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total sample</td>
<td>No</td>
<td>No</td>
<td>Yes (41/66, 62.1%)</td>
</tr>
<tr>
<td>Clinic</td>
<td>No</td>
<td>No</td>
<td>Yes (19/26, 73.0%)</td>
</tr>
<tr>
<td>Hospital</td>
<td>No</td>
<td>No</td>
<td>Yes (22/40, 55.5%)</td>
</tr>
</tbody>
</table>

Notice: No ABCDE transitive order

Table 2 shows the preference orders for the total sample. According to Coomb’s goodness of fit criteria, [9] there is none of the eleven ‘transitive’ orders completely emerged, also none of the contrast orders as ‘ABCDE/EDCBA’. The sample of this study is fit to the 50%+1 transitive orders. Comparing the sample of clinic and hospital, the clinic has 73% fit to 50%+1 transitive orders and the hospital has 55.5% which is a bit over the standard.
DISCUSSIONS
Content analysis of the verbatim data regarding patients’ rationales for their role preference revealed the following:
Four-six of the 66 patients interviewed mentioned lack of knowledge of the subject as influencing their ability to participate in treatment decisions, and several comments were: “I don’t know the science behind medicine, so I’ll leave the decision to someone who does”, “I am paying to see the expert/professional, therefore should consider his/her opinion”.
Besides, trust was specifically referred to by ninety of the 66 patients’ comments were: "the doctor is a professional, therefore you should trust him/her", “if you can’t trust the doctor, there’s something wrong”. Therefore, lack of knowledge about health care appeared to be closely linked with trust for these patients.
A further common theme amongst patients was lack of time for discussion. Forty of the 66 patients cited lack of time as a reason, and comments were: “there isn’t enough time for the doctor to really consider my opinions”, “the doctor just needs to get my treatment done as quickly as possible”, “there’s never enough time to sit and discuss everything”. Typical comments relating to the consumerist stances issue were: ‘The dentist is calculating compensation by the amounts of case, so there is lack of consumer rights.’
In the part of preferences for patient participation in treatment decision making, the most preferred role in medical center is semi-passive compare to collaborative role in dental clinics. The two extreme choices ‘active’ and ‘passive’ were overwhelmingly the least preferred at both sites. In the part of preference orders, for patients in medical center, the most common preference order was ‘collaborative-active’ preference order. By contrast, the most commonly preference orders in dental clinic was “collaborative-passive”. In the part of perceived roles in treatment decision-making, nearly 70% clinic patients perceived passive role in treatment decision making whereas 50% patients in medical centre.
In summary, Taiwan patients have positive attitudes towards participation in relation to dental treatment decision making, provided they are fully informed of the nature of the disease, the treatment options, and benefits of the options. Physicians can increase patient satisfaction by accepting the role of helping their patients participate in decision-making and understanding their patients’ wishes, and so cultivating a democratic relationship in which decisions can be made cooperatively. In this study, the collaborative role was most commonly preferred, but an active role was more commonly perceived in clinics than in medical centre. Less patients in Taiwan prefer active rather than collaborative role, and patients in medical centre prefer passive role. However, there was no clear evidence that Taiwan patients prefer more passive roles than do their counterparts in advanced countries. Finally, this finding suggests that a majority of Taiwan patients have positive attitudes towards participation in medical decision making if they are fully informed.

FURTHER RESEARCH AND SUGGESTIONS
Two important questions will arises as researchers conduct further studies with this study. The first involves the nature of the relationship of perceived facilitation to measured facilitative behaviors objectively. Our ongoing research seeks to determine whether all facilitative behaviors are equally important in fostering positive patient outcomes, such as satisfaction and adherence. If they are not, interventions might focus particularly on increasing those behaviors that are most important to patients. The second major question involves the interaction between a healthcare provider’s encouraging patient involvement and the patient’s desire to be involved.

Another focus of our ongoing research is an examination of outcomes related to complementary versus contradictory ideas about the patient’s role. For instance, interactions between patients who want to be involved and physicians or dentists who hinder the patient’s involvement are apt to be the most problematic. These interactions are also promising areas for research because they influence both objective and subjective patient outcomes. Similarly, if a patient prefers to play passive role but has a physician or dentist who constantly encourages involvement, conflict and dissatisfaction are again the likely outcomes. Therefore, it may be that facilitation is most important when viewed in the context of the “match” between the physician’s facilitation and the patient’s desire for involvement.

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MODELING MEDICAL SUMMARY SHARING SERVICE WITH WEB SERVICES

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Abstract

Enterprises are entering a new Internet era. The Web, initially designed for human use, will now evolve to better support automated use. In this new era, enterprises will have the capability to assemble large-scale systems out of network-bound software components within the reach of mass-market consumers. This study aims to depict the conversations between business processes and Web service technologies, explain what and how can Web services support message sharing between business partners. A Medical Summary Sharing process from IHE is implemented with Web services technologies in a Long-Term Care Management Center setting. In this scenario, one manager in Care Management Center uses a care plan creation application to evaluate care requirements for one patient. The conversations between the application and Web services are explained using Web Service Business Process Execution Language (WS-BPEL) in business process side and Web Services Description Language (WSDL) in technical side. We discovered that basic Web service technologies have matured enough to support enterprises in composition of Web services and further research should be made to identify novelty in using the technologies and to ensure operational quality while the services are consumed.

Keywords: Business Process, Care Management Center, Web Service

Introduction

Medical summary is a subset of patient data that contains essential information for the purpose of communication among healthcare or other service providers [1]. Other than the minimum patient identification data, this summary can be adapted into the forms that include the information suitable for different business processes such as, referral, discharge, emergency events, insurance claiming, and care planning [2-3]. These processes connect service providers in a loosely coupled manner that the connections will only be activated through the request from the occurrence of specific events.
The structure of this will follow by a brief literature reviews on nature of service oriented business process and the standards related to medical summary sharing form IHE and web service from W3C working group. Section 3 describes the modeling process and the software architecture used in implementing the service. Section 4 presents the results of the implementation with the details of how the processes interact with each other. Section 5 discusses the finding and implications of this study with a conclusion remark.

**Literatures**

Sharing patient information among healthcare or other service providers is a business process that different organizations such as insurance firms or social welfare organizations may need the information to evaluate or plan the follow on services [4]. The process is now a time consuming and labor intensive operation that policy makers and healthcare practitioners are trying to redesign or restructure the system to make the information more accessible by various parties [12-13]. However, the operation in hospital is a set of tightly control disease curing procedure that is very different from that outside hospitals [14]. The care services outside hospital focus more on the inter-organizational collaborative procedures [15]. These procedures are loosely coupled, service oriented business processes that each organization can operate autonomously and can have the choices to maintain or release the connections [16]. To facilitate this information sharing process between different types of institutions, two sets of developments should be in place for the participants to follow. One is a set of scenario that is developed in the service domain such as healthcare industries and accepted by those participants. Other is a set of technologies that is developed to support this loosely coupled operation and accepted not only by standard bodies but also by major venders in the domain of ICT [17-18].

IHE is an industrial initiative designed to stimulate the integration of the information systems that support healthcare organizations [11]. It defines medical information sharing standard as technical framework (TF) for various domains such as cardiology, radiology, or patient care coordination (PCC). Under each TF, integration profiles (IP) are defined as the sharing scenarios to include the actors, transactions and their content. Cross-Enterprise Sharing of Medical Summaries (XDS-MS) is an IP from PCC-TF that mirrors current manual sharing processes: operator in hospital gathers appropriate information from patient medical record, copies and packages them up and ships the packages with a cover letter explaining the intention of the information. This manual process has been defined by IHT with automotive sharing process between information requester and provider with the web service technologies.

Web service is a set of business-driven technologies [4] that integrates business tasks as loosely coupled business services [10]. As defined in W3C, a Web service is a software system designed to support interoperable machine-to-machine interaction over a network [11]. A typical Web service architecture consists of three entities: service providers who create Web services and publish them to outside world, service brokers who maintain a registry of published Web services; and service requesters who find Web service required and bind those services components within their applications [12]. Based on Extensible Markup Language (XML), three Web service technologies facilitate the interaction among the entities. They are Simple Object Access Protocol (SOAP): communication protocol among entities, Universal Description, Discovery and Integration (UDDI): registration and searching of web services, and Web Services Description Language (WSDL): the service description language. In deploying Web service as operational...
Methods

This study models the medical summary sharing service operated in a community HSC. The service scenario depicts the process that a manager in HSC processes a care plan creation service for a senior citizen discharged from hospital. After interviewing with the citizen, the manager requests medical summary from the hospital, checks the family status of the citizen from FAS in the HSC, and sends the initial care package with the medical summary to SWO for evaluating available social benefit. The care plan creation process needs information from various parties that many of the information collection procedure are now conducted by the care plan applicants.

This study model the care plan creation service with the standards from IHE’s PCC-TF and implement the roles and information content from XDS-MS profile. Five roles are identified in the service and a care plan creation application is developed with the web services technologies to demonstrate the information sharing operation. The computer language used for developing the application is C# in Microsoft Visual Studio 2005, database is SQL 2005, and the process engine is BizTalk 2006. Figure 1 depicts the operational architecture of the application.

Use case method was used to describe the interactions among different roles in the care plan creation service. Table 1 depicts the use case description.

Results

This study develop an application with the web service technologies to models the care plan creation service in HSC. The development explains the information sharing interactions in terms of business process management level and technical communications level. Figure 2 is a sequence diagram that describes what business entities are involved in sharing the required information and how these entities are being incorporated into care plan creation service.

The sharing service is formed dynamically because each care plan may have different medical summary provider. Figure 3 demonstrate how the information from each provider be coordinated as an integrate service process by the process engine. In technical level, Figure 4 depicts how WS-BPEL uses <sequence> and <flow> to composite WS_MS and WS_FS in parallel and orchestrates WS_BP to form the integrated service process. Figure 5 describes how WSDL uses <operation> to describe input and output message and <binding> from detail implementation.

Discussion and Conclusion

The sharing service is formed dynamically because each care plan may have different medical summary provider. Figure 3 demonstrate how the information from each provider be coordinated as a
integrate service process by the process engine. In technical level, Figure 4 depicts how WS-BPEL uses <sequence> and <flow> to composite WS_MS and WS_FS in parallel and orchestrates WS_BP to form the integrated service process. Figure 5 describes how WSDL uses <operation> to describe input and output message and <binding> from detail implementation.

Web service is now the most popular paradigm for service oriented business process integration. It provides a framework of software technologies designed to support interoperable machine-to-machine interaction over a network. In this study, APP_CP integrates intra- or inter-organizational business processes to fulfill the care plan creation operation. Business designers can also create the new service out of the integration of web services from other providers to respond to certain business needs. The capability of web service has opened up the opportunities for a new generation of e-commerce applications to emerge.

Current healthcare systems have been challenged by ever increasing aging population and prevalence of chronic disease. New healthcare models and service applications need to be developed to provide the care outside the boundaries of institutional care. This study develops a medical summary sharing application that can streamline the operation in community HSC. The web service technologies used in the application can facilitate the sharing processes among various participants. More healthcare

Figure 2 Sequence Diagram of APP_CP

Sharing medical summary is a business process that can be done in an effective and efficient way. This study adopts the industrial standards both in healthcare domain and ICT fields to model the sharing processes. The entities that provide the information need not to restructure their whole information processing procedures or systems. For instance, hospitals will create and store patient data during the caring processes. The data can be organized in the forms and published as a medical summary sharing web service to allow the requests from other service providers. The development of the summary sharing web services is not a hi-tech project that limited resources can contribute substantially on saving traditional labor operations.
applications should be developed for decision makers to trust the web service technologies and for business designers to innovate adequate care services.

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References


MINING IMPLICIT PATTERNS OF CUSTOMER PURCHASING BEHAVIOR
BASED ON THE CONSIDERATION OF RFM MODEL

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Abstract
Association rules have been developed for years and applied successfully for market basket analysis and cross selling among other business applications. One of the most used approaches in association rules is the Apriori algorithm. However the Apriori algorithm, has long known for its weaknesses that generate enormous amount of rules and already-known facts. In this study, we integrate the RFM attributes with the classical association rule mining, Apriori. Based on RFM model, two indicators, RF score and Sale ratio, are used as measure of interestingness. We propose two algorithms, DWRF and DWRFE, to mine for implicit pattern. In our experimental evaluation, the performance of Apriori, DWRF and DWRFE are compared. The result of our algorithms offers an effective measurement of interesting patterns. Moreover, the DWRF algorithm that uses the RF score as a measure of interestingness seems to be able to promptly reflect the fast-changing customer’s purchase patterns.

Key words: Data mining; Association rules; RFM; CRM

Introduction
Because of the industry competitiveness and free communication of market information, customers are easier to change their preferences and buying behaviors. While the traditional marketing tools are unlikely to aim at customers’ behavior or transformation of preferences (Shaw et al., 2001), database marketing becomes more and more popular. With the transaction records in database, it is important to analyze the correlation information of the customer, because these records represent the accumulation of customers’ past decisions (Holtz, 1992). If the company can use this data to discover the patterns of customers’ consumption behaviors, it can help marketing associates to make a more effective marketing program (Chen et al., 2005). Many enterprises have gathered great number of data into their data warehouses (Inmon, 1996). With the tradition marketing analysis tools, it is too difficult for employees to analyze such a huge database (Shaw et al., 2001). Data mining solves the difficulties of data analysis and also helps to discover hidden information (Fayyad et al., 1999). The mining technique depends on different distance of functions which can be distinguished as cluster, classification, estimation, prediction, and affinity group, description and profiling (Berry and Linoff, 2004).

The most frequently used tool in the affinity group is the association rule analysis. Association rules have developed for many years; they are useful and easy to understand, and they are widely applied in various industries such as finance, telecommunications, retail, and online commerce (Kotsiantis and Kanellopoulos, 2006). It has increasingly attracted much academic research interest in recent years. Its main purpose is to discover the relationship of associated products. However, for capturing other interesting insights within these patterns, we can only depend on the expert domain knowledge to do the matching. Some of researches called these problems the “interestingness” problem (Liu et al., 1999). Our main purpose is to develop a new algorithm which will take RFM attributes as parameters in order to mine the implicit patterns. This research incorporates recency and frequency to discover the latest purchase patterns. We will assign a RF score based on its recency attribute and a sale-ratio score based on its monetary attribute to every rule in order to discover the most recent patterns and also the patterns that customers are willing to spend more.

Literature Review
Association rule mining, one of the famous researched friend of data mining According to Agrawal and Srikant (1994), Association Rule is defined as:” to find out these association rule among a set of product items frequently purchased together”.

The rule is written in the form as: {milk→ noodles}. It implies that if the customer purchases the milk, he would probably buy noodles. The Association Rule Mining has two indicators to evaluate the meanings of these rules, which are support and confidence (Cavique, 2007; Chen, 2006; Kotsiantis and Kanellopoulos, 2006). support
of an association rule can be defined as the percentage of records that contain X ∪ Y to the total number of records in the database. The user needs to set the threshold for support called minimum support; it is a key element to prune the search space and to limit the number of rules (Chen et al., 2006).

Another indicator, confidence is defined as the percentage of the number of transactions that contain X ∪ Y to the total number of records that contain X. Confidence mainly measures the strength of the association rules. Apriori is the most traditional approach of association rule mining. According to Chen (2002), rules generated by association rule mining could be can meaningless. It is not enough to discover the user’s interesting patterns only by o=support and confidence. (Padmanabhan and Tuzhilin, 1999).

RFM model primarily analyzes and evaluates the consumer behavior (Miglautsch, 2002). RFM represents three reference indicators respectively, such that recent purchase time (Recently), frequency of buying (Frequency) and how much you pay (Monetary) (Hughes, 1994). By using these three indexes, it’s able to evaluate the relationships between companies and customers and determine the value of every customer. Because this model can successfully analyze customer behaviors and segment customers, some data mining research has already combined this model into their approaches, such as in the areas of classification and cluster analysis and RFM model into their approaches, such as in the areas of cluster analysis and classification (Kuo, 2007). In cluster analysis, these researches use the RFM point to segment the customers into a number of clusters with similar characteristics (Sung and Sang, 1998; Russell and Lodwick, 1999). Another research is in the area of classification and RFM variables are used to classify customers into different categories according to customer’s value. (Kitayama et al., 2002; Kaymak, 2001). In those researches that incorporate the RFM Model, the RFM attributes are used mainly to identify the customers but not to improve the algorithms of apriori (Liu and Shih, 2005).

3. Problem Statement and Definition

Market basket analysis, a typical example of association rule mining, is widely used in the retail industry. This process analyzes customer buying patterns by finding associations between different items that customers have purchased in their carts. However, the disadvantages of this approach, apart from generating enormous amount of rules, are that the strong rules are not always interesting. According to Lin (Lin, 2001), the findings always represent the ordinary rules, i.e. the fact that are already known. These rules are easily deduced from our life experience, thus they provide little value for marketing campaign (Balaji and Padman, 1999).

Market basket analysis varies according to different criteria, such as the types of values, dimension of data, level of abstractions and the methods of finding frequent itemsets. However, none of the above approaches takes account of the impact of rapid transitions on customer purchase behavior. In this study, we will integrate RFM attributes with resulting association rules in hopes that these attributes will help decision makers to extract interesting pattern programatically. These attributes could be used as useful measures of interestingness of association rule.

Firstly, we will take the recency attribute, i.e. purchase time, into consideration. Recency attribute will be split into several intervals, for instance, we can categorize recency attribute into 3 intervals: customers with purchases within the last one month; between last one and last two months; and between last two and last three months. Such categories may be arrived at by applying business rules or by domain expertise.

Apriori ranks these association rules by the confidence and support measures, however, these measures are insufficient to provide the information of recency. Therefore, some strong rules could be outdated. Since the buying patterns might change dramatically with time, the most recent rules can accurately reflect customer purchase patterns more than others. Without the consideration of purchase time, the resulting rules generated by association rule mining might mislead the managers into the wrong marketing strategies. Secondly, the monetary attribute, i.e. sale amount of each rule, is regarded as a valuable factor to invest. In this study, we will explore the ratio of the sales amount contributed by the items from a specified frequent itemset to the total sales amount of the transactions that contains this frequent itemset. The frequent itemsets with a higher expense ratio indicate that these itemsets take up a considerable portion of the sale amount for every visit and, that customers are willing to pay more for these items. In the following section, we will define the terms used in this study.

Definition 3.1: Transaction database

Let the database, \(D=\{T_1, T_2, T_3...T_n\}\) be a set of customer transaction records, \(T\) represents a transaction and is labeled by a cart number. For instance, \(T_1\) contains a set of products that customer has purchased, and is denoted as \(T_1=\{P_1, P_2, P_3, P_4.....P_n\}\), \(P\) is regarded as items in \(T_1\).

Definition 3.2: Recency variable

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Recency is defined as the duration from customer’s last transaction to the time that analysis starts. The recency attribute can be split into intervals which are determined by domain expert.

Definition 3.3: RF_weight

\[ \text{Formula 3.4.1:} \]

\[ I=\text{number of time intervals}, \{F\} = \text{total frequency}, \] that is the number of carts that contain the specified frequent itemset

The weight for those transactions containing a specified frequent itemset, whose purchase time fall into interval \( i \), the formula (see Appendix) is, so as \( \frac{(F+I-1)!}{F!(I-1)!} \) at \( \frac{(F+I-2)!}{F!(I-2)!} \) interval II, and so on.

The complete weight list for interval 1 to I is:

\[ \frac{(F+I-1)!}{F!(I-1)!} : \frac{(F+I-2)!}{F!(I-2)!} : \cdots : \frac{(F+1)!}{F!1!} \]

Example 3.5.1:

\( I=3, F=10 \)

\[ W1: W2: W3 = C_i^{F+1} : C_i^{F+2} : C_i^{F+3} \]

\[ = C_i^{10+3-1} : C_i^{10+3-2} : C_i^{10+3-3} \]

\[ = 66:11:1 \]

Definition 3.6: sale ratio

Sale-ratio is defined as

\[ \frac{\sum(S_i)}{\sum(E_k)} \quad 0<i<=n, \quad 0<k<=m, \]

For those transactions containing the specified frequent itemset, we sum up the total sale amount contributed by items in this frequent item set, as in

\[ \sum(S_i) \quad 0<i<=n, \]

here \( n \) represents the size of the frequent itemset \( l \);
\( S_i \) represents the total sale amount of Item \( i \) of all the transactions that contain this frequent itemset

We sum up the total of sale amount For those transaction containing the specified frequent itemset, as in

\[ \sum(E_k) \quad 0<k<=m, \]

for those transaction that contain the specified frequent itemset, \( m \) represents the number of transactions ;where \( E_i \) is the total sale amount of cart1

4. Algorithm

4.1 The DWRF – Algorithm

(Dynamic Weighted Recency and Frequency - Algorithm)

Derived from the classical algorithm, Apriori, we like to propose an novel algorithm which integrates the time and frequency factors to help screen out outdated rules. The new measure, RF Factor(i.e. Recency-Frequency score), can be used as another objective measure of interestingness for the decision makers.

We propose a new algorithm, DWRF, which use a RF score to filter out out-of-date patterns. The algorithm emphasizes the relationship between purchase time and patterns, therefore it will timely reflect the customer purchase patterns. In this approach, manager can dynamically set up the time intervals for comparison, for instance, the recency can be split into the last week, the last 2nd week, the last 3 week and so on. The RF scores are calculated dynamically depends on 2 parameters, the time intervals and the frequencies in each time slot for those transactions with a particular frequent itemset.

The DWRF- algorithm includes 5 phases as follows.

Phases 1: Defining time intervals by managers/users

Phases 2: Retrieving transactions which contain the frequent itemsets generated by Apriori.

Phases 3.a: Assigning every transaction with this specified frequent itemset to the right time slot by its purchase time and recording the count of every time slot.

Phases 3.b: Calculating the sale amount that is contributed by the items in every transaction with this specified frequent itemset, and the total amount of this transaction.

Phases 4: Calculating RF score for the specified frequent itemset, repeat phase 2 to 4 for next frequent itemset until all the frequent itemsets are scanned.

Phases 5: Retrieving the frequent itemsets or rules whose RF scores exceed the RF-threshold given by manager or domain expert.

Example 4.1.1: Divide into three time intervals in the research period

Large itemset: A and B (generated by Apriori)

Total frequency = 10

Time intervals are 2006/01, 2006/02, 2006/03
Table 4.3: An illustrative of the generation of RF_Score for all of large itemset

<table>
<thead>
<tr>
<th>Frequent itemset</th>
<th>Total frequency</th>
<th>Time intervals by Month-frequency</th>
<th>RF_Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>A b c</td>
<td>805</td>
<td>272 179 354</td>
<td>0.3</td>
</tr>
<tr>
<td>a d</td>
<td>354</td>
<td>122 200 32</td>
<td>0.3</td>
</tr>
<tr>
<td>c e</td>
<td>322</td>
<td>145 139 38</td>
<td>0.4</td>
</tr>
<tr>
<td>b d</td>
<td>259</td>
<td>50 167 41</td>
<td>0.1</td>
</tr>
<tr>
<td>c b</td>
<td>249</td>
<td>182 52 15</td>
<td>0.7</td>
</tr>
<tr>
<td>b e</td>
<td>243</td>
<td>145 90 8</td>
<td>0.6</td>
</tr>
<tr>
<td>e f</td>
<td>232</td>
<td>96 90 46</td>
<td>0.4</td>
</tr>
<tr>
<td>e g</td>
<td>231</td>
<td>111 92 28</td>
<td>0.4</td>
</tr>
<tr>
<td>c f</td>
<td>218</td>
<td>9 149 60</td>
<td>0.0</td>
</tr>
<tr>
<td>b g</td>
<td>218</td>
<td>85 98 35</td>
<td>0.3</td>
</tr>
</tbody>
</table>

4.2 The Incremental Mining Large Itemsets from DWRFE Algorithm

We propose another algorithm, DWRF, which uses another measure, sale amount ratio, to extract those patterns that take up a good portion of sale per visit. We present that this pattern has the stronger strength with purchase monetary behavior.

4.2.1 The Sale Ratio Indicator

Sale ratio is defined as

\[
\text{Sale ratio} = \frac{\sum_{i=1}^{10} w_i \cdot F_{t_i}}{\sum_{i=1}^{10} F_{t_i}}
\]

For those transactions that contain the specified itemset, the summation of sale amount which is contributed by items in frequent itemset divided by the summation of sale amount of transactions. We can infer that the customers are willing to pay more portion for those patterns with higher sale ratio.

Example 4.2.1:

Assume there are 10 transactions that contain a frequent itemset \{A,B,C\}:

Table 4.6: An illustrative for \{s_i\} and \{e_i\} for one of large itemset
Mining Implicit Patterns of Customer Purchasing Behavior

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<table>
<thead>
<tr>
<th>Transaction</th>
<th>items</th>
<th>sale amount</th>
<th>total sale amount in this case</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>{A,B,C,D,E}</td>
<td>40</td>
<td>80</td>
</tr>
<tr>
<td>2</td>
<td>{A,B,C,F,G}</td>
<td>60</td>
<td>300</td>
</tr>
<tr>
<td>3</td>
<td>{A,B,C,G,H}</td>
<td>100</td>
<td>160</td>
</tr>
<tr>
<td>4</td>
<td>{A,B,C,D,H}</td>
<td>70</td>
<td>180</td>
</tr>
<tr>
<td>5</td>
<td>{A,B,C,H, I}</td>
<td>150</td>
<td>200</td>
</tr>
<tr>
<td>6</td>
<td>{A,B,C,M,I}</td>
<td>55</td>
<td>140</td>
</tr>
<tr>
<td>7</td>
<td>{A,B,C,M,N}</td>
<td>65</td>
<td>120</td>
</tr>
<tr>
<td>8</td>
<td>{A,B,C,O,P,Q}</td>
<td>90</td>
<td>170</td>
</tr>
<tr>
<td>9</td>
<td>{A,B,C,S,T}</td>
<td>160</td>
<td>190</td>
</tr>
<tr>
<td>10</td>
<td>{A,B,C,M, T}</td>
<td>350</td>
<td>500</td>
</tr>
</tbody>
</table>

From the above data, the sale ratio would be calculated, as the formula:

\[
\frac{40+60+100+70+150+55+65+90+160+350}{80+300+160+180+140+120+170+190+500} = 0.537
\]

4.2.2 The Incremental Mining Frequent Itemsets from DWRF Algorithm

This approach can focus on the users interesting pattern to be discovered faster and we show a whole process of DWRF pattern generation as follows.

\[<\text{DWRF} \text{-algorithm incremental mining process}>\]

Generating large itemset by Apriori

Evaluating all of RF score of large itemsets

Generating DWRF pattern

Evaluating the Sale Ratio of DWRF pattern

Generating DWRF pattern

Figure 4.3: DWRF -algorithm incremental mining process.

5. Experiments

The experiments were used to examine our algorithm performance which are compared with the original approach,Apriori. The tools include Microsoft SQL Server 2005 BI Suite and Java language.

5.1 Data Sources and Data Structures

In this section, we assign four datasets in our experiment for testing our algorithm. All of the four datasets sources are from real datasets of one of major retailers in Taiwan during January 2005 to December 2006. The data are divided into a 75 percent and a 25 percent randomly, named RT-75 and RT-25; another two, CT-1 and CT-2, are modified data. Table 1 summarizes the parameters used.

<table>
<thead>
<tr>
<th>Datasets Description</th>
<th>Dataset 1</th>
<th>Dataset 2</th>
<th>Dataset 3</th>
<th>Dataset 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>RT-25</td>
<td>RT-75</td>
<td>CT-1</td>
<td>CT-2</td>
</tr>
<tr>
<td>Size</td>
<td>19995</td>
<td>65819</td>
<td>10343</td>
<td>14433</td>
</tr>
<tr>
<td>Data source</td>
<td>Real data</td>
<td>Real data</td>
<td>Synthetic</td>
<td>Synthetic</td>
</tr>
</tbody>
</table>

5.2 Performance Evaluation

The comparison of the effectiveness among the three algorithms ,Apriori, DWRF and DWRF was made by the following aspects; firstly the number of frequent itemsets; secondly, the importance of the top ten frequent itemsets.

Comparison with the Number of Frequent Itemset

We applied these algorithms to the four datasets and observed that the number of frequent itemsets decreased when the RF-threshold increased.(see Figure 5.1), where the minimum support is 0.0017, minimum sale ratio is 0.3, and RF score ranges from 0.25 to 0.5. When the RF-threshold went up, there is no change in number for Apriori, however, the number of frequent itemsets in both DWRF and DWRFE dropped dramatically. We also observed that the numbers became closer between DWRF and DWRFE when the RF-threshold increased. This might imply that the DWRF has screened out the majority of unsatisfied rules. The consequence was similar in all datasets no matter whether the minimal support was changed (Fig. 5.1(b))

Thus, we can infer that DWRF and DWRFE can diminish numbers of patterns successful better than the classical approach.

\[<\text{Figure 5.1: Comparison of DWRF and DWRFE pattern generation}>\]
Comparisons of Top Rules with Algorithm Outputs

We applied the three algorithms to dataset CT-2, with a minimum support of 0.0020, and selected the top rules from these algorithms (table 5.2). Ranking by confidence, RF score, and sale ratio are listed also. We observed that the rules were ranked differently according to different criteria, especially the great difference between Apriori and DWRF. For instance, the fifth rule of RF algorithm is ranked as the 41th place in Apriori algorithm. This indicates that we might accidently delete some rules by increasing minimal confidence, thus we might miss some interesting patterns. There made little difference between the ranking of rules between DWRF and DWRFE. This is possibility due to the total sale amount of shopping carts is too huge, and sale amount contributed by the specified frequent itemset is relatively smaller.

<table>
<thead>
<tr>
<th>DWRF ranking</th>
<th>DWRF-Ranking</th>
<th>Apriori-ranking</th>
<th>RF_score</th>
<th>rules</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>4</td>
<td>13</td>
<td>0.529</td>
<td>222341-&gt;222343</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>17</td>
<td>0.601</td>
<td>8076-&gt; 8074</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>19</td>
<td>0.578</td>
<td>8085-&gt; 8074</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>23</td>
<td>0.554</td>
<td>8081-&gt;8074</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>39</td>
<td>0.468</td>
<td>107626-&gt;118909</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>41</td>
<td>0.497</td>
<td>118909-&gt;7685</td>
</tr>
<tr>
<td>5</td>
<td>7</td>
<td>43</td>
<td>0.479</td>
<td>115881-&gt;7685</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>49</td>
<td>0.483</td>
<td>118909-&gt;135008</td>
</tr>
</tbody>
</table>

e=0.005 and the time intervals were set by quarter.

6. Conclusions and Suggestion

In this research, in order to solve the interestingness problem, we present two novel approaches, DWRF-algorithm and DWRFE-algorithm to mine for the implicit patterns. Two parameters, RF score and Sale Ratio, are used as measures of recency and monetary characteristics of rules. The DWRF and DWRFE algorithm not only reduce the number of rules but also retrieve prompt and interesting patterns. Moreover, the time intervals can be set dynamically according to managers’ wishes; either in a consecutive or discrete manner. In addition, the RF weight formula for each time interval is devised mathematically. The DWRF provides a rational base for weight assignment. The approach is able to respond fast to user’s needs in the different environments by analyzing the current customer purchase pattern. It seemed to be that our approach is more flexible than other classical algorithm.

We tested Apriori, DWRF, DWRFE on four datasets and compared the result. All the results show that our approach is more effective to reduce the number of the frequent itemsets than Apriori. We observe that there is a big difference between the ranking of DWRF and that of Apriori., and the result proves to be that our algorithm can retrieve timely purchase pattern.

References


EXAMINING THE ROLE OF INFORMATION TECHNOLOGY IN CULTIVATING FIRMS’ DYNAMIC MARKETING CAPABILITIES

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Abstract
Dynamic capabilities enable firms to reconfigure limited resources or relative strengths to respond to rapid changes in market conditions. This study considers the central role of IT in creating and enhancing dynamic capabilities by analyzing the essential determinants of dynamic marketing capabilities and proposing a model that includes market orientation, IT infrastructure capabilities, and use of IT to support CRM. Tests using a large-scale survey support the model and most of its hypotheses. The results reveal significant effects of a firm’s market orientation and use of IT to support CRM and the functionality of IT infrastructure capabilities on dynamic marketing capabilities.

Keywords: Dynamic Marketing Capabilities, Dynamic Capabilities, Market Orientation, IT Support for CRM, IT Infrastructure

Introduction
Competitive advantages are critical to firms and continue to receive substantial attention from researchers and business managers. The research topics in the competitive advantage area evolve overtime in response to the technology and environment changes. For example, researchers have adopted the perspective of dynamic capabilities to examine competitive advantages in recent decades to capture the dynamism in rapid, unpredictable changing environments. Dynamic capabilities, defined as firms’ abilities to reconfigure their finite resources and respond to market changes effectively [1] [2], is needed for firms to adapt to the changing business environment [3]. In addition, the role of information technology (IT) is also recognized as a central enabler in the competitive advantage literature [4]. IT is essential for firms that strive for sustainable competitive advantages through process improvement, operational excellence, and customer intimacy [5]. However, there is a miss link between IT and dynamic capabilities. Prior research has not focused on how IT infrastructure can enable better IT support for business process and thus generate dynamic capabilities in corresponding areas of the firm. Although IT represents a vital strategic asset in business, its effects on the firm’s dynamic capabilities are not well understood.

The concept of dynamic capability is broad and relates to various business processes and activities [3] [6]. Although the extant literature offers some interesting strategic insights, few studies have examined the dynamic capability of a specific and crucial area of the firm. Of particular importance is the role of IT in supporting key business processes or activities. This research void requires more detailed conceptual analysis and empirical testing of the role of IT in creating and cultivating firms’ dynamic capabilities in crucial aspects of their business. In addition, IT resources have been conceptualized in a variety of fashions in the literature. In order to better capture the contributions of IT to business values, we argue that the overall IT infrastructure capabilities and IT support to a specific business application should be both included in the study.

Among the various aspects of business, marketing is considered a critical area in developing firms’ dynamic capabilities. In the ever evolving market conditions, dynamic marketing capabilities allow firms to identify essential market signals, evaluate existing and future processes and services, and design and execute effective responses to market changes [3]. Dynamic marketing capabilities can directly influence product development, service design, and long-term customer relationships, which jointly affect the firm’s revenues and competitiveness [7]. However, most prior studies tend to approach dynamic capabilities generally [8] [9] [10] and thus offer few analyses or discussions of dynamic capabilities of the marketing function. To address this backdrop, we investigate firms’ dynamic marketing capabilities together with the emphasis on the important practices in the marketing function. In particular, customer relationship management (CRM) is the “marketing mantra of today” [11], and the CRM efforts involve a huge amount of information processing.
and needs IT support to facilitate such efforts.

We analyze key determinants of dynamic marketing capabilities with an emphasis on the central role of IT in creating and augmenting these capabilities. We propose a model that relates a firm’s dynamic marketing capabilities and its market orientation, IT infrastructure capabilities, and use of IT to support CRM. We test this model and the associated hypotheses using the data collected from a large-scale survey of major Taiwanese manufacturers and service firms. According to our results, a firm’s market orientation, functionality of its IT infrastructure capabilities, and use of IT for supporting CRM have significant influences on the firm’s dynamic marketing capabilities.

By examining the central role of IT in creating and enhancing dynamic marketing capabilities, our study contribute to the IS literature by addressing how different types of IT resources can be used to promote business values. We also contribute to competitive advantage literature by exploring firms’ dynamic capabilities from a fine-grained marketing perspective, anchored by the central role of IT in supporting key marketing processes and activities. Furthermore, we generate empirical evidence suggesting the direct or indirect effects of these key determinants on a firm’s dynamic marketing capabilities.

**Literature Review**

In the area of competitive advantages analysis, the resource-based view (RBV) has been used as a theoretical lens in prior information systems (IS) research to explore the contribution of IT to firm performance [12]. The RBV provides a logical framework for examining how firms gain sustainable competitive advantages [13], with a focus on firms’ finite resource capabilities. It also assumes that these resources are distributed heterogeneously across firms and that the differences in resource capabilities among firms remain relatively stable over time. These assumptions make the RBV limited in highly volatile environments, because it cannot explain how firms acquire and develop resource capabilities and make them sustainable over time [1]. Some researchers therefore shift their perspective to dynamic capabilities [1] [2] [14], which refer to a firm’s ability to obtain competitive advantages through its resources that enable effective responses to changes in the business environment [1] [2]. Dynamic capabilities underscore the importance of the “history” of current capabilities, as well as the importance of expanding current capabilities in the future for sustainable competitive advantages [15].

For example, in an industry characterized by the continual availability of innovative or even disruptive technology, a firm’s success or failure greatly depend on effective technology deployments and assimilation with business [16]. Dynamic capabilities further enable a firm to orchestrate its operational capabilities and resources, beyond routine production and service delivery; hence, they have significant influences on the firm’s performance and can determine its competitiveness in the market. A firm’s dynamic capabilities are difficult to replicate [2] [16], even if competitors can observe or infer their coherence or rationality from the firm’s behaviors or performance.

Dynamic capabilities are multifaceted and prevail in many crucial aspects of business. Of particular importance is marketing; firms that possess desirable dynamic marketing capabilities can adjust their marketing processes and activities in an effective and timely manner to better serve and retain their customers, increase sales, and cultivate favorable long-term customer intimacy. In this study, we define dynamic marketing capabilities as a set of specific and identifiable processes that the firm exhibits to indicate its ability to exploit its finite resources—by integrating, reconfiguring, gaining, or releasing these resources—and respond to important market changes [1]. These capabilities include a firm’s product/service development [1] [17] [18], pricing [7], channel design (i.e., place) [18], and promotion [15], which are manifested in the effectiveness of its marketing mix. Previous research explores some issues peripheral to dynamic marketing capabilities.

A review of the extant literature also suggests the importance of market orientation [2] [8] [19] [20] [21], IT infrastructure capabilities [22] [23], and IT support for CRM [5] [24], each of which can affect a firm’s dynamic marketing capabilities significantly. Firms embracing a highly market-oriented culture likely will emphasize comprehensive data gathering, seamless data integration, thorough analyses, and agile market intelligence generation, which are critical for steering and coordinating their CRM processes and activities and ultimately expanding their dynamic marketing capabilities. This strategic, customer-centric, data-driven CRM focus requires the effective use of IT, though little research explains how firms may create or enhance their dynamic marketing capabilities through the use of IT.

**Market Orientation:** Research on market orientation addresses how organizations adapt to their environments and develop competitive advantage [25]. Market orientation generally
refers to the organization-wide generation of market intelligence pertaining to current and future customer needs and the dissemination of such intelligence across functional departments and business units to ensure effective, timely responses to key market changes [19] [21] [26]. The extent to which a firm is market oriented dictates the emphasis it places on market information and internal coordination with respect to long-term firm performance and profitability; highly market-oriented firms constantly strive for value creation for their customers and performance improvements [27]. Firms with a high market orientation also demand constant monitoring of market conditions, frequent market trend analyses, and thorough understanding of customers’ needs and competitors’ strategies. Previous research empirically examines the impacts of market orientation on firm profits [8] [9] [10] and employees’ morale, job satisfaction, and commitment or loyalty [9]. The relationship among market orientation, a learning organization [10] [25], and innovation [25] also has been studied in prior research.

**IT Infrastructure Capabilities:** As a central enabler, a firm’s IT infrastructure forms the backbone of its IT architecture and applications; it is indispensable for effective business processes or functions [28]. Salient definitions of IT infrastructure seem to embrace both static technical resources (shared technological components such as hardware platforms, network equipment, telecommunications technology, data, and system applications) and the shared IT services that underpin the systems for supporting the firm’s processes, business operations, or decision making [29]. An IT infrastructure differs from the transaction processing or management information systems (or associated applications) that it supports, in that it establishes a fundamental basis for current and future business systems and applications but is not specific to any business process or management function. It also provides the flexibility necessary for coping with uncertainty in future needs [22]. According to [30], a firm’s IT infrastructure capabilities can fundamentally influence the extent to which it can create, share, and use data, information, and knowledge in an effective and timely fashion.

In general, an IT infrastructure consists of network and telecommunications technology and platform technology such as hardware and operating systems [30]. These two types of technology can be distinguished as connectivity and functionality, respectively [22]. Connectivity refers to the ability of an IT infrastructure (or its components) to link to other components within and beyond the organization’s boundaries [30] [31]; it determines the firm’s underlying capacity for providing data, voice, and video across locations that span large distances [28]. Functionality entails an array of various enterprise-wide fundamental applications or services [23]; it provides a kernel and flexible base for the firm’s long-term strategic intent. In general, the functionality of an IT infrastructure is relatively more stable than the business operations or applications it supports [30], hereby creating an enterprise-wide platform for various information systems and business applications. Functionality further affects a firm’s ability to add, modify, and remove the modules of business applications, with few adverse ripple effects on existing applications [22] [30] [31]. As a whole, a firm’s IT infrastructure capabilities can be gauged in terms of connectivity and functionality [22] [29]. Firms have relatively greater IT infrastructure capabilities when they can support a wide range of fundamental applications or services, across various geographic locations or work groups. These capabilities represent crucial resources for firms and can uniquely fuse the technology and human infrastructure [22] [23].

**IT Support for CRM:** Firms constantly seek technological opportunities to solve their business problems or respond to market changes better and faster [32]. Effective CRM allows firms to identify valuable customers, obtain and accumulate crucial knowledge about them, and thus create greater value for them [33]. Prior research seems to focus on examining CRM effects on customer satisfaction and, firm performance [34] and customer loyalty and firm profitability [24] [35]. By and large, IT support for CRM denotes the degree to which a firm uses IT to support and improve its CRM activities. Adequate use of IT can increase the effectiveness and efficiency of CRM. By collecting and analyzing detailed customer demographic and behavioral data, firms can improve their communications with customers, enhance marketing strategies and activities, select appropriate distribution channels, and make customer support and call centers effective [5]. Inherently CRM is information intensive; thus, its effectiveness relies on the firm’s ability to gather and integrate voluminous, comprehensive data about customers and their behaviors, perform detailed processing and analyses of these data, and propagate the resulting information and knowledge quickly throughout the organization. Moreover, IT can empower firms to perform these tasks better [35]. For example, a firm can use database marketing, decision support systems, or analytics software to improve its customer communications or service channels. Using IT, firms can improve their customer intimacy, stay
 abreast of market changes, anticipate market trends, cut costs, increase sales and revenues, and/or foster customer satisfaction and loyalty, thus creating sustainable competitive advantages [5]. These effects suggest the important role of IT support for CRM in terms of determining the firm’s dynamic marketing capabilities.

Research Model and Hypotheses
We propose a factor model that explains a firm’s dynamic marketing capabilities using market orientation, IT infrastructure capabilities, and IT support for CRM (see Figure 1). We distinguish the connectivity and functionality of the firm’s IT infrastructure capabilities because they serve distinct purposes and have logical delineations. In particular, our model emphasizes the central role of IT in creating and enhancing firms’ dynamic marketing capabilities through its support for CRM, as well as the infrastructural capabilities.

Figure 1: Research Model
A firm’s market orientation can be described by information acquisition, dissemination, and responsiveness [19] [27]. Highly market-oriented firms tend to pay closer attention to customers—the locus of CRM [32] [34]. To achieve their business objectives in a competitive environment, these firms must be effective in CRM and often demand substantial IT capabilities for collecting, integrating, and analyzing vast amounts of customer data generated by various channels or stored in multiple sources. For example, a highly market-oriented firm might use technology to support its operational CRM (e.g., personal exchanges, face-to-face dialogue, phone-based inquiries or service requests, customer complaint management), from which it gathers essential data about customers and their product preferences or assessments. To understand their customers and their needs or preferences, firms might use IT to enhance their analytical CRM for demographic analyses, market segmentation, customer profiling, purchase behavior analysis, marketing decision support, or promotion design. In addition, a firm could use IT to improve its collaborative CRM through call center automation and seamless integrations of various contact points to reach customers. Prior research highlights the importance of IT for CRM [26] and shows that firms with a relatively higher market orientation are more likely to explore, experiment, and utilize technological solutions to address their challenges in CRM [32] than are firms that are low in market orientation.

H1: A firm’s market orientation is positively associated with its use of IT to support CRM.

Highly market-oriented firms also have a greater need for market intelligence than their counterparts that are low in market orientation [9], implying a positive influence of market orientation on dynamic marketing capabilities. To stay highly market oriented, firms must understand the changing market conditions and stay atop of emerging trends, which requires them to scan key market events constantly to detect alarming changes, as well as generate and execute effective responses in an agile and timely fashion. These firms often exhibit a paramount need for dynamic marketing capabilities to adjust their marketing processes and activities by reconfiguring their resources. Market orientation further demands that firms undertake continual market surveillance [36] and integrate multiple functional departments and channel partners to reconfigure ineffective competencies that will generate promising skills that align better with key market changes [1] [2] [14] [17]. Market orientation has important influences on firm performance measured by new product (service) development effectiveness and cycle time [8] [10] or product (service) market performance [17], which are manifestations of the firm’s dynamic marketing capabilities. Accumulated empirical evidence suggests that a firm’s market orientation positively affects its dynamic marketing capabilities, as manifested by product development, pricing, or channel design.

H2: A firm’s market orientation is positively associated with its dynamic marketing capabilities.

Connectivity offers a central conduit through which different applications can run simultaneously across locations, people, groups, or departments. Such connectivity often appears at different levels, ranging from simple data exchanges within a single business unit to complex application process (typically involving multiple functional departments or external partners) for users that are geographically dispersed [22]. High connectivity also creates the
The functionality of a firm’s IT infrastructure capabilities relates closely to the modular component design in IT. Functionality offers the basic services instrumental to a wide array of information systems and business applications [22]. Firms can better design and execute CRM if their IT infrastructure has a higher level of functionality. As a firm’s CRM practices evolve over time, its functional IT infrastructure can enhance the CRM system by implementing new applications or changing existing applications to meet new requirements. In addition, greater functionality in the IT infrastructure capabilities offers a more comprehensive and desirable set of fundamental services that support various IS or business applications. Functionality such as adequate database capability, data analysis capability, computational processing in hardware, operating systems, or kernel system software is indispensable to the success of IT-supported CRM. For example, analytical CRM applications depend on the ability to capture customer transactions and extract important patterns from prior product search and purchase data stored in various databases. In this case, a CRM system relies on the IT infrastructure’s functionality to support its processing and analyses. When a firm’s IT infrastructure offers a greater functionality, it can benefit more from data integrations from different sources, thorough data processing and sophisticated analyses, and novel business intelligence about customers, markets, or competitors. Firms can become more effective in addressing evolving customer needs and market demands by establishing adequate functionality in their IT infrastructure [6], which then better supports the CRM processes or activities.

H5: The functionality of a firm’s IT infrastructure capabilities is positively associated with its use of IT to support CRM.

Firms also depend on their IT infrastructure’s functionality to respond to essential market changes [38]. In general, this functionality refers to the ability to modify, add, or remove new applications efficiently on the basis of different business application requirements [31]; Infrastructures provide a flexible base for future business initiatives [31]. At a higher level, functionality can enable or support a more comprehensive range of kernel services that collectively provide the foundation necessary for adjusting operations, changing processes, and reconfiguring marketing resources, both internal and external [37]. As a result, greater functionality can enable firms to create initiatives or pursue business opportunities in response to important market changes. Furthermore, functionality can improve data processing and information flows in the organization, through which firms improve their business analyses and decision making. For
example, firms might leverage the functionality of their IT to analyze information and extract essential business intelligence that will support their strategic decision making or operational efficiency improvement. Through improved application developments and standardized service management, firms can better allocate system resources, closely monitor and fine-tune business operations, and execute process reengineering efforts efficiently. In turn, these efforts can foster the creation and augmentation of their dynamic marketing capabilities for adapting to essential market changes or seizing valuable business opportunities.

H6: The functionality of a firm’s IT infrastructure capabilities is positively associated with its dynamic marketing capabilities.

Finally, by using IT to support their CRM, firms can optimize their sales processes, improve customer service designs, combine related and often disintegrated data about customers and the market, enhance service quality, facilitate customer communication, profile valuable customers, and support effective marketing campaigns [5]. With these capabilities, firms become more effective in adapting to market changes, forecasting market demands, or providing customization [5]. For example, firms might discover profitable cross-selling opportunities, increase customer retention rates, foster online exchanges, or refine promotion activities by using analytical CRM technology. Firms also can improve their collaborative CRM by integrating various distribution channels, direct sales storefronts, Web sites, and customer support centers; then, through these integrated channels, they can develop essential data about customers and their behaviors.

H7: A firm’s use of IT to support CRM is positively associated with its dynamic marketing capabilities.

Study Design and Data Collection

Our survey targets leading manufacturers and service firms in Taiwan.1 We employed a key informant approach and sent survey packets to the (chief) marketing officer of each firm, who generally has a good understanding of the firm’s business and operations from a marketing perspective. Our survey packet consisted of a cover letter that describes our study and its purpose, the questionnaire, and a self-addressed stamped return envelope. To encourage voluntary participation, we promised firms, in the cover letter, that we would make, on each respondent’s behalf, a donation of 50 New Taiwan dollars (i.e., approximately US$1.5) to a nonprofit charity organization. We used multiple question items to measure each construct. Specifically, we operationalized market orientation with nine items adapted from MARKOR [20], using a five-point Likert scale anchored by “strongly disagreed” and “strongly agreed.” These items target market intelligence generation, information dissemination, and firm responsiveness. To measure IT infrastructure capabilities, we used a previously developed and validated scale [22], which includes both connectivity and functionality. Connectivity uses five discrete levels: do not have, send messages, access to information, perform simple transactions, and perform complex transactions. The functionality measure has 13 dichotomous items, for which 1 represents “affirmative” and 0 otherwise. We obtained six items to measure IT support for CRM, according to a previous analysis of the CRM process [33]. These items employed a five-point Likert scale, with 1 being “strongly disagreed” and 5 “strongly agreed.” We followed existing discussions [1] and extended the dynamic capabilities analysis [2], with a emphasis on key aspects manifested in the firm’s marketing mix: product (service) development, pricing, channel design (i.e., place), and promotion. In particular, we measured dynamic marketing capabilities with 12 question items, using a five-point Likert scale anchored by “strongly disagreed” and “strongly agreed.”

The questionnaire was administered in Chinese, the official language in Taiwan. Adapted items were translated into Chinese by experienced translators, and then two researchers fluent in both English and Chinese reviewed the translation to ensure consistent semantics of the question items between languages. After resolving some minor wording discrepancies, we conducted a pretest to assess the reliability and validity of the instrument. The results are satisfactory; several minor wording changes make the question items more appropriate to the targeted context and subjects.

We sent the survey packets, by postal mail, to a sample of 500 firms randomly selected from our target pool. Each firm had three weeks to complete and return the survey, and at the end of this initial response window, we sent a reminder letter to those from whom we had not received completed surveys, promising them an additional two weeks to do so.

1 We target the top 1,000 manufacturers and top 500 service firms listed in the Largest Corporations in Taiwan, published in a special issue by Common Wealth (May 2002).

2 We adopted the nine widely validated items from the original MARKOR 20-item scale.

3 Question items are available upon request.
Analyses and Results

Of the 149 surveys we received, 14 incomplete questionnaires are excluded from our subsequent analyses. Thus, the effective response rate is 13.86%. The responding firms span a wide range of industries; most are manufacturing firms (63%), mostly in the electronics (14.1%), computers and communications (12.6%), and non-metallic production (12.6%) sectors. Our sample firms vary in total assets and number of full-time employees; approximately half of them own total assets of around US$60 million and, on average, employ about 500 full-time employees.

We test our model and hypotheses using partial least squares (PLS), which allows for simultaneous testing of both the measurement and structural models [39]. We evaluate our instrument in terms of reliability and convergent and discriminant validity. To evaluate item reliability, we examine the loading of each item on its corresponding construct. Items with a loading greater than .7 are generally reliable, whereas those with a loading lower than .5 should be considered for removal, and all loadings for items are exceed this suggested cutoff threshold [40]. The loadings of all the remaining items are statistically significant at the .01 level.

We analyze our instrument’s construct reliability in terms of internal consistency and composite construct reliability. We use Cronbach’s alpha to assess internal consistency and adopt the common threshold of .7 [40]. All investigated constructs exhibit a Cronbach’s alpha value greater than .7 and thus satisfactory internal consistency. The composite reliability of each construct we investigate exceeds .7, a common threshold in social science research for signifying satisfactory construct reliability [41]. Our overall results thus suggest the instrument’s satisfactory construct reliability.

We next examine convergent validity using average variance extracted (AVE). Each investigated construct has an AVE score greater than .6, which indicates our instrument exhibits adequate convergent validity [41]. We further analyze convergent and discriminant validity by examining the cross-loadings computed from the correlation between each construct’s component score and the manifest indicators of other constructs [39]. All items load substantially on their own construct compared with any other constructs. The square roots of the AVEs are also greater than the correlation among any pair of latent constructs [39]. Together, these results suggest that the instrument exhibits appropriate convergent and discriminant validity.

Model and Hypothesis Testing Results: We test our model by examining the R² value of each exogenous variable. As we show in Figure 2, the model explains a significant portion of the variances in dynamic marketing capabilities (R² = 63%) and IT support for CRM (R² = 42%). We test each hypothesis by assessing the statistical significance and magnitude of its corresponding path in the model. For increased statistical rigor and validity [39], we also use a bootstrap resampling procedure with resamples of 250. According to our results, market orientation has a significant, direct effect on IT support for CRM (path coefficient = .53, p < .01). Moreover, IT support for CRM is significantly influenced by the connectivity of IT infrastructure capabilities (path coefficient = .21, p < .01) but is not significantly affected by the functionality. Thus, our data support H1 and H3 but not H5, suggesting the importance of the connectivity, but not the functionality, of a firm’s IT infrastructure for the firm’s use of IT to support CRM. In addition, market orientation has a significant influence on dynamic marketing capabilities (path coefficient = .44, p < .01), as does IT support for CRM (path coefficient = .38, p < .01), in support of H2 and H7. Finally, the effect of the functionality of IT infrastructure capabilities on dynamic marketing capabilities is significant (path coefficient = .10, p < .01), but connectivity is not; thus, our data support H6 but not H4.

![Figure 2: Model Testing Results](image)

Discussion and Conclusion

Dynamic capabilities offer a salient anchor for competitive advantage analysis. Whereas most previous research examines dynamic capabilities in a general sense, few studies consider dynamic capabilities from the perspective of critical business aspects of the firm (e.g., marketing). We...
study firms’ dynamic marketing capabilities by focusing on the central role of IT in supporting CRM and find empirical support for most of the proposed hypotheses. Thus, our model offers reasonably satisfactory utilities for explaining and predicting firms’ dynamic marketing capabilities and the effects of IT in creating such capabilities. According to our results, market orientation and IT infrastructure capabilities can affect dynamic marketing capabilities directly as well as indirectly (through IT support for CRM). Our findings also shed light on the important linkage between the use of IT to support CRM and dynamic marketing capabilities. Our study further represents a point of departure for continued investigations of firms’ dynamic capabilities at a finer-grained level, specific to critical aspects of business, which should encourage fruitful lines of inquiry into dynamic capabilities.

By examining the central role of IT in creating and enhancing dynamic marketing capabilities, our study contribute to the IS literature by addressing how different types of IT resources can used to create and enhance business values. Our results underscore the criticality of information technology as a means to support CRM and thereby improve dynamic marketing capabilities. Overall, our findings shed light on the importance of IT in dynamic capabilities, which deserves further investigation. According to our analysis, firms that vary in their market orientation also differ in their use of technology to support CRM and in their dynamic marketing capabilities; additional research should explore desirable contingencies that may determine the relative significance of a firm’s IT infrastructure capabilities or guide its use of technology to support CRM. Our research also contributes to competitive advantages literature by investigating firms’ dynamic marketing capabilities, an essential pre-descriptive measure that indicates a firm’s competence in turbulent markets, whereas most prior studies focus on firm performance or examine dynamic capabilities holistically. Prior research tends to study firm performance using static assessments that simply provide snapshots of the firm’s performance or operations. The distinction between static and dynamic resources or abilities represents an extension of the traditional static RBV conceptualization [12]. Conceptual analyses and empirical investigations become necessary to explain firms’ competitive advantages in highly volatile markets and address key challenges that result from market volatility and fast changing technologies.

Our study results have several implications for research. First, the connectivity and functionality of a firm’s IT infrastructure have dissimilar effects on its use of IT to support CRM and on dynamic marketing capabilities. Whereas previous research examines the effects of IT infrastructure as a collective construct, we identify two important dimensions of IT infrastructure according to their distinct definitions and implications and then examine their effects separately. Because functionality represents the ability to provide comprehensive fundamental IT services, whereas connectivity refers to the level of linkages between work groups and applications, these two dimensions provide support for CRM and the cultivation of dynamic marketing capability in different ways. According to our results, functionality influences dynamic marketing capabilities directly, and connectivity affects such capabilities indirectly through the use of IT in support of CRM. Our findings point to the need to examine their separate effects when studying the impact of IT infrastructure on firms or their performance.

Second, our analyses shed light on the mediating role of IT support for CRM, which partially mediates the influence of market orientation on dynamic marketing capabilities. In addition to its direct effect, IT in support of CRM can enhance a firm’s dynamic marketing capabilities by mediating the impacts of its market orientation. Similarly, IT support for CRM channels the impact of IT connectivity on dynamic marketing capabilities. According to our results, a firm’s use of IT to support its CRM depends on its IT infrastructure, which provides a tangible, foundational architecture of the firm [4]. Taken together, our findings reveal the central role of the use of IT in support of CRM to channel the influences of these antecedents toward dynamic marketing capabilities, thus highlighting a facilitating role that deserves further attention.

Third, our findings underscore the importance of IT for creating or enhancing firms’ dynamic marketing capabilities. The use of IT offers a vital linkage between the firm’s technology and its business strategy to create competitive advantages. Dynamic marketing capabilities are created by a firm not only to use specific technological capabilities but also to leverage IT in the context of the firm’s organizational capabilities [16]. Overall, our results reinforce the alignment between technology investment/utilization and business strategy [16] and vividly underscore the central role of IT in strategic management research, particularly for firms competing in highly volatile markets.

Our findings also have several implications for practice. Though the connectivity of IT infrastructure does not seem to contribute to the
firm’s dynamic marketing capabilities directly, the effects of its connectivity on IT support for CRM cannot be ignored. A firm’s technology usage appears most valuable when it is congruent with the firm’s business strategies, as illuminated by the use of IT to support CRM. In this light, firms must thoroughly plan their IT investments and carefully assess their assimilation with essential business processes or activities. A firm may not benefit fully from its network upgrades throughout the organization if it fails to use it to support key business processes, such as communications among various functional departments or with customers and suppliers. Alternatively, a firm might improve its collaborative CRM by using a newly implemented communication system (e.g., a VoIP system) that enhances the customer experience and improves coordination among different departments.

The functionality of IT infrastructure instead affects dynamic marketing capability directly, which implies that it is important for firms to establish a modular IT infrastructure so that the IT resources can be easily reconfigured to enhance the dynamic marketing capability. However, the functionality of IT infrastructure is not established for a specific application but provides a foundation for shared IT services used by multiple IT applications [23]. Therefore, the effect of functionality does not affect IT-supported CRM significantly.

Our results further point to the essential role of IT support for CRM in market-oriented firms that must maintain a good understanding of their customers and competitors. Accordingly, market-oriented firms are relatively more motivated to exploit technological opportunities to support their CRM. CRM technologies can help the firm achieve its marketing goals, and as our findings show, its market orientation can affect the firm’s use of IT to support its dynamic marketing capabilities. That is, market orientation drives customer-centric technology usage, which influences dynamic marketing capabilities. These results reinforce the importance of a desirable fit between the firm’s technology usage and key business practices, particularly for market-oriented firms in competitive and volatile markets. Firms should pursue technologies congruent with their core business processes to improve their dynamic marketing capabilities.

This study has several limitations that must be considered when interpreting our results. First, our results derive from a single study involving a sample of firms; therefore, we cannot rule out self-selection biases. Second, measuring IT infrastructure capabilities and dynamic marketing capabilities is challenging. We believe our measures are reasonable, but our study also could benefit from further conceptual analyses and empirical testing. Third, our analysis focuses on some key determinants of dynamic marketing capabilities but may ignore other important antecedents. Additional investigations should consider and test a broader set of factors that may explain how firms create and augment their dynamic marketing capabilities. In addition, dynamic capabilities may straddle multiple dimensions of business, so research should examine other fundamental aspects of firms, such as operations, services, finance, or knowledge management. The role of IT in firms’ dynamic capabilities, specific to such dimensions, may differ. Along similar lines, a remaining challenge facing researchers and business managers is identifying the specific aspects of business that firms must develop to improve their dynamic capabilities.

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A VALUE-BASED FRAMEWORK FOR INTERNET-ENABLED CRM SERVICES

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Abstract
The global competition for enterprises has been the significant issue for recent years. However, the customer needs are difficult to satisfy due to specialized characteristic of existing customers. A good CRM strategy may assist firms to earn advanced profits, increase customer perceived value, and acquire new customers. This research aims to provide a holistic framework based on two dimensions. The first dimension is the level of customer needs which is related to customer perceived value. The second value is the process of CRM; for instance, attracting, interacting, and retaining customers. This paper intends to: (1) identify the level of needs based on perceived value, (2) recognize the possible step of CRM processes, and (3) recommend an appropriate CRM e-service to a customer.

Keywords: E-Service; Customer Value; Internet-Enabled CRM

Introduction
The global competition for enterprises has been the significant issue for recent years. However, the customer needs are difficult to satisfy due to specialized characteristic of existing customers. Companies need to manage the relationships with customers more efficient than competitors. For example, firms can get closer to their customers by interactive communication and needs/habits identification and enhance the value of customer. The profitability of customers can also be increased through sustainable attracting, interacting, and retaining customers. Consequently, the key for enterprises is offer superior customer relationship management strategies.

Customer relationship management (CRM) is a significant issue for today’s companies. In particular, a good CRM strategy may assist firms to earn advanced profits, increase customer perceived value, and acquire new customers. The popularity of information technology and Internet has changed the concept to deliver services over the Internet. Certain enterprises provide the opportunity to deliver services over the Internet, which is considered as a way to decrease service cost, tighten with customers, and furnish mass communication.

In this study, CRM is transformed from traditional CRM (face-to-face) to Internet-Enabled CRM (over the Internet). This paper defines Internet-Enabled CRM as conducting CRM by utilizing devices which can deliver e-services through the Internet. The extent of Internet-Enabled CRM includes electronic CRM (E-CRM), mobile CRM (M-CRM), and ubiquitous CRM (U-CRM). The existing CRM framework is based mostly on the company’s perspective; for example, it considers how to acquire customers, retain customers, and create profits from customers. Hence, a holistic framework for both sides is still lacking, especially for e-service industry.

Furthermore, Internet is also the major problem for e-CRM which cannot provide face-to-face contact and difficult to grasp customer needs. Hence, it is important to obtain customer needs accurately and interact with customers efficiently to put effort on valuable customers. This research aims to provide a holistic framework based on two dimensions. The first dimension is the level of customer needs which is related to customer perceived value. The second value is the process of CRM; for instance, attracting, interacting, and retaining customers. We believe each customer has different perceived value for a same service. That is, this paper intends to: (1) identify the level of needs based on perceived value, (2) recognize the possible step of CRM processes, and (3) recommend an appropriate CRM e-service to a customer.

The rest of this paper is organized as follows. Section 2 surveys the extant literature, such as customer perceived value and e-service. Section 3 devises a conceptual framework for customer value management. Section 4 provides the implications of the proposed framework, and section 5 provides a conclusion.

Background
Definition of Perceived Value
The definition of perceived value is proposed by Zeithaml [11], which indicates customer perceived value is the consumer’s overall assessment of the utility of a product based on what is received and what is given. Kolver [5] specifies customer delivered value is the difference between total customer value and total customer cost. That is, the benefit of a specific product or service for a customer. The total value includes product value, service value, and
personnel value and the total cost enfold monetary cost, time cost, and spirit cost. Holbrook [1] defines customer value as interactive, experienced, relative, and favorable. This study considers customer value is the difference between obtaining and devoting and various from people.

However, why value is important? Companies attempt to create profit from their customers who evaluate the firms that can provide products or services to satisfy their value [5]. Consumers always consider value as the most important factor when they purchase the products or services. The value stands for what the customers obtain from the transaction. Yan [10] indicates customer value reflects consumer behavior and affects the order of needs. Kim et al. [4] specifies that needs emerge before attitude and purchase and can create value, trigger behavior, and satisfy required level of needs. Hence, the concept of customer value and customer needs is relative (see Fig. 1). Customer value is the obtained benefit from the perception of products or services. Customer need is the motivation to achieve goals that belongs to a type of spontaneous behavior. Hence, this research will utilize the concept of value to build the holistic framework in terms of customer perspective.

![Figure 1 Relationship between customer value and customer needs](image)

**CRM E-Service**

Järvinen and Lehtinen [2] define e-service as a benefit providing object of transaction that can be characterized as an intangible process that is at least partially produced, marketed and consumed in a simultaneous interaction through electronic networks. The implement of e-business not only enhances the efficiency of business but creates markets and profit [7]. Meanwhile, e-services generate new service experience and customer value, such as functional value (time saving, convenience), emotional value (interaction), social value, and network value (security and privacy) [3][6].

In this study, we attempt to classify existing CRM e-services into four major components: attractive e-service, interacting e-service, analytic e-service, and retaining e-service. Attractive e-service provides e-services which employ marketing methods. For example, blog marketing, experience marketing, and 1-to-1 marketing are extremely suitable for e-services. The second component is interacting e-service, which allows firms and customers interact over the Internet. In this category, e-service providers can furnish post-purchase survey e-services, online responding e-services, and collected FAQ e-services. Post-purchase survey e-services allow firms to get a better understanding of their customers after purchase, and online responding e-service enables customers to obtain real-time answers when they have a problem.

The third component is analytic e-service, which is used to analyze customers through two main e-services: statistic analysis and data mining e-services. Statistic analysis employs conventional statistical approaches, like clustering and linear regression, while data mining employs artificial intelligence approaches, like neural networks and genetic algorithms, to analyze customers. Finally, retaining e-service includes customer segmentation e-service and performance measurement e-service. In this category, the aim is to help firms retain their customers. For example, customer segmentation e-service can assist firms to segment their customers, identify key value, and provide retaining strategies. Hence, this study will utilize the classification as the basis to build the holistic framework in terms of enterprise perspective.

**Conceptual Framework**

A Value Cube for Internet-Enabled CRM

In the era of wireless technology, three dimensions of value are identified for Internet-enabled CRM: (1) business value, (2) customer perceived value, and (3) social value (see Fig. 2). Business value is generated from companies and is always represented by monetary value (e.g., profits). Firms can easily observe the changes in profit (customer profitability) for a given time period and can modify their CRM strategies accordingly. Customer retention another indicator with which to measure profits. According to the 80/20 rule, 20 percent of customers will generate 80% of a company’s profits, so it is important to retain those customers. Internet-enabled CRM provides Internet-based e-services that customers can access anytime and anywhere, and companies can utilize new technologies (e.g., wireless and mobile devices) to help earn profits based on certain e-services, so Internet-enabled CRM is believed to attain high business value.

Customer perceived value is generated by customers and reflected in their willingness to pay. The concept of willingness-to-pay represents how much customers intend to pay for furnished e-services, and different CRM strategies may result in different behaviors of customers. For example,
customers will not pay for the e-services which are inappropriate for them, even if they are delivered. Internet-enabled CRM provides opportunities for customers to acquire the most appropriate e-services when they face problems, and the technology helps companies identify customers’ information, such as location, personalized preferences, and behaviors. Thus, Internet-enabled CRM can help attain high customer perceived value.

Social value is generated by collective intelligence—the wisdom of crowds—over the Internet. According to certain theories (e.g., Delphi method, brainstorming), group decision-making is superior to individual decision-making. Internet-enabled CRM allows peers to assist each other in solving problems based on wireless technologies (e.g., agent-based approach). Traditional CRM merely allows firms to decide what services to deliver—a one-way delivery concept—but Internet-enabled CRM allows peers from the social network to collaborate to decide what e-services will be furnished right away. Thus, Internet-enabled CRM is believed to attain high social value.

In short, Internet-enabled CRM facilitates high business value, customer perceived value, and social value in our proposed value cube. Traditional CRM may attain high business value and customer perceived value, but it lacks a social network effect in the e-service delivery process. We believe Internet-enabled CRM is superior to traditional CRM in terms of collaboration for Internet-enabled services. Hence, Internet-enabled CRM is expected to extend social value dimension from low to high and to provide complete solutions for managing customers well.

Woodruff [9] separates customer value into level of attribute, end, and goal from information processing perspective. Level of attribute describes the products or services, level of end indicates the interaction of users and products/services, and level of goal specifies the goal of individual or organization. Sheth et al. [8] indicate the determinants of customer decision for consuming value which are functional value, social value, emotional value, cognitive value, and conditional value. The existing literature specifies the significance for separating customer value into several levels. The lowest level of customer value is concrete and the highest of customer value is abstract. All levels of customer value are interconnected and the higher level of customer value needs to be satisfied from lower level of customer value. In this research, we synthesize the existing concepts to classify customer value into self-actualized value, social and emotional value, added value, and functional value.

In Fig. 3, we utilize customer value and CRM e-service process as two major dimensions to construct a customer value creation model. The lowest two levels of customer value are functional and added value which enfold the concept of CRM 1.0. In the past, CRM 1.0 allows merely closed or one-way communication which indicates only firms can decide when to communicate with customers or not. In these two levels, customers desire to accept useful e-services with basic functions and certain extended e-services to obtain added value. For example, customers need Google to help them search some information and guide them to the related websites. These two levels of customer value are based on basic and expectant value. Companies need to provide e-services that the customers perceive usefulness and completeness to fulfill their needs.

The third level is social and emotional value, which is enhanced to CRM 2.0 concept. CRM 2.0 allows value co-creation and is a type of two-way interaction. In this level, companies provide e-services that fulfill customers’ desired value and perceived belongingness from customers. The effect of word-of-mouth can be applied in this level. The most important to firms is the satisfaction of social and emotional value that can retain and create more customers. The highest level is self-actualized value which is also the expected value to customers. In this level, customers expect surprises from companies and the concept is promoted to CRM 3.0. CRM 3.0 allows customers to solve problems on their own and furnish suggestions and comments for improving e-services sustainably. The customers play a vital role to provide much valuable information to enterprises, which is also the concept of customer-centric radiation. In this level, customers dominate the process of CRM and help the companies to retain most of their customers and

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**Figure 2 A Value Cube for Internet-Enabled CRM**

**A Value-Based Model for Internet-Enabled CRM**

This research uses the dimensions of customer value and CRM process of e-services to propose a customer value creation model (CVCM), which is also a value-based model for Internet-enabled CRM.
create profits.

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<td>Self-actualized value</td>
<td>Products and services provide self-actualized value</td>
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<td>Value co-creation from social network)</td>
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<td>Usefulness from customers. (CRM 1.0 concept:</td>
<td>Functional value</td>
<td>Products and services provide functional value</td>
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<td>Basic functions of e-services)</td>
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Figure 3 Customer value creation model.

Implications

Customer-centric Management
This paper provides a new perspective for CRM in terms of motivation and value. Different customer background may result in various levels of needs and perceived value. Companies need to differentiate marketing methods according to different targets. Our proposed framework provides the opportunity to identify customer needs and furnish a combination of CRM e-services in time. In addition, we assist firms to identify psychological perception from customer value. Enterprises can earn more profits from the concept of customer-centric management.

Collective Wisdom Empowerment
The proposed framework allows customers to collaborate in order to release the power of collective wisdom. Collective intelligence (wisdom) refers to the concept that people can contribute together in order to attain good performance of Internet-Enabled CRM. Our framework can assist companies to identify the level of needs for customers and predict what CRM e-service(s) can be delivered for the next step.

Real-time E-Service Composition
Real-time e-service composition is also a significant issue for Internet-Enabled CRM. E-service providers should be aware of what customers really want at any time, based on their needs. Even when e-service providers acquire customer needs, they still have to compose the required e-services and deliver them to the customer quickly. Certain e-service providers can discover required e-services from the framework more efficiently and dynamically bundle them as a package. Our framework advances the e-service delivery process and implements the concept of service-oriented management.

Conclusions
CRM is an essential issue for companies in recent years. The emergence of e-services has been changed the essence of traditional CRM services. CRM e-services will dominate future CRM processes. This study proposes a value cube for Internet-enabled CRM in terms of business value, social value, and
customer perceived value. The value cube also illustrates the revolution of CRM. In addition, this research investigates the significance of customer value to provide a different perspective for CRM process. Thus, we propose a value-based model for Internet-enabled CRM e-services. This paper extends the concept of customer value from Maslow needs hierarchy based on existing literature. In particular, we separate customer value into four levels: self-actualized value (highest), social and emotional value, added value, and functional value (lowest). The fulfillment of customer value may be caused by different combination of CRM e-services. Hence, we aim to provide a holistic framework for future CRM e-service providers with customer and business perspectives.

Moreover, there are still some limitations for this research. For example, the proposed value cube and value-based model need to be verified in details. Real-world cases or simulation of collected data can examine the feasibility and validity. Although the proposed frameworks are novel and preliminary, the value is existed for further investigated. The other limitation is the separation of level of customer value. We extend the concept from Maslow needs hierarchy to construct our framework. However, some other concepts that can separate the level of customer value are existed. The different separation of levels can be applied to compare the difference between our model and others. In sum, we believe our proposed model/framework is crucial and potential for future CRM studies. Additionally, the contribution will be significant if the real-world cases are applied in details.

References
HOW DOES A RETAILER'S SERVICE PLAN AFFECT A MANUFACTURER'S WARRANTY?

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Keywords: Service Plans, Warranty; Signaling, Distribution Channels, Game Theory.

A Summary
Service plans are a type of warranty contract under which retailers promise to repair or replace products for consumers. Separate from manufacturers' warranty policies, which typically come bundled with the products, and also known as service contracts, protection plans, or retailer extended warranties, retailers' service plans are optional and usually offer broader and more prolonged coverage than those offered by manufacturers' base warranties. Today, these plans are available for almost all durable goods in retail stores, and so pervasive that it is rare to find a major retailer in the U.S. that does not provide them. In fact, it has become the norm that, when purchasing a product, consumers are faced with warranties offered by multiple parties, typically the manufacturer base warranty that is bundled with the product and an optional retail service plan.

It is well documented that manufacturers use warranties to protect consumers against product failure and to signal product quality. In this paper, we argue that these roles of the manufacturer's warranty can be affected by the offering of retail service plans. From the consumer's point of view, the retailer's service plan complements and can even substitute for the manufacturer's base warranty. Given that the retailer has already offered a more extended warranty, it seems obvious that the manufacturer should offer a minimal warranty so as to avoid free-riding on the part of the retailer. So why does manufacturer still offer a base warranty? More generally, what motivates manufacturers to offer a base warranty when service plans are available to consumers? What are the strategic interactions between the retail service plan and the manufacturer base warranty? How do these service plans affect the role of manufacturers' warranties and channel performance?

Regardless of the prevalence of service plans in the retail sector, studies on these plans and their interactions with manufacturers' warranties are scarce. The present research strives to contribute to a better understanding of the role of the retail service plan in distribution channels in which the manufacturer also offers a (base) warranty. Our investigation starts with a context in which consumers are able to assess product quality—-in this research, high quality refers to a high degree of reliability in product performance (or a low risk of product failure). It then addresses the more interesting scenario of consumers being unable to assess that quality. It is well accepted that when quality is unobservable to consumers, a high quality manufacturer has the incentive to use a warranty to signal quality (Spence 1977). Our research therefore specifically investigates the role of a retailer's service plan in the manufacturer's signaling strategy. To concentrate on the signaling issues involved in warranty strategy, we abstract from the consumer moral hazard problem by assuming that consumer action does not affect the quality or reliability of products. Consequently, the results of our analysis are most applicable to products that require little consumer maintenance and present little opportunity for consumer moral hazard.

We consider a market in which a manufacturer markets a product through a retailer to a group of consumers. The product is subject to a certain probability of failure. The consumers are heterogeneous in their willingness to pay to avoid the incidence of product failure. In a model with complete information, we assume that the quality of the product is known by all parties in the market. The manufacturer determines whether to bundle the product with a base warranty, and sets a wholesale price accordingly. Based on the manufacturer's decisions, the retailer then sets a retail price for the product and a price for an optional service plan, if it is offered. Consumers then determine whether to purchase the product and the service plan. In such a context, offering an optional service plan can help the retailer to promote product demand, and segment
and better serve heterogeneous consumers. We show that when the retailer offers a service plan, the manufacturer offers its warranty only if it is more cost efficient than the retailer in providing a warranty.

We then develop models with incomplete information where the probabilistic product failure rate, either high or low, is determined by nature and known only to the manufacturer and the retailer, not known to the consumers. In such cases, a high quality manufacturer will have the incentive to signal its quality. Intuition suggests that in the presence of a more extended retail service plan, a high quality manufacturer should reduce its warranty coverage to avoid free-riding on the part of the retailer (Lutz and Padmanabhan 1995). In addition, because consumers who are very concerned about product quality can opt for a service plan to obtain peace of mind, it appears that the presence of such a service plan should also reduce consumers’ need for a signal from the manufacturer, thus reducing that manufacturer’s incentive to signal. Indeed, we find that the presence of a service plan can nullify the effects of a manufacturer’s offering of a (longer or greater) base warranty as a signaling strategy, i.e., the availability of service plans can diminish the positive relationship between warranty and quality, as suggested by the signaling rationale of warranty. However, we also find that, in the presence of a service plan, a high quality manufacturer may have greater incentive to signal and offer greater warranty coverage in the signaling equilibrium. It is even possible that the greater the coverage of the service plan, the greater the incentive the manufacturer has to signal and the greater base warranty coverage it offers. These unexpected results highlight two opposing effects of a service plan on a manufacturer’s incentive to signal quality by offering a warranty. Because, from the consumer’s point of view, a service plan can substitute for the manufacturer’s warranty, the availability of such a plan makes the presence of a manufacturer warranty less attractive. This mitigates the manufacturer’s motivation to use a warranty to signal quality. At the same time, however, because a service plan can promote demand for a product, it can also enhance the manufacturer’s motivation for such signaling. Therefore, when consumers are unable to access product quality, the impact of a service plan on the manufacturer’s warranty strategy depends on these two opposing effects.

The presence of a service plan also affects the profits of both the manufacturer and the retailer. We find that whether or not consumers are able to assess product quality, offering a service plan always increases profits for the retailer, but not necessarily for the manufacturer. The retailer cannot be rendered worse off by the acquisition of an additional marketing instrument, whereas the manufacturer will be better off only if the retailer’s cost for providing the service plan is low enough.

**Literature Review**

There is a rich body of literature on product warranties. The insurance role of warranties was understood fairly early on and documented by Heal (1977). In this view, warranties provide insurance against product failure to risk-averse consumers. Because consumers have heterogeneous preferences for warranty coverage, the literature also shows that a seller can use a menu of warranty coverage to screen (i.e., to segment) consumers (Musso and Rosen 1978).

For instance, an optimal policy may consist of two warranty options, with a base warranty being offered to less risk-averse consumers and an extended warranty to more risk-averse consumers. When consumers’ actions are unobservable but affect product liability, it has been shown that the consumer moral hazard problem can affect a firm’s warranty strategy for screening (Padmanabhan and Rao 1993).

Spence (1977) initiated a new branch of research on the signaling role of warranty. In markets in which product quality is not readily observable to consumers, a high quality manufacturer can use a better or longer warranty to signal its quality if it is too costly for a low quality manufacturer to offer the same coverage. Soberman (2003) considers a situation in which a seller uses a warranty both to screen and to signal, and shows that signaling can limit the seller’s ability to screen because, to signal, it generally lengthens the base warranty and shortens the optional extended warranty. Lutz (1989) examines the use of prices and warranties as signals of product quality under consumer moral hazard and shows that, surprisingly, quality can be signaled with a low-coverage warranty. Although firms should take the consumer moral hazard problem into account when making warranty policy for certain products, we focus on other products that present little opportunity for the problem to highlight the signaling role played by the manufacturer’s warranty.

Provided that high quality products are less expensive to guarantee than low-quality products, it seems intuitively reasonable that an observable warranty could serve as a signal of unobservable product quality. It has been verified that a warranty can influence consumers’ risk perceptions (Bearden and Shimp 1982). However, although some researchers have evidenced better and longer warranties as signals of high product quality (Wiener
1985, Kelley 1988, Boulding and Kirmani 1993), others have found lower quality products to offer longer warranties (Bryant and Gerner 1978, Gerner and Bryant 1981). A number of models have been proposed to address this inconsistency. Gal-Or (1989) showed that oligopolistic competition in a product market could affect firms' incentives, such that higher quality would be signalled by a lower warranty coverage. Balachander (2001) shows that a less reliable product may carry a longer warranty in a product market in which a new entrant competes with an established product. More researchers have argued that in the presence of consumer moral hazard, high-quality firms may optimally choose to offer less warranty coverage than low-quality ones because a strong warranty results in a low degree of maintenance effort on the part of consumers (Cooper and Ross 1985, Lutz 1989, Dybvig and Lutz 1993). Our results contribute to this stream of research by offering an alternative explanation for the weak relationship between quality and warranty: the presence of retailer service plans can diminish the correlation between them.

The role of warranty has also been studied in the context of the supply chain, with a focus on channel coordination. Desai and Padmanabhan (2004) show that a manufacturer can use its warranty to coordinate a bilateral-monopoly distribution channel. In their model, the manufacturer warranty can be offered through three channel arrangements, direct (i.e., selling though the manufacturer itself), indirect (i.e., selling through a retailer) and dual distribution (i.e., selling through a combination of the aforementioned two). They find that the ability of a manufacturer to market a complementary good (i.e., a warranty) that helps to combat the price coordination problem in a channel alleviates its need to consider forward integration as a means of combating double marginalization. In an unpublished paper, Li et al. (2008) examine the role of warranty in a bilateral-monopoly distribution framework, but they assume that the warranty is offered by either the manufacturer or the retailer (but not by both). With reduced-form demand functions, they show that when the warranty is offered by the retailer, it has longer coverage and the system profit is greater.

In all of the aforementioned, the warranty option(s) is assumed to be offered by one firm only. To the best of our knowledge, only two studies are exceptional in this regard, those carried out by Lutz and Padmanabhan (1995, 1998). In the context of consumer moral hazard, Lutz and Padmanabhan (1995) provide an explanation for the minimal manufacturer base warranties observed in certain markets. They show that the provision of an extended warranty by an independent insurer and the presence of consumer moral hazard create a negative cost externality on the manufacturer's warranty. To avoid the insurer free-riding on its own warranty, the manufacturer bundles its product with a minimal base warranty. Under conditions of producer moral hazard, these researchers (Lutz and Padmanabhan 1998) also focus on a manufacturer's ability to use a menu of warranties to segment consumers. They show that the availability of extended warranties from an independent insurer has an important effect on a menu of warranties to screen, and that the entry of the insurer can, surprisingly, increase the manufacturer's profits.

The present research is among the few theoretical studies to explicitly model the interactions between warranties offered by different firms. Moreover, it is the first study on warranty in a distribution channel context in which both the up- and down-stream parties offer a warranty, and it is the first attempt to examine the interactions between warranties from a signaling perspective. We offer a number of insights that have not been addressed in the previous literature.

Concluding Remarks

Service plans are a type of optional warranty beyond the manufacturer's base warranty that retailers offer to consumers. Regardless of their prevalence and nontrivial implications in distribution channels, research on service plans is scarce. In this paper, we examine the impacts of a retailer's service plan on a manufacturer's base warranty policy and on channel performance. Analysis shows that when consumers can assess product quality, in the presence of a service plan, a manufacturer should not offer a base warranty unless it is more cost efficient than the retailer in providing that warranty. When consumers cannot assess product quality, a high quality manufacturer is motivated to use its own warranty to signal that quality. In such cases, we find that, in the presence of a service plan, the manufacturer's base warranty serves as a credible signal only when the manufacturer is less cost efficient. The service plan can render the manufacturer's signaling either more or less viable, and result in either greater or lesser warranty coverage in the signaling equilibrium. Whether or not consumers can assess product quality, offering a service plan always increases profits for the retailer and the channel as a whole, but not necessarily for the manufacturer.

References

Working Paper, University of Illinois, Urbana-Champaign.
PERSONALITY FACETS AND CUSTOMER LOYALTY IN ONLINE GAMES

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Abstract
Online games have attracted numerous customers and brought stable revenues to game providers. However, some customers frequently switch to other games, and thus, it is important to identify which customers are likely loyal customers. The literature has identified openness, conscientiousness, and extraversion as predictors for loyalty in online games (Teng, Huang, Jeng, Chou, & Hu, 2008). However, the three broad traits contain multiple facets. Thus research addressing the three broad traits may mix the influences of multiple facets. Thus this study investigates the influences of personality facets on online game customer skill, challenge, flow experience, and loyalty.

The sample comprised 994 online gamers. This study employed structural equation modeling for analysis, and found that (1) ideas and achievement striving are positively related to skill, (2) achievement striving, competence, and excitement-seeking are positively related to challenge, (3) gregariousness is positively related to interdependence, (4) fantasy, skill, challenge, and interdependence are positively related to customer likelihood of experiencing flow, and (5) experienced flow is positively related to customer loyalty.

The study findings suggest managers improve gamer skill and challenge when gamers are in their early stages in online games, boosting their likelihood of experiencing flow and thus building their loyalty. Managers are also suggested to target individuals who are high in personality facets such as ideas, achievement striving, competence, excitement-seeking, to effectively build a loyal customer base. Educators are also suggested to notice students who are high in those personality facets, because these students may continuously play online games when they begin to play.

Keywords: Online games, personality trait, personality facet, flow experience, skill, challenge, customer loyalty

Introduction
DFC Intelligence (2006) forecasted that the global revenues of online gaming industry would reach 13 billion dollars in 2011, indicating that online gaming is an important industry. Online gamers frequently switch between games (International Data Corporation, 2008), resulting in losses of game provider revenues. Gamer loyalty may bring substantial and stable revenues.

Recently, Teng (2008) adopted the Big Five personality typology of Costa & McCrae (1992) and found that openness, conscientiousness, and extraversion significantly differ between online gamers and individuals who do not play online games. Each personality trait comprises several facets. For example, conscientiousness contains facets of order, achievement striving, and ability. Thus employment of personality facets can describe personality more precisely, revealing the opportunities to precisely identify the personality of loyal gamers. Identification of loyal gamer personality enables effective allocation of marketing resources. Thus this study investigates the relations between personality facets and gamer loyalty.

Literature
Loyalty indicates the willingness to make repetitive purchases (Dick & Basu, 1994), and thus is one key indicator of marketing effectiveness. Applying loyalty to the e-commerce contexts, e-loyalty indicates the positive attitudes that motivate customers to repetitively purchase from certain e-businesses (Anderson & Srinivasan, 2003). The literature seldom addressed the relations between loyalty and personality, indicating the needs for research.

The literature demonstrated the personality influences on individual behaviors in multiple business contexts (Teng, Hsu, Chien, & Chang, 2007; Teng, Huang, & Tsai, 2007). Recent studies have identified that openness, conscientiousness, and extraversion are three key personality traits in online gaming (Teng, 2008). Thus this study aims to further investigate the facets associated with these three traits. Utilization of facets is more precious then that of broad traits (Soto & John, 2009).

Costa & McCrae (1992) delineated 18 facets regarding these three traits. Inclusion of all 18 facets makes a study overly complex, supporting the necessity to include part of them. Basing on the relevance with gamer loyalty, the present study chose to investigate 7 of them, that is, fantasy, ideas (as included in openness), order, achievement striving, competence (as included in conscientiousness), excitement-seeking and
Hgregariousness (as included in extraversion).

Costa & McCrae (1992) defined all the facets. Fantasy indicates the individual tendency to position oneself in a virtual environment imagined by one's self. Ideas indicate the individual willingness to understand and learn new knowledge. Order indicates the employment of organization and regularity. Achievement striving is aggression and strong needs for a sense of achievement. Competence indicates belief in self's abilities. Excitement-seeking is the tendency to be bold and adventurous. Gregariousness refers to the preference to being in groups.

When discussing the relations between personality and gamer loyalty, flow is one critical mediator (Teng et al., 2008), motivating the present study to include flow as a key moderator. Flow is an experience in which individuals totally concentrate on activities and obtain implicit pleasures (Hsu & Lu, 2004). In flow, customers lose the senses of themselves and perceive distorted time duration (Csikszentmihalyi, 1997). Flow fosters extreme or optimal pleasure in Internet activities (Chen, Wigand, & Nilan, 1999; Csikszentmihalyi, 1997). The reinforcement theory (Skinner, 1969) posits that positive experiences or feedbacks motivate individuals to conduct behaviors associated with repetitive experiences or continuous feedbacks. Applying the reinforcement theory to flow, online gamers who experience flow are likely to play online games repetitively for experiencing flow again. Restated, flow urges gamers to repetitively play online games, indicating the potential relation between flow and gamer loyalty.

The literature indicates that flow comprises high levels of skills and challenges (Chen et al., 1999). Skill indicates the capability for engaging in activities (Novak, Hoffman, & Yung, 2000). Applying the definition of skill to online gaming, the present study defined skill as the capabilities for gamers to engage in gaming. Challenge indicates the opportunities with which users can demonstrate their capabilities (Hoffman & Novak, 1996). The present study, in online gaming contexts, defined challenge as difficulties with which gamers accept and implement tasks in online gaming. Since skill and challenge are two keys to flow, the present study took them into our theoretical model.

The literature on flow has not covered the social aspect in online gaming. When gamers regard their friends as very important, they are likely to devote much of their energy to online gaming, creating a high level of concentration. Concentration also drives flow (Hsu & Lu, 2004). Thus consideration of the social aspect is adequate when discussing antecedents of flow. In the literature of Internet interpersonal relationships, interdependence is one important construct, which increases the intimacy and relevance of online friends to individuals (Parks & Floyd, 1996). Interdependence is thus likely another antecedent of flow. The following develops the hypotheses that linking personality, flow and its antecedents, and gamer loyalty.

Hypotheses

Fantasy indicates the individual tendency to position oneself in a virtual environment imagined by one’s self (Costa & McCrae, 1992). That is, individuals characterized by a high level of fantasy may likely posit themselves into gaming worlds and lose their sense of selves. Since the loss of sense of one’s self features flow (Csikszentmihalyi, 1997), a positive relation can be hypothesized between fantasy and flow.

H1: Fantasy is positively related to flow.

Ideas indicate the individual willingness to understand and learn new knowledge (Costa & McCrae, 1992). Individuals with a high level of ideas are likely to understand and learn new knowledge regarding the game world when playing online games. They are likely to increase their capabilities (or skills) in gaming faster than other gamers, creating a hypothetical relation between ideas and skills.

H2: Ideas is positively related to skills.

Order indicates the employment of organization and regularity (Costa & McCrae, 1992). Applying this trait to online gamers, online gamers with a high level of order are likely to search official or forum websites to look for tips, maps, stories, quests, scenarios, or secrets for successful gaming, in order to make their gaming organized. Organized gaming behavior increases their capability for successful gaming (or gaming skills). Thus this study hypothesized a positive relation between order and skills.

H3: Order is positively related to skills.

Achievement striving is aggression and strong needs for a sense of achievement (Costa & McCrae, 1992). Individuals with strong achievement striving are likely to be diligent, purposive, and achievement-oriented (Costa & McCrae, 1992). In online gaming, gamers with strong achievement striving are likely to be diligent in improving their gaming capabilities (or skills) for reaching their goals and achievements in online gaming, thus yielding a positive link between achievement striving and skills.

H4: Achievement striving is positively related to skills.

Individuals with strong achievement striving are likely to be diligent, purposive, and achievement-oriented (Costa & McCrae, 1992). Applying to
online gaming, gamers with strong achievement striving are likely to accept tough challenges that enhance their sense of achievement when overcoming those challenges. Restated, achievement striving may be positively associated with the difficulties of which challenges accepted.

**H5: Achievement striving is positively related to challenges.**

Competence indicates individual belief in one's capabilities (Costa & McCrae, 1992). Such construct is similar to self-efficacy. The self-efficacy theory (Bandura, 1997) posits that self-efficacy (the belief in that oneself can accomplish certain tasks) improves individual tendency to engage in associated activities. In online gaming, contexts, gamers who have strong competence (or self-efficacy) are likely to engage in difficult gaming tasks in which they feel they are capable to deal with. Restated, competence may have a hypothetical relation with challenges.

**H6: Competence is positively related to challenges.**

Excitement-seeking is the tendency to be bold and adventurous (Costa & McCrae, 1992). Uncertainty and risks are generally associated with adventures. Thus individuals with strong excitement-seeking tendency are likely to accept uncertainty and risks. In online gaming, touch challenges are generally associated with uncertainty, risks, and novel virtual-world adventures that fascinate gamers with strong excitement-seeking.

**H7: Excitement-seeking is positively related to challenges.**

Gregariousness refers to the preference to being in groups (Costa & McCrae, 1992). The preference to being in groups prevents individuals to do anything deviating from the opinions of other group members. Individuals with strong gregariousness are thus likely to rely on other group member for making decisions. Reliance on others for making decisions was defined as interpersonal interdependence (Parks & Floyd, 1996). Thus gregariousness may have a positive link to interdependence.

**H8: Gregariousness is positively related to interdependence.**

The literature agrees that skill is one key antecedent to comprise flow (Novak et al., 2000; Teng et al., 2008). The theory of four channels of flow (Csikszentmihalyi, 1997) also indicates that a high level of skill is necessary for creating flow. This study agrees with the literature and thus hypothesized a positive relation between flow and skills. Although this hypothesis is not new to the literature, this hypothesis is necessary in linking personality and gamer loyalty, indicating its adequacy to be developed.

**H9: Skill is positively related to flow.**

The literature and the theory of four channels of flow (Csikszentmihalyi, 1997; Novak et al., 2000) also agree that challenge is a key to flow experiences. The present study agrees with the literature and thus hypothesized the positive link between challenge and gamer likelihood of experiencing flow.

**H10: Challenge is positively related to flow.**

Reliance on others for making decisions was defined as interpersonal interdependence (Parks & Floyd, 1996). In online games, gamers often form task groups that are aimed to collectively accomplish difficult tasks and exciting adventures. In such tasks and adventures, gamers need successful teamwork and total concentration of all members since they are critical for the group success. Total concentration to gaming is thus expected or required by all group members. Gamers with strong interdependence with other gamers are thus likely strongly motivated to comply with such expectation or requirement, by totally concentrating on gaming. Total concentration is key to flow (Hsu & Lu, 2004), consequently yielding a positive link between interdependence and flow.

**H11: Interdependence is positively related to flow.**

Flow is an implicitly happy and enjoyable experience (Csikszentmihalyi, 1997), which brings positive value to users. The reinforcement theory (Skinner, 1969) posits that positive feedbacks reinforce or encourage individuals to engage in activities that may repetitively bring positive feedbacks. Applying to online gaming contexts, gamers who experienced flow are likely to play online games repetitively, since they are reinforced by positive feelings associated with flow. Thus flow and gamer loyalty may have a positive relation.

**H12: Flow is positively related to gamer loyalty.**

Figure 1 illustrates the study hypotheses.

![Conceptual Framework](image_url)

**Figure 1: Conceptual Framework**

**Methods**

This study utilized a web form for collecting data.
Online gamers were solicited from forums and electronic bulletins associated with online games. The sample comprised 1013 online gamers, leading to 994 effective responses and an effective response ratio of 98.1%. Among the sample, 63.9% were male, 46.2% were aged <22 years old, and 62.0% had a monthly income >$100 US.

Items measuring personality facets came from the NEO-PI-R developed by Costa and McCrae (1992). Items measuring skill, challenge, and flow came from the scales of Novak et al. (2000). Items measuring gamer loyalty were modified from the scale of Parks and Floyd (1996). Items measuring interdependence came from the scale of Zeithaml, Berry, and Parasuraman (1996). Items measuring gamer rigidity in their gaming behavior.

All indicator loadings exceeded .5 and had t values >2, suggesting the convergent validity. The maximum squared correlation between constructs (.31) was below the minimum AVE (.55), indicating the discriminant validity for the study measures.

This study conducted a confirmatory factor analysis and yielded fit indices that are acceptable ($\chi^2=5392.59$, NFI=.90, CFI=.91, IFI=.91, RMSEA=.081). Correlations between constructs were <.56, further suggesting the measurement discriminant validity and the absence of common method biases.

### Analysis

This study utilized structural equation modeling technique to test the hypotheses. Table 1 lists the testing results. All hypotheses were supported, except for the path from order to skill, which had a path coefficient of .04. One potential explanation may be that order is related to both organization and regularity (Costa & McCrae, 1992). Organization, though, helps learning in online games, whereas organization and regularity formulate gamer rigidity in their gaming behavior. The rigidity of gaming behavior may take a period of time to be changed even when they learn something new from other gamers. Thus this study did not observe the hypothetical positive relation between order and gamer skills.

Table 1: Hypotheses Testing Results

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Path</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1: Fantasy → Flow</td>
<td>.34*</td>
</tr>
</tbody>
</table>

H2: Ideas → Skill .24*
H3: Order → Skill .04
H4: Achievement Striving → Skill .16*
H5: Achievement Striving → Challenge .15*
H6: Competence → Challenge .19*
H7: Excitement-seeking → Challenge .09*
H8: Gregariousness → Interdependence .08*
H9: Skill → Flow .11*
H10: Challenge → Flow .08*
H11: Interdependence → Flow .11*
H12 Flow → Loyalty .28*

Note. Path denotes the standardized path coefficient. * denotes a p value <.05.

The fit indices of the structural model were also acceptable ($\chi^2=6256$, NFI=.88, CFI=.89, IFI=.89, RMSEA=.089), indicating the fit of our theoretical model to the empirical data.

### General Discussion

This study identified six personality facets that may indirectly lead to gamer loyalty, contributing to the Internet marketing and the e-business literature. This study also supported the moderator role of skill, challenge, interdependence, and flow in the relations between personality facets and gamer loyalty, explaining the processes by which personality facets formulate the gamer loyalty.

Specifically, this study found that: (1) ideas and achievement striving are positively related to skill, (2) achievement striving, competence, and excitement-seeking are positively related to challenge, (3) gregariousness is positively related to interdependence, (4) fantasy, skill, challenge, and interdependence are positively related to customer likelihood of experiencing flow, and (5) experienced flow is positively related to customer loyalty.

This study extended the study of Teng et al. (2008) which found that openness, conscientiousness, and extraversion are critical personality traits to online gaming. The present study in-depth investigated the relations between personality and gamer loyalty by utilizing personality facets that explain and describe personality than broad traits. The present study demonstrated that six facets among the three traits (as discussed in Teng et al., 2008) were critical to gamer loyalty, enabling subtle targeting and customer management practices of online game providers.

This study recommends online game providers to target the prospect gamers who are high in fantasy, ideas, achievement-striving, competence,
excitement-seeking, and gregariousness. According to the analytical results of the present study, gamers who are high in these facets are likely to experience flow, and thus likely to become loyal customers. The social psychology literature has indicated numerous demographics highly associated with personality, providing further guidance in game provider targeting decisions.

Game providers are also suggested to ask their new registered gamers to fill several items regarding the six facets, for the purpose to identify who are less likely to experience flow. According to the present study findings, new gamers who are low in these six facets are less likely to become loyal customers, due to the difficulties to experience flow. Thus game providers may ask their game managers or customer support staff to monitor and help such customers to increase their skill, encourage them to encounter challenges, and help build interpersonal relationships with other gamers, for facilitating them to access flow experiences.

This study did not measure all facets provided by Costa and McCrae (1992), which comprises one limitation. This study thus cannot help understand whether other facets are influential. However, this study laid an initial foundation for subsequent investigations into the relations between all other facets and gamer loyalty.

Acknowledgement. The authors thank National Science Council, Taiwan, for financial support (NSC96-2416-H-182-002-MY3).

References
EXAMINATION OF FOUR CHANNELS OF FLOW

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Abstract

The four channels of flow (Csikszentmihalyi & Csikszentmihalyi, 1988) posit that high and low levels of skills and challenges comprise flow, boredom, frustration, and apathy. This theory has been frequently applied to explanation of flow formulation. This theory, however, lacks empirical evidences on if high/low skill/challenge formulates the four channels. Empirical evidence of the formulation of the four channels of flow is necessary for ensuring its validity.

This study thus sampled 253 online gamers to examine whether skills and challenges formulate the four channels of flow. Consistent with the theory of the four channels of flow, this study found that gaming skill is positively related to flow and boredom, whereas negatively related to frustration and apathy. Challenge encountered in gaming is positively related to flow, frustration, whereas negatively related to apathy. However, this study did not observe a theoretical negative relation between challenge and boredom, indicating the necessity for future research.

Keywords: flow theory, four channels of flow, skill, challenge, boredom, frustration, apathy.

Introduction

Csikszentmihalyi & Csikszentmihalyi (1988) proposed the theory of the four channels of flow, encouraging the subsequent studies on flow (Hsu & Lu, 2004; Mathwick & Rigdon, 2004; Teng et al., 2008). This theory posits that highly skilled individuals encountering high challenges will experience flow (the experience in which individuals highly concentrate on activities that are intrinsically enjoyable) (Csikszentmihalyi, 1997). Highly skilled individuals encountering low challenges will experience boredom (unpleasant feeling of lack of interest and concentration on current engaged activities) (Fisher, 1993). Lowly skilled individuals encountering high challenges will experience frustration (the unsatisfying or insecure feeling associated with inability to solve problems and meet needs) (Merriam-Webster Online Dictionary, 2009). Finally, lowly skilled encountering low challenges will experience apathy (the feeling of unconcern, unwillingness to pay attention to certain activities) (Merriam-Webster Online Dictionary, 2009).

The flow construct has been applied to multiple contexts (Hsu & Lu, 2004; Mathwick & Rigdon, 2004; Teng et al., 2008). The theory of the four channels of flow was also frequently utilized for explaining the formulation of flow. However, this theory needs more empirical evidences that support its validity in multiple contexts. This study thus investigates if skill and challenge create the four channels as the theory states.

Literature and Hypotheses

Csikszentmihalyi (1975) may be the pioneering work proposing flow, which is a highly enjoyable experience in which individuals concentrate in currently engaged activities. In flow experience, individuals also feel control and intrinsic pleasures (Hsu & Lu, 2004). The flow construct was characterized by eight elements: a clear goal, feedback, challenges that match skills, concentration and focus, control, loss of self-consciousness, transformation of time and the activity becoming autotelic (self-reinforcing) (Csikszentmihalyi, 1997).

Flow has received plenty of attentions, partly because of its positive influences on individual intention and behavior. Individuals experience ultimate happiness when they experience flow (Csikszentmihalyi, 1997; Chen, Wigand, & Nilan, 1999) that strongly motivates them to repetitively engage in the associated activities (Chung & Tan, 2004). In marketing terms, flow may improve user loyalty (Choi & Kim, 2004; Teng et al., 2008).

The literature on flow has identified skill and challenge as two prominent antecedents of flow (Hoffman & Novak, 1996; Skadberg & Kimmel, 2004). Skill refers to the capability to engage in current activities (Novak, Hoffman, & Yung, 2000) and challenge indicates the competition and obstacles encountered in activities (Rollings & Adams, 2003). Skill may come from the accumulation of gaming knowledge and familiarity. Challenge may come from the uncertainty and suspense. The suspense in online games is a driver of online game enjoyment (Klimmt, Rizzo, Vorderer, Koch, & Fischer, 2009).

The four channels of flow have three other channels except for flow, that is, boredom, frustration, and apathy. The theory of the four channels of flow (Csikszentmihalyi &
Csikszentmihalyi, 1988) has also predicted their formulation. Basing on this theory, this study developed the specific hypotheses that describe their formulation.

Flow is an experience of total concentration and intrinsic enjoyment (Csikszentmihalyi, 1997) and skill is the capability to engage in current activities (Novak, Hoffman, & Yung, 2000). High skills thus enable individuals to overcome or resolve the difficulties, creating intrinsic enjoyment. High skills may thus foster flow, consistent with the literature on flow (Hoffman & Novak, 1996; Skadberg & Kimmel, 2004; Teng et al., 2008).

Boredom is the unpleasant feeling of lack of interest and concentration (Fisher, 1993). Highly skilled individuals may regard themselves as experts who know everything, reducing their interests. Highly skilled individuals may also feel themselves top experts and thus lose concentration, boosting their feeling of boredom.

Frustration indicates the unsatisfying or insecure feeling associated with inability to solve problems and meet needs (Merriam-Webster Online Dictionary, 2009). Lowly skilled individuals are likely blocked by difficulties or obstacles and left their achievement needs unmet, increasing their feeling of frustration.

Apathy refers to the feeling of unconcern, unwillingness to pay attention to certain activities (Merriam-Webster Online Dictionary, 2009). Lowly skilled individuals lack sufficient capabilities to attain achievements, which discourage them to further concern or attend to the associated activities, that is, create the feeling of apathy.

H1: Skill is (a) positively related to flow, (b) positively related to boredom, (c) negatively related to frustration, and (d) negatively related to apathy.

Challenge is the competition and obstacles encountered in activities (Rollings & Adams, 2003). Challenge thus may inspire individuals to win in competitions and to overcome obstacles for attaining a sense of achievements. For winning in competitions and overcoming obstacles, individuals are forced to concentrate to fully display their capabilities. The elevated concentration is a key element creating flow (Csikszentmihalyi, 1997). Thus high challenges are likely associated with a high likelihood of experiencing flow.

Challenges inspire individuals to win and to overcome obstacles. Individuals are thus motivated to have interests in understanding what can lead to victory, reducing their boredom. Contrary, challenges are obstacles that may be too tough to be overcome, preventing achievement need satisfaction of users and increasing frustration.

Finally, challenges involve competitions in which individuals are invited to win, attracting attentions or reducing feeling of apathy.

H2: Challenge is (a) positively related to flow, (b) negatively related to boredom, (c) positively related to frustration, and (d) negatively related to apathy.

Method

Cross-sectional design was utilized. This study used a web form for collecting data. This study chose to survey online gamers. Totally 309 online gamers participate in this study and 253 returned usable responses, yielding an effective response ratio of 81.9%.

Items measuring skill, challenge, and flow were modified from Novak et al. (2000). Items measuring boredom, frustration, and apathy were developed basing on the scales of Kozma and Stones (1980) and Kammann and Flett (1983). All items involve a response option ranging from 1: very disagreeable to 5: very agreeable.

Items measuring each construct had a Cronbach’s α > .68, a composite reliability (CR) > .69, and an average variance extracted (AVE) > .45, indicating the tolerable reliability, basing on the criteria of Baggozzi and Yi (1988). All except one item measuring boredom had indicator loadings > .59 and t values > 5.16, satisfying the convergent validity criteria of Anderson and Gerbing (1988). Squared correlations between any pair of constructs exceed AVE of related constructs, meeting the discriminant validity criterion of Fornell and Larcker (1981).

Results

Of the participants, 64% were male, 82% had attended to colleges or universities, and 45% had monthly income >$100 US. Participants had played online game for 15.2 months on average.

This study utilized structural equation modeling techniques to test hypotheses. Testing results indicated that skill was positively related to flow and boredom (path coefficient > .14, p < .05), supporting H1a and H1b. Skill was negatively related to frustration and apathy (path coefficient < − .22, p < .05), supporting H1c and H1d.

Challenge was positively related to flow and frustration (path coefficient > .13, p < .05), supporting H2a and H2c. As hypothesized, challenge was also negatively related to apathy (path coefficient = − .42, p < .05), supporting H2d. This study did not observe a negative relation between challenge and boredom (path coefficient = − .01, p > .05). Potential explanation is that new challenges surely reduce boredom. Existing

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Challenges, however, may increase boredom, offsetting the hypothesized negative relation between challenge and boredom.

This study further elucidates the mechanism of the formulation of the four channels. Skill and challenge may independently contribute to the formulation of the four channels, or interactively contribute to their formulation.

This study thus employed analysis of variance (ANOVA) to test the interaction of skill and challenge on the four channels. This study utilized median split method to separate the sample into high-skill, low-skill, high-challenge, and low-challenge groups. The factors high vs. low skill and high vs. low challenge were employed as independents. Flow, boredom, frustration, and apathy were utilized as dependents.

Analytical results did not observe any significant interaction of skill and challenge on four channels ($F(1, 249) < 1.29, p > .26$). Such phenomenon supported that skill and challenge contributed to the four channels independently, rather than interactively.

**Conclusions**

This study initiated to examine the formulation of the four channels of flow, supporting the validity of the theory of four channels of Csikszentmihalyi & Csikszentmihalyi (1988). Most of this theory was supported by the empirical data obtained from online gaming contexts. One exception was observed that challenge is not significantly related to boredom, encouraging future investigations.

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**References**


CRITICAL FACTORS INFLUENCING THE EXTENT OF CUSTOMER RELATIONSHIP MANAGEMENT SYSTEMS ADOPTION IN HOSPITALS

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Abstract
Customer relationship management system (CRMS) is an innovation technology which has dramatic impacts on healthcare quality and customer satisfaction. Although the critical factors for the adoption of information systems have been identified in prior studies, few of them specifically explore the extent of CRMS adoption in hospitals. To fill this gap, this study proposes an integrated model that incorporates both organizational and system related factors as primary determiners the extent of CRMS adoption in hospitals. A series of survey were conducted with three levels of health institutions including medical centers, regional hospitals, and community hospitals in Taiwan. The results indicated that hospital size and complexity have significant influence on the scope of CRMS adoption, and also indicated that hospital size, complexity and compatibility have significant influence on the depth of CRMS adoption in hospitals. These findings provided fruitful implications for both associated academics and practitioners.

Keywords: Customer Relationship Management; Information Systems Adoption; Hospitals

Introduction
American College of Healthcare Executives [2] identified a list of top issues confronting hospitals based on a survey among 1,080 hospitals in 2007. Three of nine issues concerned by the CEOs are related to customer relationship (care for the uninsured, physician/hospital relations and customer satisfaction), and interestingly, they were also on the top nine in the previous two years. Customer relationship management (CRM) for healthcare providers is a method to learn all they can about their customers and prospects, to communicate relevant, timely information to them, and to track results to make message and program adjustments as necessary [5].

In Taiwan, the National Health Insurance [24] system funded by the government in Taiwan covers nearly all of the country’s population because it is a compulsory insurance for all citizens. This gives insured customers a much low access fees for various healthcare services, and in turn, has resulted in customers choosing the hospital by their favorites rather than price.

Due to customers can freely choose the healthcare providers and medical institutions without facing the financial burden, the expense of medical services is no longer a priority consideration when customers seeking the healthcare providers and medical institutions in Taiwan. Customers are attempting to address their concern on the satisfaction of medical services provided by Taiwan’s hospitals when making a decision on choosing healthcare providers.

The cost of retaining existing customers is well below the cost of acquiring new customers. Better customer relationship and satisfaction can facilitate the hospitals to keep their existing customers and thus save their cost. CRM system (CRMS) is a software-based approach which used to capture customer information and maintain customer relationship. Many hospitals expect CRM application to provide services which can meet their customer need. Therefore, the application of CRMS is becoming more important in healthcare sectors.

A number of studies focused on exploring the factors affecting the adoption of CRMS in various industries, for example, financial servicing [15], fashion [17], and manufacturing industries [40]. Although these studies found some factors or characteristics, the applicability of these factors in the healthcare context is questionable. Medical customers sometimes need to be considered differently from business clients because they actually expect to receive more care than business customers, such as anticipating doctors to remember their attitudes and expectations [23].

American Hospital Association [3] indicated that nearly half of studied community hospitals reported moderate or high usage of information technologies (IT) for quality of care in 2006, compared to a response of 37 percent in 2005. Despite the increased usage of IT in hospitals, few studies specifically explore the critical factors for the extent of IT adoption. Once critical factors influencing the extent of CRMS adoption are understood, hospitals can develop better strategies to popularize CRMS usage and minimize resistant.

This study proposes an integrated model to investigate the critical factors for the extent of CRMS adoption in hospitals. We proceed with a
review of the literature. Then, a research model for investigating the extent of CRMS adoption is constructed, as followed by the research method, data analysis and results. Finally, this paper summarizes the research findings and provides implications for associated academics and practitioners.

**Literature Review**

Customer Relationship Management

Researchers viewed CRM from both managerial and technological perspectives. From a managerial perspective, Tiwana [35] believed that CRM is a process which manages the relationship with current customers and selectively retain newer customers in order to enhance customer loyalties, and increase customer profitability. Swift [32] believed that CRM is an organizational method which is used to improve customer acquisition, customer retention, customer loyalty, and customer profitability through a meaningful way of communication that understands and influences customer behaviors. Peppers and Rogers [25], from a narrower and IT oriented perspective, believed that CRM is a one-to-one marketing which utilizes computer technologies, such as database, interactive technologies, and mass production in order to develop and manage the learning relationship existed between customers and organizations.

CRM was originated from relationship marketing. Over the past 50 years, marketing strategies and practices have changed dramatically, from public marketing to one-on-one marketing. In order to sustain a long-term relationship with customers, Peppers et al. [26] believed that organizations should establish a long-term and continuous “learning relationship”. Organizations could utilize a variety of technologies for CRM purpose, such as database management systems, Internet, data warehousing, online analytical processing (OLAP), data mart, data mining, and Call Centers. Supportive technologies include various kinds of interactive media, for example, telephone service centers, Web sites, sales automation, automation on the point-of-sale, which allow customers to specify what types of services they desire.

CRM and Supporting Systems in Hospitals

CRM in healthcare industry has three characteristics. Firstly, customer knowledge management is a basis. Wayland and Cole [38] believed that CRM is the use of effective knowledge and experience to acquire, develop, and maintain customer relations. Medical services are involved with a variety of professional medical service personnel, which is a knowledge-intensive industry. Thus, it is essential for medical institutions to manage customer related knowledge.

Secondly, the use of IT is the sufficient condition for implementing CRM that also helps the implementation of CRM and relationship marketing. An effective CRM requires a synergistic integration of strategies, people and technologies of an organization [28]. Customer knowledge database is the foundation for carrying out a customer demand analysis and forecast, active interaction, and marketing automation. Medical service providers particularly need to control and access to a large amount of customer information if they are involved in the National Health Insurance systems. Currently, most of medical institutions are utilizing electronic mediums to declare their cost [7]. This shows that the medical institutions must already have IT hardware, software, and infrastructure which are able to record, store, and transform their service information electronically.

Thirdly, the CRM in healthcare industry seeks to obtain customer loyalty and the lifelong value. In regard to customer loyalty, organizations which implement CRM consider two important effects. First, the effect derived from the number of customers. If the organization can increase customer retention rate, then substantial future revenue growth will occur from the repeat customers [6]. In medical institutions, loyalty indicators, such as the customer return rate, can show how satisfied and loyal the customers are [13]. With no difference to other types of organizations, the higher customers return rate, the more profits the hospital will have.

Although the disease has been cured this time, it is with no guarantee that this customer will not be sick anymore. Moreover, some sequels are left after treatment of some diseases, and resulted in continued treatment or follow-up rehabilitation. Facing some diseases, the customers are usually unable to be cured completely in one treatment, and need continuously tracking and treatment, such as hypertension, and diabetes. Therefore, it is strategically and economically important for healthcare providers maintain a high-quality and long-term relationship with customers.

Antecedents of CRMS Adoption in Hospitals

From the organizational perspective, the discussion of IT adoption is based on the characteristics of the technology and the organization. Thong [34] believed that it is necessary to examine whether large and small environments affect the adoption of innovative IT. In addition, Thong [34] also believed that the characteristics of executives, innovation, and organization could affect the adoption of IT.

Kimberly and Evanisko [16] suggested that several factors affect the innovative adoption: characteristics of the leaders of organizations, characteristics of the organization, and characteristics
of the environment. Tornatzky and Fleischer [37] also have similar view and believed that the background of technological innovation includes three major elements: organizational, technical, and environmental backgrounds. Rogers [30] defined innovation as an idea, event, or an object. These ideas, events, or objects are perceived by an entity or adoption unit as a new item, that is, innovation. Rogers [30] also believed that the characteristics of innovation are important background factors for introducing IT.

Research Model
This research tries to examine what factors affect the extent of CRMS adoption among hospitals, and summarized the factors into two categories: characteristics of organization and characteristics of CRMS. The proposed model is shown in Figure 1.

A significant number of previous studies based on technology, organization and environment (TOE) framework have already explored the critical factors on IT adoption [7, 8, 18, 41]. Diffusion refers to the spread of innovation within the organizations. As organizational and information systems contexts are playing a pivotal role in this study, this study summarizes the factors which influence the extent of CRMS adoption as characteristics of organization and characteristics of CRMS.

Research Hypotheses
Dewar and Dutton [10] and Moch and Morse [22] believed that a large-scale organization has more resources and infrastructure to promote innovation. Welsh and White [39] also argued that small businesses usually suffer more restrictions, such as lack of resources, financial constraints, lack of experts, and management with short-term insight. Baldridge and Burnham [4] and Lind et al. [21] placed speculation that large organizations have more potential than small ones to the use of information systems because of their large-scale operations. Thus, the size of organization is positively related to the scope and depth of CRMS adoption.

H1a: hospital size will be positively related to the scope of CRMS adoption.

H1b: hospital size will be positively related to the depth of CRMS adoption.

Thong [34] believed that the characteristics of senior executives in organizations affect the adoption of IS. Rizzoni [29] believed that the senior executives in organizations are the critical person to determine the organizational attitude toward innovation because these executives are usually owners and important policy-makers. Generally speaking, the change of organizations depend not only on its size and market factors, but also the ability of senior executives, his or her preferences, and his or her readiness to prompt.
H2a: innovation of senior executive will be positively related to the scope of CRMS adoption.
H2b: innovation of senior executive will be positively related to the depth of CRMS adoption.

The meaning of knowledge management capabilities is that organizations based on reliable information capture, manage, and transmit real-time customer product and service information organizations in order to enable organizations a rapid decision-making to improve customer response [1, 14]. Therefore, Skyrmie and Amidon [31] proposed that it is important for organizations to work on the development of knowledge management and having adequate capacities to manage knowledge in order to respond to dynamic global economy.

H3a: knowledge management capabilities will be positively related to the scope of CRMS adoption.
H3b: knowledge management capabilities will be positively related to the depth of CRMS adoption.

Rogers [30] defined perceived characteristics of the innovation based on what affects the adoption of innovation of the organization implementing the innovation. In Rogers' innovation diffusion theory, he believed that the formation of a personal attitude towards innovation as a cause of a decision to adopt or reject, to decide whether to adopt or implement an innovation. According to the characteristics of innovation in the innovation literature, Tornatzky and Klein [36] defined relative advantage, compatibility, and complexity based on the innovation characteristics of the attitude to the use of IT innovation.

H4a: relative advantages will be positively related to the scope of CRMS adoption.
H4b: relative advantages will be positively related to the depth of CRMS adoption.

H5a: complexity will be negatively related to the scope of CRMS adoption.
H5b: complexity will be negatively related to the depth of CRMS adoption.

H6a: compatibility will be positively related to the scope of CRMS adoption.
H6b: compatibility will be positively related to the depth of CRMS adoption.

Research Methodology
Definitions of Variables and Measurements
The variable of the size of hospital in this research was measured as the number of beds on seven levels. According prior research [16], the predominant trend of hospital researches is to use the same method to measure this variable.

Innovation of Senior Executive is the preferences of senior executives adopting different problem structures which are the solution to innovation. The source of items was adopted from Thong and Yap [33]. Knowledge Management Capabilities is the abilities of retrieving, managing, and transmitting real-time customer information in order to enable timely responses to customers, and shortened decision-making process. The source of items was adopted from Croteau and Li [9]. Relative Advantage is the advantage, such as economical benefits and reputation that the innovation can bring into the organization. The source of items was adopted from Premkumar and Roberts [27]. Complexity is the difficulties of understanding and utilizing the innovation. The source of items was adopted from Premkumar and Roberts [27]. Compatibility in the process of innovation is perceived as consistent with present systems, procedures and value systems. The source of items was adopted from Premkumar and Roberts [27]. All of these research variables were measured based on five-point Likert-type (1 = strongly disagree, 5 = strongly agree).

There are two variables used to measure the extent of CRMS adoption in this study: scope and depth of CRMS adoption. The scope of CRMS adoption is measured by how many types of communication channels are being utilized for performing CRM while the depth is measured by how many types of CRM related technologies are being used in the hospital (Some examples of communication channels and CRM related technologies are shown in Table 2).

Liang et al [20] developed an instrument for measuring the dependent variable in their adoption model. Since this instrument is designed specifically for measuring the adoption degree of innovation in Taiwan context, it is suitable for this study to measure the adoption of CRMS in the same country and culture. Based on Liang et al’s [20] instrument, hospitals were asked if they are currently adopting CRMS by selecting which stage of CRMS adoption that they are in: (1) fully implemented with profits earned, (2) implemented and promotion is in progress, (3) partially implemented, (4) planning to implemented, (5) unimplemented. This study identifies hospitals as adopters who respond “adopted” and select one of the first three stages, and the respondents who select the last two stages are categorized into non-adopters.

Population and Sampling Method
The study subjects of this research were the hospitals ranked by the Department of Health (DOH) as medical centers, regional hospitals, and community hospitals which passed the “Accreditation Appraisal on Hospitals and Teaching Hospitals”. Sample source is achieved by using the roster of “Taiwan Bureau of National Health Insurance”. A total of 508 health institutions were identified including 21 medical centers, 74 regional hospitals, and 413 community hospitals. Questionnaires were sent to the IS executives of these institutions (such as: Chief
Questionnaire Distribution and Collection

In this study, questionnaires were posted to the 508 health institutions. The electronic address of an online questionnaire was listed on the sent questionnaires in case any participant preferred to reply their answers conveniently through the virtual channel.

This study sent questionnaires to 508 hospitals, and with a total of 97 returned questionnaires showing a response rate of 19.09%. However, only 95 usable questionnaires since two incomplete questionnaires were deleted. The usable response rate was 18.7% in this study.

Results of Analysis

Sample Characteristics

Table 1 summarizes the sample characteristics including to the type of respondent and hospital. This table shows that, 50.5% of respondents hold top-level positions in IS department. Furthermore, there is a wide distribution of hospitals ranking among medical center (13.7%), regional hospital (32.7%) and community hospital (53.6%) in terms of the sample characteristics.

<table>
<thead>
<tr>
<th>Hospital rank</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical center</td>
<td>13</td>
<td>13.7%</td>
</tr>
<tr>
<td>Regional hospital</td>
<td>31</td>
<td>32.7%</td>
</tr>
<tr>
<td>Community hospital</td>
<td>51</td>
<td>53.6%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Title of Responder</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chief Information Officer</td>
<td>48</td>
<td>50.5%</td>
</tr>
<tr>
<td>Vice President of MIS</td>
<td>15</td>
<td>15.8%</td>
</tr>
<tr>
<td>Other Senior Managers</td>
<td>32</td>
<td>33.7%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Adoption Stage</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fully implemented with</td>
<td>2</td>
<td>2.1%</td>
</tr>
<tr>
<td>profits earned</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Implemented and promoting</td>
<td>8</td>
<td>8.4%</td>
</tr>
<tr>
<td>Partially implemented</td>
<td>29</td>
<td>30.5%</td>
</tr>
<tr>
<td>Planning to implement</td>
<td>11</td>
<td>11.6%</td>
</tr>
<tr>
<td>Unimplemented</td>
<td>45</td>
<td>47.4%</td>
</tr>
</tbody>
</table>

Since this study tends to explore the critical factors influencing the extent of CRMS adoption, the subject in this study should adopt the CRMS in hospital essentially. In total, 39 hospitals were adopters and 56 hospitals were non-adopters. Table 2 summarizes the communication channels and CRM related technologies regarding CRMS adopters.

<table>
<thead>
<tr>
<th>Communication Channels</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Call center</td>
<td>27</td>
<td>69.2%</td>
</tr>
<tr>
<td>Interactive Web services</td>
<td>26</td>
<td>66.7%</td>
</tr>
<tr>
<td>e-mail</td>
<td>28</td>
<td>71.8%</td>
</tr>
<tr>
<td>Kiosk</td>
<td>22</td>
<td>56.4%</td>
</tr>
<tr>
<td>Others</td>
<td>1</td>
<td>2.6%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CRM related technologies</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data warehouse</td>
<td>10</td>
<td>25.6%</td>
</tr>
<tr>
<td>Data mart</td>
<td>9</td>
<td>23.1%</td>
</tr>
<tr>
<td>Data mining</td>
<td>6</td>
<td>15.4%</td>
</tr>
<tr>
<td>Database</td>
<td>34</td>
<td>87.2%</td>
</tr>
<tr>
<td>OLAP</td>
<td>10</td>
<td>25.6%</td>
</tr>
</tbody>
</table>

With small sample size, this study utilized Partial Least Squares (PLS) for data analysis for the technique’s ability to analyzing small sample size. Following a two-stage analytical procedure, this study then conducted an assessment of construct reliability and validity in the measurement model, and followed by the assessment of the structural model.

Measurement Model Analysis

Convergent validity is demonstrated when the associated items are high correlations among the same construct [12]. Table 3 presents the Cronbach’s alpha, composite reliability (CR), the loadings of items and the average variance extracted (AVE) for each construct.

Excluding one item of RA1 factor loading less than 0.7, two items of KMC5 and ISE3 are also loading less than 0.7, other items have significant classification component and load stronger on their associated factors. The loading coefficient is above 0.7 and significant at the 5% significance level. All of the reliability and CR in each construct are greater than 0.7. The AVE for each construct also exceeds 0.5. Thus, the convergent validity is demonstrated.

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Factor loading</th>
<th>Alpha value</th>
<th>CR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innovation of ISE1</td>
<td>0.94**</td>
<td>0.70</td>
<td>0.86</td>
</tr>
</tbody>
</table>
Discriminant validity is demonstrated when the associated items have low correlations among the other constructs [12]. Table 4 presents the square root of each variance shared in diagonal which between a construct and its items. Correlations between the constructs and other constructs should lower than the square root of each variance shared between a construct and its items. The results confirm the criteria and demonstrate the discriminant validity in this study.

Table 4. Discriminant validity

<table>
<thead>
<tr>
<th></th>
<th>ISE</th>
<th>KMC</th>
<th>RA</th>
<th>COM</th>
<th>COMPA</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISE</td>
<td>0.87</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KMC</td>
<td>0.27</td>
<td>0.87</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RA</td>
<td>0.19</td>
<td>0.61</td>
<td>0.84</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COM</td>
<td>-0.04</td>
<td>0.41</td>
<td>0.30</td>
<td>0.46</td>
<td>0.93</td>
</tr>
<tr>
<td>COMPA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Diagonal represent the square root of AVE.

Structural Model Analysis
The testing results are presented in Table 5. The results indicated that hypothesis H1a and H1b are supported. This shows that hospital size has positively influence on the scope and depth of CRMS adoption. H5a and H5b are supported. This denotes that complexity has negatively influence on the scope and depth of CRMS adoption. H6b is support, and this shows that compatibility has positively influence on the depth of CRMS adoption.

$R^2$ means the predictive power for the dependent variables in the model. The $R^2$ for the scope of CRMS adoption was 0.22, and for the depth of CRMS adoption was 0.30.

Table 5 Hypothesis testing results

<table>
<thead>
<tr>
<th>The scope of CRMS adoption</th>
<th>$\beta$</th>
<th>t-st</th>
<th>ati</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size of Organization</td>
<td>0.41</td>
<td>2.0</td>
<td>4**</td>
</tr>
<tr>
<td>Innovation of Senior Executive</td>
<td>-0.04</td>
<td>-0.</td>
<td>4</td>
</tr>
<tr>
<td>Knowledge Management Capabilities</td>
<td>0.12</td>
<td>0.5</td>
<td>7</td>
</tr>
<tr>
<td>Relative Advantage</td>
<td>0.14</td>
<td>0.8</td>
<td>7</td>
</tr>
<tr>
<td>Complexity</td>
<td>-0.43</td>
<td>0.3</td>
<td>6</td>
</tr>
<tr>
<td>Compatibility</td>
<td>0.30</td>
<td>1.7</td>
<td>4*</td>
</tr>
</tbody>
</table>

Discussion
An increase of size seems to have a positive influence on the scope and depth of CRMS adoption because of the increased availability of resources and specialized knowledge [19]. This study chose the number of beds to measure the size of hospital. In general, the hospital with more beds is larger in the scale and with more abilities to set up more assets, and therefore is more affordable to the resources required for using more CRMS related technologies.

Moreover, the number of beds positively affects the relationship with the number of customers the hospitals can handle. When dealing with more customers, hospitals face more medical problems. They need deploy more communication channels between the customers and hospitals in order to understand what their customers want and what the problem their customers are experiencing. For larger hospitals adopting CRMS is to provide more timely information to customers and to respond to their requests efficiently in order to establish a powerful communication channels.

Technological innovation is always considered
as a complex assignment and bewildered to the adopting department [11]. Complexity in this research is significant to influence the scope and depth of CRMS adoption negatively. The more complexity in CRMS, the less willingness the hospital would have to use CRMS related technologies. Since the existing CRMS is complexity for hospitals, they will decrease in using more CRMS related technologies to maintain the customer relationships.

On the other hand, the more complexity in CRMS, the less willingness the hospital would have to add communication channels between customers and hospitals. The existing CRMS is difficult to understand and utilize in hospitals. They will not increase the communication channels which are supported by CRMS in order to decrease their loading on keeping customer relationships.

The variable of compatibility discussed in this research showed that the more compatibility of CRMS with present system, the more willingness the hospital would have to use CRMS related technologies. When CRMS is perceived as consistent with present systems, it is easier for hospitals to use. Hence, the characteristic of compatibility let hospitals try using more related technologies to assist CRMS in supporting CRM.

**Implications**

**Implications for Researchers**

Several implications are suggested here for researchers studying on the extent of CRMS adoption. First, this research contributes to the IS adoption literatures in healthcare domain by empirically building an integrate model. Although this research provides the critical factors toward the extent of CRMS adoption, sufficient explanations for justifying how these factors influence managerial decision-making is lacking. Therefore, we suggest that future research can use follow-up interviews with hospital’s CEO to elicit the explanations.

Second, the current study, based on surveys, indicated the factors which have direct influence to the extent of CRMS adoption for healthcare. Future research can investigate whether other potential factors exist.

Third, researchers can refine the current model to a better extent. Understanding the factors which influence the performance and implementation of CRMS is encouraged.

Last, researchers can consider medical policies and IT security standards in their future research on the extent of CRMS adoption. Customers are not the only ones driving change in healthcare. For example, in the United States, Health Insurance Portability and Accountability Act (HIPAA) sets a variety of security norms, standards, and restrictions on the deployment of the healthcare information technology [39].

Therefore, when hospitals deploy and use of CRMS, they must be particularly careful to consider medical policies and the regulations of security restrictions.

**Implications for Hospitals**

Two implications are revealed for hospitals. First, it is reasonable to infer that a larger hospital, which is with more sickbeds, should have more needs to increase the scope and depth of CRMS adoption because of maintaining more complicated customer relationships and fulfilling more customers’ requirements. In line with this inference, the larger hospital should explore the invisible advantages and potentials of CRMS.

Second, this research provides lessons for the smaller hospitals. They will face the same situations that the larger hospitals are facing, such as more complicated customer relationships when they are expanding CRMS. Therefore, they should be enhancing their system capabilities while growing their business scales.

**Implications for CRMS Vendors**

Three implications are revealed for CRMS vendor. First, the fact of hospital size (in terms of sickbed number) being positively associated with the depth of CRMS adoption gives CRMS vendors a clue to develop specific marketing strategies for identifying potential adopters. Hospitals with sufficient assets and financial resources have more intention to be innovative and thus vendors can promote CRM related technologies for larger hospitals.

However, smaller hospitals are normally lack of financial ability to cover the enormous cost of CRM related technologies. Purchasing the module of CRM related technologies and fitting with their core organization functionality therefore is an attractive solution to smaller hospitals. This study recommends that CRMS vendors to invest on the development of module packages of CRM related technologies for smaller hospitals because those can alleviate the pressure of financial expenditure and support the original CRMS in smaller hospitals.

Second, CRMS vendors need to prepare IS training to hospitals that can relief hospitals from technological barriers in innovation diffusion stage. If the vendor could assign consultants to assist hospitals in preparing related IS capabilities, it will improve the extent and depth of CRMS adoption.

In the end, the more compatibility, the more CRM related technologies will be used in hospitals. This relationship offers CRMS vendors a useful advice for designing CRMS and planning marketing propaganda to hospitals. Vendors can improve their marketing strategy on CRM related technologies according to the degree of the compatibility of CRMS in hospitals. They can promote the new CRM related technologies for hospitals when they have

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**The 9th International Conference on Electronic Business, Macau, November 30 - December 4, 2009**
perceived the compatibility of the existing CRMS.

Research Limitations
The cross-sectional nature of this research restricts our ratiocination to the decision-making of CRMS adoption. This research recommends that longitudinal study is needed to identify the dynamics of the effects among the critical factors and decision-making. With no difference to other research, this research only considered the major characteristics of organization and CRMS, and thus may ignore other undiscovered contexts. When possible, future research should attempt to conjoin additional theory-based contexts in order to enhance the explanatory ability of our model.

Conclusions
CRMS can facilitate the customer relationship management by providing timely information and quickly responses. The purpose of this research is to identify the factors which will influence the extent and depth of CRMS adoption in healthcare from the organizational and system perspectives. Theoretically, a review of prior IS innovation literatures supported us to generate an empirical model, and this model had been empirically verified by the results of a survey on 508 hospitals in Taiwan. The results indicated that hospital size, complexity and compatibility have significant influence on the extent and depth of CRMS adoption in hospitals. Hopefully, the critical factors identified by this study can provide substantial aids and advices for academics and associated practitioners.

References
Critical Factors Influencing the Extent of Customer Relationship Management Systems 111


The 9th International Conference on Electronic Business, Macau, November 30 - December 4, 2009
INTELLIGENT E-LEARNING SYSTEM WITH PERSONALIZED MISCONCEPTION DIAGNOSE AND LEARNING PATH GUIDANCE

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Abstract
In recent years, to advances network technology, IT-enabled learning and support learning are important in on-line education. More learners obtain knowledge by the Web-Learning Instruction (WBI). Learners usually induce the problem of misconception and cognitive overload when they use Web-based learning system. At present, most of the studies in the on-line education either concentrate on the technological aspect (e.g. personalization technology development) or focus on adapting learner’s interests or browsing behaviors, while, learner’s ability and level of knowledge is neglected. Therefore, it is important to consider learner’s ability while designing web-based learning system. This study developed an On-line Knowledge Diagnose System (OKDS) to diagnose learner’s misconception and provide personalized remedial guidance that based on a graphic organizer technology - concept map. The results indicate that the OKDS can effectiveness enhance learners learner’s learning performance and learner also has positive perception of OKDS.

Keywords: concept map, web-based learning system, personalization remedial learning guidance.

Introduction
In decade years, as numerous web-based tutoring system have been developed, and many researches have tried to aid more efficient learning [1] [2] [4] [7] [9] [8] [11] [12] [13]. In order to aid more efficient learning, many powerful personalized and adaptive guidance mechanisms (i.e. adaptive presentation, adaptive guidance path support, curriculum arrangement, and artificial intelligence analysis of learner’s solutions) have been proposed to improve learner’s learning performance [1] [2] [4] [8] [11] [12]. While, most personalization adaptive systems focus on learner’s interests or browsing behaviors but neglect learner’s ability and level of knowledge [8] [11]. Several researches proposed to consider learner’s level of knowledge in designing adaptive learning system [1] [2] [4] [8]. One way to present learner’s level of knowledge is to organize learner’s knowledge structure by the technologic of concept map [3] [6] [10]. Concept map can both present the relationship between concepts and the order and degree of different characteristic (i.e. hierarchical structure or sequential specialization) among concepts. In addition, concept map is appropriated to present structure of knowledge and diagnose misconception.

The most common way to discover misconception is to compare the concepts difference between expert and novice. Therefore misconception exists either in the situation of the expert has but the novice without or the expert without but the novice has. Previous studies based on the teacher-center mode to diagnose and discover learner’s misconceptions and learning barriers focus on the situation of expert has but novice without [2] [4]. While, they omitted other type of misconception that novice has but expert without. To understand learner’s misconception completely and then provide individualized service this study develops an intelligent e-learning system based on student-center mode to diagnose learner’s misconception and provide personalized remedial learning guidance to improve learner’s learning performance.

System Architecture and Components
To reach the completely misconception diagnose and provide remedial learning guidance, the study applied PHP to develop the Online Knowledge Diagnose System (OKDS) that based on the concept map model. The system architecture is shown in Figure 1. The OKDS includes six intelligent agents and three databases. The six intelligent agents are the learning interface agent, interface management agent, test questions management agent, pre-test process agent, post-test process agent and remedial learning path generate agent respectively. Three databases include the user account database, test questions database and misconception database.

The interface management agent and test questions management agent aims at providing a flexible managing interface. The system managers can use it to design the corresponding concept and weight of each test questions. The learning
interface agent aims at providing a flexible interface for learners to interact with the pre-test process agent, personalized remedial learning path generate agent and post-test process agent. The pre-test process agent aims to generate a test questions for the learner to determine the misconception of individual learner according to the diagnose results. In the meanwhile, the pre-test process agent will pass these misconceptions to the remedial learning path generate agent to establish personalized remedial learning path based on the proposed misconception diagnose approach. Moreover, the post-test process agent provides a final test while the learner finished the whole remedial learning process. The test questions management agent will provide a responsive test questions for individual learner. This agent also can aid system manager to create new test questions and course unit concepts, upload, delete or modify test questions from the test questions database.

**Step 5:** Students login the OKDS through the learning interface agent by the users’ accounts. After a student login in the OKDS, the learning interface agent will check it whether his/her account be stored in the user account database.

**Step 6-7:** If the student has already owned a registered account, the OKDS request the student to conduct pre-test, the result will transfer to the pre-test process agent.

**Step 8:** The pre-test process agent analyzes the pre-test results and conveys the misconception database. Furthermore, the remedial learning path generate agent establishes personalized remedial learning according to the diagnose result stored in the misconception database. At the same time, the personalized remedial learning path generation agent submits a learning guidance to students for further remedial learning.

**Step 9-11:** After, the students finished the entire remedial learning provided by the personalized remedial learning path generate agent, the post-test process agent generate a test question to the student for performing a post-test to evaluate the learning performance.

**Step 12:** The students asked to finish satisfaction questionnaire.

**Step 13:** The system managers analyzed the results of pre-test, post-test and student’s misconception information for teacher.

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**Research Approach**

**Constructing the Structure Map of Conceptual Relationship of Subject Materials**

This study proposed a novel approach based on the Concept Map model. To construct the structure of conceptual relationship, the structure map can view a blueprint of overall key concepts as shown in (Figure 3). In Figure 3, the structure map includes stratum and priority of overall key concepts. This structure map can offer an overall concept relationship for each course unit and also provide a diagnosed based for each student’s to understand student’s learning status. For example, if a student
fails to learn the concept C3, we will presume that this student did not learn well in concept C3. Then

![Concept Map](image)

Figure 3: The Structure Map of Conceptual Relationship of Subject Materials

**Designing Threshold of Correct Ratio (CR) and Conceptual Weight of Test Questions**

In the domain of programming course, the test questions not only include one concept it usually contain two or more concepts in a question. Therefore, when we construct the relationship among a question and Concepts the Weight of each concept (CW) in a question must be predefined. If a test question comprises a single concept, the CW will be expressed by “1”. If a test question comprises two or more concepts, the range of CW is less than 1 and the sum of the CW is 1. In addition, each value of CW(Cj) denotes the total strength of concept Cj; CORRECT(Cj) is the total strength of the correct answers which are related to Cj; and CR(Cj) = CORRECT(Cj) / CW(Cj) represents the ratio of correct answers to the total strength of concept CJ (Table 1).

<table>
<thead>
<tr>
<th>Question</th>
<th>Concept</th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>C5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td></td>
<td>0.25</td>
<td>0.25</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Q2</td>
<td></td>
<td>0.25</td>
<td>0.25</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Q3</td>
<td></td>
<td>0.25</td>
<td>0.25</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Q4</td>
<td></td>
<td>0.25</td>
<td>0.25</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Q5</td>
<td></td>
<td>0.25</td>
<td>0.25</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CW</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CORRECT</td>
<td></td>
<td>0.75</td>
<td>0.75</td>
<td>0.75</td>
<td>0.75</td>
<td>0.75</td>
</tr>
<tr>
<td>CR(C2)</td>
<td></td>
<td>75%</td>
<td>75%</td>
<td>75%</td>
<td>75%</td>
<td>75%</td>
</tr>
</tbody>
</table>

Table 1: The Comparison of Designing of Conceptual Weight of Test Questions

In this section, we present a new approach to diagnose learner’s misconception base on the Concept Map model. The flow chart of misconception diagnosis is presented in Figure 4. The correct ratio (CR) for concept 1 is 75% (CR(C1)= (0.25+0.5)/1=75%), concept 2 is 80% (CR(C2)= (0.25+0.25+0.25+0.25)/1.25=80%), concept 3 and concept 4 are 50%, and concept 5 is 60%. If the threshold (γ) is 60% we can find that two concepts (C3 and C4) CR value less than 60% therefore this student has misconception on C3 and C4. Figure 4 is the flow chart of the process of this system will suggest this student to learn C2 thoroughly before he/she go to concept C3.

Figure 4: Flow Chart of Diagnosis of Misconception

**Establishment of Personalization Remedial Learning Path**

At the same time, the system establishes a Personalization remedial learning path for the student in accordance with the structure and relationship of concept map. The flow charts of the process to establish personalization remedial learning path is presented in Figure 5.

Table 2: The Illustrative Example of Test Questions in This Study

<table>
<thead>
<tr>
<th>No</th>
<th>Question</th>
<th>Weight of each option</th>
<th>correct answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>Which is the correct option? (A)Constructor is a method. (B)The object can’t automatically call constructor when the Object be produced. (C)Each Constructor have a Constructor of default. (D)The Constructor can accept the parameters.</td>
<td>(A)X=0.25 (B)X=0.25 (C)X=0.25 (D)X=0.25</td>
<td>AC</td>
</tr>
</tbody>
</table>
has misconception on C3and C4. According to the concept map that constructed in Figure 3, C3 and C4 belong to different learning level (C3 is located in the second level and C4 belong to the third level). Hence, this learner’s remedial learning path was constructed based on the order of learning level (from the lower level to the higher level), therefore the personalized remedial learning path for this student is C3 → C4

Figure 5: Flow Chart of Personalization Remedial Learning Path

Experiments
The detailed experimental design in this study is described as follows.

Experiments Design
This study conducted a true experimental design (pretest-posttest control group design) to review the validity of the treatment. The true experimental design is excellent in showing a cause-and-effect relationship, and random assignment controls for extraneous variables. In addition, the true experimental design has a high internal validity. Therefore, true experimental design is very beneficial to verify the effectiveness for our system.

This study used java programming course to evaluate the efficacy of our system. There are 45 first-grade university students participated in this study. In addition, all 45 students conducted two tests (including a pre-test and a post-test).

The Implemented Online Knowledge Diagnose

System
To illustrate how to perform the learning processes using an established PRLP for an individual student, this section will introduces the diagnosis procedure on the implement OKDS. In Figure 6 shows the user’s login interface, as a user logins the system. In Figure 7 shows the maintained interface of concepts for the system manager. In Figure 8 shows the maintained interface of test questions for the system manager. In Figure 9 shows the maintained interface of test question items for the system manager. In Figure 10 shows the interface of performing a pre-test for a student. After a student finishes a pre-test, the system will analyze the pre-test results, then the system will established a PRLP for an individual student, that can be designed to guide student in further learning. In Figure 11 displays the experimental group’s interfaces that includes PRLP, correct ratio and spend time according to the diagnosis responses of an individual student. In addition, Figure 12 displays the control group’s interface that includes correct ratio and spend time according to the diagnosis reposes of an individual student.
Experiments Analysis

(1) Pre-test
The t-test values for the pre-test results as shown in Table 3. According to Table 3 experimental group and control group has not significantly difference in the pre-test score (p-value=0.962 > 0.05).

<table>
<thead>
<tr>
<th>Item</th>
<th>group</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test results</td>
<td>Experimtial</td>
<td>2</td>
<td>40.4</td>
<td>14.75</td>
<td>10.44</td>
<td>0.048</td>
</tr>
<tr>
<td></td>
<td>Control group</td>
<td>3</td>
<td>40.3</td>
<td>13.13</td>
<td>0.048</td>
<td>0.962</td>
</tr>
</tbody>
</table>

(2) Post-test
The t-test values for the post-test results as shown in Table 4. The mean scores of the post-test clearly reveal that experimental group performed better than control group (Mean=68.23>Mean=58.91). Moreover, the p-value is 0.048, which implies that significant difference existed in the post-test (*p-value < 0.05). Therefore, we can conclude that experimental group performed significantly better than control group in the pre-test, conducted before performing the experiment. The significantly reach p-value=0.048. The result, we can conclude that experimental group achieved a better significant improvement compared to control group after receiving learning guidance via a novel approach of misconception diagnose on OKDS system.

<table>
<thead>
<tr>
<th>Item</th>
<th>group</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-test results</td>
<td>Experimtial</td>
<td>21</td>
<td>68.2</td>
<td>14.75</td>
<td>2.036</td>
<td>0.048</td>
</tr>
</tbody>
</table>
Intelligent e-Learning System with Personalized Misconception Diagnose and Learning Path Guidance

(3) Satisfaction Analysis

To understand students’ satisfaction attitude toward the OKDS, this study conduct a survey by questionnaire. There are 53 students joined this survey, the valid respondents are 44. There are 9 respondents are invalid, 60% of respondents are male. The tester’s age is from 15 to 19 years old. The educational background is under-graduated. There are 5 questions in our questionnaire, included learner’s perception of helpful and satisfaction to the learning guidance function.

The experimental group gets significantly higher overall satisfaction than the control group does (Mean=20.05>Mean=16.57, p=0.000) as shown in Table 5. Similarly, in “Steps to learn a concept in the e-learning system follow a logic sequence” (p=0.012), “Using the e-learning service can improve my learning performance” (p=0.040), “The e-learning system provides the right learning guidance to me” (p=0.000), and “The e-learning system provides the individual learning guidance to my request” (p=0.000) the experimental group gets significantly higher scores than the control group does.

According to the result, we can find that experimental group has a significant positive perception compare to control group after receiving learning guidance via the OKDS.

Table 5: T-test of Satisfaction of Experimental Group (N=24) and Control Group (N=21)

<table>
<thead>
<tr>
<th>Item</th>
<th>Group</th>
<th>T</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Steps to learn a concept in the e-learning system follow a logic sequence</td>
<td>4.14</td>
<td>2.619</td>
<td>0.012*</td>
</tr>
<tr>
<td>2. Using the e-learning service can improve my learning performance</td>
<td>4.19</td>
<td>2.115</td>
<td>0.040*</td>
</tr>
<tr>
<td>3. I find the e-learning service to be useful to me</td>
<td>4.14</td>
<td>1.416</td>
<td>0.164</td>
</tr>
<tr>
<td>4. The e-learning system provides the right learning guidance to me</td>
<td>3.86</td>
<td>4.966</td>
<td>0.000*</td>
</tr>
<tr>
<td>5. The e-learning system provides the individual learning guidance to my request</td>
<td>3.71</td>
<td>5.207</td>
<td>0.000*</td>
</tr>
<tr>
<td>Overall satisfaction</td>
<td>20.05</td>
<td>5.725</td>
<td>0.000*</td>
</tr>
</tbody>
</table>

Conclusions

The research results of this study showed that students provided by personalized remodel learning path had significant progress and higher satisfaction with this system after taking the learning guidance. Consequently, we can conclude that the novel approach proposed by this study can help students to improve their learning performance. In the meanwhile, the results of satisfaction also showed the learners have a positive perception to this system. It implies that provided the PRLP not only can satisfied requirement of individualization, but also can provided a logic sequence in learning process, and can enhanced the learning performance and satisfaction of students. Furthermore, this study reveals the novel approach not only can reach exact misconception diagnose, but also can provide learning guidance properly. Moreover the novel approach also can as a new choice in the on-line knowledge diagnose system building.

Acknowledgments

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References


ANALYZING THE RISK AND FINANCIAL IMPACT OF PHISHING ATTACKS USING A KNOWLEDGE BASED APPROACH

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Abstract
We assess the severity of phishing attacks in terms of their risk levels and the potential loss in market value to the firms. We analyze 1,030 phishing alerts released on a public database as well as financial data related to the targeted firms using a hybrid text and data mining method that predicts the severity of the attack with high accuracy. Our research identifies the important textual and financial variables that impact the severity of the attacks and determine that different antecedents influence risk level and potential financial loss associated with phishing attacks.

Key Words: Phishing, Data Mining, Financial loss, Risk, Text Mining, Variable Importance.

Introduction
Phishing is a major security threat to the online community. It is a kind of identity theft that makes use of both social engineering skills and technical subterfuge to entice the unsuspecting online consumer to give away their personal information and financial credentials [1]. Phishing caused an estimated financial loss of US $3.2 billion affecting 3.6 million people from September 2006 to August 2007, showing its tremendous financial impact [2]. Phishing attacks not only cause financial loss, but also shatter the confidence of customers in conducting e-commerce. A recent survey found that most customers of European banks only use online banking to check their account balances instead of conducting online transactions due to the fear of getting phished [3]. Another study also reported that the customer fear psychosis has resulted in a 20% decrease in the rate of opening of genuine emails [4]. To make customers aware of latest phishing attacks, some international organizations, such as Anti-phishing Working Group (APWG) and Millersmiles, and government statutory bodies have published phishing alerts on their respective Web sites. Apart from contextual information such as apparent sender, return email address, content of phishing email, URL of phishing server, and location of phishing location, an anti-phishing Web site Millersmiles has announced the associated risk level of phishing attacks and provided security advice to the general public. However, the risk level, which is based on the technical sophistication of phishing attacks, may not be directly related to financial loss caused by an attack based on past research [5]. The financial loss resulting from a phishing attack is always of great concern to security administrators, investors and consumers of an organization. In fact, both risk level and indirect financial loss are complementary measures because the two indicators may not be correlated and a high risk level of a phishing alert does not necessarily imply that the phishing attack will result in a high loss in market value [5]. Therefore, assessing the severity of phishing alerts using both these indicators helps to build a complete picture of the impact of phishing attacks.

This research has several objectives. By analyzing data related to phishing alerts using data mining techniques, we aim to identify the key characteristics of phishing attacks that determine the risk level of phishing attacks. Secondly, we predict the magnitude of loss in the market value of a firm when it is targeted by phishers. Since direct financial loss due to a phishing attack is difficult to calculate, we look into indirect financial loss in market value caused by phishing alerts.

Literature Review
Phishing has aroused great interest among information security researchers. Understanding the critical success factors of phishing and determining methods that can prevent or detect such a crime has been a popular area of research. We can roughly split current research on phishing into three streams, namely, phenomenal studies, economic analysis, and technical research.

As an example of a phenomenal study related to phishing, Jagatic et al. found that the social engineering skill of the adversary was a critical success factor for phishing [6]. Workman found that the critical success factors for some marketing strategies were applicable to phishing attacks as well [7]. Researchers also found that education of customers, standardization of technology, and sharing of phishing information were among the most important policies that could deter phishing attacks [8].

Among economic studies related to phishing, Singh studied a number of international phishing
incidents and found that the direct financial loss per incident ranged from US$900 to 6.5 million pounds [9]. However, it is widely believed that as companies are quite reluctant to disclose information related to direct financial loss caused by phishing, the actual financial loss might be ten times more than the estimated numbers that appeared in research reports [10]. In their attempt to estimate the indirect financial loss caused by phishing, Leung and Bose found that phishing related announcements caused a significant negative reaction among investors of targeted companies [5]. It is interesting to note that a significant negative investor reaction of 2.1% loss in market value within two days of the announcement was reported in the broader context of analyzing the economic impact of information security breaches [11]. In the area of technical research, information security researchers have toiled to discover better countermeasures of phishing. Data mining techniques have been used to filter out phishing emails that contained fraudulent messages [12]. By analyzing the headers of emails, researchers were able to prevent the spread of malicious emails containing virus/worms/Trojans and stop crimes such as phishing and distributed denial of service attacks with an accuracy of 99% [13]. To authenticate the URL embedded in the emails, logistic regression [14] and decision trees have also been used [15].

Text mining has also gained popularity as a research tool due to its ability to mine digital content available on the Internet. The most typical application of text mining is in document management involving tasks such as text segmentation, key words extraction, indexing, and text categorization. Wei et al. have used clustering techniques and integrated information on personal preferences for document management [16]. A hybrid methodology that combined text mining with data mining has been adopted by some researchers as well. Ma et al. used text mining to analyze company news and discover social networks among companies and utilized the discovered characteristics of the social networks to predict the revenue of the associated companies using decision trees and logistic regression [17]. Although text mining has been frequently used in a number of domains, its application in the area of information security is not so common. Wang et al. used text mining to analyze disclosures about information security incidents in financial reports and determined if they impacted the valuation of the firm [18]. We believe that text mining techniques can be used to analyze text-based phishing alerts in the same way for identification of important textual variables that characterize phishing attacks. Prior research has demonstrated that phishing as an online crime is growing in terms of frequency of occurrences, financial loss imparted to firms and their customers, as well as technical sophistication. As there is a lack of research in the area of assessment of phishing attacks, we are motivated to construct a warning system based on a knowledge based approach. In the context of security breaches, past research has evaluated the impact of the characteristics of the attack on the financial loss generated by the security breach [11,19] but did not find any significant relationship between them.

### Data Collection and Analysis

In this section we describe how we collect, prepare, and analyze phishing alerts to assess their severity and determine important antecedents that influence the classification.

#### Data Collection and Preparation

To determine the severity of phishing attacks, we utilized phishing alerts available from the database Millersmiles and financial data available from the financial statements of the firms. The phishing alerts data used in this research is the largest available data at the time of research and was collected from mid-2005 to mid-2008.

As phishing is primarily motivated by financial gains, corporate financial data may be relevant for the assessment of severity of phishing. Relevant financial data that was reported in the last month of the year prior to the release of the phishing alert was retrieved from The Center for Research in Security Prices. In the raw dataset, there were 168 financial variables. The authors conferred with each other and an expert in the area of finance to choose relevant financial variables that were appropriate for the context of this research. This resulted in the choice of 75 attributes related to the financial performance of a firm. Then we used the Pearson’s Chi-square statistic to determine the strength of the relationship between those 75 financial variables and the target variables. The top 25 variables for the classification tasks (in terms of the Pearson’s Chi-square statistic) were selected. The list of those 25 financial variables appears in Table 1. As some targets of phishing attacks did not have publicly available financial data, (e.g., Internal Revenue Service) some sample data was discarded at this stage.

#### Table 1. List of Financial Data

The technical sophistication of the phishing attack was measured in terms of the risk level of the attack that was determined by the information security specialists of Millersmiles. As for financial impact, an event study was conducted to determine the change in market value of the firm after the release of the phishing alert, similar to the research done by Leung and Bose [5]. First, all events related to
private firms were removed. Then events that were affected by some confounding events such as mergers, acquisitions, dividend announcements, and changeovers were eliminated from further consideration. Then the stock return of the firm was compared with that of a market index to determine the cumulative abnormal return (CAR) of stock prices of firms due to the release of the phishing alert. We used CAR in this study because the change in the stock price of a firm is a synthesized reflection of various consequences due to phishing attacks, such as loss of clients, shrinkage in market share, and reduced confidence of consumers as well as investors. A total of 1,030 phishing alerts in our sample data had relevant CAR data and were subsequently used for classification of risk level and CAR. The CAR for these 1,030 phishing alerts ranged from -7.9% to 5.7% with an average of 0% and standard deviation of 1.3%.

Numerical Experimentation

We used a 3×3×2 experimental design in this research incorporating three sets of input data, three classifiers, and two classification tasks. The design included:

- Textual data from phishing alerts, financial data of the targeted companies, and combined textual and financial data. Text mining techniques were used on the phishing alerts to determine important semantic concepts that could act as input variables to the classifiers.
- Three classifiers – decision trees (DT), support vector machines (SVM), and neural networks (NN).
- Classification of risk level and CAR.

After the models were built, their performances were compared using top decile lift as performance metric. In addition, we also evaluated the relative importance of the different input variables for the various models. Further details about the experimental design are provided in the following sub-sections.

Textual Content Analysis Using Text Mining

Text mining was used to convert free text of the phishing alerts to structural data in the form of a document-term matrix. We grouped similar terms together so that the dimensionality of the document-term matrix was significantly reduced. In fact, we found that some of the frequently occurring words had almost similar meaning and thus it was more efficient to group such words together under a higher level concept. For example, the terms ‘cash’, ‘refund’, and ‘savings’ could be grouped under the concept ‘money’.

Usually, a dictionary which contained the linguistic and semantic relationships between words is used for grouping of concepts. We used the text mining module of the SPSS Clementine data mining suite to extract the key semantic concepts from the phishing alerts that had its own built-in dictionary. After grouping various terms under the broader semantic
concepts, a document-concept matrix was built. Each cell of the matrix represented the frequency of occurrence of the concepts within a document (i.e., a phishing alert). By performing this analysis, the natural language of phishing alerts was converted to structural data that could be used as input variables to the classification models.

**Development of Classification Models for Risk Level and CAR**

We first categorized phishing alerts according to the risk level assigned by Millersmiles. There were several predefined risk levels, namely, Low, Low-Medium, Medium, Medium-High, and High. For the sake of simplicity, we grouped risk levels Low and Low-Medium to form a new group ‘Low’ and Medium-High and High to form a new group ‘High’. Next, we categorized phishing alerts according to the CAR generated by them. Positive CAR indicated that the market responded favorably to the phishing alert whereas a negative CAR indicated unfavorable market response. Although CAR is a continuous variable we categorized it into three groups, namely, positive, stable, and negative. The positive group consisted of phishing alerts that resulted in CAR greater than 3%, while the negative group consisted of phishing alerts associated with a CAR less than -3%. This method of creating groups with the choice of 3% as a threshold value was also used in prior research [18].

In the subsequent modeling phase, we classified risk level and CAR using input variables obtained from textual categories or financial data or both. NN, SVM, and DT were used in this research due to their history of superior performance in other applications related to information security [15]. The three classifiers have different characteristics. NN consists of three inter-connected layers, namely, input layer, hidden layer, and output layer. Each layer contains interconnected nodes than can process the data. The interconnections are assigned weights that continue to change as the NN ‘learns’ the pattern from the input data. Because of the structure, NN is good at learning non-linear relationships between input data and output data. SVM views data sets as vector spaces and performs classification by constructing a hyperplane that maximizes the separation in order to divide the vectors into different classes. SVM can perform either linear or non-linear classification. DT can tolerate the presence of outliers and missing data and so minimum effort is required for data preprocessing using DT. When processing categorical data with more than two levels of value, NN and SVM create dummy variables for each level of value of the related input variable, and this adds to the computational burden. In contrast, DT can derive rules directly from categorical data without creating dummy variables. However, DT cannot use continuous variables directly and has to convert them to categorical data. The DT model adopted in this research was C5.0.

The risk levels and the CAR for the phishing alerts were not evenly distributed. Table 2 shows the distributions of the two variables. Therefore, for classification of risk level, we oversampled the high risk and low risk instances of data but kept the medium risk instances the same so that the distribution of the three groups became 1:1:1 in the training and testing data sets. For classification of CAR, we repeated the process by oversampling the negative and positive instances while retaining the stable instances in its original form. To build the classification model, 70% of the oversampled data was used for training and 30% was used for testing. However, in the validation data sets, we retained the original distribution of data. We also used 10-fold cross validation and calculated the average accuracy of the model from the cross-validation models.

<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
<th>Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk Level</td>
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<td></td>
</tr>
<tr>
<td>High</td>
<td>86</td>
<td>8.37%</td>
</tr>
<tr>
<td>Low</td>
<td>23</td>
<td>2.24%</td>
</tr>
<tr>
<td>Medium</td>
<td>919</td>
<td>89.45%</td>
</tr>
<tr>
<td>CAR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative</td>
<td>24</td>
<td>2.33%</td>
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<td>Positive</td>
<td>28</td>
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<tr>
<td>Stable</td>
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<td>94.95%</td>
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</table>

**Results**

In this section, the results obtained by applying the trained classification models on the validation data are presented. We evaluated the decile lift of the models and then identified the important variables discovered by the models for the two classification tasks.

**Decile Lift**

In Tables 3 and 4, we showed the lift values obtained for the two classification tasks. For classification of risk level, the models assigned likelihood scores to phishing alerts that indicated how likely it was for the phishing alerts to be high risk. The top decile lift was equal to the ratio of true high risk phishing alerts among the top 10% of phishing alerts in terms of the likelihood score of high risk divided by the ratio of high risk phishing alerts in the whole population of phishing alerts. The higher the top decile lift, the better was the model. We used lift values to compare...
the model’s ability to capture high risk phishing alerts. As shown in Table 3, the combined textual and financial data always performed best in terms of top decile lift up to the 7th decile. For SVM, the use of only textual data was consistently better than the use of only financial data in terms of top decile lift. For DT, the performance using textual data was not as good as that using financial data in the first decile but was consistently better up to the 6th decile and for NN the performance using textual data was better than that using financial data up to the 4th decile. The results indicated that analyzing the textual content of the phishing alerts was important for the classification of risk levels of the phishing alerts. The results also illustrated that combining textual data with financial data made the classification more accurate. Among the three classifiers, the performance of SVM was the best for the top decile. The top decile lift of the SVM classification model using hybrid textual and financial data as inputs was 6.40. This meant that this particular model was 6.4 times more likely to capture true high risk phishing alerts than random selection.

Table 3. Lift Values for Classification of Risk Level

<table>
<thead>
<tr>
<th>Deciles</th>
<th>Combined DT</th>
<th>Text. DT</th>
<th>Fin. DT</th>
<th>Combined SVM</th>
<th>Text. SVM</th>
<th>Fin. SVM</th>
<th>Combined NN</th>
<th>Text. NN</th>
<th>Fin. NN</th>
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</thead>
<tbody>
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<td>1</td>
<td>5.26</td>
<td>4.07</td>
<td>4.09</td>
<td>6.40</td>
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<td>3.95</td>
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<td>3.07</td>
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<td>2.55</td>
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<tr>
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Table 4. Lift Values for Classification of CAR

<table>
<thead>
<tr>
<th>Deciles</th>
<th>Combined DT</th>
<th>Text. DT</th>
<th>Fin. DT</th>
<th>Combined SVM</th>
<th>Text. SVM</th>
<th>Fin. SVM</th>
<th>Combined NN</th>
<th>Text. NN</th>
<th>Fin. NN</th>
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<td>1</td>
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</tbody>
</table>

The lift values obtained for the classification of CAR are shown in Table 4. The results shown are consistent with those in Table 3. Again, the combined textual and financial data performed best in terms of lift in most cases and the use of only textual data was better than the use of only financial data for SVM but not for DT and NN. Table 4 again illustrated the importance of combining textual data with financial data for the purpose of classification. As in the case of risk level classification, the SVM model using combined textual and financial data as inputs obtained the highest lift value of 8.52.

Comparison of Important Variables

In order to understand the antecedents that governed the classification of risk level and CAR of phishing alerts, we calculated the importance of all input variables. As the combined textual and hybrid data gave rise to good decile lift in general, we listed the top five most important textual variables and the top five most important financial variables identified for each of the classification tasks using the three classifiers with this data as input. The variables are listed in order of their importance in Tables 5 and 6 where the column ‘Identifying Classifier(s)’ showed which classifiers rated the variable as a top five variable.

We can observe that there was no general agreement among the classifiers about the most important textual category. For classification of risk level, ‘update’ was identified as an important textual category by all three classifiers. This implied that updating personal information was of high risk phishing attacks with messages requesting recipients to update their personal information were of high risk phishing attacks. The results also illustrated that combining textual data with financial data made the classification more accurate. Among the three classifiers, the performance of SVM was the best for the top decile. The top decile lift of the SVM classification model using hybrid textual and financial data as inputs was 6.40. This meant that this particular model was 6.4 times more likely to capture true high risk phishing alerts than random selection.
three classifiers whereas ‘information’ and ‘writing’ were identified as top five categories by two of the three classifiers. When phishers pretended to be authenticated service providers and requested their customers to reveal personal information, then such attacks became likely to cause financial loss to the customers, hurt brand reputation, and affect present and future revenues of the company.

Table 5. Textual Concepts Listed in Order of Importance with Identifying Classifiers

<table>
<thead>
<tr>
<th>Risk Level</th>
<th>Identifying Classifier(s)</th>
<th>CAR</th>
<th>Identifying Classifier(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Update</td>
<td>DT, SVM, NN</td>
<td>Consumer</td>
<td>DT, SVM, NN</td>
</tr>
<tr>
<td>Security</td>
<td>DT, SVM</td>
<td>Information</td>
<td>DT, SVM</td>
</tr>
<tr>
<td>Email</td>
<td>DT, SVM</td>
<td>Writing</td>
<td>SVM, NN</td>
</tr>
<tr>
<td>Bank account</td>
<td>SVM, NN</td>
<td>eBay</td>
<td>DT</td>
</tr>
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<td>Confirmation</td>
<td>DT</td>
<td>Warning</td>
<td>DT</td>
</tr>
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<td>Account</td>
<td>SVM</td>
<td>Person</td>
<td>SVM</td>
</tr>
<tr>
<td>Information</td>
<td>NN</td>
<td>Account</td>
<td>SVM</td>
</tr>
<tr>
<td>Computers</td>
<td>NN</td>
<td>Work</td>
<td>NN</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Computers</td>
<td>NN</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Assets</td>
<td>NN</td>
</tr>
</tbody>
</table>

*Textual concepts common to both classifications are shown in italic

In Table 6, the top five most important financial variables identified by the three classifiers are listed. There were no common financial variables for classification of risk level and CAR. This showed that the underlying financial variables determining the two measures of severity of phishing attacks were significantly different. For classification of risk level, total of inventories was identified as an important financial variable by all three classifiers whereas other intangibles and advertising expense was identified as a top five financial variable by two out of three classifiers. These financial variables indicated the preference of phishers towards launching attacks on large firms. High total inventories and intangibles is a hallmark of a large firm and high advertising expense identified a company that had greater media exposure. This meant that large companies were preferred targets for high risk phishing attacks because they had a strong customer base and their customers were likely to be misled by fake emails due to their inherent trust on these companies. For classification of CAR, number of employees, total invested capital, and total liabilities were identified as top five financial variables by two out of three classifiers. Again, the number of employees and total invested capital indirectly hinted at the large size of the firm. It was interesting to note that firms that already had high total liabilities were at greater risk of being penalized by investors when phishing attacks took place and shook the confidence of the investors.

Table 6. Financial Variables Listed in Order of Importance with Identifying Classifiers

<table>
<thead>
<tr>
<th>Risk level</th>
<th>Identifying Classifier(s)</th>
<th>CAR</th>
<th>Identifying Classifier(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inventories_Total</td>
<td>DT, SVM, NN</td>
<td>Employees</td>
<td>DT, SVM</td>
</tr>
<tr>
<td>Other_Intangibles</td>
<td>DT, NN</td>
<td>Invested_Capital_Total</td>
<td>SVM, NN</td>
</tr>
<tr>
<td>Advertising_Expense</td>
<td>SVM, NN</td>
<td>Liabilities_Total</td>
<td>SVM, NN</td>
</tr>
<tr>
<td>Price_High_Annual_Fiscal</td>
<td>DT</td>
<td>Receivables_Total</td>
<td>DT</td>
</tr>
<tr>
<td>Operating_Expenses_Total</td>
<td>DT</td>
<td>Net_Income_Loss</td>
<td>DT</td>
</tr>
<tr>
<td>Income_Before_Extraordinary_Items</td>
<td>DT</td>
<td>Price_Low_Annual_Fiscal</td>
<td>DT</td>
</tr>
<tr>
<td>S_P_Core_Earnings</td>
<td>SVM</td>
<td>Long_Term_Debt_Total</td>
<td>DT</td>
</tr>
<tr>
<td>Preferred_Preference_Stock_Capital_Total</td>
<td>SVM</td>
<td>Assets_Total</td>
<td>SVM</td>
</tr>
<tr>
<td>Market_Value_Total_Fiscal</td>
<td>SVM</td>
<td>Book_Value_Per_Share</td>
<td>SVM</td>
</tr>
<tr>
<td>Common_Equity_Tangible</td>
<td>NN</td>
<td>Notes_Payable_Short_Term_Bors.</td>
<td>NN</td>
</tr>
<tr>
<td>Earnings_Before_Interest_and_Taxes</td>
<td>NN</td>
<td>Debt_in_Current_Liabilities_Total</td>
<td>NN</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cost_of_Goods_Sold</td>
<td>NN</td>
</tr>
</tbody>
</table>

Discussion

Keeping in mind that it is important to evaluate the technical sophistication as well as the potential financial impact of phishing attacks, we conducted this research and developed a mechanism to predict the severity of phishing alerts in terms of risk level and potential loss in market share indicated by CAR of stock prices. From the list of top five most important input variables generated using the three classifiers, we found that the overlap for the two types of classifications was consistently low and this implied that risk level of a phishing alert was not indicative of the CAR generated by it. The loss in market value of the targeted firm could be added with the information of the risk level by anti-phishing organizations to give a complete picture of the
impact of a phishing attack. Furthermore, our research results indicated that assessment based on data that consisted of important textual categories discovered from the text of phishing alerts as well as financial data of the targeted companies, outperformed assessment based on any of the above data items alone. Information security specialists usually assess risk level of phishing incidents based on the textual description of phishing alerts. Our results indicated that for assessing severity it was important to consider the financial condition of the targeted company as well.

From an academic perspective, our research made an important contribution in terms of application of a hybrid text and data mining method for solving a problem in the area of information security. Text mining was used in the first stage to extract key semantic concepts from the textual content of the phishing alerts. The performance of the classifiers in terms of top decile lift showed that the hybrid text and data mining model was successful in classifying different levels of risks and different types of financial impact caused by phishing attacks. The results were more or less consistent for the three different classifiers and indicated that a hybrid data mining model was able to generate consistent results of high accuracy. Data mining techniques have been frequently used in the past to filter out phishing emails or thwart access to phishing Web sites and our research showed that the same techniques could be used to assess severity of phishing attacks effectively. From a managerial perspective, our study paved the way for automating the assessment of severity of phishing attacks. As there are an increasing number of phishing incidents that are reported around the world every day, manual assessment of such incidents could be time consuming as well as inaccurate due to the subjective bias of the evaluator. The method proposed in this paper automated the assessment of phishing incidents using past data and provided a richer assessment of such incidents than what is currently being done by the anti-phishing organizations. We hope that the findings of this study can encourage anti-phishing organizations to adopt our proposed method to predict the risk level as well as potential financial impact of a phishing alert as soon as it is reported on their Web site.

Conclusion

In this research, we adopted a hybrid text and data mining model that used text mining to discover important semantic categories from the textual content of the phishing alerts and combined those discovered categories with financial data of the targeted companies to come up with classification of risk level of the attack and the loss in market value of the firm that it was likely to cause. The performance of the hybrid model was quite superior in terms of top decile lift and demonstrated the need to consider textual data as well as financial data for making prediction about the severity of the phishing alert. Furthermore, our results showed that risk level and CAR were fundamentally different from each other as we discovered that different textual and financial factors impacted them. This implied that it was important to evaluate both for fully assessing phishing alerts – a practice we recommend that all anti-phishing organizations should adopt in future to make their members more knowledgeable about the severity of phishing attacks.

References


PROPERTY PRICE MODELLING: THE REGRESSION MODEL AND THE NEURAL NEWTWORK MODEL

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Abstract
Hedonic regression models are widely used in housing price studies. However, incorrect identification of the functional relationship may lead to potential bias. This research studies the neural network model in modeling housing price. A neural network model is regarded as a nonlinear regression model without a predetermined functional form. The adoption of the neural network model could overcome the biasness inherent in the hedonic price regression model. The performance of neural network models and hedonic regression models are discussed based on the Hong Kong property price data.

Keywords: Hedonic Regression, Neural Network Model

Introduction
There are two widely adopted approaches in modeling housing price indices. The repeated sales model follows the changes in the prices of the properties that are sold more than once in the study period and the hedonic regression model considers the relationship between the property price and the property attributes. Although repeated sales models have been used in constructing housing price indices, there are deficiencies to apply the repeated sales models in predicting property prices.

Hedonic Price Model
Hedonic regression was first introduced by Lancaster (1994) for measuring market price. Dipasquale and Wheaton (1996) suggest a multiplicative relationship between the property's sales price and its attributes. That is,

\[ P_j = \prod_{j=1}^{k} X_{ij}^{\alpha_j} \]  

(1)

where the parameter values \( \alpha \) of the housing attributes \( X \) are assumed to be stable over the study period. In order to model the relative changes in market valuation of housing attributes over time, it is multiplied by the exponential term of time shifts.

\[ P_j = \left( \prod_{j=1}^{k} X_{ij}^{\alpha_j} \right) \exp\left( \sum_{t=1}^{T} \beta_t D_t \right) \]

(2)

where the dummy variables \( D \) account for the trend in housing prices over the study period. The modeling of Hong Kong residential property prices using hedonic regression models are presented in Mok et al. (1995) and Cheung (2003). Cheung (2003) also discussed the construction of the Hong Kong residential property price index, Centa-City Index, using the hedonic regression approach.

Housing Attributes
Kingswood Villa is one of the popular residential estates in the suburban area of Hong Kong. All units are high-rise apartments in a total of 58 blocks constructed in six phases. There were over four thousands transactions in 1997 and over one thousand transactions annually. Since all housing units in this study are high-rise units, twenty four housing attributes such as floor level, direction, window view, etc are selected as important factors to affect the selling price. The hedonic price regression model is developed using the Land Registry’s transaction data recorded from July 1996 to June 1997 and the unit attributes collected from Centaline Property Agency Limited. A set of time-dependent variables is added to model the monthly changes in the market evaluation of housing attributes. The data was fitted to the following hedonic regression model:

\[ \ln P_j = \sum_{i=1}^{24} \ln \alpha_i X_{ij} + \sum_{t=1}^{T} \beta_t D_t \]  

(3)

It is found that twenty unit attributes and all time dependent variables are significant.

Neural Network Model
It is known that the hedonic regression model may encounter potential bias from incorrect specification of the functional form between unit attributes and housing price. A neural network model combines many computing modules (neurons) into an interconnected system (neural network). It mimics the complex relationship between the dependent variables (output modes) and the independent variables (input nodes). A neural network model is regarded as a flexible nonlinear regression model without an explicit form. It could overcome the bias problem inherent in the hedonic regression model.
The Kingswood Villa data is considered in the neural network study. The dependent variable is the logarithm of unit price per square foot and all the unit attributes in the hedonic regression model are included in the neural network models. We include the time variable, WEEK, to represent the weekly change in the economy in the neural network model.

The data set (4,639 records) are split into three parts: training data set (40%), validation data set (30%) and testing data set (30%). Two neural networks: MLP(2, 2) and MLP(3, 3) are constructed. The model sum of squared errors are 3.6333 and 4.0233 for MLP(2, 2) and MLP(3, 3) respectively.

Comparisons Between Neural Network Model and Hedonic Price Model

Theoretically, the neural network model is preferred over the hedonic price model since it assumes a nonlinear relationship between the dependent variable and the independent variables. However, a common phenomenon, overfitting, usually exists in neural network modeling. In this case, the model gives a small sum of squared errors but its prediction power is not guaranteed.

Eight hundred transaction records (out sample) are taken from the period immediately after the study period that the hedonic regression model and the neural network models are fitted. The sum of squared prediction error is used to evaluate the model performance. The results are presented in the following table:

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squared Error</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>In sample</td>
</tr>
<tr>
<td>MLP(2,2)</td>
<td>3.6333</td>
</tr>
<tr>
<td>Hedonic regression</td>
<td>3.7983</td>
</tr>
</tbody>
</table>

It is shown that the out-of-sample prediction error of the hedonic price model is smaller than that of the proposed neural network model.

Conclusion

Although neural network models overcome the bias encountered in the hedonic price models, hedonic price models usually have better prediction powers.

References

EFFECT OF WEB MINING ON B2B MARKETING

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Abstract
The Indian B2B marketplace in IT sector is going through a transformation. Both existing and new players are experimenting with new Buying solutions through internet as they lack a seamless flow of information among customers, suppliers and their employees. This research paper attempts to analyse the effect of web mining on B2B marketing on the basis of certain parameters of Web Positioning, Product Availability, Layout of a web site and Ease in Accessibility. Further, analysis regarding the relationship between age, qualification, profession and income group has been done. Thus, the main purpose of the research work is to discuss the relation of various variables related to web mining, and the extent of their influence on the success of B2B marketing of a product.

Keywords : Web Mining, B2B, B2B Marketing, Internet, Internet Influence, B2B Procurement, e-Procurement, IT sector

Introduction
India is one of the major booming economies of the world and will continue so till centuries. This is of great interest to the Fortune 1000 companies as western economies are tapering off in growth rates due to competitive forces in place.

With the explosive growth of information sources available on the World Wide Web, it has become increasingly necessary for users to utilize automated tools in order to find the desired information resources, and to track as well as analyze their usage patterns. These factors give rise to the necessity of creating server side and client side intelligent systems that can effectively mine for knowledge. Web mining, the discovery and analysis of useful information from the World Wide Web, describes the automatic search of information resources available on-line, i.e. Web content mining, and the discovery of user access patterns from Web servers, i.e., Web usage mining.

Further, a person might see consumer market much bigger than business-to-business market place. In fact, B2B is much bigger than B2C markets. Whether we talk about commercial markets, trade industries, government organizations or institutions, all are involved in B2B transactions, either directly or indirectly. Some firms focus entirely on business markets, while some sell both to consumer and business markets. Satyam, TATA, IBM, Wipro, Logitech, Epson, HP, Canon, LG, for example. The Business-to-Business markets deal with organizational purchases of good & services to support or facilitate production of other goods & services, either to facilitate daily company operations or for resale.

Web Usage Mining :
Web servers record and accumulate data about user interactions whenever requests for resources are received. Analyzing the web access logs of different web sites can help understand the user behavior and the web structure, thereby improving the design of this colossal collection of resources. There are two main tendencies in Web Usage Mining driven by the applications of the discoveries: General Access Pattern Tracking and Customized Usage Tracking.

The general access pattern tracking analyzes the web logs to understand access patterns and trends. These analyses can shed light on better structure and grouping of resource providers. Applying data mining techniques on access logs unveils interesting access patterns that can be used to restructure sites in a more efficient grouping, pinpoint effective advertising locations, and target specific users for specific selling ads.

While, customized usage tracking analyzes individual trends. Its purpose is to customize web sites to users. The information displayed, the depth of the site structure and the format of the resources can all be dynamically customized for each user over time based on their access patterns.

While it is encouraging and exciting to see the various potential applications of web log file analysis, it is important to know that the success of such applications depends on what and how much valid and reliable knowledge one can discover from the large raw log data. Some scripts custom-tailored for some sites may store additional information. However, for an effective web usage mining, an important cleaning and data transformation step before analysis may be needed.

Web Mining:

- Traditional methods: Do the work for the customer.
- **Internet delivered**: Gives tools to the customer to do the work for him/herself (log: tracking, troubleshooting, FAQ) with  
  - Improved communication, Automated process and Speedier resolution of problems  
- **Customer-focused**:  
  - Make it easy for customers to do business online; Business processes redesigned from customer’s point of view; Design a comprehensive, evolving EC architecture; Foster customer loyalty by Personalized service, Streamline business processes and Own customer’s total experience

**Web Mining Functions:**
- Provide search and comparison capabilities, free products and services as well as specialized information and services  
- Allow customers to order customized products and services  
- Enable customers to track accounts or order status  
- Justifying customer service and CRM program’s 2 problems  
  - Most of the benefits are intangible;  
  - Substantial benefits reaped only from loyal customers, after several years  
- Metrics - standards to determine appropriate level of customer support  
  - Response and download times; Up-to-date site and availability of relevant content; Security and privacy; On-time order fulfilment

**Research Methodology:**
The research methodology is descriptive in nature, since the research done here describes the influence of various variables effecting web mining & marketing.

The primary data, in a descriptive type of research is taken by conducting sample survey. These are obtained by directly communicating with the respondents in the form of questionnaires. The secondary data has been obtained by doing extensive study of internet, newspaper and magazines.

**Data Collection Techniques:**
The collection of data was done by distributing the questionnaire among respondents, from different fields to have a complete idea about the perception of customers about various factors related to web mining for example web layout, accessibility, easy methods to pay, clustering of product on same site, presence of many sites for same product. A Questionnaire was developed in which the different scaling techniques like dichotomous scaling and Likert-type Scales were used. In Likert-type Scale a number statements which express either favourable or unfavourable attitude towards the give variable to which the respondents are asked to react. The respondents indicate their agreement or disagreement with each statement.

A total of 525 questionnaires were filled, where 75 were rejected and 450 questionnaires were analysed, so constitutes the sample size (450) of research. The sample was drawn from India. Through responses from respondents involved in B2B markets on various parameters, we have arrived at the findings and conclusion of the research.

**Objective of the Study:**
Main Objectives : To study the effect of web mining on B2B marketing on the basis of following parameters:
- a). Web Positioning;  
- b). Availability of Product.;  
- c). Lay out of a web site.;  
- d). Ease in Accessibility.

Sub objective: To study the significant difference due to age and qualification over the preference of e-based business transactions.

Further, to study the significant difference due profession and income group over the preference of e-based business transactions.

Thus the main purpose of the research work is to find the relation of various variable related to web mining, and the extent of their influence on the success of B2B marketing of a product.

**Limitations of Web Mining:**
- Too much data is available so it is very difficult for customers and firms to extract the required data.; Not suitable for every customer or product, there are variety products that customers prefer to buy through traditional methods.; Who are the actual sellers of these product is not apparent for customers.; Skewed toward highly educated males with high disposable income; Sometimes there is mistrust that the data may be unreliable, biased.; More knowledge is needed.

**Data Interpretation and Analysis:**

![Figure1](image-url)

The Figure 1, concludes that around 30% respondents belong to age group 18-29 year, 27% of respondents belong to 30-45 years of age, 22% of respondents...
belong to 45-55 years of age, 13% respondents are above 55 years of age and only 8% respondents are under 18 years of age.

**Figure 2.**
The figure 2 shows that most of the respondents are either self-employed (13%), in service (33%) or professionals (37%), while only 17% respondents are either home maker (8%) or student (9%).

**What are your Qualifications?**

<table>
<thead>
<tr>
<th>Qualification</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doctorate</td>
<td>21, 18%</td>
</tr>
<tr>
<td>Post Graduate</td>
<td>28, 24%</td>
</tr>
<tr>
<td>Graduate Technical</td>
<td>13, 11%</td>
</tr>
<tr>
<td>Graduate (Non-Technical)</td>
<td>28, 24%</td>
</tr>
<tr>
<td>Under Graduate</td>
<td>13, 11%</td>
</tr>
</tbody>
</table>

**Figure 3.**
The Figure 3 concludes that most of the respondents are well educated. Respondents include 11% doctorates, 36% Post Graduates, 24% Technical Graduates, 18% Non-Technical Graduates and only 11% Under Graduates.

**Which income group you belong to?**

<table>
<thead>
<tr>
<th>Income Group</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-3 Lac</td>
<td>29, 25%</td>
</tr>
<tr>
<td>3-4 Lac</td>
<td>28, 24%</td>
</tr>
<tr>
<td>4-5 Lac</td>
<td>13, 11%</td>
</tr>
<tr>
<td>5-8 Lac</td>
<td>11, 10%</td>
</tr>
<tr>
<td>&gt;8 Lac</td>
<td>24, 21%</td>
</tr>
</tbody>
</table>

**Figure 4.**
The figure 4 shows that many of the respondents have good income class. Around 10% constitutes 2-3 Lac annual income, 21% earn 3-4 Lac, 33% have 4-5 Lac annual income, 25% earn 5-8 Lac annual income and 11% have more than 8 lac income annually.

**Do you prefer traditional method of business transaction over e-banking?**

<table>
<thead>
<tr>
<th>Preference</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Agree</td>
<td>38, 33%</td>
</tr>
<tr>
<td>Agree</td>
<td>26, 22%</td>
</tr>
<tr>
<td>Neither Agree nor Disagree</td>
<td>38, 33%</td>
</tr>
<tr>
<td>Disagree</td>
<td>11, 9%</td>
</tr>
<tr>
<td>Strongly Disagree</td>
<td>15, 13%</td>
</tr>
</tbody>
</table>

**Figure 5.**
The Figure 5 shows the use of internet for Business Transactions, wherein 54% respondents agree to use internet frequently, while 31% neither agree nor disagree and around 30% shows negative behaviour for the same.

**Before purchasing do you like to have a physical feel of the product?**

<table>
<thead>
<tr>
<th>Preference</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Agree</td>
<td>38, 33%</td>
</tr>
<tr>
<td>Agree</td>
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<tr>
<td>Neither Agree nor Disagree</td>
<td>38, 33%</td>
</tr>
<tr>
<td>Disagree</td>
<td>26, 22%</td>
</tr>
<tr>
<td>Strongly Disagree</td>
<td>11, 9%</td>
</tr>
</tbody>
</table>

**Figure 6.**
The Figure 6 concludes that around 32% respondents want to do e-banking transactions, while around 48% respondents prefer traditional methods for business transactions and 34% are neutral in case of business transactions.

**Figure 7.**
The figure 7 shows that before purchasing most of the people (79%) like to have physical feel of the product, while only a few people disagree to the statement.
You are attracted by the web layout of the website?

- Strongly Disagree: 15.13%
- Disagree: 2.2%
- Neither Agree nor Disagree: 15.13%
- Agree: 52.45%
- Strongly Agree: 31.27%

Figure 8.

The Figure 8, concludes that most of the people (58%) are attracted towards the web layout of websites, while only a few (15%) disagree for the same.

You find traditional method of transactions more secured?

- Strongly Disagree: 26.23%
- Disagree: 9.36%
- Neither Agree nor Disagree: 8.73%
- Agree: 44.38%
- Strongly Agree: 31.27%

Figure 9.

The Figure 9, shows that in today’s digital age many people (38%) are confused regarding the security of Business transactions over the internet. While only a few accept (34%) e-transactions more secure and 28% respondents find traditional transactions more secure.

You find commodities on net easily accessible?

- Strongly Disagree: 31.27%
- Disagree: 10.95%
- Neither Agree nor Disagree: 51.39%
- Agree: 9.13%
- Strongly Agree: 0.17%

Figure 10.

The Figure 10, concludes that around 69% respondents do not find commodities on net easily accessible, while only 15% respondents find the commodities easily accessible.

You are disturbed by the pop up ads on net?

- Strongly Disagree: 31.27%
- Disagree: 10.95%
- Neither Agree nor Disagree: 51.39%
- Agree: 9.13%
- Strongly Agree: 0.17%

Figure 11.

The figure 11, shows that most of the people (61%) are disturbed by pop up ads on net, while only 17% behave neutral to the statement and only 22% people are not disturbed due to their knowledge of blocking the pop up ads.

You like to have related products on the same site?

- Strongly Agree: 30%
- Agree: 26%
- Neither Agree nor Disagree: 10%
- Disagree: 17%
- Strongly Disagree: 13%

Figure 12.

The figure 12, concludes that around 83% respondents want to have related products on the same site for easy comparison and getting the best available deal, while only a few (8%) don’t want to go with the statement.

You like to browse different sites for the same product?

- Strongly Agree: 34%
- Agree: 31%
- Neither Agree nor Disagree: 20%
- Disagree: 13%
- Strongly Disagree: 0%

Figure 13.

The figure 13, shows that 38% people would like to browse different sites for the same product, while 31% people do not want to browse different sites and 46% are neutral for the statement.

Conclusion:

In recent years, the growth of IT Industry in B2B markets is all set to give a breakthrough in Indian economy. With relatively competitive budgets and high profit margins, the situation calls for smart and strategic internet optimization, which can help a business to create and enhance the organizational buying.

According to the research, majority (54%, Figure 5.) of the respondents use internet frequently for business transactions and around (32%, Figure 6.) respondents prefer e-banking over traditional banking transactions, while around 34% are neutral in case of business transactions.

Further, most of the people (79%, Figure 7.) like to have physical feel of the product. While, many of the people (58%) are attracted towards the web layout of websites and only a few (15%) disagree for the same.

The Figure 9, shows that in today’s digital age many people (38%) are confused regarding the security of Business transactions over the internet. While only a few accept (34%) e-transactions more secure.
Further, the Figure10, concludes that around 69% respondents do not find commodities on net easy accessible, while only 15% respondents find the commodities easily accessible, which shows that many people are not aware of the web usage to a greater extent.

The figure11, shows that most of the people (61%) are disturbed by pop up ads on net, so pop ups should be avoided by the website developers, if possible. Moreover, only 22% people are not disturbed due to their knowledge of blocking the pop up ads.

Further, figure 12, concludes that around 83% respondents want to have related products on the same site for easy comparison and getting the best available deal, while only a few (8%) don’t want to go with the statement.

The Figure13, shows that 38% people would like to browse different sites for the same product, while 31% do not want to browse different sites. So, website developers should try to concentrate the related product information for easy search by the related target markets.

References


ANNEXURE: 1

QUESTIONNAIRE

Q1 Do You Browse internet Regularly?   a) YES  b) NO

You use internet for

Q2 a) Entertainment   b) Knowledge Purpose   c) Business   d) Official use   e) Others

The following questions are on likert scale. Questions Having ranking between 1 to 5

1 2 3 4 5

Strongly Disagree  Disagree  Neither agree nor Disagree  Agree  Strongly Agree

Please Tick the option you think is most suitable to you.

Q3 You use internet frequently for business transaction?

1 2 3 4 5

Q4 Do you prefer traditional method of business transaction over e-banking?

1 2 3 4 5

Q5 Before purchasing do you like to have a physical feel of the product?

1 2 3 4 5

Q6 You are attracted by the web layout of the website?

1 2 3 4 5

Q7 You find traditional method of transactions more secured?

1 2 3 4 5

The 9th International Conference on Electronic Business, Macau, November 30 - December 4, 2009
Q8 You find commodities on net easily accessible?
1  2  3  4  5

Q9 You are disturbed by the pop up adds on net?
1  2  3  4  5

Q10 You like to have related products on the same site?
1  2  3  4  5

Q11 You like to browse different sites for the same product?
1  2  3  4  5

Q12 Which age group you belong to?
1  2  3  4  5
Under 18  18yr - 29yr  30yr - 45 yr  45yr & 55  55 or Above

Q13 What are your Qualifications?
1  2  3  4  5
Under Graduate Graduate (Technical) Graduate(Non-Technical) Post Graduate Doctorate

Q14 Which Profession are you in?
1  2  3  4  5
Self Employed Service Student Home Maker Professionals

Q15 Which income group you belong to?
1  2  3  4  5
Below 18yr 18 – 29 yr 30 – 45 yr 45 – 55 yr Above 55yr

Thank you for your response.
A REVIEW OF APPROACHES TO ENSURE THE QUALITY OF DATA COLLECTED ON THE INTERNET

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Abstract
Different approaches have been used to detect errors in data collected on the Internet. Some of these existing approaches require prior knowledge of data. Others have to test a large number of parameter values. To address these limitations, two approaches have been recently proposed. In this paper, we review these two approaches.

Introduction
Surveys have been commonly used to understand public opinions and views. Data can be collected by interview and postal-mail. However, interviews are very costly for large samples and postal-mail surveys are slow. With the ubiquitous of personal computers, and the availability of broadband network, Internet surveys have become possible.

With the Internet, surveys can be conducted to reach out a large number of potential survey subjects at very low cost. Nevertheless, the subjects enter their responses without any assistance. Although data-type and data-range checking may be implemented together with an electronic survey form, they are not always effective given a diversity of survey questions and responses. Hence, data collected through this means may contain erroneous values. These erroneous data must be identified to ensure the survey quality. In this work, we shall focus on the detection of unsystematic errors. These errors are those that are not caused by survey design faults.

To assess the quality of data, application-dependent approaches use of prior knowledge of data and, hence, require different quality-checking procedures for different survey applications. Application-independent approaches do not need any such knowledge and provide one general quality-checking procedure for all applications. The flexibility of application-independent approaches makes them more appealing than the application-dependent approaches. However, many existing approaches require the testing of large number of parameters. In this paper, we review two recent approaches to address this limitation.

Review of Existing Approaches
Although the classical database literature considers errors in a database a serious problem (e.g., Felligi and Holt [4] and Naus et al. [13]), few studies propose ways to deal with the problem. Application-dependent approaches such as those by Freund and Hartley [5], Naus et al. [13], and Felligi and Holt [4] are all statistical-based. In detecting errors in a database, these approaches require knowledge of the data. Using these approaches, software developers may have to develop different programs for different database applications.

All application-independent approaches use clustering analysis techniques. Lee et al. [10] first applied a clustering approach. They defined a distance function to measure the difference between two records. Based on a distance matrix, they found the shortest path between a pair of records. Since the determination of the shortest path is an NP-complete problem (Storer and Eastman [17]), the shortest spanning path algorithm (Slagle et al. [14]) is used to find an approximate solution. A link between two records that is longer than the pre-specified threshold value will be broken. Records whose distances are less than the threshold value are similar and are placed in the same group. A record with no similar partners is an outlier.

Storer and Eastman [17] proposed three related clustering approaches. They used the same distance function as defined by Lee et al. [10]. The first approach is called the leader algorithm (Hartigan [7]). The leader algorithm clusters $M$ records into $K$ groups, where $M$ and $K$ are positive integer values and $M > K$. It assumes that the distance function between two records and the threshold value for group membership are available. The first record is a leader for the first group. A record is assigned to an existing group if its distance from the group leader is less than the threshold value. It becomes a new leader for a new group if its distance from every existing leader is less than the threshold value. It becomes a new leader for a new group if its distance from every existing leader is more than the threshold value.

The second approach is a modification of the leader algorithm that we refer to as an average record leader algorithm. This modified algorithm uses the average record instead of the first record as an initial leader. The leader algorithm clusters $M$ records into $K$ groups, where $M$ and $K$ are positive integer values and $M \geq K$. It assumes that the distance function between two records and the threshold value for group membership are available. The first record is a leader for the first group. A record is assigned to an existing group if its distance from the group leader is less than the threshold value. It becomes a new leader for a new group if its distance from every existing leader is more than the threshold value.

The third approach is a modification of the leader algorithm that we refer to as an average record leader algorithm. This modified algorithm uses the average record instead of the first record as an initial leader. Therefore, the algorithm can generate a solution independent of record order. On each pass, a record that is furthest from its group leader becomes a leader for a new group. If the algorithm were to produce $K$ groups, it requires $K$ passes through the data.
A Review of Approaches to Ensure the Quality of Data Collected on the Internet

The third approach is another modification of the leader algorithm. Storer and Eastman [17] called it the greatest distance algorithm. The greatest distance algorithm uses a different criterion for selecting new group leaders. First, Storer and Eastman [17] define a non-deviant cluster as one that has more than one percent of all records. A new leader is the record that is furthest from a leader of a non-deviant cluster and is greater than the average record distance from its cluster leader.

Cheng et al. [2] proposed the use of hierarchical clustering. They demonstrated that the use of hierarchical reduces the number of parameter values to test for data quality. In another work, Cheng et al. [3], they made use of a non-hierarchical clustering based on genetic search.

Data Quality

Currently, application-independent approaches use clustering analysis techniques. Clustering analysis gathers data records into groups or clusters based on their field values. Similar data records occupy the same group while dissimilar records do not coexist in the same group. Records, whose field values make them significantly different from all others, may not find themselves related to any other group members at all (see Figure 1). They are called outliers (Storer and Eastman [17]).

A data record, \( R_i \), may be represented by a vector. That is, \( R_i = (x_{i1}, x_{i2}, \ldots, x_{iN}) \), where \( x_{ip} \) is the value of the \( p \)th field of \( R_i \), for \( p = 1,2,\ldots,N \) and \( i = 1,2,\ldots,M \). A record can be classified into one of the three types (Lee et al. [10]).

Type I records: All field values in this type of record are numerical. The distance between two records \( R_i \) and \( R_j \) is defined in equation (1).

\[
d_{ij} = \sum_{p=1}^{N} c(x_{ip}, x_{jp}) / N ,
\]

where

\[
c(x_{ip}, x_{jp}) = \left\{ \begin{array}{ll}
|x_{ip} - x_{jp}| / S_p & \text{for a numerical field } p, \\
0 & \text{otherwise}
\end{array} \right.
\]

\[
S_p = \max_{1 \leq i \leq M} x_{ip} - \min_{1 \leq i \leq M} x_{ip}
\]

For example, if \( R_i = (4.5, 3.1, 0.9, -2.1) \), \( R_j = (4.1, 2.1, 0.3, -1.1) \), \( S_1 = 5.0, S_2 = 4.0, S_3 = 2.0 \), and \( S_4 = 2.1 \), then \( d_{ij} = 0.2765 \).

Type II records: All field values in this type of record are non-numerical. The distance between two records \( R_i \) and \( R_j \) is defined as:

\[
d_{ij} = \sum_{p=1}^{N} c(x_{ip}, x_{jp}) / N
\]

where

\[
c(x_{ip}, x_{jp}) = \left\{ \begin{array}{ll}
1 & \text{if } x_{ip} \neq x_{jp} \\
0 & \text{otherwise}
\end{array} \right.
\]

Type III records: Fields in a type III record may assume either numerical or non-numerical values. The distance between two records \( R_i \) and \( R_j \) is defined as:

\[
d_{ij} = \sum_{p=1}^{N} c(x_{ip}, x_{jp}) / N
\]

where

\[
c(x_{ip}, x_{jp}) = \left\{ \begin{array}{ll}
|x_{ip} - x_{jp}| / S_p & \text{for a numerical field } p, \\
0 & \text{otherwise}
\end{array} \right.
\]

\[
S_p = \max_{1 \leq i \leq M} x_{ip} - \min_{1 \leq i \leq M} x_{ip}
\]

For example, if \( R_i = (\text{black}, \text{black}, 3.1, 5.0) \), \( R_j = (\text{black}, \text{white}, 2.1, 5.1) \), \( S_3 = 4.0 \), and \( S_4 = 5.5 \), then \( d_{ij} = 0.3170 \).

Lee et al. [10], and Storer and Eastman [17] use Euclidean distances or city block distances for type I records, and hamming distances for type II records. There is no upper bound on the value of either distance function. Therefore there are a large number of possible threshold values.

To illustrate the new distance function, consider a simple example with type III records. Table 1 is a personnel database for a hypothetical company.

<table>
<thead>
<tr>
<th>Record</th>
<th>POS</th>
<th>EDU</th>
<th>MON</th>
<th>SAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>15</td>
<td>20,000</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>1</td>
<td>10</td>
<td>20,000</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>11</td>
<td>20,000</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>1</td>
<td>35</td>
<td>60,000</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>0</td>
<td>17</td>
<td>30,000</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>1</td>
<td>17</td>
<td>30,000</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
<td>0</td>
<td>16</td>
<td>20,000</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>1</td>
<td>33</td>
<td>65,000</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>0</td>
<td>16</td>
<td>46,000</td>
</tr>
<tr>
<td>10</td>
<td>0</td>
<td>0</td>
<td>50</td>
<td>80,000</td>
</tr>
</tbody>
</table>

Note

1. POS = 1, when an employee has a middle management position; and POS = 0, when an employee has a supervisor position.
2. EDU = 1, when an employee has a college degree; and EDU = 0, when an employee does not have a degree.
3. MON is the number of months an employee has worked for the company.
4. SAL is the current salary of an employee.

Matrix (4) shows the distance value between a pair of records. Note that in the matrix, \(d_{ii} = 0\) and \(d_{ij} = d_{ji}\). A small distance value between two records implies that they are similar, while a large distance value means that they are different.

An erroneous record, being so different from other records, has large distance values with other records. When records are clustered into groups, erroneous records (i.e., outliers) will not be associated with other records.

<table>
<thead>
<tr>
<th>Records</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.00</td>
<td>.52</td>
<td>.02</td>
<td>.73</td>
<td>.29</td>
<td>.29</td>
<td>.01</td>
<td>.73</td>
<td>.34</td>
<td>.36</td>
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<tr>
<td>2</td>
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<td>.00</td>
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<td>.32</td>
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<tr>
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</tbody>
</table>

When we rearrange rows and columns in Matrix (4) with the purpose of putting similar records together, we may get one possible solution shown in Matrix (5). It is not difficult to observe that there are three clusters: \{1,3,7\}, \{4,8\}, \{5,9\}. It is also apparent that Records 2, 6, and 10 are not associated with other records in any way. Therefore, they are the outliers.

<table>
<thead>
<tr>
<th>Records</th>
<th>1</th>
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<th>6</th>
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<td>.57</td>
<td>.36</td>
<td>.63</td>
<td>.53</td>
<td>.00</td>
</tr>
</tbody>
</table>

When we rearrange rows and columns in Matrix (4) with the purpose of putting similar records together, we may get one possible solution shown in Matrix (5). It is not difficult to observe that there are three clusters: \{1,3,7\}, \{4,8\}, \{5,9\}. It is also apparent that Records 2, 6, and 10 are not associated with other records in any way. Therefore, they are the outliers.

Hierarchical Clustering
Cheng et al. [2] used hierarchical clustering. A hierarchical clustering technique operates on a distance matrix. It constructs a dendogram that depicts relationships among records. Anderberg [1] discusses seven hierarchical clustering techniques. Among the seven techniques, single linkage, average linkage, and complete linkage clustering are most widely used. In this paper, we choose single linkage clustering. Note that other hierarchical clustering techniques may also apply.
While the expression for the average distance between groups is given as:

\[
\sum_{i=1}^{M-1} \sum_{j=i+1}^{M} d_{ij} Y_{ij} - \frac{1}{Y_d} \sum_{i=1}^{M-1} \sum_{j=1}^{M} d_{ij} Y_{ij}
\]

(7)

In order to achieve the objective of maximizing the homogeneity of records within groups as well as the heterogeneity of records between groups, the difference between the average distance within groups and the average distance between groups is minimized as shown in criterion (9):

\[
\sum_{i=1}^{M-1} \sum_{j=i+1}^{M} d_{ij} Y_{ij} - \frac{1}{M} \sum_{i=1}^{M} \sum_{j=1}^{M} d_{ij} Y_{ij}
\]

(8)

All clustering results obtained by using various threshold values are given in Table 2. Since each result has its own associated outliers, a selection criterion is needed to determine the best clustering result so that the most appropriate outliers can be identified. Among the eight clustering results, solution 5 is the best as the value of its selection criterion is the lowest. Based on solution 5, we conclude that records 2, 6, and 10 are outliers.

### Table 2: The possible clustering results

<table>
<thead>
<tr>
<th>No.</th>
<th>Clustering results</th>
<th>Outlier/s</th>
<th>Val. of criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>{1,3,6,7,10}, {2,4,5,8,9}</td>
<td>no outlier</td>
<td>-0.2581</td>
</tr>
<tr>
<td>2</td>
<td>{1,3,6,7}, {2,4,5,8,9}, {10}</td>
<td>10</td>
<td>-0.2775</td>
</tr>
<tr>
<td>3</td>
<td>{1,3,6,7}, {2,4,8}, {5,9}, {10}</td>
<td>10</td>
<td>-0.3439</td>
</tr>
<tr>
<td>4</td>
<td>{1,3,7}, {2,4,8}, {5,9}, {6}, {10}</td>
<td>6,10</td>
<td>-0.3897</td>
</tr>
<tr>
<td>5</td>
<td>{1,3,7}, {4,8}, {5,9}, {2}, {6}, {10}</td>
<td>2,6,10</td>
<td>-0.4431</td>
</tr>
<tr>
<td>6</td>
<td>{1,3,7}, {4,8}, {2}, {5}, {6}, {9}, {10}</td>
<td>2,5,6,9,10</td>
<td>-0.4402</td>
</tr>
</tbody>
</table>

**Non-Hierarchical Clustering**

This approach consists of two phases: obtaining a sequence of sample data records, and classifying records into groups. The first phase uses a genetic algorithm and the second phase adopts a classification criterion for grouping.

A chromosome represents an individual. For example, \(x_1 = (1011001)\) and \(x_2 = (0111011)\) are two distinct individuals. Offspring (new individuals) are generated by crossover. A crossover point will be selected randomly. The parent chromosomes will be split at the chosen point and the segments of those chromosomes will be exchanged. Using this basic crossover operator, two fit individuals may combine their good traits and make fitter offspring.

Nevertheless, the simple representation scheme described above is not suitable for TSP. Instead, three vector representations for TSP were proposed (Michalewicz [12]): adjacency, ordinal, and path. Each representation has its own genetic operators. Among the three representations, the path representation is the most natural representation of a tour. For example, a tour \(3 \rightarrow 4 \rightarrow 1 \rightarrow 6 \rightarrow 5 \rightarrow 2 \rightarrow 7\) is simply represented by \((3 4 1 6 5 2 7)\). This proposed approach uses this representation.

Initialization involves generating of possible solutions to the problem. The initial population may be generated randomly or with the use of a heuristic. In this approach, the initial population is generated randomly.

Fitness function is used to evaluate the value of the individuals within the population. According to the fitness value scored, the individual is selected as a parent to produce offspring in the next generation or is selected to disappear in the next generation.

In TSP, the total distance is calculated as the distance travelled from the starting city to the last city plus the distance from the last city to the starting city. In this data auditing problem, returning to the starting city (i.e., record) does not have any practical meanings. Therefore, the problem is simplified to the associated Hamiltonian Path Problem (HPP). As the first and last records need not be connected, we may calculate the total distance of a path instead of a tour in our fitness functions.
Let $\rho$ be the permutations of records along the row of the initial matrix. For a sequence of cities (i.e., records): $(1 \ 3 \ 7 \ 4 \ 8 \ 5 \ 9 \ 2 \ 6 \ 10)$, $\rho(2) = 3$ and $\rho(7) = 9$. The proposed approach converts the initial sequence of records (specified by the initial matrix) to a new sequence that minimizes the following fitness function:

$$\sum_{i=1}^{n} \rho(i) \rho(i+1)$$

(10)

where $n = \text{number of records (i.e., rows or columns)}$.

Parent selection is a process that allocates reproductive opportunities to individuals. There are several selection schemes: roulette wheel selection, scaling techniques, ranking, etc. (Goldberg [6]).

As the process continues, the variation in fitness range will be reduced. This often leads to the problem of premature convergence in which a few super-fit individuals receive high reproductive trials and rapidly dominate the population. If such individuals correspond to local optima, the search will be trapped like hill climbing.

Fitness ranking is used to solve the problem of premature convergence (Whitley [18]). Individuals are sorted according to their fitness values, the number of reproductive trials are then allocated according to their rank.

Several TSP crossover operators are defined: partially-mapped (PMX), order (OX), cycle (CX), and edge recombination (ER) crossover. Whitley et al. [18] found that ER is the most efficient crossover operator for TSP. Starkweather et al. [16] proposed an enhancement to ER and find it more efficient than the original operator.

Cheng et al. [3] used the EER operator. Since the EER operator incorporates random selection to a break tie, this mechanism creates an effect similar to mutation. In our approach, we do not use any mutation operator.

Mutation is applied to each child individually after crossover according to the mutation rate. It provides a small amount of random search and helps ensure that no point in the search space has a zero probability of being examined. Several mutation operations have been suggested by Michalewicz [12]. We do not plan to use mutation operation. This is because the crossover operator used incorporates a random selection in completing a legal permutation and the effect is similar to a mutation.

In each generation, only two individuals are replaced. In other words, parents and offspring may co-exist in the population. The genetic process is repeated until a termination criterion is met. In this case, we use a pre-specified maximum number of generations as a termination criterion. The same classification criteria by Stanfel [15] may be used to classify data records into groups.

**Conclusion**

In this work, we discussed the use of clustering algorithms for assessing the quality of data collected on the Internet. Limitations of some existing approaches were identified. Two recent approaches to address these limitations have been reviewed.

**Reference**


KNOWLEDGE DISCOVERY FROM FINANCIAL TEXT

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Abstract
The abundance of on-line electronic financial news articles has opened up new possibilities for intelligent systems that could extract and organize relevant knowledge automatically in a usable format. While most typical information extraction systems require a hand-built dictionary of templates and, subsequently, are subject to ceaseless modification to accommodate new patterns that are observed in the text, in this research, we propose a novel text-based decision support system (DSS) that will (i) extract event sequences from shallow text patterns and (ii) predict the likelihood of the occurrence of events using a classifier-based inference engine. We investigated more than 2,000 financial reports with 28,000 sentences. Experiments show the DSS outperforms other similar statistical models.

Introduction
There has long been a strong interest in applying computational intelligence to analysis financial data. Traditionally, attempts have been concerned with forecasting the future based on past price data. One area of limited success in financial prediction comes from textual data. Textual data contain more information than numeric data because the former not only allows us to predict the financial trends, but at the same time, provides us with justification why it is to be done. Meanwhile, the current availability of huge volumes of financial electronic text has created a pressing need for better knowledge discovery and the construction of applications for managing the knowledge that is extracted, most existing literature on financial text mining or knowledge discovery from texts (KDT) relies on identifying a predefined set of keywords. In this approach, a text is usually scanned for a specific type of event template, such as corporate acquisitions. The main goal of the approach is to fill up the values for sets of handcrafted and predefined template slots. As a consequence, the construction of event extraction templates is a fairly laborious activity. It is hard to design templates that anticipate all the possible combinations of events or objects of interest that can be described. Given the brittleness of the approach and the demand for high-level representations, i.e., not just keywords, to take advantage of linguistic knowledge, there has been considerable interest in the development of an automatic means of learning shallow event patterns from text. In this article, we propose a novel inference engine for financial text sequences prediction which brings together the benefits of shallow text processing and classifier-based inferences to produce effective knowledge discovery. In particular, our approach aims at extracting key underlying event sequences from financial texts and then hypothesizing and assessing the incoming, even new and unseen, event sequences in her prediction. Unlike other similar approaches, an inferential mechanism is developed in the engine that can extract event sequences from a collection of relevant texts, and then collate the sequences in such a manner that both explicit and implicit information can be tailored to the needs of users. The task we are addressing and the problem of predicting financial event sequence can be stated as follows: Assume we have been given a corpus of financial documents which demonstrate chains of event sequences, we will explain how to extract all the event sequences from the texts, to discover the cause-consequence pairs underlying the events, and to predict the interesting and unseen relationships between them. This article is organized as follows. Section 2 outlines our system overview, along with issues regarding text preprocessing, shallow parsing, textual information generalization and event sequences extraction. Section 3 describes a classifier-based inference engine for the event sequence prediction. An inferential mechanism is introduced into the engine to produce a set of prediction rules. Numerous features that characterize the sequences and their latent inter-event relations are captured in the engine. The system prototype has been implemented and we have conducted a series of experiments to evaluate and compare the engine with the hidden Markov model. Section 4, followed by a conclusion, provides an overview of our experimental design. We also quantify the outcome along with a detailed analysis of the results in our evaluation.

System Overview
In this section, we will first present an overview of our system and the relevant methodology used throughout this study. Our text-based DSS includes four major components that involve text preprocessing, shallow parsing, event sequence extraction and a classifier-based inference engine.
inference engine. The system architecture of the DSS is shown in Figure 1. For an incoming text, after the text preprocessing, every sentences in the text are analyzed. Textual information is then extracted via a shallow parser and semantic roles assignment in the textual information generalization module. Every piece of textual information may indicate a possible event and a series of consecutive events signal an event sequence which is decisive for the sequence prediction.

![System architecture of the text-based DSS](image)

### Text Preprocessing

The English language usually contains some redundancy and not every piece of English text delivers useful meaning. Sentences tend to include information which is not equally important. One possible way to eliminate the redundancy is to use a preprocessing technique to transform the input text into a pre-defined format. Our preprocessing consists of the sequential application of three major components in a pipeline as depicted in Figure 1. The components include tokenization, part-of-speech tagging and morpho-syntactical analysis. The output of the preprocessing is textual information which contains the most important information in the sentence and ignores the irrelevant. As shown in Figure 1, the first stage of the preprocessing is carried out by a tokenizer, which segments the input text into sentences and phrases. While punctuation signs, such as periods, may hint on the end of sentences as shown in the sentence (P1) below, they can be the end of an abbreviation, such as the word U.K., or can be used in the specification of dates, times, initials of names, or email addresses.

"The pound fell against the dollar and the euro. Reports showed the U.K. economy slumped the most in two decades and home sales dropped to the lowest level since at least 1978." -- The New York Times.

(P1)

Similarly, spaces are the delimiter of English words and they are not necessarily true to identify the word boundaries as in the case for many named entities such as The New York Times. After the tokenization, all the sentences of the text documents are then tagged with a part-of-speech tagger. Part-of-speech tagging is the task of assigning to each token its corresponding part-of-speech, i.e., its syntactic word category such as noun, adjective, verb or adverb. Different tagsets as well as different paradigms have been applied to the task. In this research, we adopt the Brill’s tagger which is a transformation-based approach in the sense that a tag is assigned to each word and changed using a set of predefined rules (Brill, 1994). The basic rationale of the tagger is that it first computes the error score of each candidate rule and then best rules with higher score are selected. The winning candidates will be added into the ruleset until no further rule has a score above a given threshold.

The final step in the text preprocessing is the morpho-syntactical analysis which is used to reduce the number of irrelevant and rare terms in the sentences. The analysis is a language-dependent unit which performs stemming and lemmatization. Stemming is the process for reducing derived words to their base form and removes all prefixes and suffixes for each token. Our dictionary-based stemmer reduces the words predicts, predicted, predicting, prediction to the root word predict. Similarly, lemmatization is the process of reducing the morphological variants of the words to their corresponding base form. All these two tasks provide the important morphological features of each word. In addition, only words with informative POS tags are included, simply because these words contain relevant and important information to support the future prediction.

### Textual Information Generalization

After the lexical processing in the preprocessing module, the textual information is further extracted in the textual information generalization module. In the module, a set of finite-state rules is applied to the sentences and produces a sequence of non-overlapping phrases as output. During the generalization, all the words in the sentences are being categorized into function or content words. While function words are words that have little lexical meaning and they usually serve to express grammatical relationships with other words within a sentence, content words which mainly include nouns, verbs and adjectives will deliver the full meaning of sentences. Technically speaking, the generalization is achieved by a shallow head-driven parser. The shallow parsing is a heuristic approach which consists of matching certain regular expressions and rules over part-of-speech tags of the input sentences. The parser begins with the identification of every potential phrasal heads of the input sentences, which is guided by phrasal patterns registered in the regular expressions. It mainly distinguishes the possible chunks of the sentences. Chunks are non-overlapping and non-recursive. Non-recursive means that chunks are not embedded within other chunks. The chunks
extracted exhibit islands of words which build up the syntactic units that include noun phrases, verb phrases, prepositional phrases, location/position phrases, date/time phrases, quantifiers and the others. In particular, the noun phrases are further categorized into proper nouns, such as the names of country, stock, currency, organization, individual, and place, are further tagged by a name entity lexicon. The parser is found to have 92% and 85% F-measure for training and testing data respectively (Chan, 2009). In addition, the generalization will also assign the extracted chunks with the type of semantic restrictions they typically refer to.

The extracted chunks, together with their headwords, syntactic and semantic information, are stored in a textual information database (TID) as shown in Figure 1. The information extracted from the two modules produces a tabulated representation for every sentence in the financial text. To clarify the above discussion, as an example, suppose for the input sentence (P1), the system will generate a tabulated representation of the sentence as shown in Table 1. In the TID, every sentence is broken down into one or more instance-attribute pairs as shown in the rightmost column of the table. The TID, without any language redundancy, provides a quick reference of the sentence in form of instance-attribute pairs, without referring back to the piece of text.

<table>
<thead>
<tr>
<th>Phrase</th>
<th>Headword(s)</th>
<th>Syntactic category</th>
<th>Semantic class</th>
<th>Instance-Attribute-Pair</th>
</tr>
</thead>
<tbody>
<tr>
<td>the pound</td>
<td>pound</td>
<td>NNP</td>
<td>currency</td>
<td>(UK-pound, fall)</td>
</tr>
<tr>
<td>fell against</td>
<td>fall</td>
<td>V</td>
<td>down</td>
<td>(UK-pound, fall)</td>
</tr>
<tr>
<td>the dollar and the euro</td>
<td>dollar, euro</td>
<td>NNP</td>
<td>currency</td>
<td>(modifer, dollar)</td>
</tr>
<tr>
<td>UK-economy</td>
<td>UK-economy</td>
<td>NNP</td>
<td>economy</td>
<td>-</td>
</tr>
<tr>
<td>skipped the most</td>
<td>skip</td>
<td>V</td>
<td>down</td>
<td>(UK-economy, down)</td>
</tr>
<tr>
<td>In two decades</td>
<td>Two decades</td>
<td>TP</td>
<td>time stamp</td>
<td>(modifier, UPR)</td>
</tr>
<tr>
<td>Home sales</td>
<td>home sales</td>
<td>TP</td>
<td>property stamp</td>
<td>-</td>
</tr>
<tr>
<td>dropped to the lowest level</td>
<td>drop</td>
<td>V</td>
<td>down</td>
<td>(properly, down)</td>
</tr>
<tr>
<td>since 1978</td>
<td>since 1978</td>
<td>TP</td>
<td>time stamp</td>
<td>(modifier, UPR)</td>
</tr>
</tbody>
</table>

Table 1: Structure of the textual information database (TID)

**Event Sequence Extraction**

Certainly, causality, temporality and spatiality are the intertwining links among all the possible events in a text when behavioral episodes are unfolded in the sentences. It is ascertained that readers attempt to tie each event or fact encountered to the prior text. To model the event sequence underlying in a text, we first assume \( U = \{u_1, u_2, \ldots, u_n\} \) be a set of \( m \) distinct instances comprising the alphabet and \( A = \{a_1, a_2, \ldots, a_n\} \) be a set of \( n \) distinct attributes which describe the possible states of the instances. An event is a non-empty instance-attribute pair \( S = (a_i, a_j) \) and an event sequence \( S \) is an ordered list of events and denoted as \( S = (S_1 \rightarrow S_2 \ldots \rightarrow S_n) \). In addition, a sequence \( S \) is a subsequence of \( T \), if all elements of \( S \) can be found in \( T \) in the same order (Zaki, 2001; Dong & Pei, 2007), no matter whether \( S \) and \( T \) are equal in length or whether one or more elements are being inserted into \( T \). For example, \( S = (A \rightarrow B \rightarrow C) \) is a subsequence of \( T = (Z \rightarrow A \rightarrow Y \rightarrow B \rightarrow X \rightarrow C \rightarrow D) \). An event subsequence differs from an event substring in that the events in an event substring must be contiguous, whereas the events in an event subsequence need not be. This explains \( S \) is an event subsequence, but not an event substring, of \( T \). Frequent event subsequences are particularly useful in two basic aspects in analyzing the financial news. First, event subsequences capture the common intertwining links among the events delineated in the financial texts. For example, the frequent subsequence \( S \) tells us that at least two events \( A, B \) will usually occur prior to the event \( C \). Second, the subsequence can also be used for predicting the financial trends or behaviors in the market (Eichinger et al., 2006).

As shown in Figure 1, our event sequence extraction is a process of identifying the relevant event sequence in the dataset and discarding the irrelevant ones. In this research, we shift our event sequence extraction to the problem of approximate matching of event subsequences which specify in the user query \( S \) with all the event sequences \( T \) stored in the textual information database. Given two event sequences \( S \) and \( T \), a longest common subsequence \( Q = \text{LCS}(S, T) \) is a longest possible subsequence with events in \( Q \) also being the events in \( S \) and \( T \) and they are in the same order (Crochemore et al., 2007; Gusfield, 1997). We compute the LCS at the basis of the computation of an optimal alignment between the two sequences. The process utilizes a technique called dynamic programming in which the production of an alignment between two sequences is based on the computation of the edit distance between them. The edit distance, also called the Levenshtein distance, between two sequences is defined to be the minimum number of edit operations to transform the sequence from \( S \) to \( T \). The edit operations include change, insertion and deletion. It is an efficient method of identifying the subsequences with closest match, even with some unknown gaps. It is out of the scope of this paper to further explain the algorithm in details, however, interested readers could refer to the above literatures for references. To put it in a nutshell, for a given user input event sequence \( S \), we attempt to extract all the possible relevant sequences in the database. Each extracted event sequence is in form of a series of instance-attribute pairs. Certainly, the attribute of each event in the sequences aren’t independent, but rather the attribute of each event depends on the preceding, or subsequent, event in the sequence. For example, the attribute \( down \) in the instance \( property \) relies on the attribute of its preceding instance \( UK\text{-economy} \) in that event sequence shown in the...
sentence (P1). It is interesting to know: Do all extracted event sequences originated from the input \( S \) follow some particular patterns? Are they on the rolls of a particular family? If confirmative, the frequent event sequences of \( S \) reveal the strong association among the events and suggest a clue in the prediction. Next, we will clarify how the event sequence prediction is being modeled as an extrapolation of underlying inter-related chain of attributes from which the actual events shown in the sequence are generated.

Machine learning methods often play a key role in sequence prediction because it is extremely difficult and costly to encode the prescribed prediction models manually. The general form of probabilistic model, called a hidden Markov model (hereafter, abbreviated HMM), has been among the most conventional and accurate methods for situations where certain sequences can be generated from different major states. While HMM is useful when one can think of the underlying attribute chain generates the surface events probabilistically, we explore a decision tree classifier in identifying the most likely sequence of attribute chain that could have emitted the given event sequence (Quinlan, 1993; Li, 2005). One of the advantages of using the decision tree classifier is that sequence prediction generally requires an interpretable model. While some other classifiers are far more enough to produce an accurate prediction, it is absolutely desirable for the classifiers to be explanatory. That is, any prediction model should and could provide a qualitative understanding of the relationship between the joint values of the input variables and the resulting predicted values. As opposed to other classifiers, such as probabilistic or neural network approaches, the decision tree classifiers provide meaning and justification to every verdict they returned in their prediction. The hierarchical structure of a decision tree also renders a relatively fast construction and produce interpretable model.

**Classifier-based Inference Engine**

Our inference engine is designed to learn a set of prediction rules from the event sequences, so that they can be used to classify or predict the likelihood of the occurrence new observations. A set of classifiers and rules are learnt from the training data in form of \( n \)-tuple. For each tuple, we include properties of the current event as well as information about its preceding and subsequent events in the training data. The assumption here is that the events in the sequence are not independent, but they are mutually related. One can model this dependence implicitly by including information about the preceding and subsequent events. This tactic is inspired by the methods in natural language processing for tasks such as part-of-speech (POS) tagging, where tags of both preceding and subsequent words are used as features to predict the current POS tag. In this inference engine, for any attribute \( a_i \) of the event \( S_i \) in the event sequence, we consider the following feature set.

- The attribute \( a_i \) of the current target event \( S_i \).
- The attributes of two preceding events, \( S_{i-1} \) and \( S_{i-2} \).
- The attributes of two subsequent events, \( S_{i+1} \) and \( S_{i+2} \).
- The relative position of the event \( S_i \), found in the event sequence.
- Two major information-theoretic functions, mutual information and likelihood ratio, in quantifying the collocation of the attributes.

To train the classifier to learn the current target attribute, we provide the attributes of its neighbors in the event sequence \( S \) in the learning. The relative position of the event \( S_i \) in the sequence \( S \) is calculated by dividing the absolute position in the sequence by its length. Two kinds of information-theoretic functions, namely, mutual information (MI) and likelihood ratio (LR), are applied in quantifying the collocation of events. They quantify the collocation disparity between the events around the target event. MI of two random variables is defined as a quantity that measures the mutual dependence of the two variables. It is roughly a measure of how much one event tells us about the other. It compares the probability of observing events \( X \) and \( Y \) together to the probability of observing them by chance. The mutual information between particular events \( X, Y \) is defined in Eqn.(1).

\[
MI(X, Y) = \log \frac{P(X, Y)}{P(X) \times P(Y)} \quad \text{Eqn.(1)}
\]

On the other hand, the log LR is a formalization of independence which provides another good measure for the collocation between the two events. While there is evidence that sparseness is a problem for MI, the likelihood function seems to be a good complement to it. In applying the LR, the two alternative hypotheses are examined.

\[
H_0: P(Y|X) = p = P(\neg Y|X) \\
H_1: P(Y|X) = p_1 \neq p_2 = P(\neg Y|X) \quad \text{Eqn.(2)}
\]

If \( c_1, c_2, \) and \( c_{12} \) are the frequencies of events \( X, Y \) and the event \( X \) followed by event \( Y \) and \( N \) is the total number of events in our training, the log of the LR is calculated as follows:
log \( LR \) = \( \log L(c_{i2}, c_{i1}, p) \) \\
+ \( \log L(c_{i2}, c_{i1}, N - c_{i1}, p) \) \\
- \( \log L(c_{i2}, c_{i1}, p) \) \\
- \( \log L(c_{i2}, c_{i1}, N - c_{i1}, p) \)  
\text{Eqn.}(3)

Both mutual information and likelihood ratio reflect the event co-occurrence information in a continuous function instead of discrete values shown in the feature set. Training of the inference engine proceeds as follows. Each attribute in the event sequence produces a training example for the decision tree construction. Given a sequence, the feature set is computed with respect to each target attribute noise. Since the attributes of the adjacent events are unknown particularly for the subsequent events \( S_{i+1} \) and \( S_{i+2} \) as mentioned in the feature set, the majority of the features cannot be evaluated. In other words, the classifier receives a noisy set of features as input due to the attribute dependence on the unknown attributes of their adjacent events. This situation is remedied in two stages in our inference engine. In the first stage, the default one is to use as the baseline attributes, i.e., the most frequent attribute for the event found in the training examples. Although this baseline attribute is clearly far from perfect, it provides a rough estimation, associated with an uncertainty, to all unknown attributes. In our second stage, instead of predicting all event attributes from the beginning of the sequence till the end consecutively, our prediction starts from the attributes with highest uncertainty in the first stage, with the hope that its adjacent events which have higher confidence will shed some light on the current prediction. All the features with attribute dependence in the tree classifiers are all activated during the prediction. All the event attributes in the sequence will be evaluated from the highly unresolved to the most promising ones in one complete cycle. Under this second stage, because of the attribute dependence, the adjacent attributes will surely be altered if the current attribute are being modified. In the same reason, the current attribute will also be affected by the newly altered adjacent attributes. This intertwined cause-and-effect chains in the prediction mechanism are settled by allowing the whole prediction mechanism to repeat iteratively for several cycles until the event sequence becomes steady. An event sequence is defined as steady if there is no further modification of attributes during the prediction. Similarly, the certainty factor of attributes predicted by the classifier in the \( i \)-th cycle will define the precedence order of event attributes in the \( (i+1) \)-th prediction cycle. Table 2 below shows the pseudocode of the inferential mechanism which describes the main rationale behind the event prediction in more detail.

<table>
<thead>
<tr>
<th>s</th>
<th>( c_{i1} )</th>
<th>( N - c_{i1} )</th>
<th>p</th>
<th>( \log L )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

As shown in Table 2, in order to take into the account of the effects from its adjacent events, the vote \( v_n \) of the attribute class \( n \) relies on the certainty of its neighbors. In other words, the vote will always be diminished by its neighbors, even though a large certainty factor may be deducted in the classifier. This is somewhat unreasonable and the situation will also be deteriorated as the certainty factors are propagated along the computational chain before the final verdict becomes steady. To maintain the impacts of its adjacent events without withering away the deduction from the classifier, a normalized certainty factor (NCF) is defined to alleviate the possible negative impacts during the normalization as shown in the mechanism. Without the normalization, the certainty factors will get smaller.
and smaller after each prediction cycle. The NCF at position $j$ of an event sequence is defined as follows.  
\[
NCF_j = \left( \frac{CF_j - CF_{\text{min}}}{CF_{\text{max}} - CF_{\text{min}}} \right) \times (1 - LB) + LB \quad \text{Eqn.(4)}
\]

where
- $CF_j$ be the certainty factor of the attribute at position $j$.
- $CF_{\text{min}}$ be the minimum certainty factor found in the sequence.
- $CF_{\text{max}}$ be the maximum certainty factor found in the sequence.
- $LB$ be the lowest bound of the NCF.

**Experiments and Evaluation**

We have conducted an experiment to measure the performance of our approach in predicting the financial event sequences and make a head-to-head comparison with a statistical model. More than 28,000 financial sentences from 2,000 financial reports have been analyzed. They are all extracted from two financial websites, www.bloomberg.com & www.quanmnet.com which is a popular financial portal. Quanmnet is supported by a team of professional financial analysts. It is well-known for its independent financial research and analysis on Hong Kong’s stock market. They are all used for gathering the statistics in analyzing sentence patterns in financial events. All the sentences are then subject to our shallow parsing strategy and over 70% of the sentences can be further analyzed and being parsed into the event sequences as described in Section II. Each sequence contains at least 4 events.

Statistical models of sequence prediction, particularly the Markov chain models, have been extensively studied due to their elegant theoretical framework. However, while each state of Markov chain models corresponds to an observable event which may be too restrictive to be applicable to many problems of interest, it is more general to extend the concept of Markov chain models to include the case where the observation is a probabilistic function of the states (Rabiner, 1989; Skounakis et al., 2003). The resulting model is called a hidden Markov model (HMM). The word hidden in the name indicates that the sequence of observed events, especially in the context of hidden Markov models (Forney, 1973). Table 3 below shows our evaluation of the Viterbi algorithm using different set of parameters. The bigram model looks at pairs of events and uses the conditional probability that an event $S_i$ will follow another event $S_{i-1}$. The trigram model uses the conditional probability of one event given the two preceding events. Our forward induction is the prediction that starts from the first event of a sequence, and then infers consecutively till the end. The backward induction is similar to the forward counterpart but starts at the end of the sequence and sweeps backward through the events in the sequence. Additionally, in any real world predictions, we cannot guarantee that the complete information about the event sequences are all reflected in our training cases, we address the event prediction problems with the open world assumption. That is, it is allowed to have some unknown events found in the testing cases, but absent in the training cases. Hence, we define in-Event (IE) be the events that can be found in our training data while out-of-Event (OOE) is an event that are unknown to the training data.

<table>
<thead>
<tr>
<th>No.</th>
<th>Different combinations using Viterbi Algorithm (HMM)</th>
<th>Total</th>
<th>IE</th>
<th>OOE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bigram-forward induction</td>
<td>77.25%</td>
<td>82.67%</td>
<td>21.82%</td>
</tr>
<tr>
<td>2</td>
<td>Trigram-forward induction</td>
<td>76.64%</td>
<td>81.90%</td>
<td>22.78%</td>
</tr>
<tr>
<td>3</td>
<td>Bigram-backward induction</td>
<td>77.60%</td>
<td>83.40%</td>
<td>22.22%</td>
</tr>
<tr>
<td>4</td>
<td>Trigram-backward induction</td>
<td>76.14%</td>
<td>81.10%</td>
<td>25.39%</td>
</tr>
<tr>
<td>5</td>
<td>Bigram-forward + Bigram-backward</td>
<td>78.87%</td>
<td>84.40%</td>
<td>22.21%</td>
</tr>
<tr>
<td>6</td>
<td>Trigram-forward + Trigram-backward</td>
<td>77.06%</td>
<td>82.11%</td>
<td>25.21%</td>
</tr>
<tr>
<td>7</td>
<td>Bigram-forward + Bigram-backward + Trigram-forward + Trigram-backward</td>
<td>79.63%</td>
<td>85.26%</td>
<td>24.21%</td>
</tr>
</tbody>
</table>

Table 3: Results of the HMM in event prediction, where Total, IE and OOE represent the overall accuracy in all events, in-events and out-of-events respectively.

While the increase of $n$-gram does not show any significant improvement over the accuracy as compared with the bigram counterparts, three different combinations in studying their synergy effects are further investigated as described in trials 5-7. For example, in trial 7, we incorporate the forward and backward probabilities for both bigrams and trigrams during the predictions. However, the results show that it is not necessary to produce any significant positive synergy effect, even though there involve heavy computational resources. To justify our approach and evaluate the performance of our text-based DSS, we compare our system using several prototypes which include,
Model-1: a baseline model in which attributes are estimated using the most frequent attributes for the events found in the training cases;
Model-2: the most outstanding combination of HMM, i.e., trial-7, as shown in Table 3;
Model-3: first approximates by Model-1, and then refines using our text-based DSS;
Model-4: first by Model-2 and then refined by our DSS.

Figure 2 summarizes the evaluation results of the above four models. As shown in the figure, the overall accuracy of Model-3 and Model-4 are higher than that of the one-component models. While all the models, except Model-1, demonstrate a strong predictive power for the in-events (IE), our DSS model exhibits a total accuracy (Total) higher than the HMM. Specifically, the DSS model appears to have a significant improvement on the predictive power for the OOE with the average over 50% in Model-3 and Model-4. The differences between the Model-2 and our DSS are statistically significant. Another important point of comparison is that the DSS is trained with the features described in Section III. HMM, on the other hand, computes the probability of any sequence of events simply by finding the likelihood of events and multiplying the transition probabilities together. On the other hand, the learning and predicting mechanism in our DSS relies on the interdependences between the target attribute and the features. These features reflect the properties of the preceding and subsequent events as well as their collocation information. All these features are all considered as a whole in every single instant during the training of the inference engine. As a result, it is not surprising that our DSS outperforms the HMM.

Next, we experiment with the sensitivity of the inference engine to several options of labeling the training data. In Model-4, all features, including the target feature, of the training instances are computed in terms of actual attributes of the events in the training event sequences. In our sensitivity analysis, we gradually replace the actual attributes in the training cases by the most probable attributes for the events found in all training examples, whereas the targets still correspond to the correct target attribute. In other words, the quality of the training data is deliberately deteriorated to an extent that they are only approximated by a maximum likelihood estimation based on the probability density function. It is not surprising the performance of the engine begins to get worse as compared to the one trained from the actual datasets.

However, as shown in Figure 3, the degeneration is slow-crawling with the total overall accuracy drops gradually from 89.09 to 71.34%. It is interesting to note that the performance of the engine using 100% of maximum likelihood estimation (MLE) for the actual dataset is still acceptable, at least it is much better than the performance of our baseline model in Model-1. In other words, a “simple-minded” inference engine using 100% MLE performs reasonably well in predicting the event sequences. This tolerance characteristic explains why we can alleviate any possible lack of inter-dependence features by adopting the maximum likelihood estimation in our OOE prediction.

Conclusions
The current one-size-fits-all design in knowledge discovery from text (KDT) ignores the fundamental variety of domains which may involve a fairly laborious annotation. Thus, most approaches are forced to depend on impoverished text models like bags of words or n-grams. As a result, the predictions that they are making ought to be based on the meanings of those words in context. That lack of semantics causes misinterpretation of meaning that results in failing to extract the relevant knowledge from text. On the other hand, in most of the current KDT systems, the information that is sought must be explicitly stated, but not implied, in the text. This lack of inferential capability can pose significant
problems when knowledge is extracted from documents that expect the reader to draw simple deductions. In this research, we have developed an inferential mechanism in a text-based DSS that can extract knowledge from a collection of relevant texts. The DSS does not rely on any bag of words, but on a shallow language model. As a consequence, the incorrectly conflated information is excised and the proper coreference of event sequence can be accomplished. In addition, instead of learning from a limited set of hand-crafted rules or templates, our DSS collates the prior event sequences in a manner that both explicit and implicit knowledge could participate into the inferences. This mechanism provides a robust and efficient means to handle the predictions in financial text which demonstrates a high propensity that the extracted event sequences are being finite at various level of analysis. Certainly, further investigation has to be conducted to extend the work to a fully unrestricted functionality text domain. However, we have demonstrated one of the alternatives in the knowledge discovery from real text.

Acknowledgements
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References
A RESEARCH REVIEW ON ENTREPRENEURIAL AND INTRAPRENEURIAL CHARACTERISTICS

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Abstract
The enthusiasm for entrepreneurial management in the past two decades has led to a definition for the boundary and legitimacy. Entrepreneurial research is no longer focused on the individual level of characteristic traits, but extends to multi-level analysis, e.g. prior experience, corporate culture, social relationships, and educational background. The paper intends to review researches on entrepreneurs and intrapreneurs for the purpose of identifying the similarities and differences between the two. We found that entrepreneurs tend to be higher risk taking, and uncertainty bearing, and intrapreneurs are better in communication and leading techniques. This paper tries to review, organize, and analyze the previous research contributions and hopes to provide managers with a practical reference for personnel filtering, training, and policy making as it gives employees an advanced mechanism for self-evaluation as a potential entrepreneur/intrapreneur.

1. Research Background:
With rapid movement of economies, technologies, and competitions in the business world, entrepreneurial management has turned out to be much more complicated than before. About 50% of new ventures were terminated due to the environmental factors (Tsai, et al., 2008). The drop in the survival rate of new businesses, plus the 2008 Global Financial Crisis has highlighted the difficulties of establishing new ventures. As a result, employees are not sanguine about their future and often plan to reserve their entrepreneurial spirit for three years to wait for the investment could be safer. So, global entrepreneurial action is shrinking (GEM, 2008). The scale of entrepreneurial firm remains small for risk minimizing. Statistics show investment capital dropped as well as the total number of enterprises (GEM, 2007 and 2008). The scale of entrepreneurial firm remains small for risk minimizing. So, this research intends to review the previous and current entrepreneurial studies to identify the direction of entrepreneurship and intrapreneurship. When the entrepreneurial firms were downsized, turn-over rate increased, core competitiveness dropped, pressure increased, and entrepreneurial action is no longer the only option. The complexity of economics, culture, society, competition, finance, technology and the nature has moved rapidly with the times, and entrepreneurship is not favorable for business development. Intrapreneurship, acting as the strategic alternative for organizational revolution and improvement for innovative development or diversification, has played important role as another option for business survival (Chambeau and Mackenzie, 1986). Intrapreneurship breaks the managerial bureaucracy and hierarchy and intends to utilize the internal resources efficiently; borrows the wisdom from managers; takes the free ride in the market, and eliminates the ineffectiveness of ossification. It is another choice for employee in career development also. Intrapreneurship could also face the challenges of resources shortage, opportunities distinction, market uncertainty, weak social networks, inferior entrepreneurial team support, or managerial problems. Still it is a potent tool. When the industrial plight has not been eased by the governmental policies, then, such new economy that transformed from classical economic pattern remains high competitiveness (Wennekers, 2006). So, intrapreneurship acts as a path to pervasive innovation and is a driver to make business diversify and remain aggressive. When uncertainty and risk from the environment are the major threats for entrepreneurs, for intrapreneurs they can be
advantages.

2. Methodologies

This research searched through ASP Data Base as the major resource and we collected three types of information. First, we collected articles that were listed in leading journal of entrepreneurial management: Journal of Business Venturing, Entrepreneurship Theory & Practice, and Journal of Small Business Management. Second, we gathered related research papers that were published in the managerial journal’s special issues. Third, we searched on the key words, “entrepreneurial”, “entrepreneurial management”, “entrepreneurship”, “new venture”, “new venturing”, “entrepreneur”, “intrapreneurship”, “intrapreneurial management”, “intrapreneur”, “corporate venture”, “small business venturing”, and “internal entrepreneurship.” Fourth, we checked book reviews and comments that are related to entrepreneurial/intrapreneurial characteristics. Fifth, we collected information from published books that are related to entrepreneurial/intrapreneurial characteristics. After collecting the data, we tried to organize the papers by reading the content and dividing them into different categories. Then, we intended to conclude the development direction and doing a comparison between entrepreneurs and intrapreneurs, and provide suggestion for managers, employees, and potential entrepreneurs/intrapreneurs.

3. Literature review

3.1 Entrepreneurial characteristics development

While some scholars of entrepreneurial management have tried to distinguish entrepreneurs and non-entrepreneurs based on characteristics traits (Gartner, 1989; Chell et al, 1991); others have used demographic variables like genders, age, or races to distinguish the difference between different types of entrepreneurs, e.g. female or male (Tienne and Chandler, 2007); minorities or non-minorities (Johnson and Thomas, 2008); entrepreneurs with or without technical background (Corman, Perles, and Vancini, 1988). If we define entrepreneurs from the perspectives of the organization, entrepreneurship represents external individual venture and intrapreneurship represents internal organizational evolution (Pinchot, 1998). If we focus on the methodologies, entrepreneurial management can be divided into qualitative, quantitative, and financial modules research. Until now, entrepreneurial researchers have focused more on the study of external entrepreneurial characteristics, and the reason is because the academic study of entrepreneurship is a relatively new research field that needs to clarify its boundaries (Busenitz et al., 2003).

Despite this, some scholars have concentrated on gender, age, educational background, or other demographic variables as the media for researching entrepreneurial characteristics, and some have focused on behavioral or psychological aspects. Back in the era of S. A. Schumpeter (1934), entrepreneurs were considered as innovators as well as new venture founders. Most of the researchers were studying additive variables, either from personal needs to achieve, motivation, educational background, or prior experience. So, there are studies that emphasized the personal satisfaction through entrepreneurship (Hisrich, 1988), interpolated from self-achievement. Different aspects and interpretations did not lead to mutual ground when demographic, psychological, and behavioral attracted more attention. Entrepreneurial researchers particularly emphasized the psychology and characteristics because they are quite manifest to distinguish non-entrepreneurs from entrepreneurs, the latter believed having these characteristics, behaviors, and attitudes (Tsai, Hsieh, Lee, and Hsu, 2008). Moreover, action is also a practical measurement of evaluating entrepreneurs and non-entrepreneurs, it evokes the attention of the academic scholars that consider an entrepreneur as an innovator (Schumpeter, 1934: Amo and Kolvereid, 2005); or as an individual who recognizes, discovers, evaluates, and utilizes opportunity (Shane & Venkataraman, 2000); as a person who has vision and intention and, grasps opportunity (Yee, 1991). Acs & Audretsch (2003) analyzed the subject from a psychological perspective, and found out that, entrepreneurs have certain risk preferences, psychological tendencies, and characteristics traits.

3.2 Intrapreneurial Characteristics Development

On the other hand, intrapreneurs are quite distinct showing different character traits from entrepreneurs and non-intrapreneurs (Mueller and Thomas, 2000). Intrapreneurs are dissimilar to entrepreneurs because the organizational structure, power of control, and ownership varies. Moreover, the influential factors of forming characteristics are different since the role-acting, responsibility, and task are not the same. In 1985, Kanter invented the term -Corporate Venture- to distinguish the internal venture from the external one, and thus, corporate venture gained a unique position. So, when Gifford Pichott (1985) indicated intrapreneurship in his research that was defined as "corporate policy to
encourage current employee conducting entrepreneurial activities” (Kuratko & Montagno, 1989). Until now, there are no plenty studies about intrapreneurial characteristics because intrapreneurship is considered as the newly developed research field as well as an organizational strategy.

When intrapreneurship is considered as a strategic plan, a significant portion of intrapreneurial researchers focus on the issues of sponsorship, support for the colleagues, relationships with the parent organization, empowerment, and commercial models of running the established venture. Intrapreneurial research not only extends its antenna to the discussion of relationship cross the organization, but also goes into the discussion of supportive system in organization. Intrapreneurship acts as an innovative and revolutionary character that tries to break the status-quo and hierarchy (Pinchot, 1998). It will of course be treated differently because it was created to change the ossification (Simon et al., 1999) and it is quite reasonable to be considered as part of the organizational transformation (Colin, 2000). Therefore, intrapreneurial characteristics research is relatively sparse and some of the managers are borrowing the ideas from entrepreneurial characteristics.

Peter & Waterman (1982) indicated that the index for evaluating entrepreneur and intrapreneur is quite similar, so they are the twins (Badiru, 2009)—similar outlooks with different characters. Contrary to this, some scholars argue that the role playing, resources, environmental circumstance, financial risk, power of control of entrepreneurship and intrapreneurship, so the traits of characteristics are different (Luchsinger & Bagby, 1987). There is much more pressure, risk, and responsibility taken for external entrepreneur than intrapreneur. On the other hand, the intrapreneur, a system reformer, usually builds up the business with a consistence direction from the parent organization (Block & MacMillan, 1993), and is not expected to be overly aggressive and ambitious. Intrapreneur has to recognize the innovative ideas than opportunity, maximize financial support and leverage resources (Amo & Kolvereid, 2005), but with moderate risk (Altinay, 2005). Their roles could be very different from entrepreneurs same as their characteristics varied.

4. Comparison of entrepreneurial and intrapreneurial characteristics
As the difficulties of entrepreneurship increased intrapreneurship has become an option for managers to take for reserving employees, maintaining core competitiveness, managing knowledge, technology innovation, and employee screening. Intrapreneurship acts as a mechanism for most of the employees to break the status-quo and to fight bureaucracy; is the dream for workers with entrepreneurship.

The embryo of intrapreneurship is the project that runs in cooperation by crossing-departments and enjoys the support and assistance from top-managers and colleagues. As it evolves, intrapreneurs transform from project managers who utilize corporate resources, social networks, industrial experience, and market advantages to establish a new firm under the control of the sponsored corporation and top managers. Practically, the intrapreneurial scenario is different no matter in task-orientation or ownership-orientation. Until now, previous academic studies that focused on entrepreneurial characteristics traits had extended to the traits of intrapreneurial characteristics.

When the industrial environments have changed quickly, intrapreneural candidates are important since it increases the possibility of success based on the point of resources-based theory (Block and MacMillan, 1993; Green et al, 1999). When the scholars make interpretation from the perspective of environments, a creative atmosphere for intrapreneurs to appreciate and to stimulate innovative ideas is obvious (Kanter, 1984). If intrapreneurship intends to be declared as an independent study field, the researchers have to prove that it has different formation and background compared with entrepreneurship in influential environments, employees, strategies, and organizational transformation. Therefore, this research is designed to exam the following aspects.

4.1 Role playing of entrepreneur and intrapreneur
When the academic literatures on entrepreneurial characteristics are quite extensive (Timmons, 1989; Vand den Flier, 1990; Wong et al, 2005; Nandram and Samson, 2000), relatively the intrapreneurial characteristics studies are insufficient (Simon et al, 1999: Luchsinger and Bagby, 1987). In fact, intrapreneurs, sponsored managers, the parent organization, and supervising department are the major decision makers who control the direction of investment and future development decisively. Theoretically, the intrapreneur is a subordinate and the entrepreneur acts as a boss. When the purpose of studying entrepreneurial characteristics is to attribute those characteristics that are relevant to a successful entrepreneurial action (Stormer, Kline, and Goldenberg, 1999), researching intrapreneurial characteristics can help the managers to better understand nascent intrapreneurs.

Since intrapreneurship is a possible alternative
for the top manager to choose, it is an important mechanism for managers to cite while designing the training program, recruiting employees, and setting promotional policies. Therefor, intrapreneur without absolute power of control, truns out to have a unique mindset. Regarding roles, Singh (2006) believed that the intrapreneur is a saviour for a declining organization, while Teltumbde (2006) considered entrepreneur has no consultant, and the other has. Marcus and Zimmerer (2003) believed that the intrapreneur is a reformer and the entrepreneur is an initiator even though both of them are seeking opportunities to make dream come true. But Intraperneurs are recognizing innovative ideas better than opportunities distinction.

Table 1: Comparison of role playing between entrepreneurs and intrapreneurs

<table>
<thead>
<tr>
<th>Comparative roles</th>
<th>entrepreneurs</th>
<th>intrapreneurs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk and uncertainty accepter</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Decision maker</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Industrial leader</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Innovator</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Organizer/coordinator</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Contractor</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Arbitrager</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Resource allocator</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Financial capital supplier</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Manager/superintendent</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Proprietor</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Employer</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

Organized by this research

Table 1 indicates that intrapreneurs differ since the comparative roles were developed from the entrepreneurial point of view. It shows that their roles are similar in four out of the twelve criteria. It could be necessary to study intrapreneurial roles in an organization since they are different.

4.2 Comparison of Research Issues

“Who is the entrepreneur?” is key statement to help us understand entrepreneurship better (Shane & Venkatraman, 2000), therefore, it also acts as the major issue. Gartner (1985) believe that there are four categories regarding research issues: entrepreneur, environment, organization, and process. Ucbasaran, et al (2001) indicated that entrepreneurial theory, types of entrepreneurs, process, organization, external environment, and performance are the most important aspects. Timmons’ (1999) list was: entrepreneur, opportunity, team, and resources are the key factors that will determine whether the venture is going to be successful or not. Liu and Hsieh (2003) took five aspects as the essential aspects: entrepreneur/team, opportunity, resources, environment, and performance. Busenitz et al, (2003) indicated the utilization of favorable environmental condition to survive new business while Elfring & Hulsink (2003) emphasized social network theory. The entrepreneurial action can also be studied through the entrepreneur who will determine to take action or not based on the evaluation of risk and uncertainty (Miller, 1983), proactive people seek the opportunity and overcome the challenges. There are some differences, but overall, the entrepreneur is always in the central position in terms of entrepreneurial research.

Although there are a few papers that discussed intrapreneurship, we believe that there will be supportive researches in the future. Intrapreneurship is a newly emerged topic, and still has room in framework building and boundary clarification. Carrier (1996) indicated that there are four influential factors which will determine the intrapreneurial success: external environment, intrapreneur, organizational objectives, and internal environment. Hayton and Kelley (2006) focused on different issues: intrapreneurs, opportunity, social network, and process. When businesses choose intrapreneurship as an option to reserve core knowledge that is embedded in employees, the analysis of intrapreneurial characteristics will help to predict the performance of intrapreneurship (Sykes, 1992). The other essential element will be appropriate corporate strategy (Teltumbde, 2006).

4.3 Research Aspects Comparison

Until now, intrapreneurial has limited researches just as table 2 showed. From the comparison from research aspects, we intended to explain that their research focal points are different in some aspects. Especially, those aspects are inter-reacted with each other. Since they are different type of entrepreneurs, they acted differently and worked in different organizational structures with different believes and job codes. Since the dissimilar organizational structures, they face different degree of risk and uncertainty. Intrapreneurs are not actually identifying the opportunity, but the innovative ideas that they consider might have a
future (Hewison and Badger, 2006). Therefore, the whole entrepreneurial process will be discrepancy as well as the outcome.

Table 2: The different aspects of entrepreneurship and intrapreneurship

<table>
<thead>
<tr>
<th>Aspects</th>
<th>entrepreneur</th>
<th>intrapreneurship</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entrepreneur type</td>
<td>Independent external entrepreneur</td>
<td>Transformed from Employee to intrapreneur</td>
</tr>
<tr>
<td>Theory</td>
<td>Cognitive theory</td>
<td>Resources-base theory/Reinforcement Theory</td>
</tr>
<tr>
<td>Organization</td>
<td>Register under the independent owner</td>
<td>Attach to the current business</td>
</tr>
<tr>
<td>External environments</td>
<td>Technological, financial, economics, social-cultural political-legal, human-resource, competitive environments</td>
<td>Technological and competitive environments get more attention. Internal environments are much more important.</td>
</tr>
<tr>
<td>Opportunity</td>
<td>Recognize, identify, utilize by the entrepreneurs with prior knowledge</td>
<td>Recognize and identity ideas and intend to persuade the top manager to utilize</td>
</tr>
<tr>
<td>Process</td>
<td>Complicated and needs more evaluation before start up</td>
<td>Persuasion and communication with parent corporation are the first priority, resistance and pressure from the colleagues could be high</td>
</tr>
<tr>
<td>Performance/outcome</td>
<td>Monopolistic profit and achievement</td>
<td>Sharing the glory</td>
</tr>
</tbody>
</table>

Organized by this research

However, contemporary study of intrapreneurial characteristics is established on the existed entrepreneurial researches and extending to different perspective, e.g. experiences, educational background, or gender even. Although intrapreneur are still having the traits of risk-taking, needs to achieve, internal-locus-of-control, and high autonomy; but still the degree of those characteristics are differently interworked. The major reason for employees to choose internal venture instead of starting up an external enterprise reveals some constraints either in environmental consideration or personal preference. Even previous researcher had considered intrapreneurs as employees who are not trained intentionally, or recruited differently at the first beginning (Altiny, 2005). In other words, nascent intrapreneur is formed under the corporate culture and self-identification, not nature born. Current research found out that organizational and policies are two important factors which will determine the success of intrapreneurship, so training program and employee education are crucial. (Marcus and Zimmerer, 2003)

4.4 Characteristics comparison

Practically, we found intrapreneurs are quite in between in terms of risk-taking and motivation. Intrapreneurial candidate has the option to choose while entrepreneur has no room to surrender if the new business is defeated. Entrepreneur has more responsibility while intrapreneur was protected under the umbrella of the parent organization. They are different type of leaders who are supposed to have different talents. Table 3 provides the explanation for researchers to take entrepreneurs as external venture founders only since intrapreneur is not viewed as a new enterprise establisher, but an employee who was given order to diversify a new business. It could be a project, not a new venture at the start-up period. There is no doubt; entrepreneurs are facing more challenges from the external environments while intrapreneurs are dealing with more sophisticated tasks and responsibilities under different influential factors. Even they both have needs to achieve, but entrepreneur has to success by no means. On the contrary, intrapreneurs are trained to be more professional in managerial techniques with the attitude of compromised patience. They are not the same.

Table 3: Characteristics Comparison of Entrepreneur and Intrapreneur

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Entrepreneur</th>
<th>Intrapreneur</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motivation</td>
<td>Free minded, goal-orientation, arbitrary, self-motivated</td>
<td>Free minded, utilize corporate resources, self-motivated, reactive to promotional award</td>
</tr>
<tr>
<td>Needs to</td>
<td>Drive to achieve and succeed</td>
<td>Needs to achieve</td>
</tr>
<tr>
<td>Achievements</td>
<td>Risk taking</td>
<td>Action / enthusiastic</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>High risk taker</td>
<td>Moderate risk taker, layoff is not an issue.</td>
<td>Understand the meaning of empowerment with integrity, reliability, patience and enthusiasm</td>
</tr>
</tbody>
</table>

Referring to intrapreneurial research, according to Pinchot (1985), we can see the characteristics traits, no matter in the tendency, attitude, and backgrounds; we could find the different traits inherited with the non-intrapreneurs. Take upbringing background as an example, Pinchot’s research has some different interpretation with current researches, so we believe that the research of characteristics has the same expectation. Simon et al (1999) found out that intrapreneurs have to balance between autonomy and desire of control because those characteristics conflict in the process of intrapreneurial action since the power of control usually falls into the hand of the parent organization or sponsor, not intrapreneurs. Even Luchsinger and Bagby (1987) indicated that the quality of internal locus of control and needs to achieve are not the same in both of the parties. Intrapreneurs used to be defined as innovators, not revolutionists (Chambeau and Machenzie, 1986). They are the challengers to status quo. Except Pinchot, most of the intrapreneurial papers focus on certain issues, not overall examination about intrapreneurial characteristics.

5. Conclusion and Discussion

There are different characteristics development process and determinants between entrepreneur and intrapreneur because of the following factors 1) role playing 2) organizational structure 3) goal and mission 4) start up process 5) opportunity and 6) resources/support. Especially, when the corporate venture is a choice, then, the organizational policy and program will enhance the success of intrapreneurship as well as the supportive system and corporate culture (Hewison and Badger, 2006). Intrapreneurship is an option for top managers to collect and transform knowledge across boundaries of the organization. Although it is unique, there are not too much researchers that focus on the discussion of intrapreneurial characteristics aspects yet.

From the perspective of entrepreneurial characteristics measurement, entrepreneurs get higher score in self-esteem, needs to achieve, willing of identity, and leadership (Hornaday & Abound, 1971). Some of the traits are inherited with the family and upbringing background (Shavinina, 2006) while some characteristics are trainable (Luchsinger & Bagby, 1987). Personality and characteristics are formed in childhood with
environmental influence, changed, reformed, adjusted, or even evolved with the process of socialization or other influential factors. Nascent entrepreneurs and intrapreneurs have the habit to identify opportunity/ideas because they were used to such characteristics that embedded internally and expressed through behavior externally.

This research intended not to screen those non-entrepreneurs/non-intrapreneurs from entrepreneurs/intrapreneurs, but provide the managers and investors a better view about characteristics traits when they are making decision. Some of the characteristics can be trained, e.g. responsibility (Bamubeck & Mancuso, 1987) and innovative talent, some can be enhanced through projects or programs, e.g. social network and problem-solving style. Even some of the characteristics has same track between entrepreneurs and intrapreneurs, their intention and motivation are different. When entrepreneurial and intrapreneurial characteristics varied, the future research could be developed to measure and evaluate intrapreneurial characteristics traits and intended to screen those trainable from non-trainable for managerial purpose. It will be much more adequate for intrapreneurship having its own measurement and index in terms of characteristics traits.

References:
A Research Review on Entrepreneurial and Intrapreneurial Characteristics


UNDERSTANDING BUYER’S ADOPTION INTENT OF B2B ELECTRONIC MARKETPLACES

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Abstract
Despite the significant role of business-to-business (B2B) e-marketplaces (EMPs) in providing firms with opportunities to transform the way that organizations conduct trading activities and supply chain management (SCM) tasks, few studies emphasize the motive for adoption intent of EMPs. Drawing on institutional theory and information processing theory, this study develops a model aiming for delineating the relationship between institutional pressures (in terms of mimetic, coercive, and normative pressures), benefits of SCM tasks (involving interdependent tasks and procurement life cycle (PLC) activities), and adoption intent. Data collected from 79 potential adopters of EMPs largely support our research hypotheses. Theoretical contribution and managerial implications of this study are discussed.

Key words: institutional pressures, supply chain management (SCM), e-marketplaces (EMPs), interdependent tasks, procurement life cycle (PLC)

Introduction
E-marketplaces (EMPs), as one kind of inter-organizational systems, enhance communication, coordination and collaboration between trading partners or buyers and sellers. Studies also suggest that EMP plays a key role in the performance of supply chain management (SCM) and business-to-business (B2B) commerce [23][22][30], arguing that EMPs enable seamless information, as well as physical and financial flow between firms. EMPs have the potential to offer enormous benefits to both organizational buyers and sellers. The major benefit for sellers is to broaden their customer bases and to reach out to new profitable customers, leading to new trading activities between business partners. Buyers benefit mainly from significant reduction in procurement costs [32][41]. Given the large potential of B2B e-marketplaces, quite a few B2B e-marketplaces have launched in the dot-com boom period of the late 1990s [40]—more than 4000 B2B e-marketplaces are in operation by 2004 [39].

Although some experts are optimistic about the future of e-marketplaces, others show that about two B2B e-marketplaces would be sufficient in each industry [2]. Empirical findings show that many of the e-marketplaces established in the dot-com era have terminated their operations without ever turning a profit [29]. But many others have successfully been established as viable arenas for organizational trading activities in industries such as cars, metals, and chemicals [32][39]. Given the many thriving B2B e-marketplaces, major market analyst firms, including Gartner Research and Meta Group, begin to predict the renaissance of e-marketplaces. Various types of B2B e-marketplaces have been established to date. Among the large number of approaches used to classify them, it is worth mentioning the following two to identify the scope of the present study. The first is based on who operates a B2B e-marketplace (private versus nonprivate), and the second on the number of industries served by a marketplace (vertical versus horizontal). Private marketplaces are owned and operated by an individual company to connect itself directly to its buyers/suppliers (e.g. Wal-Mart). The nonprivate marketplaces incorporate public and consortium-based e-marketplaces, which are created and operated by an independent third-party intermediary (e.g. Alibaba) and a group of dominant players in an industry (e.g. Elemica) respectively [35]. Vertical marketplaces are industry specific (e.g. Covisint), while horizontal marketplaces serve more than one industry (e.g. Global Trade Village). The current study focuses on intermediary e-marketplaces serving more than one industry because most of the existing e-marketplaces fall into this category [32]. Despite the potential benefits of using B2B e-marketplaces to facilitate organizational trading activities, relative few of the prior studies investigate the intention of EMPs adoption intent. To fill this gap,
drawing on both institutional theory and information processing theory, this study seeks to better understand the motivation of B2B e-marketplaces adoption. EMPs differ significantly from vertical integration in traditional organizations in that supply chain partners are integrated via information flows rather than ownership [16]. According to them, the main features of EMPs are the shift from conection of physical processes, including shipment, inventory, and warehousing, to information-based integration across upstream and downstream operations. This study focuses on two fundamental features of SCM tasks, channel interdependence and procurement life cycle (PLC) [23][30], and understanding how the efficiency of them is related to a firm’s motive for EMPs adoption intent. Channel interdependence refers to dependence of a SCM task between partners in SCM context, including pooled interdependence, sequential interdependence, and reciprocal interdependence [38]. Procurement life cycle (PLC) entails all the internal and external operations regarded as necessary for a SCM task, including five stages (search, negotiation and price discovery, ordering, order coordination, and payment) [24]. Since both PLC and task interdependence play a key role in affecting SCM performance based on organizational information processing theory, this study investigates how they affect the adoption of EMPs.

In addition to the motivation of improving information processing efficiency, drawing on institutional theory, EMPs adoption can also be affected by legitimacy [20][22]. Specifically, institutional pressures, i.e. coercive, mimetic and normative pressures, have been proposed and found to be significant factors leading a firm to conform to norms and expectations regulated by other constituents, either trading partners or competitors in the institutional environments [22][32]. While prior work has identified the roles of institutional pressures and information processing in adoption intent separately, they fail to consider how institutional pressures affect the efficiency of fundamental features of SCM tasks (PLC and channel interdependence), which in turn influences the adoption intent. According to institutional theory, organizations’ decision making can best be understood with the lens of organizational legitimacy, which refers to the acceptance of an organization within its external environment. Legitimacy is conferred on an organization by external constituents when the values and actions of the organization are congruent with its external environment, such as their key suppliers and other organizations that produce similar services or products [15].

Based on the above rationale, the questions this paper seeks to answer are: (1) how do institutional pressures affect the way in which buyers employ the key features of SCM tasks (in term of PLC and channel interdependence)? (2) and how the above features in turn influence buyers’ motive for EMPs adoption intent? In answering these questions, this research differs from prior EMPs-related investigations in the following ways. First, as a novel contribution, we investigate to what extent the features of SCM tasks mediate the effect of institutional forces on EMPs adoption intent. Second, recognizing the inherent multidimensionality of the concept of SCM tasks, PLC and channel interdependence are selected to represent the information processing capability of a firm and a SCM context it faces respectively. Finally, this study extends prior research on EMPs adoption intent by confirming that EMPs adoption intent is affected by both institutional forces and the features of SCM tasks, and the latter also mediates the relationship between institutional forces and adoption intent. Our findings enrich information processing and institutional theory by showing how they can be used together to explain EMPs adoption intent.

**Theory and hypothesis development**

Figure 1 lists the research model of this study. To explain buyers’ intent of EMPs adoption, this study draws on two theories—organizational information processing theory (OIPT) and institutional theory,
and postulates that the key reasons for a firm’s adoption of EMPs are usually based on two primary motives—improving the effectiveness of information processing and achieving organizational legitimacy [20][23]. For the former, organizations adopt B2B e-marketplaces based on the rationalistic expectation of processing information efficiently and effectively such as collection of appropriate information, firms’ timely movement for addressing the uncertainty in the supply channel, and transmission without distortion [23]. On the other hand, firms that embrace the legitimacy-oriented perspective as their primary motive for adopting B2B e-marketplaces emphasize the importance of social norms and institutional expectations existing in the external environment. For example, a firm devotes its time and energy to developing more effective processes and strategies of PLC and of interdependent tasks because others have already adopted them. Following prior work [11][37], adoption intent was chosen as the dependent variable for potential adopters.

Organizational information processing theory and intermediate benefits of B2B commerce

According to OIPT, in order to prosper, organizations must resolve uncertainty. Different organizations may be confronted by different amount and types of uncertainty, including the unstable external environment, the predictable core processes, and the level of interdependence among those subdivisions [19]. B2B e-marketplaces can be viewed as a particular class of information processing mechanism [35]. One of the motives that firms participate in a B2B e-marketplace is because it may help the firms obtain quality information [8][19]. To improve channel performance and handle the contextual factors that give rise to information processing needs that a supply channel faces, firms participating in the channel relationships use appropriate information processing mechanism to enhance the information flow and thereby reduce uncertainty [30].

Effective information processing is likely to affect the coordination of business operations and monitoring of operations, from which the performance of SCM tasks can be improved [23]. Coordination costs are costs of coordinating decisions and operations among economic activities that occur between channel partners [6]. The decision and operational activities in the procurement cycle include ordering, receiving and storing products, and payments [30]. Studies also report that IT is capable of reducing both of these costs [5][26]. They propose that when choosing from alternative IT-enabled governance structures, a firm tends to use the one that best fits its economic efficiency rationales. Two types of IT-enabled governance structures have been identified—electronic markets (e.g. nonprivate B2B e-marketplaces) and electronic hierarchies (e.g. electronic data exchange (EDI)) [32][35].

Barua et al. (1995) argue that truly understanding how IT investments create value for the organization requires a research model that includes the intermediate benefits or intermediate variables through which the functional impacts occur. Understanding the intermediate benefits helps us explain why buyers adopt e-marketplaces in more details. Two types of intermediate benefits are likely to improve transaction efficiency in the context of B2B e-marketplaces—efficiency of interdependent tasks and coordination improvements of procurement life cycle activities (PLC) [23][30].

In the continuum of task interdependence, three anchor points have been identified—pooled interdependence, sequential interdependence, and reciprocal interdependence [23][38]. Since task interdependence plays a key role in affecting information uncertainty and performance in SCM context, the above three types of interdependence were used to measure firms’ capability of handling uncertainty. Pooled dependency is likely to result in a mutual dependence because the supply-channel participants pool their resources. For example, the channel partners may share resources such as transportation vehicles and call center operations. In this situation, channel partners may exchange information that is limited to what is operationally necessary. Sequential dependency implies that units work in series where the output from one unit becomes input to another unit. For instance, an automobile manufacturer focusing on assembly lines production uses the automobile parts produced by partners in the alliance. To perform the above operations effectively and efficiently, the channel partners need to exchange information about related activities of B2B commerce, including order entry, and inventory control. Finally, in reciprocal dependency, members of a supply channel feed their work back and forth among themselves—each receives input from and provides output to the other, often interactively. Reciprocal dependency is usually used for highly customized components or integrated subsystems that entail high levels of coordination between the channel participants [7]. To achieve this, exchanging information between partners across multiple stages is necessary, from the concept design through the development of tooling and manufacturing processes at the assembler and the supplier [9].

Given all of the three forms of interdependence are likely to occur in B2B commerce and the extent to which the success of a supply channel depends on how firms are capable of processing the information of the above interdependence efficiently and effectively [23], we expect that EMPs’ information processing capabilities to handle the information processing need of channel dependency (i.e.
efficiency of task interdependency) play a key role in their adoption intent. This leads to H1.

**H1:** Efficiency of task interdependence will positively influence the adoption intent of a B2B e-marketplace among organizational buyers.

In addition to the efficiency of interorganizational task, how to coordinate the internal activities of firms may also affect their adoption intent of a B2B e-marketplace. Theory suggests that when confronted with uncertainty, including demand uncertainty, supply uncertainty, and relationship uncertainty (firm and supplier investment, and trust), firms implement structural mechanisms and information processing capability to enhance the information flow and thereby reduce uncertainty [30]. This usually entails the redesign of business processes in organizations and implementation of integrated IS (information systems) that improve information flow and reduce uncertainty within organizational subunits [12][23].

Following Premkumar et al (2005), a firms’ capability of addressing uncertainty and facilitating information flow is conceptualized as the coordination improvements of PLC activities. PLC activities consist of multiple stages, including search, negotiation and pricing or price discovery, ordering, order coordination, and payment [24]. Each stage has different communication needs—while some stages rely on unstructured communication that is difficult to automate, such as communicating customized product specifications or price negotiation, other stages use structured transaction communication, such as orders, invoices, and so on. Fully addressing PLC activities need a variety of information processing capabilities [36], thus a powerful information processing mechanism such as EMP may help a firm coordinate its PLC activities.

**Institutional theory and isomorphism pressures**

This study uses institutional theory to explain the role of organizational legitimacy in affecting buyers’ motives for the adoption of B2B e-marketplaces. According to institutional theory, organizations’ decision making can best be understood with the lens of the concept of organizational legitimacy, referring to the acceptance of an organization within its external environment [13]. Legitimacy is conferred on an organization by external constituents when the values and actions of the organization are congruent with those of its constituents, including key suppliers, consumers, and so on [15]. Organizational isomorphism, indicating that organizations tend to adopt processes, structures, and strategies that their constituents have already adopted, refers to one of the most fundamental mechanisms through which organizations achieve organizational legitimacy [13]. Study suggests that uncertainty about the adoption of new innovation is likely to be reduced by using isomorphism [32]. They identified three types of isomorphic processes--mimetic, coercive, and normative, that serve as external institutional pressures for an organization.

Mimetic pressures indicate that over time organizations become more similar to other organizations in their environment, because the organizations adopt processes or strategies similar to their constituents’ [11][15]. Organizations tend to be affected by two types of mimetic pressures. The first one is bandwagon effect, which suggests that when the majority of organizations in their environment have taken the same action, it is likely organizations are subject to imitating these actions without a great of thought [27]. Second, when confronted with high levels of uncertainty about the outcomes of a strategic action, organizations achieve legitimacy by closely monitoring actions taken by others to identify successful practices applied to them and by following the “best practices” adopted by other similar organizations [13]. Mimicking early adopters is able to reduce the costs associated with searching for alternatives [32].

Several IS-related studies have used mimetic isomorphism to explain the adoption of IT. Following Son and Benbasat’s (2007) research, this study focuses on two types of mimetic pressures salient to B2B commerce—the extent of adoption by...
competitors within an industry and the perceived success of competitor adopters.

Research shows that mimetic pressures have been used for attracting more participants and encouraging them to participate in the related-activities of EMPs [22][32]. Task interdependence and PLC activities refer to the processes and strategies essential to B2B commerce and their efficiency and effectiveness play a critical role in supply-channel performance [23][30]. Thus, we expect that the efficiency of task interdependence and the coordination improvements of PLC activities are likely to be affected by mimetic pressures. This leads to H3a and H3b.

H3a: Mimetic pressures will positively influence buyers' efficiency of task interdependence.
H3b: Mimetic pressures will positively influence buyers' coordination improvements of PLC.

Coercive pressures refer to the fact that firms are likely to be affected by both formal and informal pressures exerted by other firms on which they are dependent and by cultural expectations in the society within which firms function [15]. Formal and informal pressures may lead to soliciting compliance of an organization’s stakeholders, including trading partners (e.g. customers and suppliers involved in performing interdependent tasks), investors, and government regulatory agencies [34]. Coercive pressures may take several forms, such as force, threats, and invitations of a firm’s trading partners to the EMP [15]. Coercive pressures directly or indirectly affect a firm’s adoption of EMPs and the strategies related to B2B commerce. In a private e-marketplace owned by a large firm, coercive pressures influence a firm’s adoption and business processes directly, such as inviting trading partners to the e-marketplace or enforcement of cooperation between participants. In other types of EMPs such as intermediary marketplaces, dominant organizations in an industry may indirectly pressure others in the industry to follow the rules such as the process flow or PLC activities [42]. Research on the adoption of B2B e-marketplaces identifies the association between such indirect pressures and the successful deployment of nonprivate EMPs [32], suggesting that under the pressure of the dominant players in an industry, other firms are more willing to participate in EMPs and follow the rules established by the dominant players, such as the structures and strategies used in processing information, negotiation, payment, and delivery [42].

In B2B EMPs, when a dominant party with control over scarce and important resources demands its trading partners to adopt business practices or structures to serve its interests, it is likely a target firm will comply with the demand to secure its access to these resources and to ensure better supply-channel performance [22]. In the context of SCM, empirical studies [35][32][42] show that coercive pressures have a positive influence on the target firm’s adoption, including structure and control of the fulfillment process, strategic partners network and so on. Extending this notation, we expect that coercive pressures positively affect the improvements in the efficiency of task interdependence and in the coordination of PLC activities, leading to H4a and H4b.

H4a: Coercive pressures will positively influence buyers' efficiency of task interdependence.
H4b: Coercive pressures will positively influence buyers’ coordination improvements of PLC.

Normative pressures imply that strategic processes taken by organizations are subject to the values and norms shared among the members of their social networks [31]. Organizations’ behavior is based on their beliefs about what members in their social networks view as appropriate [13]. Normative pressures can be derived from several sources, including trade and professional associations, accreditation agencies, and channel partners. Through direct and indirect interactions with others in EMPs, organizational decision makers learn how to deal with transactional processes and provide personalized and customized services, and understand what the desirable and undesirable consequences of certain organizational actions are [32][35]. This is similar to the notion of “informational social influence” proposed in the interpersonal relationship context, arguing that the value of an innovation relies heavily on social interactions between members of a social network [14].

Since the primary aim of B2B EMPs is to support trading activities between buyers and sellers, trading partners’ business practices are likely to affect a firm’s decision to move toward the EMP. Theory suggests that the extent to which an e-marketplace is successful and valuable depends on the number of trading partners who have already adopted the EMP [17][28]. This assertion has been confirmed by Teo et al.’s (2003) study in the context of EDI. Empirical studies [33][42] show that normative pressures can be implemented in B2B e-marketplaces such as advertising the number of participants and the number of products listed, demonstrating various trade functions and the transactions volumes. When exposed to the above information from EMPs, nonadopters is likely to have adoption intent due to normative pressures. Son and Benbasat (2007) found that the extent of adoption by suppliers is positively associated with buyers’ decisions to adopt B2B EMPs. Based on the above arguments, we propose that the more suppliers or partners in IOS have adopted the business practice, norms, or values of professionals regarding how
work should be conducted in the context of B2B EMPs, the more buyers would focus on improving their efficiency of task interdependence and coordination of PLC, because these refer to the key business practices in e-marketplaces that buyers aim to address [23][30].

Normative pressures can also be derived from participation in trade and professional associations [37]. Organizational behavior is associated with normative rules such as active participation in a wide range of events, including conferences and educational programs organized by trade and professional associations [15]. The more individuals participate in the above events, or subscribe to the professional publications of these associations, the more likely they learn the prevalent norms and innovations in the institutional environments, which in turn affect their adoption of business practices [22][32]. In a SCM context, since task interdependence and PLC activities refer to the professionally appropriate practices that influence operational and strategic benefits of buyers [23], we expect that improving their performance is affected by the normative pressures, leading to H5a and H5b.

**H5a:** Normative pressures will positively influence buyers' efficiency of task interdependence.

**H5b:** Normative pressures will positively influence buyers' coordination improvements of PLC.

**Research methodology**

**Development of measures**

While SCM entails a dyadic environment, this study examines the phenomenon from the buyer’s perspective in the dyad. To test the proposed model, we collected data from the firms that are in the preadoption period of B2B EMPs established for the industry (or potential adopters) in which they operate, using a survey questionnaire administered to members of the e-market association of Taiwan (EAT) between July 2008 to December 2008. We developed the items in the questionnaire by adapting measures that have been validated by prior work. All latent variables were measured with multiple items on five-point Likert scales, anchored with “strongly disagree” to “strongly agree.”

The measures for the legitimacy-oriented constructs were directly adapted from prior studies [32][37] with some minor modifications, so that they were suitable for the context of this paper. The adoption intent for potential adopters was assessed with three-item measures adapted from Son and Benbasat (2007). The measures of coordination improvements of PLC and of efficiency of task interdependence were adapted from Premkumar et al. (2005) and Kim et al. (2006) respectively.

The draft questionnaire was pretested for face and content validity with two IS executives who have been involved in their firms’ procurement activities and have considerable experience in EMPs. This procedure resulted in some modifications of the wording of several survey items and dropping 4 items. Then, pilot tests were conducted by selecting the respondents (N=55) who are currently the members of the EAT and their firms are in the preadoption period. Respondents of the pilot tests were asked not only to provide feedback and suggestions for improvement if the meaning of questionnaire was not clear, but also to answer all the questions by following the instructions that were given. A total of fifty respondents returned the completed questionnaires.

**Sample and data collection procedure**

A total of 500 potential respondents who are familiar with an organization’s SCM activities were selected from a membership list of the EAT. Of the 500 potential respondents, 323 members’ firms belong to the preadoption period. A sample frame of 55 randomly chosen members was used for the pilot test, and the remaining 268 members constituted a sample frame for the main study. We mailed them both a survey questionnaire and a cover letter endorsed by the president of the EAT to encourage members’ participation in the survey. An online version of the questionnaire was also available so that respondents had an option to participate in the study either by mailing a completed survey questionnaire or by submitting the online version of the completed questionnaire.

A total of 97 respondents returned the questionnaire either by mail (74; 76.3%) or online (23; 23.7%), yielding a response rate of 30%, which is typical for similar surveys conducted in Taiwan. After discarding unusable responses, we obtained 79 useful responses. Because of no changes were made in the questionnaire after the pilot testing, ten responses from the pilot testing were added to the sample of this study. Thus, 89 responses were used in the subsequent analysis.

An array of industries and a fair distribution of responding organizations, in terms of size, were in our samples (see Table 1). These respondents came from potential adopter organizations, which were defined as organizations that were aware of B2B e-marketplaces operating in their industry, but these

**Table 1**

<table>
<thead>
<tr>
<th>Industry groups</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer</td>
<td>20</td>
<td>22.5</td>
</tr>
<tr>
<td>Electronics/semiconductor</td>
<td>16</td>
<td>18.0</td>
</tr>
<tr>
<td>Information technology</td>
<td>21</td>
<td>23.6</td>
</tr>
</tbody>
</table>
firms had not adopted the e-marketplaces. In addition, nonresponse bias was assessed, using the procedure recommended by Armstrong and Overton (1977). No significant differences between the first third and the last third of the respondents were found on the key research variables, nor on other variables such as the size of the firms and the type of industry groups. Accordingly, there were no apparent problems that might skew responses.

Data analysis

The Partial Least Squares (PLS) approach to structural equation modeling was used to validate the proposed model, using PLS-Graph 3.0. Compared with covariance-based modeling approaches such as LISREL, a PLS approach is considered to be more suitable to model small- and medium-sized samples[10].

Table 2

<table>
<thead>
<tr>
<th>Construct</th>
<th>Composite reliability</th>
<th>Average Variance extracted</th>
</tr>
</thead>
<tbody>
<tr>
<td>AI</td>
<td>0.89</td>
<td>0.74</td>
</tr>
<tr>
<td>TI</td>
<td>0.87</td>
<td>0.77</td>
</tr>
<tr>
<td>PLC</td>
<td>0.88</td>
<td>0.56</td>
</tr>
<tr>
<td>MP</td>
<td>0.93</td>
<td>0.77</td>
</tr>
<tr>
<td>CP</td>
<td>0.84</td>
<td>0.65</td>
</tr>
<tr>
<td>NP</td>
<td>0.94</td>
<td>0.80</td>
</tr>
</tbody>
</table>

Adoption intent (AI); Efficiency of task interdependence (TI); Coordination improvements of PLC (PLC); Mimetic pressure (MP); Coercive pressure (CP); Normative pressure (NP)

Measurement model

Following recommended two-stage analytical procedures [21], confirmatory factor analysis was first conducted to examine the measurement model; then, the structural relationships were evaluated. To validate our measurement model, three types of validity were assessed—content validity, convergent validity, and discriminant validity. Content validity was established by ensuring consistency between the measurement items and the extant literature. This was done by interviewing senior practitioners and pilot-testing the instrument. To validate convergent validity, we examined composite reliability and average variance extracted (AVE) from the measures [21]. Although many studies employing PLS have used 0.5 as the threshold measure of the reliability, 0.7 is a recommended value for a reliable construct [10]. As shown in Table 2, our composite reliability values range from 0.87 to 0.94. As to the AVE, a score of 0.5 indicates acceptability [18]. The AVE values in Table 2 range from 0.56 to 0.8, demonstrating the acceptability of AVE measures. Finally, we verified the discriminant validity of our instrument by examining the square root of AVE as suggested by Fornel and Larcker (1981). The result in Table 3 attests the discriminant validity—the square root of the AVE for each construct is greater than the levels of correlations involving the construct. Further, the results of the inter-construct correlations also show that each construct shares larger variance.

Table 3

<table>
<thead>
<tr>
<th>Construct</th>
<th>Mean</th>
<th>S.D.</th>
<th>AI</th>
<th>S.D.</th>
<th>TI</th>
<th>S.D.</th>
<th>PLC</th>
<th>S.D.</th>
<th>MP</th>
<th>S.D.</th>
<th>CP</th>
<th>S.D.</th>
<th>NP</th>
<th>S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>AI</td>
<td>3.00</td>
<td>1.16</td>
<td>0.860</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>TI</td>
<td>3.59</td>
<td>0.65</td>
<td>0.528</td>
<td>0.877</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PLC</td>
<td>3.63</td>
<td>0.68</td>
<td>0.432</td>
<td>0.518</td>
<td>0.748</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>MP</td>
<td>3.29</td>
<td>0.65</td>
<td>0.612</td>
<td>0.481</td>
<td>0.439</td>
<td>0.877</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>CP</td>
<td>3.62</td>
<td>0.72</td>
<td>0.397</td>
<td>0.521</td>
<td>0.225</td>
<td>0.405</td>
<td>0.806</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NP</td>
<td>3.26</td>
<td>0.74</td>
<td>0.616</td>
<td>0.574</td>
<td>0.479</td>
<td>0.705</td>
<td>0.474</td>
<td>0.894</td>
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</tbody>
</table>
Structural model
The test of the structural model includes estimating the path coefficients, which indicate the strengths of the relationships between dependent and independent variables, and the $R^2$, which shows the amount of variance explained by the independent variable(s). $R^2$ represents the predictive power of the model and interprets the same as in multiple regression. Based on a confidence estimation procedure other than the normal approximation, a bootstrap resampling procedure was used to generate t-statistics and stand error [10]. Resamples of 500 was chosen, indicating that sampling with replacement from the original sample set and this procedure continues to sample until it reaches the specified number of 500. The results of the path analysis are shown in Figure 2. As expected, the level of EMPs adoption intent were affected by both the efficiency of task interdependence ($\beta=0.42$, $p<0.01$, H1) and the coordination improvements of PLC ($\beta=0.22$, $p<0.01$, H2) significantly, suggesting that both of the fundamental SCM tasks’ performance (i.e. efficiency or coordination improvements) exert a significant influence on the EMPs adoption intent. Regarding the influence of legitimacy-related factors, efficiency of task interdependence is positively affected by coercive pressures ($\beta=0.31$, $p<0.01$, H4a) and normative pressures ($\beta=0.35$, $p<0.01$, H5a), but not by mimetic pressures ($\beta=0.11$, H3a). The coordination improvements of PLC are influenced by mimetic pressures ($\beta=0.20$, $p<0.1$, H3b) and normative pressures ($\beta=0.35$, $p<0.01$, H5b), but not by coercive pressures ($\beta=-0.02$, H4b).

To further examine the intermediate effect of both the efficiency of task interdependence and coordination improvements of PLC, we first tested the direct relationships, including a model of mimetic, coercive, and normative pressures predicting the adoption intent. The $\beta$s of mimetic, coercive, and normative pressures were 0.34 ($p<0.01$), 0.1 ($p<0.05$), 0.33 ($p<0.01$) respectively, accounting for 32.7%. We then proceeded to see if there is a mediation effect by adding the intervening constructs (efficiency of task interdependence and coordination improvements of PLC). The foregoing constructs partially mediated the relationships between the mechanisms of organizational isomorphism (in terms of mimetic, coercive, and normative pressures) and adoption intent because the indirect paths were significant and the direct paths were lessened. Besides, the increase in $R^2$ (i.e. from 0.33 to 0.47) perhaps shows that mimetic, coercive, and normative pressures are not the only variables that predict efficiency of task interdependence and coordination improvements of PLC.

Discussion, implications, and limitations
Our study provides valuable insight into the adoption intent of EMPs, in terms of organizational isomorphism and the performance of the fundamental features of SCM tasks (i.e. PLC and channel interdependence). This is the first empirical study, to the best of our knowledge, explaining the motive for EMPs buyers’ adoption intent from legitimacy-oriented and information processing perspectives. While our model was based on Son and Benbasat’s (2007) research, including mimetic, coercive, and normative pressures, and adoption intent, we proposed an alternative way that may affect buyers’ adoption intent—i.e. improving the efficiency of fundamental SCM tasks. In other words, we contended that buyers’ EMPs adoption intent is affected not only by the organizational legitimacy, but also by whether EMPs improve the performance of fundamental features of SCM tasks. Our findings confirm that adoption intent is affected by both the efficiency of interdependence tasks and the coordination improvements of PLC, which in turn are

![Figure 2. Results of the model testing](image-url)
influenced by most of the mechanisms of organizational isomorphism. The following sections elaborate on the implications of our findings.

Organizational legitimacy, task interdependence, PLC, and EMPS adoption intent

From Figure 2, as expected, we found that both the efficiency of task interdependence and coordination improvements of PLC are positively associated with EMPS adoption intent. Three implications regarding the influence of the organizational legitimacy can be drawn. First, different types of institutional pressures exert different level of impact on the efficiency of fundamental features of SCM tasks. Normative pressures exert the most significant impact on the efficiency of task interdependence, while mimetic pressures have the least effect. This implies that different types of institutional pressures affect the efficiency of task interdependence differently. Our hypothesis on the relationship between mimetic pressures and task interdependence is not support. There are two possible explanations. First, when a firm faces interdependent tasks, they rely more on inter-organizational channels and shared norms (i.e. normative pressures), leading to adopting new practices which are consistent with the norms and values of its constituents in the institutional environment. On the other hand, the efficiency of task interdependence is less likely to be affected by the perceived success of competitors’ actions (or mimetic pressures) because mimetic pressures don’t usually operate in inter-organizational relationships [22].

Second, regarding the influence of institutional pressures on the coordination improvements of PLC, normative pressures have the most impact, while coercive pressures have the least. This implies that normative pressures play a key role in affecting not only the performance of inter-organizational tasks (such as interdependence tasks) but also the coordination improvements of intra-organizational tasks (such as PLC activities) in SCM context. Our findings don’t support the hypothesis on the relationship between coercive pressures and coordination improvements of PLC. The possible reason is that the EMPs of this study don’t involve an extremely large firm (or a dominant organization), upon which other firms (focal firms) are dependent. Thus, certain strategic actions or institutional rules taken by dominant organizations in an industry don’t make the focal firm perceive a high legitimate requirement for adopting EMPS.

Finally, concerning the mediation effect of the efficiency of SCM tasks, different types of institutional pressures exert different level of influence on adoption intent. First, mimetic pressures affect adoption intent either directly or indirectly through the coordination improvements of PLC. As noted before, the effect of mimetic pressures on adoption intent was partially mediated by the efficiency of SCM tasks. This implies that adoption intent is not fully affected by the explicit benefits derived from PLC activities. Rather, implicit benefits derived from mimetic pressures also contribute to the EMPS adoption because mimicking behavior enables firms to minimize the costs associated with searching for alternatives and to follow the best practices adopted by other similar firms. In addition, our findings also show that mimetic pressures only affect the performance of PLC, their influence on interdependence tasks is not significant. This indicates that mimetic pressures don’t exert the same influence on every kind of SCM tasks. For interdependence tasks, since the best practices that a firm can adopt depend on the type of channel interdependence (such as pooled interdependence) the firm is involved in, interdependence tasks are unlikely to be affected by mimetic pressures. Second, coercive pressures affect adoption intent either directly or indirectly through the efficiency of task interdependence. The relationship between coercive pressures and adoption intent is partially mediated by the efficiency of SCM tasks. These findings confirm that organizations are likely to be subjected to formal and informal pressures exerted on organizations by other organizations upon which they are dependent. This is the possible reason why the performance of interdependent tasks is more likely to be affected by coercive pressures, but coordination improvements of PLC are not. Finally, normative pressures affect adoption intent either directly or indirectly through improving the performance of SCM tasks, including interdependent tasks and PLC activities. Our results attest that strategic processes taken by organizations are affected either by inter-organizational shared norms or by intra-organizational decision making, which in turn influence the organization’s performance of interdependent tasks and PLC activities respectively. Our model also shows among the three institutional pressures, normative pressures exert the most significant influence on the benefits of SCM tasks, which in turn affect adoption intent.

Limitations and future research

This study has three limitations. First, we emphasized a limited number of variables that may affect EMPS adoption intent. Although these factors play a critical role in affecting EMPS adoption intent, other factors such as power, and trust may influence EMPS adoption. Second, this study considered the adoption intent from legitimacy-oriented and information processing perspectives of ERPs, other perspectives may also affect the adoption intent such as efficiency-oriented and non-contractibility (in terms of responsiveness, technology investment and so on) perspectives. Future study may take these variables into consideration. Finally, the usually limitations of cross-sectional surveys are ascribed to
lack of causality, as is this study. In-depth process-oriented research design based on institutional pressures and information processing theory may help us understand why different types of institutional pressures cause the performance of SCM tasks (interdependence tasks and PLC activities) to increase/decrease. This is the important issue that should be addressed in the future.

Implications for practice and theory
From the theoretical perspective, our research extends current understanding of drivers for EMPs adoption intent. In particular, we differentiate different types of institutional pressures and assess their varying effects on benefits of SCM tasks and EMPs adoption intent. Prior research on IS tend to consider the impact of institutional pressures on adoption intent and ignore how the benefits of SCM tasks mediate the above relationship. In contrast, our study helps delineate the relationships among different types of institutional pressures, benefits of SCM tasks focused on inter-organizational channels (i.e. interdependent tasks) and intra-organization decision making (i.e. PLC activities), and adoption intent. Because EMPs refer to a special type of IS innovation, involving both inter-organizational and intra-organizational activities, integrating buyers perceived institutional pressures and the benefits of SCM tasks in a single model may shed new light on our understanding of drivers for EMPs adoption intent. Ignoring the mediating role of the benefits of SCM tasks may lead to inaccurate research results.

This study has implications for practice. Millions of dollars have been invested in IS to help firms gain competitive benefits. However, these investments may not reach their highest level of profits if firms don’t integrate their internal activities across organizational boundaries, and leverage IS to achieve operational and strategic benefits so that the performance of SCM tasks, such as interdependent tasks and PLC activities can be improved effectively. Therefore, it is critical for the potential of EMPs adopters to use institutional pressures such as participating in professional and trade associations, or understanding the extent of adoption by suppliers (i.e. normative pressures) to facilitate the fulfillment of SCM tasks. Our findings provide EMPs adopters with useful guidance and knowledge. It is important for managers to realize the different effect of institutional pressures on SCM tasks. Based on our results, firms should focus on coercive and normative pressures when implementing interdependent tasks, and on mimetic and normative when addressing PLC issues.

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NORMATIVE LEGITIMACY IN THE COMMERCIALIZATION OF ONLINE COMMUNITY WEBSITE

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Abstract
Many online community websites start their operation by a not-for-profit business model, which attracts a lot of users to engage in. The huge user base and heavy Internet traffic could generate revenue and wealth for the websites. When the online communities are becoming popular, entrepreneurs of the online community website may hope to commercialize the online community. Nevertheless, some of community participants are against the commercialization of the online community website, since they regard that the property of online community is belonged to users rather than website owners. Users may challenge the legitimacy in the commercialization process of online community, and argue that the online community should be owned by the public rather than by a company since the enormous community participants put effort in it and make the website a popular one. This study used two case studies of online communities to explain the normative legitimate issues in the entrepreneurship of online community.

Keywords: Normal legitimacy, Commercialization, Online Community Website

Introduction
Internet is an appropriate place for entrepreneurs to create business to realize their dream of entrepreneurship. A popular website with huge user base and heavy Internet traffic may generate revenue and wealth for entrepreneurs. Online community is one opportunity for Internet entrepreneurs to attract users and bring richness contents for the website.

In 2004, Tim O'Reilly proposed the idea of Web 2.0 [1]. Online communities are examples of Web 2.0 sites which allow users to interact with other users and change and enrich website content. Many Internet entrepreneurs start their business with an online community website which is free for all users. In the beginning, the policy of free-charge makes the website an attractive one for all users.

However, this policy also means that entrepreneurs can not get any incomes from users by collecting membership due. The advertisement revenues of the website in the beginning are limit due to the small user base. Low cost servers in their garage, school laboratory, or from website hosting providers are the possible solution at this stage, since that few revenue means that entrepreneurs should economize. The whole online community website is, or looks like, a not-for-profit organization in this stage.

Not-for-profit is not the final purpose for entrepreneurs. The increased user base provides the entrepreneurs ways to make revenues. Selling website advertising are intuitive and reasonable way to make money and selling the whole online communities to other portal websites or large Internet companies is another alternative for the entrepreneurs. Entrepreneurs may try to make the online communities a commercial website which can bring income for the entrepreneurs.

Nevertheless, users of the online community website may against the commercialization of the online community website. These users regard the online community as property of the website users rather than entrepreneur. They challenge the legitimacy in the commercialization of online community and argue that the online community should be owned by the public rather than by a company since that the enormous community participants put effort in it and make the website a popular one.

The terms of service may indicate that the online community is owned by the company rather than users, and the company reserves the right to use change their terms of service. Nevertheless, users may still think that the online community is owned by users rather than the company and the company has no right to make money by the online community. Psychological ownership in the field of organization behavior can explain this phenomenon. Psychological ownership describes individuals' feeling of possession without the formal ownership or legal claim of ownership [2].

Legitimacy
Legitimacy is a social generalized perception [3], [4] which the action of an entity is desirable, appropriate within the social system. Legitimacy of ventures is decided by acceptance and compliance
Normative Legitimacy in the Commercialization of Online Community Website

with relevant institutions of social systems in which ventures exist. Few researchers claimed that the importance of legitimacy to new ventures [3], [4]. The effects of legitimacy have been studying in various contexts, linking it to firm survival rates [5], new venture growth [4], organization emergence [6], initial public offering success [7], strategic alliance [8], and product introduction [9]. Zimmerman and Zeitz (2002) [4], argued that legitimacy is an essential resource for acquiring other resources, such as human resources, financial resources, technology, and government support, which are essential for new venture growth. They also pointed that the greater level of legitimacy new venture had, the more resources it could access.

Suchman (1995) [3] integrated with both evaluative and cognitive dimensions among the leading strategic and institutional approaches. He made the commonly cited definition of legitimacy as “a generalized perception or entity assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definition”.

Previous studies proposed several frameworks to classify legitimacy into categories. Aldrich and Fiol (1994) [10] proposed that cognitive legitimacy and sociopolitical legitimacy are two dimensions for success in industry. Cognitive legitimacy means the knowledge about the new activity and what is needed to succeed in an industry. Sociopolitical legitimacy means the value placed on an activity by cultural norms and political authorities. Hunt and Aldrich (1996) [11] and Scott (1995) [12] argued that sociopolitical legitimacy in Aldrich and Fiol (1994) [10]’s framework should be divided into regulatory and normative legitimacy and proposed the framework of three forms of legitimacy: regulative, normative, and cognitive. Regulative legitimacy is derived from regulations, rules, standards created by governments or professional bodies.

Suchman (1995) [3] identified three types of legitimacy: pragmatic, moral, and cognitive. In this classification, pragmatic legitimacy is based on self-interest considers of people who directly exchange with, the moral legitimacy is similar to normative legitimacy and based on normative approval of others.

Normative legitimacy is derived from social norms and values [4] and is granted when one thing is normative approved by people. It is similar to judgment on that a given activity effectively promotes social welfare built by the social value system. It is necessary for successful new venture. For new venture, legitimacy is as important as other resources, such as capital and technology, and plays a key role for the survival of new ventures. Zimmerman and Zeitz (2002) [4] argued that normative legitimacy can be as a means to access resources which are critical for the venture's survival and growth. When new venture addresses the norms and values held by that control needed resources, it sill be help for entrepreneurs to get the resources.

If users regard the online community as property of users rather than the company, the commercialization of the online community website will damage the legitimacy because of the psychology ownership of users for the contents in the online community and the user database. Once users regards it as inappropriate since the non-for-profit organization became profit one, and chose exit to express their resistance for the commercialization of online community, the entrepreneurs may reduce the normative legitimacy of the online community.

Case Studies
This study used two case studies of Wretch (http://www.wretch.cc/) and Bahamut (http://www.gamer.com.tw) to discuss the normative legitimacy issues in the commercialization process of the online community websites in Taiwan.

Bahamut
Bahamut, founded in November 1996 and commercialized in 2000, is currently the largest online community in Taiwan for all kinds of computer and video games. Bahamut started the website operation in the laboratory of National Central University, Taiwan [13].

Before Bahamut, game players in Taiwan shared their experience in a discussion board of PTT (http://ptt.cc), which is a general purpose of nonprofit bulletin board system in Taiwan. Online community plays an important role for game players to share their experiences in playing games.

Game players played different games and preferred to classify their discussions by the games. Put all discussions in one discussion board would make the board full of all kinds of game messages. Finding useful messages was not an easy task for most players. Nevertheless, PPT offered only one discussion board for all games, although game players tried to ask PTT to create more discussion boards for different kinds of video and computer games.

As a game player, JengHong Chen (Sega), the founder of Bahamut, founded an opportunity of virtual communities for computer and video games. To meet the demand of game players, Bahamut provided an environment to host a lot of discussion boards for all kinds of computer and video games.
Each game has its own discussion boards in Bahamut.

As a pioneer of online community for computer and video games, Bahamut quick received a lot of attention from game players. The amount of member of Bahamut reached to fifty thousand in three years.

In October 1999, Bahamut went to commercialization. When Bahamut announced the plan to register as a company, some members criticized this decision. They challenged the legitimacy of commercialization. In the beginning, Bahamut went into market as a substitute for PTT. PTT is a nonprofit discussion board provider. These game players argued that Bahamut was supposed be nonprofit and not use these game discussions to earn a profit for a company.

The argument continued and Bahamut was forced to move the articles posted by members who hold protest position on the commercialization. The argument was ceased after Bahamut agree to move these contents.

In the first two years of commercialization, the Bahamut loss all of its first wave capital, NT$ 5 million, which was half of the capital provided by angel investor. Most members did not criticize Bahamut since the commercialization did not immediately bring any profit for entrepreneurs of Bahamut and Bahamut left National Central University campus right after commercialization.

The amount of users of Bahamut increased continually. Bahamut was broken even in 2002. The member of Bahamut was excess two million in 2007. Bahamut was the number one online game community and in the top seven website in Taiwan.

In the commercialization process, Bahamut confronted a legitimate critic. Some members challenged the legitimacy for using the contents contributed by the members to earn money. It is no longer a serious legitimate issue since the commercialization did not bring an immediate profit for the entrepreneurs of Bahamut. Besides, Bahamut did not use any university resource after the commercialization of Bahamut. Although Bahamut was forced to move some contents in the commercialization process, the damage was limited. The legitimate issue still existed, but was not too serious.

Wretch

Wretch, found in 1999, commercialized in 2005 and merged into Yahoo Taiwan in May 2007, is currently top one blog and photo album providers in Taiwan with millions of users registered [14].

Wretch started their website operation at one laboratory of Department of Computer Science and Information Engineering of National Chiao Tung University in 1999. The founder and co-founders were all students, researchers and their adviser of the laboratory. The amount of members increased to 2 million in June 2004. This huge amount of members brought heavy burden for the website servers as well as the university campus network. In November 2004, a serious service interrupt happened and all functions of the Wretch suspended. To promote the hardware and quality of Internet connection, Wretch decided to register as a company in March 2005. To thank the incubation and get permission to spin-off as a new company from the National Chiao Tung University, Wretch donated NT$ 10 million in 2005 and promised to donate 4% of the profit in the next ten years. According to the rule of National Chiao Tung University, 80% of the donation was distributed as rewards to people who founded the Wretch. In this case, the entrepreneurs received 80% of the donation. In most case, this reward is for the faculty or researchers at the university. However, in this case, the entrepreneur donated the money and received the reward. The only thing was that by this donation, the Wretch got permission to commercialization it as a private company.

Some users of Wretch challenged the commercialization process and argued that why they could use the hardware and Internet in the university campus to run incubate their business. In the late 2005, after the Wretch registered as a company, users uncovered that Wretch still used the Internet resource on the campus of National Chiao Tung University to send their emails. In February 2007, Wretch provided users a program to speed connection to Wretch. Nevertheless, some users detected that this program based on two proxy servers, one in the laboratory of Department of Computer Science and Information Engineering and another one in student dormitory of National Chiao Tung University. Users and the public questioned that Wretch still used university resource to run their business.

In May 2007, Yahoo acquired Wretch in about NT$ 700 million. At this acquisition, Yahoo donated NT$ 20 million to National Chiao Tung University to exchange the original promise made by Wretch in 2005 that donating 4% of the profit for the year 2006 to 2015. After the donation, six entrepreneurs of Wretch asked National Chiao Tung University to give 80% of the donation back to them, NT$ 160 million as rewards to them. Some Wretch users as well as faculty in National Chiao Tung University defined this argument and questioned the legitimacy in the commercialization process of the Wretch.

In the late 2006, when the news media reported the acquisition, many users, including some famous bloggers, decided to move their blogs to other blog service providers. Shortly after the
acquisition, some more angry users move their blogs. Internet traffic of Wretch slipped down until the 3rd quarter of 2007.

Wretch is a typical Web 2.0 website in which the content is provided by the users. Blog and photo album are two major services provided by Wretch. In the beginning, Wretch used computer and Internet resource of the university to run their business. When Wretch provided free of charge service to users, people thought that the usage of university resource was acceptable since the not-for-profit operation model. However, when the web 2.0 website went into commercialization, the website should do something to repair legitimacy and let their users to accept their commercialization. If they do not repair the legitimacy enough, users may decide to move their blogs to other blog service providers. This move will damage the website.

The Wretch did not repair the legitimacy enough when went into commercialization in 2005 and acquired by Yahoo in 2006. The low legitimacy may be an obstacle for the growth of Wretch. As a web 2.0 website, low legitimacy will bring users bad feeling which may induce users to exit their usage. Contents and user base are the most important resources for web 2.0 website. The exit or suspension in usage for users will bring serious impact to web 2.0 website.

In the case of Wretch, people did not hold a strong objection for the commercialization. Nevertheless, people questioned Wretch when they detected that Wretch still used university resource to run their business and knew that most contribution to National Chiao Tung University came back to the entrepreneurs. When Yahoo acquired Wretch, people protested the acquisition since that they ascertained that the entrepreneurs were the only ones who got benefits from Wretch. The original incubation university only got 20% of the donation. The major proportion of donation, 80%, was belonged to the entrepreneurs. Besides, when Wretch was acquired by Yahoo, the NT$ 700 million was also belonged to entrepreneurs and angel investors. The Wretch users got nothing from the commercialization and acquisition process. They were really contributors of Wretch and they ascertained in mind that they were merchandise sold by Wretch to Yahoo. The lack of legitimacy in the commercialization made the users leave the Wretch.

Discussion
Both Bahamut and Wretch confronted users challenge for normative legitimate issue in the commercializing procedure. The current study used these two cases as examples to explain the normative legitimacy issues which may happen in the online community entrepreneurship. In the case of Bahamut, some users argued that Bahamut was supposed to be nonprofit and contents provided by users should not serve as a tool for entrepreneurs to earn money. This legitimacy issue made Bahamut lost some members in the commercialization process. Nevertheless, the legitimate issue was no longer serious when users found that the commercialization process did not bring immediately profit for the entrepreneurs of Bahamut.

For the case of commercialization of Wretch, there was also legitimacy consideration. After commercialization, people criticized that Wretch still used university Internet connection to run its business. Using university resource to run business brought a serious legitimate issue. Besides, 80% of the donation by the entrepreneurs to the university came back to the entrepreneurs. This unreasonable arrangement bought another legitimacy issue for Wretch.

Online communities allow users to interact with each others and to enrich website contents. Users and contents provided by the users are the most important property for online communities. Once users challenge the legitimacy of the online communities, they might choose to exit. The exit of users will bring negative effect for the development of the online communities. As an online community, legitimacy is an important issue in the commercialization process.

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A FRAMEWORK FOR POSITIONING THE GLOBAL BUSINESS

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Abstract
This framework offers positioning and revitalizing approaches by which high performing global businesses may strategically meet their global business challenges. These approaches offer ways to capture business competitiveness, and if approached in unison can yield additional benefit to the global business. A more responsive, revitalized global business can emerge – one capable of moving its position in conjunction with business-monitored customer drift or changed customer requirements.

Several business or operational solutions, plus business-customer interface approaches, and a final services gateway system offer three challenging ways for the leading-edge global business to revitalize itself, and to competitively re-position itself closer to its customers. By setting very tough goals, the global business can then intelligently link its operational, business-customer interface and customer knowledge capture zones into a finely-tuned, multiple-channel services gateway connectivity system. Built outwardly from the interface this approach continually analyses, aligns, and refocuses the back-end business deliverables, as its best solution to each customer requirement.

Keywords: company solutions, service value networks, services gateways, business strategies, interactive market, customer niches

Introduction
IBM [8] suggests high-performing global companies are suitably positioned to deliver competitive enterprises of the future. Such high performing companies carefully assess their competitive business environment (Keenan, Bixner, Powell, & Brooks, 2008). They note the possibilities of turbulent times, they understand and benchmark their competition, and they recognize and harness the power of their consumers. In addition, they carefully monitor the overarching market factors [9] [12] [17]. They move with changes in the global environment, they aim to lead and to generate change, and they recognize the competitive value of sophisticated supplier-to-business-to customer linkages – which are often reliant on operational or technological enhancements. These high-performing global companies chase business opportunities, and they understand the unique value-adding components embedded across such opportunities. They also build solutions from multi-dimensional assessment approaches. They then skillfully redesign and refocus their strategically-determined component options into ones that better enable them to extract maximum value, and to drive leading-edge change pathways into new niches [9] [12] [17].

To follow such leading-edge pathways, high-performing global companies should be agile and prepared to adapt to their ever changing environment. They should deliver new efficiencies by exploiting their existing knowledge capabilities. By combining such new efficiencies with new capabilities, in conjunction with specifically-targeted opportunities (or exploitation-style processes), new knowledge can be released. This approach can deliver innovation and rapid adaption to changing business conditions [13]. Business adaptation may be delivered via the remix of existing lower-level business procedures, processes or programs. This sometimes results from experimentation with existing business capabilities, whilst exploitation may be achieved by harnessing a range of adaptive internal business approaches (or outcomes) into higher level change-driving macro business templates. High-performing global companies may choose: (1) to build such a business system where experimentation/exploration and exploitation must be jointly sustained [16] or (2) to largely neglect experimentation/exploration, and just pursue the quick returns often generated by pure exploitation [11].

Business-Customer Targeting
Business solutions are delivered in terms of an interaction with an external party. To influence this external party a cone of customer influence as shown in Figure 1 is exerted. This Business-Customer Targeting model shows external parties – which are typically potential customers or some form can be influenced by the business’s product offering. These potential customers are then drawn downwards experiencing or seeking more product information, and so progress towards the business and its actual product (and/or service) offering. Many potential customers leave this cone of influence, passing out through the porous sides of the cone, whilst others move all the way through yet
still pour out the base of the cone without considering an interaction or transaction with the business. Some potential customers do choose to engage in interactions and only some of these actually choose to complete the transaction. Hence, from the business point of view this system is very inefficient. The lower cone represents the business concentrating its ingredients into a final product (and/or service) for the potential customer. Again this business product (and/or service) development process is inefficient, and continual improvements are generated by the business. The business-customer interaction zone is a third area of weakness. For example, the two cones may be misaligned and so only a small spillover of customers is captured, or the two cones may be widely separated by fields such as distance, or time, or by the potential to pay an asking price. Hence, the high performing global company has many areas of business in which in can focus and generated new business solutions. The most critical area remains the area of engagement termed the business-customer encounter. The author suggests the high performing global company should re-tool and redesign its business model outwards from the interface and aim to deliver very responsive business solutions. This entails advancing the business model, targeting the customer, and developing toolkits (such as service value networks [4]) to capture the business interface into one services gateway [5] approach.

**Figure 1: Business-Customer Targeting Model**

**Customer and Interface Solutions**

Beyond the business back-end is the customer engagement area. This business-customer interface is an area where high-performing global companies have many ways to improve their business model. In general, the options here do not capture real-time customer data and real time business responses. Hence, real-time business intelligence is often lacking. The business can improve its interface solutions by:

- pursuing mechanisms that allow it to develop quality measurement mechanisms across its business-customer interface [4].
- focusing on targeted marketspaces by adopting overlaying marketspace matrices populated with researched approaches that specifically time-line
the capture and growth of the specifically chosen customer niche [6] [14].

- using customer relationship management or service value networks approaches to drive the business-to-customer solution. Service value networks add an additional quality in that they measure engagement pathways, and these channels can then become the focus of traceable business-customer alignment systems, and potentially can deliver real-time business and management solutions, along with measurable degrees of customer perceived satisfaction, value and servicing [1] [3] [5] [6] [15].

- creating competitively-positioned, new product suites delivered into new niches or ‘blue oceans’ that are further expanded with second level segmented non-customer targeting [10].

Business-Customer Knowledge Management

To manage knowledge high-performing global companies should build their systems outwardly using a services gateway approach use their services gateway to accurately service and track each customer (and their changing requirements) over-time [5].

Discussion

High-performing global companies have several ways to rethink and to advance their business model, and over time, to build and revitalize their global business in-line with competitive global challenges. They may adopt an operational back-end supply-side, plus a business-customer engagement, and then add customer approaches (as shown in Figure 2), and then link these using services gateways as a means to deliver instantaneous customer responses. These challenges and strategies for business growth are each achievable. The high performing company may tackle these approaches individually, or as blocks of related solutions, or even as one complete all encompassing approach. Solution choices engaged depend on the circumstances and on the commitment of each high-performing global company, and also on how they perceive the likely key challenges and strategies for growth within their specific international business arena.

Figure 2: Business through to Customer Framework

Management Implications

Goal setting

Companies like Toyota set seemingly impossible goals like a pollution free car. This executive ploy builds an incentive for each employee to be creative, and to experiment, and to progress their research into new dimensions. This approach allows managers to measure such competing ideas and to balance these new possibilities into company advancing best solutions. This offers staff ways to explore, and to move beyond their comfort zone. Companies must allow such exploratory processes, or miss-out on these potential benefits. Astute managers may thus move their company further along the business learning curve.
Focused operations
To value add and align the business back-end, smart intelligence gathering systems linked to operational deliverable systems are necessary. This strong operational networking also extends to supplier systems and sometimes into peripheral information or alternate product support systems. This is a key focus area for management, and if aligned into customer recognition and request deliverance networks it is often an area of internal business tension. Here management should balance its competing expansive and inwardly focusing systems, whilst strengthening its operational and customer integration connectivity.

Focused staff and executive teaming
Toyota teams its staff information sharing both horizontally and vertically. It generates deep knowledge and understanding systems across its enterprise, and management are appreciative of hearing about business related negatives and/or positives. These open communication channels encourage idea and information circulation, and they generate new business ideas for the company.

Customer orientation
Businesses aim to generate contact, and/or transactions and/or exchanges with their customers. In turbulent times businesses must focus on their customer base and on their customer-targeted product value adding. This research field is under-developed, and it remains a rich area for management intelligence gathering.

Interface intelligence
The intelligent interaction between a business and a customer remains a vital component of any exchange. This processes engaged here may win or lose a potential customer. Few empirical studies capture both sides of the business-customer encounter whilst also capturing the multiple engagement pathways that interplay. This area engages business strategy, marketing, communications, innovation services, economic value, interaction and interactivity, and external systems [4]. This area offers considerable scope for the high performing global company.

Services gateways
Services gateways complete the business approach for managers of high performing companies. Multiple database and intelligence systems are involved, and these jointly engage, dissect, source, compile and deliver the business solution required by each specific customer. This highly intelligent structure allows the business to closely engage with its customers, management to test scenarios and experiment with real-time data, and the intelligence system to grow, adapt and plot alternative solutions that allow for degrees of customer drift. This research area is in its infancy. When all the business systems are integrated and made operational across an integrated intelligent services gateways type system, near instantaneous customer responses are achievable.

Conclusion
This framework to position high performing global businesses suggests other strategies beyond cost containment and labour rationalization, and ones that do not hamper learning, intelligence and innovation can readily be sourced. Operational perspectives such as: increasing efficiencies, consistent execution of offerings, learning, innovation, optimization of processes and long-term adaptability all offer ways to move beyond the business restraining principles of integration, whilst also offering a means to innovate, experiment, and to reach-out towards seemingly impossible goals. Customer interface perspectives and knowledge management may be intertwined and linked to the business product (and/or service) and to the business-customer engagement strategies. When these operational and customer perspectives are jointly linked and developed with business intelligences such as those captured by service value network, services gateway, marketspaces and niche focused approaches these three challenging zones of business improvement can deliver additional ways for the high performing global company to revitalize itself, to bridge challenges, to strategically re-position itself closer to its customers.

References


WHAT DYNAMIC CAPABILITY ARE NEEDED TO IMPLEMENT E-BUSINESS?

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Abstract
The study focuses on what capabilities are needed to implement electronic business (E-Business) successfully. We utilize an E-business innovation model to analyse the key differences in both business technology and business model dimensions between brick-and-mortar business and E-Business. The results indicate that the nature of the innovation from brick-and-mortar business to E-business is a radical change for the incumbents. A set of dynamic capabilities of exploiting and implementing E-business is identified. These results provide great insight for practitioners and scholars for enhancing their understanding of E-business innovation and provide guidelines to help incumbents adapt to new E-business applications.

Keywords: E-business, Dynamic capabilities, E-business innovation, E-commerce

Introduction
Over the past decade, rapid developments in information and communication technologies such as the Internet and mobile computing have substantially changed the landscape of both the established and emerging commercial world. In the digital world, electronic business (E-business) is being used in innovative ways that involves inter-organizational process digitization and integrates E-commerce technologies, business modeling and information exchanges among the collaborative stakeholders. Today, it has been a promising solution to improve the efficiency and quality of business operations and has been receiving significant attention of business practitioners. In fact, several innovative E-business applications, such as enterprise resource planning (ERP), supply chain management (SCM), and customer relationships management (CRM), have dominated the applications of business information system now.

However, E-business is not just suturing on an E-commerce appendage to the body corporate [1], but also innovating in servicing customers, collaborating with supply chain partners, and offering new products or services to expand business area [2]. The implementation of E-business will change the way of doing business and transform the existing business operations. Zhuang [3] argued the E-business enabled change as “E-business innovation”.

E-business innovation will alter the existing capabilities of the incumbent businesses. From dynamic capability perspective [4], in order to cope with the E-business innovation, the incumbents need to evaluate E-business-enabled changes in business technology and business model and concern with the extent to which they will meet capability gaps in the change. Then, it is necessary to identify and dispose the organizational capabilities to match the requirements of implementing E-business successfully. To this end, the incumbents must understand the significant differences in nature of technology and business model in the transformation from traditional business to E-business. Possessing the understanding is crucial for identifying core capabilities that implement E-business and match the requirements of exploiting E-business innovation [5]. Therefore, this study applies E-commerce innovation model [6], with a secondary data analysis and comparative analysis to analyze the differences in business technology and business model, so as to identify the core capabilities for E-business implementation.

The remainder of this paper is organized as follows. First, we briefly describe the concept of E-business innovation and introduce the E-business innovation model. Second, we analyze the key differences in technology and business model dimensions between brick-and-mortar business and E-business. Third, we analyze and identify the specific capabilities necessary to leverage the E-business innovation. The last section concludes with a summary that discusses the implications for exploiting E-business innovation.

E-Business Innovation
The Evolution of Business maturity in managing IT
Today’s enterprise has evolved to the point where its goal to explore and exploit the business opportunities with information technology (IT). In digital era, organizations have embraced E-business to achieve a high degree of integration and performance by increasing the business maturity in managing new IT. Willcocks et al. [7] proposes an evolutionary growth model to elucidate the path an organization can take in evolving its IS capabilities and maturing its ability to manage and source IT, as shown in Figure 1. It indicates an evolutionary process (passing through delivery, reorientation, and reorganization phases) according to an organization’s business maturity in managing IT. For businesses to succeed in IT exploitation at different phases they must acquire and focus new sets of information system (IS) capability over time and their CIOs must have different emphasis in roles. Hoque et al. [8] also identified the three states of alignment, synchronization, and convergence to demonstrate different business maturity in managing IT. Similarity, the enterprise architecture maturity stages model identifies four stages are: business silos; standardized technology, rationalized technology, and business modularity to indicate an organization’s progress in using IT strategically [9]. Each stage incrementally increases the strategic value of IT and enhances business effectiveness.

Figure 1: The evolution of business maturity in managing IT

As E-commerce technologies grow, new E-business applications will soon follow. Over the past decade, we have witnessed the intense progression of E-business applications has substantially changed the landscape of business. More and more businesses adopt new E-business applications to integrating business information and business processes internally or externally. However, the adoption of new E-business applications often transforms the current business operations and stimulates organizational changes [10]. In the E-business enabled innovation, the incumbents need to mature its ability to use new E-business technology and reinvent their business models.

Categories of E-Business Innovation
Damanpour [11] defined an innovation as adoption of an internally generated of purchased device, system, policy, program, process, product, or service that is new to the adopting organization. The elements of this definition are embedded in E-business. E-business is defined as the key business operations of an organization are carried out through the use of information and Internet technology. It is an inter-organizational IS that integrates IT and business model and allows the various participating stakeholders to exchange information about commercial offerings. Essentially, E-business is also an innovative inter-organizational application of business technology. It implies the important characteristics of the definition an innovation [11]. Moreover, when E-business is introduced into a firm, it requires new technologies such as computer hardware, networking, software applications, and policies for conducting business transactions and safeguarding confidential information. Thus, the implementation of E-business will transform the incumbents’ business technology applications and business model. It implies the important characteristics of the definition an innovation[11].

Understanding the nature of an IT-enabled innovation is a crucial first step in managing the changes associated with the innovation [10]. To comprehend E-business innovatively, it is necessary to understand the attributes of E-business innovation [12]. Barua et al. [13] argued that the E-business drivers include three distinct but related areas: IT applications, business model (processes), and the partnerships with customers and suppliers. In fact, the implementation of E-business involves business technology upgrade, business reorganization, business model reinvention, supply chain reconfiguration. Moreover, the collaboration of a firm’s suppliers, customers, and strategic partners can play important role in E-business innovation. Thus, E-business innovation can be characterized as both technical and business innovation in terms of inter-organizational focus.

E-business innovation can be conceptualized as a net-enabled organizational innovation arising from new business technology. By drawing upon Wu and Hsia’s [6] E-commerce hypercube innovation model, we propose a three-dimensional E-business innovation model, shown in Figure 2, to analyze the typology of E-business innovation. The model suggests the overall domain of E-business innovation is made up of three principal constructs:...
business technology, business model, and collaborators.

**Figure 2. E-business innovation mode**
The taxonomic model considers that an E-business innovation can be described in terms of its changes in business technology and business model. The changes of E-business innovation can be categorized into four types: incremental, modular, architectural, and radical depending on the extent to which the innovation impacts the existing business technology and business model. An E-business innovation is incremental if it conserves the existing business technology and business model; modular if it destroys business technology but conserves the business model; architectural if it destroys the business model but preserves the business technology, and radical if both business technology and business model become obsolete.

Business technology is defined as the application of IT to deliver a product or service and automate a business operation [8]. In E-business environments, the three key domains about business technology generally include: IS integration, process integration, and digital services [5][14][15]. Here, IS integration refers to the degree to which a firm has established IT infrastructure for the consistent and high-velocity transfer of information within and across its boundaries. Process integration refers to the degree of a firm that has integrating the flow of information, materials, and finance with its partners by using IT [15]. Digital services refer to the degree of digitization of a firm’s business operations and transactions executed with its partners and online services. These components are further divided into several elements for comparison described as:
- IS integration — consisting of IT infrastructure, business applications and data consistency.
- Process integration — consisting of information flow, logistic flow, and financial flow.
- Digital services — consisting of operational service, transaction mechanism and security.

A business model is a coherent framework that converts the business technologies through markets into business value [16]. A business model is often used to describe the key elements of a given business. Johnson et al. [17] argued that a business model consists of four interlocking elements: customer value proposition, profit formula, key resources, and key processes taken together, create and deliver value. Afuah and Tucci [18] proposed a set of elements of Internet business model, including profit site, customer value, scope, pricing, revenue sources, implementation, capabilities, and sustainability. Based on the aforementioned literature, the functions of a business model are to: articulate the customer value proposition; distinguish a market segment; estimate the cost structure; assess the profit potential; identify the structure of the value network within the bank needed to collaborate with their customers and other stakeholders. We therefore define the components of a business model, including value proposition; market segment, cost structure, profit potential, and value configuration. Furthermore, in E-business environments, a company needs to work with other collaborators such as suppliers, customers, and strategic partners. Thus, the model presents the collaborators dimension specially to indicate the three key stakeholders.

**Dynamic Capabilities Perspective**
To cope with rapid changes of business environment, a firm must constantly reconfigure, gain, and dispose organizational capabilities and resources to match the requirements of a changing environment [4]. The ability to recognize and identify a firm’s new market opportunities, determine their potential strategic importance, and renew its competencies is called “dynamic capabilities.” Dynamic capabilities vary with environment dynamism. That is, the capabilities are essentially change-oriented capabilities that help the firm redeploy its resources and renew its competences to sustain competitive advantages and to achieve congruence with the shifting business environment. However, the development of dynamic capabilities reflects an organizational ability to cope with the change in a timely way. Dynamic capabilities perspective (DCP) has been applied for the E-business domain. For instance, Rindova and Kotha [19] employed the concept of dynamic capabilities to examine how the organizational form, function, and competitive advantage of E-business dynamically coevolved.
Daniel and Wilson [20] identified eight dynamic capabilities that are necessary for E-business transformation and proposed practices in developing these capabilities that are both effective and common across firms. Dynamic capabilities can be beneficially applied for understanding core capabilities that are necessary for implementing E-business in a dynamic E-commerce environment. Wheeler [21] proposes the Net-Enabled Business Innovation Cycle (NEBIC) model for measuring, predicting, and understanding a net-enabled organization’s ability to create customer value through the use of innovative IT. This approach incorporates both variance and process views of net-enabled business innovation and defines four essential capabilities: choosing new IT, matching capabilities that are necessary for implementing E-business innovation, for growth, and accessing customer value for net-enabled business innovation that creates customer value. The strengths or weaknesses of these capabilities can be used to predict the firm’s ability to create value for the net-enabled business innovation.

Analysis of E-Business Innovation
To further understand the nature of E-business innovation, we propose an E-business innovation model (see Figure 2) by using secondary data analysis to evaluate and analyze differences in two dimensions: business technology and business model and then explores the dynamic capabilities for implementing E-business innovation.

Changes in Business Technology
Initially, to understand the transformation from brick-and-mortar business to E-business in terms of business technology, we analyze the key differences in the dimensions such as IS integration, process integration, and digital services, considered in the previous section, based on an analysis of the extant literatures. Table 1 summarizes the major variations relating to each of these dimensions.

The history of business automation records the shifts in the IT-infrastructure from mainframe, to PCs, to client/server, before the emergence of the Internet. These IT-architectures are embodied in desktop computing and wired networking architecture, which is supported by proprietary electronic network implemented by private third party. In the past, the business networking is largely based on the wide area network (WAN) architecture. Traditional online transaction systems, conducted with the use of IT centering on electronic data interchange (EDI) over proprietary value-added networks (VANs) that are established by vendors to deliver services over and above those of common carriers. The EDI is generally an industrial standard that provided the data exchange

<table>
<thead>
<tr>
<th>Elements</th>
<th>Brick-and-mortar business</th>
<th>E-business</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IS Integration</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>IT infrastructure</strong></td>
<td>1. Desktop computing</td>
<td>1. Web-based and mobile computing</td>
</tr>
<tr>
<td>2. Isolated network architecture</td>
<td>2. Open network architecture</td>
<td></td>
</tr>
<tr>
<td>4. Quarantined bandwidth</td>
<td>4. Multimedia transmission</td>
<td></td>
</tr>
<tr>
<td>5. Regional EDI Standards: UN/EDIFACT, ANSI X12</td>
<td>5. Abundant bandwidth</td>
<td></td>
</tr>
<tr>
<td><strong>Business application</strong></td>
<td>1. Functional information systems</td>
<td>1. Cross-functional information system integration</td>
</tr>
<tr>
<td>2. Support internal business operations</td>
<td>2. Dominate inter-organization business operations</td>
<td></td>
</tr>
<tr>
<td>3. Transaction processing oriented</td>
<td>3. Information and strategy oriented</td>
<td></td>
</tr>
<tr>
<td>4. Combination of paper-based information and electronic information</td>
<td>4. E-business applications: ERP, SCM, CRM</td>
<td></td>
</tr>
<tr>
<td><strong>Data consistency</strong></td>
<td>1. Disparate data formats</td>
<td>1. Standardized data formats</td>
</tr>
<tr>
<td>2. Heterogeneous and fragmented database systems</td>
<td>2. Integrated database systems</td>
<td></td>
</tr>
<tr>
<td><strong>Process Integration</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Information flow</strong></td>
<td>1. Information is a supporting role in value chain</td>
<td>1. Information is a strategic role in value chain</td>
</tr>
<tr>
<td>2. Operational information sharing</td>
<td>2. Operational, tactical, strategic information sharing</td>
<td></td>
</tr>
<tr>
<td>3. Information transmission in a firm</td>
<td>3. Information transmission across the supply chain.</td>
<td></td>
</tr>
<tr>
<td>4. Combination of paper-based information and electronic information</td>
<td>4. Information flow integration</td>
<td></td>
</tr>
<tr>
<td><strong>Logistic flow</strong></td>
<td>1. Logistic flow of marketplace and market space</td>
<td>1. Logistic flow of marketplace and market space</td>
</tr>
<tr>
<td>2. Mainly physical products and distribution networks</td>
<td>2. Integrated logistic flow</td>
<td></td>
</tr>
<tr>
<td><strong>Financial flow</strong></td>
<td>1. Cash flow of physical payment</td>
<td>1. Financial flow of virtual payment</td>
</tr>
<tr>
<td>2. Mainly cash, invoices, credit terms, and accounts</td>
<td>2. Electronic transaction and payment</td>
<td></td>
</tr>
<tr>
<td>3. Integrated financial information</td>
<td>3. Integrated financial information</td>
<td></td>
</tr>
<tr>
<td><strong>Digital Services</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Operational services</strong></td>
<td>1. Physical operation activities</td>
<td>1. Click-and-mortar operation activities</td>
</tr>
<tr>
<td>2. Physical supply chain</td>
<td>2. Virtual supply chain</td>
<td></td>
</tr>
<tr>
<td>3. Paper-based material requisition and order management</td>
<td>3. Electronic material requisition and order management</td>
<td></td>
</tr>
<tr>
<td>4. Physical distribution channel</td>
<td>4. Multiple distribution channels</td>
<td></td>
</tr>
<tr>
<td>5. Physical contact or phone services</td>
<td>5. Serve online customers simultaneously</td>
<td></td>
</tr>
<tr>
<td><strong>Transaction mechanism</strong></td>
<td>1. Paper-based or EDI contract</td>
<td>1. Online transaction</td>
</tr>
<tr>
<td>2. Over-the-counter</td>
<td>2. Anywhere-anytime</td>
<td></td>
</tr>
<tr>
<td>3. Physical players, processes, or payments</td>
<td>3. Virtual player, processes, or payments</td>
<td></td>
</tr>
<tr>
<td>4. Location and time critical</td>
<td>4. Overcome geographic or time limitations</td>
<td></td>
</tr>
</tbody>
</table>

of standardized electronic transaction documents
and data. In contrast with the Internet, the VANs provide higher security features and quarantined bandwidth. The centralized control architecture limits the interoperability of linking additional networks and integration of heterogeneous IS applications. Moreover, the vast majority of traditional IS applications are meant to support transaction functions within firms and do not provide much information because of limited bandwidth, platform dependency, and data inconsistency [22]. Thus far, E-business systems are based on web-based and mobile platforms over wired or wireless networks, which are supported by TCP/IP protocol. By relying on the open network and standardized protocol, the Internet provides an interoperable and worldwide networking model. Contrary to the limited bandwidth of the private network, the capacity of public Internet is abundant and nearly free. The World Wide Web (WWW) can support the transmission of multimedia data. Based on the platform, the E-business applications can be characterized as intense multimedia systems. They are frequently inter-organizational systems that must integrate with existing legacy transaction processing systems within a company and often need to connect with their suppliers, customers, and business partners. Developing E-business applications therefore require a combination of new skills such as content, online service, and user interface design together with web-based IS development techniques [23].

Table 1 Difference in business technology
The mechanisms of conducting secure transactions are important for inter-organizational transaction. Traditional business transaction processes mainly involve physical players, processes, and payments. In contrast, E-business is a new channel of integrating physical and virtual transaction activities via the Internet or mobile networks. It constructs an alternative channel by which customers can easily make a transaction anywhere-anytime and reduce their needs for intermediaries. Given the open nature of Internet, security is likely to emerge as the biggest concern among the business stakeholders [13]. Thus far, several well-developed digital transaction mechanisms and online payment systems have been developed to support the digital channel. For instance, the new generation of payment systems (e.g. electronic funds transfer networks) can be introduced to simplify use of cross-border transactions by global standardization. The typical security schema of e-business includes the encryption, firewall, and a certification of the firm’s server to prevent another masquerading. Now, the popular security protocols include Secure Socket Layer (SSL), Secure Electronic Transaction (SET), Wireless Transport Layer (WTL), and wireless Public Key Security (PKS) [24].

Over the past years, business operation has already been migrating customers from physical activities to online services. The nature of the former mainly focuses on internal activities such as transactional and administrative functions that allow firms to perform routine operations and to conduct transactions. In contrast, E-business is a click-and-mortar service channel whose utilization must be maximized, and is an interface to the customer base whose usage should enable customer s and partners relationship management [25]. Thus, E-business should be utilized as an integrated service channel that not only focuses on transactional and administrative services but also supports more informational services [26]. For instance, a company could share and distribute inter-organizational information, business intelligence, and other value-added services to partners in the supply chain by using E-business. Besides, it can use CRM systems to offer recommendations based on past transaction profile or customer interaction and tailor the services to the customers. In E-business environment, the collaborators have full access to business and customer information, and needs no longer to rely on the traditional communication services.

Change in Business Model
Every successful company already operates according to an effective business model [17]. Business model is the method by which a company develops and uses its resources to offer its customers better value and to make profit [18]. It is also a mediating framework between new technologies and business value [16]. A good business model provides the answers for: Who is the customer? What does the customer value? How do we make money in this business? How can we give value to customers at a proper cost? The elements of a business model include value proposition, market segment, cost structure, profit potential, and value configuration [6][18]. The differences in the five elements of a business model — customer value proposition, profit formula, key resources and key processes — between brick-and-mortar business and E-business are independently analyzed in this section. Table 2 summarizes the key differences relating to each of these elements.

Table 2 Differences in the business model dimension

<table>
<thead>
<tr>
<th>Elements</th>
<th>Brick-and-mortar business</th>
<th>E-business</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>1. Localization</td>
<td>1. Efficiency: low cost,</td>
</tr>
</tbody>
</table>
Brick-and-mortar business needs to establish a physical channel presence in a geographical location in order to serve local customers there. The outlet is more effectively serve customers with lower IT awareness and acceptance. Therefore, brick-and-mortar business is better able to build consumers’ trust because of their physical presence in the markets they serve. It has realized the value arising out of reduced transaction risks and improved trust.

E-business channel eliminates physical and geographic boundaries and time limitations of bricks-and-mortar business. It provides consumers with convenience—time-saving and high speed—services online. Customers should be able to access rich information and services via the Internet. Such convenience has three potential impacts. First it may result in an information asymmetry where the partners share more business information. Second, it is possible that an information transparency may result in a online service channel in virtual world [27]. In addition, E-business can be utilized as a click-and-mortar channel to develop long-term customer and partner relationships through ready access to a broad and increasing array of products, services and low-cost financial shopping, rapid response to market inquires, and customized product or service innovation [25]. Consequently, the integrated channel may extend the existing supply chain and market. We sum up that E-business realizes these value propositions: efficiency, convenience, customization, and supply chain extension [15].

The market segment refers to the market scope to which the value should be offered. The market scope and customer base of brick-and-mortar business is restricted within local marketplace. E-business is a new marketspace, so the market segment of geographic business and E-business are quite different. To exploit the new marketspace and increase the existing market share, the incumbents must seek to capture the potential customers and strategic partners as early as possible. The cost structure of brick-and-mortar business and E-business operation is different. E-business is driven largely by the prospects of operating costs minimization and operating revenue maximization [13]. In contrast to traditional business, E-business is efficiency and it handles business operations and transactions automatically, without being weighed down by bulky documents. Thus, the use of E-business has the potential for order-of-magnitude reductions to the cost of processing and transmitting information [28]. E-business allows firms to link directly to customers and partners online, thereby significantly reducing transaction, labor, promotion, and service costs. In the brick-and-mortar business context, firms receive their revenues sources directly from operational efficiency, capacity utilization, and economics of scale. It is apparent that many firms are motivated to implement E-business by forces relating to the maximization of the earning through increased market scope and improved customer relationship due to product delivery convenience and service customization [7].

The value configuration describes the position of a company within the industry linking suppliers, customers, and partners [18]. In the brick-and-mortar business context, companies collaborate with their business stakeholders via physical supply chain. In contrast, E-business has blurred the geographic and physical boundaries between companies and their stakeholders and form an integrated supply chain [15]. The integration of virtual and physical supply chain will intensify the scope of competitive environments and the complexity of inter-organizational business involving various stakeholders.

**Development of E-Business dynamic capabilities**
The results of comparative analysis manifests pronounced variations in business technology and business model between brick-and-mortar business and E-business. The variations raise a number of changes in IS integration, process integration, digital service offerings, and business model and lead to a radical overhaul of the way of doing business. Accordingly, the capabilities that underpin the organizational ability to successfully implement E-business relate to three generic capability domains: business technology, business management, and collaboration. These capabilities combine, along with the business practices, to form the dynamic capabilities of exploiting E-business. Based on the results of aforementioned comparative analysis, we identify eleven core dynamic capabilities through the reviewed extant literatures about IS capabilities, observation, and discussions with E-business practitioners.

From technological perspective, the core business technology capabilities include planning new IT-infrastructure, integrating IS applications, sharing value-added information, enhancing information security (as shown in Table 3).

### Table 3 Dynamic Capabilities of Business Technology

<table>
<thead>
<tr>
<th>Changes in E-business</th>
<th>Dynamic capabilities of business technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>The IT infrastructures of the E-business are significantly different from those of bricks and mortar.</td>
<td>Planning new IT infrastructure.</td>
</tr>
<tr>
<td>Effectively integrating inter-organizational IS applications is critical for successful e-business and real-time information.</td>
<td>Integrating IS applications.</td>
</tr>
<tr>
<td>E-business should create and share physical information and virtual information for data consistency.</td>
<td>Sharing value-added information.</td>
</tr>
<tr>
<td>Data transformation and transactions are conveyed over public Internet.</td>
<td>Protecting information security</td>
</tr>
</tbody>
</table>

**Planning new IT infrastructures**

This capability refers to the ability to plan, deploy, and develop new IT infrastructures and information systems for e-business. This capability is important because most companies may not do all investments regarding e-business immediately. Thus, a company may need to properly plan the e-business investments based on the bottom line [29]. There are some important issues for planning new IT infrastructure, such as the timing, context and focus of information technology investments.

**Integrating IS applications**

Although E-business can create many benefits for organizations, none of the benefits are achievable unless various cross-functional ISs within an organization and across organizations can be well integrated [30]. The integration of inter-organizational IS systems has been seen as an important task for successful E-business traditionally, data integration occurs within a single organization and the problem of integration can be solved by utilizing data warehouse techniques. In E-business, data integration occurs across organizations and there are many barriers for the integration, such as different organizations with different content formats and semantics. Thus, the task of integration of IS applications is usually difficult for an organization [31].

**Sharing value-added information**

Adoption of E-business relies on effective information exchange between companies and their customers, suppliers, and partners. When digital services replace a traditional service, the customer will need real-time access to relevant information to reduce the uncertainty of transaction. Companies have to give up its information asymmetry relative to its collaborators to enable them to share their information. For example, customers may be supported by informational services to quickly query order and inventory situations online. With these features, companies must provide value-added information such as price, inventory, and customer-related information that matches the collaborators’ needs. However, a challenge for the companies is to determine what information content they need to reveal in order to remain as a preferred partner versus the information they will not share in order to control stakeholders’ decisions.

**Protecting information security**

E-business involves online transactions among many collaborators. That means that transactions data is conveyed over public internet and there are many accompanied security problems which usually cause serious disasters. It is found that the Internet attack events increase by the rate of 10% to 15% annually [32]. Thus, an E-business system needs the ability to deal with various related issues, such as privacy policy, government regulations for privacy threats and various security threats.

From business model perspective, the core business management capabilities for E-business consist of aligning IT with business strategy, planning and managing business reorganization, Exploring new business opportunities, and positioning in an attractive site, matching IT with business strategy, planning and managing business reengineering, understanding emerging technology to see new business opportunity (as shown in Table 4).

### Table 4 Core Dynamic Capabilities for Business
Management

<table>
<thead>
<tr>
<th>Changes in E-business</th>
<th>Dynamic capabilities of business management</th>
</tr>
</thead>
<tbody>
<tr>
<td>IT is the core driver of E-business and the alignment of IT and business strategy is important.</td>
<td>Aligning IT with business strategy</td>
</tr>
<tr>
<td>E-business requires a wide range of business reorganization and process reengineering.</td>
<td>Planning and managing business reorganization</td>
</tr>
<tr>
<td>Internet provides many new marketspace and business opportunities.</td>
<td>Utilizing new IT to explore new business opportunities</td>
</tr>
</tbody>
</table>

Collaboration

<table>
<thead>
<tr>
<th>Changes in E-business</th>
<th>Dynamic capabilities of collaboration</th>
</tr>
</thead>
<tbody>
<tr>
<td>The governance of E-business is important for company in the E-business value network.</td>
<td>Managing and leading virtual market development</td>
</tr>
<tr>
<td>E-business should integrate physical and virtual channels into a click-and-mortar channel.</td>
<td>Integrating physical and virtual channels</td>
</tr>
<tr>
<td>Enhancing supply chain relationships is the source of business value co-creation.</td>
<td>Co-creating business value</td>
</tr>
<tr>
<td>There are the challenges of global market and virtual collaboration.</td>
<td>Dealing with global market and collaboration</td>
</tr>
</tbody>
</table>

Aligning IT with business strategy

Although a high proportion of organizations have announced their E-business plan, not all companies can obtain value or benefit from the implementation of the E-business [33]. The key point is not concerning whether the organization deploys E-business to take advantage of IT, but concerning how the organization deploys IT to match their business strategy [34].

Planning and managing business reorganization

E-business innovation has challenged conventional organizational forms and business model. Significantly redesigning traditional business model is necessary for the company to conduct new E-business model. The reorganization of business model and the reengineering of business processes in order for E-business requires the organization to establish new routines and norms and requires employees to learn new skills for the new processes [7]. These barriers can be treated as the knowledge barriers for developing E-business successfully.

Exploring new business opportunities

Although E-business benefits to organizations in creating value and enabling more efficient operations, it also creates new types of rival which well utilize new business opportunities E-business innovation brings [35]. This capability is consist of the ability of sensing and seizing opportunities. The former ability refers to the ability of an organization to sense customer needs and technological opportunities. The later ability refers to the ability of an organization to seize the new market opportunities and technical opportunities which have been sensed by the organization. They also can be seen as business technology management capability [8].

In term of the collaboration, the core collaborating capabilities for E-business consist of managing and leading virtual market, integrating physical and virtual channels, sharing information to co-create value, dealing with global market and collaboration.

<table>
<thead>
<tr>
<th>Table 5 Core Dynamic Capabilities of business management</th>
</tr>
</thead>
<tbody>
<tr>
<td>The governance of E-business is important for company in the E-business value network.</td>
</tr>
<tr>
<td>Managing and leading virtual market development</td>
</tr>
<tr>
<td>Integrating physical and virtual channels</td>
</tr>
<tr>
<td>Co-creating business value</td>
</tr>
<tr>
<td>Dealing with global market and collaboration</td>
</tr>
</tbody>
</table>

Managing and leading virtual market development

Infinite virtual capacity is one of the most important E-business properties and utilization of the infinite virtual capacity will create additional profits [18]. However, in virtual world, customers virtually experience product features and service and employees and business partners virtually collaborate with each others. Many human contacts are eliminated [36]. Thus, the governance and of virtual market and channel is different from that of physical or traditional market, business process and channel.

Integrating physical and virtual channels

Most E-business companies provide multiple distribution channels to satisfy customers’ needs, including physical and online channels. For example, a customer can choose shopping online but paying in physical world. Effective integration of multiple channels can bring business maximum benefits.

Co-creating business value

In E-business, collaboration is a strategic resource of creating business value. For example, unlike traditional media which can only share business information to customers, online media is a two-way marketing communication in which customers requires information from a company and also provide useful information to the company. That is, the ability of an organization to share information to enhance supply chain relationships can co-create business value for the company and its collaborators [37].

Dealing with global market and collaboration

Some challenges accompanied with E-business are created, such as the issues of culture, currency, and delivery. Supply chains becomes more dispersed because of global configuration and thus have given rise to the problem and complexity of coordinating flow of information and materials between an organization with supplier or customers in its supply chain [35].
Discussion and Conclusion

The inductive results indicate that the transformation from brick-and-mortar business to E-business is radical, leading to massive changes in both areas: business technology and business model. We conclude that the change may render the incumbents’ capabilities and experiences obsolete. It implies that the incumbents attempt to duplicate the previous business technology applications and business model to respond E-business is impractical. Conversely, in the face of the change, businesses must seriously rethink how they do business reorganization.

To assist the businesses successfully exploit E-business, we further identified several core capabilities for implementing E-business innovation. These capabilities fall into three distinct domains that must be balanced and be constantly reconfigured. One domain relates to the capabilities to utilize the emerging business technologies, while the second domain is the capabilities for the reinvention of the business model, and the third domain is the capabilities for the collaboration with customers, suppliers and business partners. It stresses the notion that the incumbents are unable to properly exploit E-business without a strong dynamic capabilities related to innovative using of IT, reinventing business models, successful collaborating with stakeholders. The implications of the results for the incumbents can be viewed in two ways. On the one hand, they need to develop uniquely innovative services and products through the secure IS platforms and inter-organizational processes, and on the other hand, they need to evaluate their business model that change the way company operated and how it interacts with its stakeholders.

Our research is positioned as an exploratory one seeking to extend the dynamic capabilities perspective to the E-business context. The results provide the incumbents with appropriate recommendations for responding the changes derived from E-business. It is valuable to enhance our understanding of the nature of E-business innovation and also for providing insights into the transformation from brick-and-mortar business to E-business.

References

What Dynamic Capability are Needed to Implement E-Business


Abstract
The current research presents a theoretically sound model on information systems (IS) characteristics' effects on end-users' perception of computer self-efficacy and outcome expectations. Based on the IS success model and the social cognitive theory, the relationship among factors with regard to small- and medium-sized enterprises (SMEs) in Taiwan is examined. Using mail survey, 284 usable responses are obtained, and the total response rate is recorded at 51.64%. Structural equation modeling (SEM) is employed to assess the relationships among related constructs. In modeling the results of data analysis, it is shown that (1) there are no direct links between both information quality and service quality with computer self-efficacy, but the effect of system quality is observed; (2) the relationship between both system quality and service quality with outcome expectations is significant, but that with information quality is not; and (3) outcome expectations mediates the impacts of computer self-efficacy on end-users' satisfaction. Finally, the implications of the results are provided, and directions for future research are discussed.

Keywords: Social cognitive theory, IS success model, structural equation modeling (SEM), small- and medium-sized enterprises (SMEs)

Introduction
The rapid development of information communication technology (ICT) has spawned advancements in Internet applications. Firms are now said to be in the era of digital economy. However, along with the rapid development of e-business, firms around the world now encounter rigorous business competition. With greater customer demand and newly emerging technologies, firms must implement innovation and reforms in response to the significant challenges they face [12] [20]. With the influence of globalization and massive information diffusion, small- and medium-sized enterprises (SMEs) are hard-pressed to achieve their revenue targets.

In an unstable environment, managers should particularly recognize the operational environment, plan effective strategies, and invest in proper information technology (IT) and information systems (IS) to increase profits for the organization [1] [19]. Thus, to boost core competitiveness and positioning, sharing of important information through IS and communication technique may serve as the key strategies for SMEs to strengthen their market foothold. However, as technology is derived from human demand, the recognition of the system characteristics’ influence and users’ cognitive factors on IS satisfaction after the introduction of e-business in SMEs will be a significant research subject for improving organizations’ IS efficacy and operational management.

The characteristics of the DeLone and McLean IS Success Model are studied by examining the influence of system characteristics on users’ system use and satisfaction through information quality, system quality, and service quality of the system, and by further probing into its ultimate net benefit on individuals and organizations [10] [11]. The users’ beliefs and internal expectation on computer applications are also critical issues for IS implementation. Marakas, et al. (2007) further indicated that the users’ self-efficacy represents a complex psychological process. However, the belief of psychological constructs are also formed and used to guide human action [2] [3] [21] [22]. The Social Cognitive Theory aims to emphasize that individual cognition will be affected by external information which further influences the behavioral model.

To accomplish the objectives, this study aims to achieve the followings: (1) to examine the influences of system characteristics, information quality, system quality, and service quality on users’ cognitive behavior; and (2) to recognize the influence of users’ cognitive behavior on IS satisfaction. In analyzing the users’ IS demand from the system characteristics in the IS success
model and probes into the influence of users’ psychological aspect on system satisfaction from the view of the social cognitive theory to elaborate and validate the research hypotheses. The research findings would act as critical criteria to improve SMEs e-business applications.

**Literature Review**

**Importance of e-Business**

The implementation of e-business is based on the view of firms and their application scope, which closely combines the importance of the knowledge system, related information, suppliers, partners, agents, employees, and clients through the Intranet, Extranet, and Internet. Likewise, it aims to reform and enhance original business procedures through Internet-based techniques.

E-commerce and e-business are widely applied in e-business. Nprris, et al. (2000) suggested that e-commerce includes two functions: selling the products or providing services through the Internet and making the procurement more efficient. E-business connects firms and the suppliers at different stages in the entire value chain through IT and enforces an open standard to reinforce operational performance.

E-commerce focuses on the efficiency of sales, marketing, and procurement. Kalakota and Robinson (2000) defined e-commerce as a transaction through digital media. Meanwhile, e-business companies not only include e-commerce but the drive of modern operation and integration of front and end business as well. E-business firms involve e-commerce, and they redefine the previous operational model through technical assistance, which leads to customers’ maximum value. Therefore, e-business is an overall strategy, while e-commerce is simply an important part of e-business.

**Characteristics of SMEs and the Challenge for e-Business**

SMEs are small-scale firms that play a critical role in an environment characterized by rapid growth. They support industry development and serve as economic growth drivers. Scholars surmise that SMEs are small-scale or family-run firms with inadequate finances, poor competitiveness, insufficient capital, poor human resources, incomplete organizational structure, and weak industrial connections [1]. Rapid Internet and IT development, however, has led to new operational opportunities. SMEs should leverage IT, address their core competitiveness, and effectively combine external resources to respond to changing techniques and management.

With the emergence of a globalized and integrated world economy, industries all over the world encounter massive changes in both internal and external environments. They have adopted different market scales, organizational structures, and transaction measures to deal with these changes. To address the challenges of the new environment, firms must properly and fully implement IT and IS to create more business value and opportunities, support operation by IT/IS to obtain organizational efficiency and efficacy, reduce the costs involved, and reinforce information resources sharing. These have been the important issues in the field of information management in recent years [1] [12].

How to introduce IT successfully to increase competitiveness despite insufficient resources, capital, materials, and human resources is an important future strategy for SMEs. However, to enjoy the maximum benefits despite limited resources, SMEs should exercise caution in their e-business activities. Thus, the challenges and problems faced by SMEs are particularly critical in this study.

**The IS Success Model**

Since DeLone and McLean proposed the IS success model in 1992, there have been various researchers driving this model to examine IS implementation comprehensively [29] [31] [33] [34]. In 2003, DeLone and McLean further proposed a modified model to address change management and users’ needs of the e-commerce era. The IS success model is simple and effective, and it can fully elaborate the important concept of a successful IS. Therefore, it is a significant theoretical and practical base for future studies [11].

Shannon and Weaver (1949) organized communication issues into three different levels: technical, semantic, and effectiveness. Furthermore, Mason’s (1978) research adopted the communication theory as well as Shannon and Weaver’s three level-concept to measure information output to explain and evaluate the user’s behavioral change in IS communication application. Based on these concepts, DeLone and McLean reviewed over 180 articles in the period covering 1981 to 1988, which constituted seven publications that proposed their IS success framework in 1992. In their literature reviews, DeLone and McLean conceptualized and taxonomized their model with six interrelated constructs of IS success, including system quality, information quality, system usage, users’ satisfaction, individual impact, and organizational impact. The model likewise suggested that the constructs depend on one another and that they are sequential.

The concept of Service Quality was derived
from marketing in the mid-1980s [27] [28]. After observing and recognizing IS usage, Pitt, Watson, and Kavan (1995) demonstrated that service quality could increase IS efficacy, and thus advised future researchers and system developers to consider this critical factor when constructing and measuring the system. The IS success model is widely accepted by scholars because it integrates recent research findings on IS using objective and specific concepts. After Pitt et al. (1995) emphasized service quality, Seddon and Kiew (1996) proposed a multiple framework for the IS success model, DeLone and McLean further devoted themselves to the challenges of a successful IS in an e-commerce environment and modified the model to meet the business trends of the e-era [11] [31] [35]. After organizing the literature on IS success from 1993 to 2002 as sourced from a well-known IS periodical, DeLone and McLean modified the model and included service quality as an external variable to complete the original model. Hence, this new model can respond to the special operational requirement of growing IS in an e-commerce environment. The modified model is illustrated in Figure 1.

With the prevalence of IT application, firms have encountered more diverse operational problems. Therefore, they must invest in the integration of IS, communication network, and e-commerce to obtain competitive advantages in a dynamic market. However, the measurement of an e-commerce system’s success is a difficulty encountered mostly by firms. In this regard, the modified IS success model functions as a significant base for future studies [29] [33].

The Social Cognitive Theory
The social cognitive theory (SCT) is derived from the social learning theory (SLT). In 1986, Bandura, with authorization, launched the SCT in his book “Social Foundations of Thought and Action: A Social Cognitive Theory.” The social cognitive theory suggests that individuals’ behavioral model is based on the interaction among individual cognition, behavior, and environment. It emphasizes that individual cognition is affected by external information, which promotes changes in behavior [3] [4]. Within the perspective of SCT, humans are characterized in terms of the basic and unique capability of symbolizing; they are vicarious, possess forethought, and are capable of self-regulation and self-reflection. These characteristics provide humans with the cognitive means to determine their behavior [3] [4].

In recent years, the SCT has been widely discussed and applied in the field of social science, including modeling, skill training, behavioral rehearsal, self-monitoring, and contracting. Empirical studies on individual behavior, such as personalities and demographic characteristics, and the social stress of technology behavior have been widely cited by scholars [6] [7] [21] [22] [30]. Bandura emphasized that there are two sets of expectations that serve as the major cognitive force guiding human behavior. The first set relates to outcome expectations, while the second encompasses self-efficacy. Bandura defined outcome expectancy as a person’s estimation that a given behavior would lead to certain outcomes, and explained efficacy expectation as the belief that one could well perform the behavior required to produce the outcomes [3].

Individual self-efficacy and outcome expectations are two core concepts of the SCT. Bandura suggested that people imagine the outcomes and infer their capacity to work for such, which will result in real actions through their individual execution and expected outcomes. In brief, with the self-efficacy belief, people perform the necessary actions and feel that their efforts are not in vain because of their expectations [2] [3].

Research Method
This study is based on the IS success model proposed by DeLone and McLean (2003) combined with Bandura’s (1986) SCT. The goal is to determine how IS influenced user satisfaction through cognitive factors. In this section, the research model, development of research hypotheses, variable definition and measurement, and research design are elaborated. The theoretical research model is illustrated in Figure 2 below.
The Development of Research Hypotheses

With regard to the improvement of users’ performance, IS potentially allows organizations or users to accomplish their goals. However, users at times would not accept or use IT. The main reason is the individuals’ cognitive factors.

In relation to this, Davis (1989) suggested two important factors on IS usage: perceived usefulness and perceived ease of use, which were considered the core concepts of the technology acceptance model for the research on users’ behavioral intention and technology usage. In a study on the factors of micro-computer usage, Igbaria, Guimaraes, and Davis (1995) suggested the external factors of different constructs: user characteristics, system characteristics (quality), and organization support, which influence users’ usage of computer technology through belief in perceived usefulness and ease of use.

In a study on users’ IT application, Davis (1989) cited the self-efficacy theory to elaborate on perceived usefulness and perceived ease of use, and observed their similarity to outcome expectations and self-efficacy in theory. Piccoli, Ahmad, and Ives (2001) probed into Web-based virtual learning environments and suggested that the system with sound technology quality, reliability, and was easy to be said had a significant and positive influence on individual self-efficacy, satisfaction, and performance.

In the study of social science, the self-efficacy theory was derived from the social cognitive theory. It likewise emphasized that the belief in self-efficacy is the key factor in human beings’ drive, serving as the lead idea. The previously cited studies all indicated that beliefs in self-efficacy and outcome expectations were the most significant factors affecting individuals’ behavior. The theory has been central in IT application in recent years as well [3] [9] [16] [30]. Thus, this study developed the following hypotheses:

H1a: With regard to IS usage, information quality has a positive and significant influence on users’ outcome expectations.

H1b: With regard to IS usage, information quality has a positive and significant influence on users’ computer self-efficacy.

H2a: With regard to IS usage, system quality has a positive and significant influence on users’ outcome expectations.

H2b: With regard to IS usage, system quality has a positive and significant influence on users’ computer self-efficacy.

H3a: With regard to IS usage, service quality has a positive and significant influence on users’ outcome expectations.

H3b: With regard to IS usage, service quality has a positive and significant influence on users’ computer self-efficacy.

The SCT suggests that expectation is an important factor that influences individuals’ activities. It indicates that the behavior would lead to a certain result. In a study on computer usage based on the SCT, Compeau and Higgins demonstrated the significant and positive relationship between computer self-efficacy and outcome expectations [3] [6] [7]. Thus, this study proposed the following hypothesis:

H4: With regard to IS usage, computer self-efficacy has a positive and significant influence on users’ outcome expectations.

People’s beliefs on performance accomplishments or the attitude towards IS would influence their actions, such as their effort to achieve such targets or their persistence in facing difficulties or failure and recovery from obstacles. Thus, people’s beliefs influence their ability to work under pressure. Moreover, the SCT suggests that expectation is an important factor in people’s behavior. From the psychological perspective, people tend to accomplish things that are beneficial to them. Expectation is particularly significant when using a new computer technology and in performance [3] [6] [7].

According to the study of Compeau and Higgins (1995b) on computer application, users’ performance outcome expectations and personal outcome expectations have a significant and negative influence on performance. In the SCT, Bandura (1986) suggested that when people possess better self-efficacy, they are capable of better performance. However, Bandura failed to emphasize the relationship between outcome expectations and performance; instead, he suggested that outcome expectations were a significant factor on users’ performance. Bandura further elaborated that when people expect more from the results, they tend to perform better. Singh, Watson, and Watson (2002) likewise stressed that IS success was closely related to users’ acceptance of IS and system usage, and it influenced users’ job performance and satisfaction. Marakas, Yi, and Johnson (1998) probed into the multiple constructs of computer self-efficacy and categorized them into general computer self-efficacy and specific computer self-efficacy. They further suggested that computer self-efficacy beliefs would influence users’ computer ability and performance. Thus, this study proposed the following hypotheses:

H5: With regard to IS usage, outcome expectations have a positive and significant influence on users’ satisfaction.
H6: With regard to IS usage, computer self-efficacy has a positive and significant influence on users’ satisfaction.

Definition and Measurement of Variables

In this section, the variables’ operational definitions and a summary of related literature are provided, as well as questions on the scales and the scales per se, as organized in Tables 1 and 2.

<table>
<thead>
<tr>
<th>Names of variables</th>
<th>Operational definitions of variables</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information quality</td>
<td>Information connection, timeliness, and accuracy of information upon IS</td>
<td>[10] [11] [34] [35]</td>
</tr>
<tr>
<td>System quality</td>
<td>Ease level of specific IS perceived by the users</td>
<td>[10] [11] [34] [35]</td>
</tr>
<tr>
<td>Service quality</td>
<td>IS service providers’ development of a positive attitude and relationship with users, their overall support of communication, and users’ permission to access related and high-quality services</td>
<td>[10] [11] [34] [35]</td>
</tr>
<tr>
<td>Computer self-efficacy</td>
<td>People’s idea on their computer ability to accomplish a work</td>
<td>[6] [16]</td>
</tr>
<tr>
<td>Outcome expectations</td>
<td>People’s views on things which will influence their behavior and lead to certain results</td>
<td>[3] [7]</td>
</tr>
<tr>
<td>User satisfaction</td>
<td>Users’ overall experience and attitude after using IS</td>
<td>[5] [34] [35]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Names of variables</th>
<th>Items</th>
<th>Scale</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information quality</td>
<td>8 items</td>
<td>7-point scale</td>
<td>[35]</td>
</tr>
<tr>
<td>System quality</td>
<td>10 items</td>
<td>7-point scale</td>
<td>[35]</td>
</tr>
<tr>
<td>Service quality</td>
<td>22 items</td>
<td>7-point scale</td>
<td>[35]</td>
</tr>
<tr>
<td>Computer self-efficacy</td>
<td>10 items</td>
<td>11-point scale</td>
<td>[6]</td>
</tr>
<tr>
<td>Outcome expectations</td>
<td>11 items</td>
<td>7-point scale</td>
<td>[7]</td>
</tr>
<tr>
<td>User satisfaction</td>
<td>4 items</td>
<td>7-point scale</td>
<td>[35]</td>
</tr>
</tbody>
</table>

Research Design

To validate the theoretical model successfully, a survey was conducted for this study; samples were obtained by designing and distributing questionnaires. The targets were IS users of SMEs in the “Bridging the Digital Divide of SMEs” project of the Ministry of Economic Affairs’ Small and Medium Enterprise Administration unit. To ensure the questionnaire’s reliability and validity, this study not only constructed the model according to related literature but designed the questionnaire according to related fields as well. Further, the current research invited experts and scholars to examine and modify the questionnaire’s content to enhance content validity, as well as to validate the meaning of the questions through a pretest and pilot test.

To accomplish the research purpose and validate the hypotheses, data analysis was divided into two stages. First, descriptive statistical analysis of the returned samples was conducted using SPSS for Windows, as well as reliability and validity tests. The second stage involved the research model’s validation. This study estimated the measurement model and the structural model using the structural equations modeling (SEM) technique to assess the relationships among related constructs.

SEM involves two key characteristics: (1) it can estimate multiple regression equations that are individual and dependent, and (2) it can determine the potential concepts in the dependent relations and explain the measurement error [13] [14]. The current study planned precise research procedures and evaluated the software for data analysis to acquire reliable statistical results and analytical findings.

Data Analysis and Results

Basic Information Analysis of the Samples

This study involved SMEs with at least one year of e-business of digital divide experience in the “Bridging the Digital Divide of SMEs” Project. With the assistance from the Information Service Industry Association of R.O.C. and the Small and Medium Enterprise Administration of the Ministry of Economic Affairs, the study successfully distributed and retrieved the questionnaires. The sample collection was conducted from 30 August 2007 to 30 September 2007. There were a total of 550 questionnaires distributed, and 460 were returned. After the invalid ones were eliminated, there were a total of 284 valid questionnaires and 176 invalid ones. The overall valid questionnaire
return rate was 51.64%.

Following the frequency distribution statistical analysis using SPSS, the valid returned questionnaires included three sections. In terms of users’ basic information, majority of the respondents were female (155 respondents, 54.6%). With regard to educational level, the majority graduated from college/university (71.8%). With regard to the type of company, the majority was in the service industry (123 people, 43.3%). In terms of IS application data, 125 companies have introduced a sales, distribution, trade, and purchasing system (44%); 138 have introduced an accounting information management system (48.6%); 97 have introduced a personnel and salary management system (34.2%); 129 have introduced a client management system (45.4%); and 89 have introduced a financial management system (31.3%).

Tests of Reliability and Validity

Reliability refers to the consistency or stability of the questionnaire results. However, lower errors will lead to a higher level of reliability. In other words, a better reliability measurement will result in the consistency and stability of results. This study measures questionnaire reliability using Cronbach’s alpha, as well as the consistency of the items.

The results indicate that the alpha of all constructs is over 0.8. The alpha of the overall reliability reached 0.9611. Thus, the questionnaire employed in this study has a high level of consistency and stability. The validity test in the first stage includes content validity and convergent validity. Content validity is a systematic test on the propriety of a questionnaire’s content, the scale’s content, and the items of the scale [14]. To ensure content validity and allow the items to reflect the constructs’ real meanings, this study designed the questions using theoretical concepts as found in the literature. After the initial translation, accounting and IT scholars were invited to assess and modify the questionnaire as needed. After the first draft, experts were again invited to modify the questions based on the pretest and pilot test results.

The questionnaire design of this study is modified according to the scale of its English version. Thus, with regard to the translated scale’s common method variance, this study observes the items’ convergence by exploratory factory analysis (EFA) [32, p.893]. When extracting the factors, the study applies the principal component analysis with Varimax rotation as developed by Kaiser in 1958 for orthogonal rotation method to maximize large factor loading and minimize small factor loading before rotation. With regard to the measurement of the factor analysis, the factor loadings greater than 0.5 in 284 valid samples are considered practically significant [14, p.128]. The factor analysis results on the variables are illustrated in Tables 3 and 4 below.

Tests of Structural Equation Model

This study conducts a measurement model test through confirmatory factor analysis (CFA) using AMOS 5.0 of SEM. According to Hair et al. (2006), the measurement in SEM offers suggestions based on 5–7 indices for one construct. After confirming the normality, the model can be measured by model fit indices and criteria. To measure the models without affecting the constructs’ reliability and validity, this study eliminates the items with a lower factor loading and continues the fit model measurement according to the criteria by the suggestions pertaining to fit indices [13] [14]. After modification, the indices are as follows: GFI=0.819, X²/df =1.937, RMR=0.060, NFI=0.864, CFI=0.929, RMSEA=0.058 and AGFI=0.793.

With regard to the measurement of the constructs’ reliability and validity, Hair et al. (2006) suggested that composite reliability and average variance extracted could be applied. Composite reliability refers to a higher level of internal consistency, and reliability leads to better consistency. Generally, 0.7 is the acceptable criterion. The average variance extracted (AVE) of each construct should be more than 0.5. The measurement result of the composite reliability of the constructs in this study is as follows: information quality=0.898; system quality=0.799; service quality=0.909; outcome expectations=0.875; computer self-efficacy=0.857; and overall satisfaction=0.799.

The average variance extracted matches the criterion 0.5. Except for computer self-efficacy with a 0.473 value, which is lower, the composite reliability reaches 0.857. Thus, the constructs of this study indicate a certain level of reliability and validity.

Discriminant validity aims to recognize the multicollinearity among the variables. The related test in this study is based on the Pearson correlation matrix to assess multicollinearity and determine adequate discriminant validity. Using the radical AVE of the constructs in data analysis, the study substitutes the variables and the correlation coefficient, and the result demonstrates that the radical AVEs are more than the correlation coefficients of other variables. Thus, this study infers that multicollinearity is not significant among the variables [7] [8] [14]. The test results are displayed in Table 5 below.

After confirming the constructs’ reliability and validity, the current study conducts path analysis of the variables. After modifying the structural model, the indices are as follows: GFI=0.813, X²/df=1.996,
RMR=0.067, NFI=0.813, CFI=0.924, RMSEA=0.059, and AGFI=0.787. The significance of the path coefficient is illustrated in Table 6 below. With regard to the constructs explained in the variance (R²), the overall satisfaction is 65.1%; the outcome expectations is 65.8%; and the computer self-efficacy is 7.1%.

Table 3. Factor Analysis Results of Computer Self-efficacy and Outcome Expectations

<table>
<thead>
<tr>
<th>Names of variables</th>
<th>Items</th>
<th>Factor loading</th>
<th>Explained variance (%)</th>
<th>Names of variables</th>
<th>Items</th>
<th>Factor loading</th>
<th>Explained variance (%)</th>
</tr>
</thead>
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<td></td>
<td>2</td>
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<td></td>
<td>3</td>
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<td>4</td>
<td>0.826</td>
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<td></td>
<td>6</td>
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<td>1</td>
<td>0.812</td>
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<tr>
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<td>11</td>
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Table 4. Factor Analysis Results of the Different Constructs

<table>
<thead>
<tr>
<th>Names of variables</th>
<th>Items</th>
<th>Factor loading</th>
<th>Explained variance (%)</th>
<th>Names of variables</th>
<th>Items</th>
<th>Factor loading</th>
<th>Explained variance (%)</th>
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Table 5. Correlations and AVE

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<tr>
<th>Construct</th>
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<th>Inf-Q</th>
<th>Sys-Q</th>
<th>Ser-Q</th>
<th>Satis</th>
<th>Out-E</th>
<th>CSE</th>
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<tr>
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</table>

The diagonal elements (in bold) are the square root of the average variance extracted (AVE). The off-diagonal elements are the correlations among constructs. For discriminant validity, the diagonal elements should be larger than the off-diagonal elements.

Inf-Q=Information Quality; Sys-Q=System Quality; Ser-Q=Service Quality; Satis=Satisfaction; Out-E=Outcome Expectation; CSE=Computer Self-efficacy.
This study aims to determine the influence of IS characteristics on user satisfaction among SMEs engaged in e-business. It presents a theoretical model and proposes nine hypotheses. It gathers the users’ cognition and perception of IS usage through a written survey. After managing the collected data and statistical analysis, the study demonstrates that H2a, H2b, H3a, H4, and H5 are supported, while H1a, H1b, H3b and H6 are not. The research findings and suggestions are discussed as follows.

### Conclusions and Suggestions

The IS success model operates IS information quality, system quality, and service quality to probe into IT’s influence on users’ perception of system usage and their satisfaction. Thus, the impact on people and organizations can be recognized [10] [11]. However, can IT increase the efficacy of people and organizations? An analysis of the system cannot fully elaborate all possible factors. Thus, a more general study on external factors, the users’ computer capability, and the influence of internal computer self-efficacy on organizational and individual effects has become a central issue in modern research on IT application [21] [29] [33].

The SCT emphasizes that human beings’ behavioral model is based on the interaction among individual cognition, behavior, and the environment. Users’ behavior will be affected by the change in individual cognition through external information [2] [22]. Thus, this study combines the IS success model and the SCT to propose a theoretical model. It probes into the influence of users’ cognitive behavior on their satisfaction with SMEs by system characteristics to elaborate the validation of the hypotheses in this study’s theoretical model. According to the data analysis results, this study proposes suggestions for SMEs, information service providers, the government, and the academia.

### Suggestions for SMEs

With the emergence of the digital economy, traditional brick-and-mortar businesses can no longer satisfy internal and external business operations [18]. Thus, Internet IS introduction for the sharing of external and internal information resources has become an important strategy for firms to enhance their business efficiency and market competitiveness [1]. Data analysis results demonstrate that in IS application, SMEs should not only value technology techniques but likewise pay attention to factors such as human interface,
better service quality, and users’ cognition and behavior to construct a successful IS that will allow SMEs to create more profits in an extremely competitive economic environment.

Suggestions for IT Service Providers
In recent years, due to cost limitations, IS development in SMEs has tended to be based on outsourcing. When constructing IS, SMEs need the assistance of software and hardware suppliers to overcome technical difficulties and their lack of experience in this particular field. Thus, information service providers play a significant role in e-business. SMEs’ increasing e-demand, however, has compelled them to turn to the market for information suppliers. Service quality upgrading is an important issue in the information service industry’s future development. Upon successful IS development, the system design should be based on human interface, such as digital video and sound, video conference, and interactive interface [1] [26]. This study suggests that the information service industry should plan user functions in different levels to arrive at better system quality. In addition, a number of scholars suggest that IS service providers (such as service companies and information personnel) should have excellent communication skills because effective communication cannot only lead to the identification of users’ real demands but demonstrate the firms’ sincerity as well, which is important for maintaining long-term customer relationship [15].

Suggestions for the Government
SMEs are the drivers of the economy and constitute the base that stabilizes the social structure and creates job opportunities. Thus, an in-depth study of the problems encountered by SMEs in e-business becomes significant for the government. When facing severe competition, firms should construct an effectively integrated IS to increase their competitive advantages. An integrated IS has become more and more important in IS development in recent years because the system involves the integration of firms’ operational information and business process. It can support not only firms’ operations and schedules but connect front and end business as well. It is useful for integrating internal resources and standardizing procedures [12] [20].

Suggestions for the Academia
To measure IS satisfaction effectively, this study attempted to combine the IT and cognitive psychology theories. The result was a research model for empirical study and data validation. Although the overall model fit should be improved, the model was based on innovative and human concepts that supplement the disadvantages of technology in neglecting humanity and values procedure.

The model used in this study and the findings may be tapped as the criteria by future researchers who will delve into the same topic. According to the data analysis, the propriety of the number of items and the length of questionnaire are significantly related to the model fit’s measurement. Many scholars suggest that SEM measurement should be based on five to seven indicators for each construct, and the variables in model construction should exceed this number [14]. Respondents tend to be impatient with long questionnaires, which results in invalid questionnaires and directly affects the quality of research findings. A number of scholars emphasize that to construct a valid scale, its validity, reliability, correlation, and legitimacy should be established, and the scale quality should be simple and efficient [24] [32]. For studying different phenomena and the problems involved in IT application, it is important to apply a suitable theory and design a proper questionnaire when collecting data for further analysis.

References
[9]. Davis, F.D. “Perceived Usefulness, Perceived Ease of Use, and User Acceptance of
Effects of IS Characteristics on the E-Business Success

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THE EFFECT OF CUSTOMIZATION SERVICE ON FLOW EXPERIENCE AND BEHAVIOR INTENTIONS IN CUSTOMER CO-DESIGN PROCESS

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Abstract

Computer Mediated Environments (CMEs) prepared a satisfactory opportunity for providing customization service on line. This characteristics of synchronous and interactive allow designers or enterprises enhance to discover customer’s demands. Interface design plays a core role and influence customers’ decisions. Yet, the research of this field also has varied investigation about “flow experience”, which considerable attention has been paid in the past to research issues related to motionless state of customization product process in CMEs (e.g. system, technology, and communication tool et al.), a literature on issues of dynamic state has emerged only very slowly and in a more scattered way. It excited the curiosity of this study.

In this study, we attempt evaluate customization improvements of customer value by content customization and context customization. Further to investigate the relationships between content and context customization, flow experience and behavioral intentions when provide customer co-design service.

According the findings, content customization service and context customization service provided enhanced the flow experience occur. Yet, the flow experience was significantly associated with behavioral intention.

Key word: Interface design, Customization, Flow Experience, Co-design

Introduction

The introduction of e-commerce “is the most wide-ranging and significant area of current development in marketing” [1]. US retail e-commerce sales (excluding travel) will reach $146 billion in 2008, up 14.3% over 2007. And there are nearly ninety million broadband subscribers and the monthly growth of 1.5 million in China. The online shopper grew 79% over forty-nine million people. A recent report by Performics tells us that sixty percent of a study’s respondents are spending as much or more money on online shopping in 2009 as they did one year ago. To admit of no doubt e-commerce certainly is a major combat zone for most enterprises.

When on-line shopping already became a popular commerce behavior, both enterprises and consumer the same start to seek more interesting, flexible, and valuable business model in the WWW world. Yet, Computer Mediated Environments (CMEs) provide users to communicate and interact electronically, the characteristics of synchronous and interactive allow designers or enterprises enhance to discover customer’s demands. Therefore a numbers of industries begin provide customization service, they invite and allow consumers have more choose, even to be the co-designer of the products, some successful case as DELL and Nike and Bear.com.

A number of research focused on mass customization discussed how to execute it as an efficient strategy to companies [2] [3], it became popular in academia and was adapted as an e-business approach or a strategy of supply-chain management [5]. But few focus on the improvement and investigation of customization service process and related consumer behavior. Nowadays, B2C Web sites are becoming more and more complex with varied functions and design element, much less website that provide customization service. It is required to be more press close to consumers’ demands and has to touch affect states. The development of successful and adaptive user interfaces has been a strong research issue in human-computer interaction (HCI). User interface, which has a critical role during the interaction, should provide optimum communication between the user and the computer [5]. For the reason, scholars have input on how best to create an online space to the subject.

In the last several decades there has been a tremendous wave of interest in the relationship between users into online environment. Some previous studies explore this issue of the relationship between web interface design and consumer behaviors. They adopted the TAM (Technology acceptance model), extended TAM or combined TAM and flow theory, have mostly investigated online shopping behavior [6] the effect
of learning [7], the users’ degree of involvement in online game playing [8].

With the increasing usage of HCI related researches, requirements for understanding human behaviors have become more critical. Bai, Law, and Wen [9] reviewed number researches and provide a discussion of behavior intention. They argued that a necessary measure in understanding customer loyalty, purchase intention has been considered indispensable in this loyalty construct. However, the questioned loyalty might spurious loyalty. Oliver and Rust [10] asserted that loyalty should include cognitive, affective, cognitive (behavioral intent), and action (repeat purchase behavior) dimensions. Yet, the research of this field also has varied investigation about “flow experience”, which considerable attention has been paid in the past to research issues related to motionless state of customization product process in CMEs (e.g. system, technology, and communication tool et al.), a literature on issues of dynamic state has emerged only very slowly and in a more scattered way. It excited the curiosity of this study. Thus, this study attempts to explore the relationships between content and context customization, flow experience and behavioral intentions when provide customer co-design service.

This study attempt to address gaps in the literatures as focuses on following quotations:

1. Can the website interface which provides content customization service trigger flow experience happen?
2. Can the website interface which provides context customization service trigger flow experience happen?
3. Can the flows experience trigger behavior intention happen?

Theory Background

Customer co-design and CMEs

In this customer-centric economy, more and more customers desire the opportunity to design their own product. Bateson [11] asserted that customers might have the propensity to choose the “do-it-themselves” approach across many services, even when the service that might be more expensive or less convenient than traditional services. In most recent review, customer s can play an active role in mass customizing process. They should not be viewed as just passive receptacles, but a source of productivity gains in service industry [12] [13]. Therefore, customer-firm interaction represents a core issue for value creation through personalization strategies and eventually for customer relationship development [14].

About this kind activity of customer, it was represented in the past researches by the different terms. For instance, Customer Co-design [4] [15]; do-it-themselves [11]; co-producer [16]; customer participation [12] [17]; prosumers [18] [19]. Dabholkar [17] defined customer participation as the extent to which customers are involved in producing and delivering the product in previous study; and the participation of the consumers is required. They must adjust the timing of their demand to match the availability of service [12]. Later, Khalid and Helander [15] defined that customer co-design describes a process that allows customer to express their product requirements and carry out product realization processes by mapping requirement into the physical domain of the product. In the lately research, most researches describes this behavior as “customer co-design”, thus we to continue the term in this study.

Environment and behavior

When the commerce competing platform shifts to on-line, the computer interfaces replace the role of retail shop environment. For this reason, the development of successful and adaptive user interfaces has been a strong research issue in HCI for many years.

Several scholars start the research focus on web quality. Liu, Arnett and Litecky [20] found that a well-design website would lead to better customer recall and recognition and a favorable attitude toward the site and its products. Bai and Wen [9] divided the website quality into two factors: system quality and information quality then developed and empirically tested the impact of website quality on customer satisfaction and purchase intentions. Results indicated that website quality has positive impact on customer satisfaction, and that customer satisfaction has a direct and positive impact on purchase intentions. Yet, Chang and Wang [21] investigated the effects of the level of interactivity on web users’ attitudes and intentions towards the use of online communication tools. The results shows that attitude and behavioral intentions are directly affected by users’ internal and external motivation, and are indirectly affected by interactivity through the perceived ease of use, perceived usefulness, and flow experience.

Donovan and Rossiter’s [22] pioneering work on store atmospherics, and recently year some scholar have argued that the relationship between environment, affective state and behavior may also apply to online retailing. However, most studies considered customer as both shopper and a computer user while explore customer behavior on line. And the physical store environment has been transformed into a virtual store thought information technology. Thus, the interface could be deem that the environment of online shopping.
Scholars have special discuss of this issue start from interface feature. Seneler, Basoglu and Daim [5] examine the effects of five product design features; customization, adaptive behavior, memory load, content density, and speed on user preference through and experimental study by using conjoint analysis. And Hausman and Siekpe [23] provided a framework including human elements and computer element to explore the relationship between the interface features and consumer online purchase intentions. Further, Ethier, Hadaya, Talbot and Gadieux [24] examined four Web site interface features on the cognitive process that trigger online shoppers’ emotions. These interface features including “structure of information presentation”, “navigation/orientation”, “text (appearance and arrangement)” and “visual aspects”. They found that the interface not only a key component of the usability of a website but also influenced the cognitive appraisal of situational state and control potential impacted the six emotions examined. Studies in marketing and HCI shown that website environment play an important role on the web.

**Flow experience**
Flow theory in based on a public lecture presented by Professor Mihaly Csikszentmihalyi in Sydney on 17 March 1999. Players shift into a common mode of experience when they become absorbed in their activity. This mode is characterized by a narrowing of the focus of awareness, so that irrelevant perceptions and thoughts are filtered out; by loss of self-consciousness; by responsiveness to irrelevant perceptions and thoughts are filtered out; and by a control over the environment... [25].

Flow also has been recommended as a possible metric of the online consumer experience [26] [27]. Whereas strong theoretical arguments support the flow experience contribute to enhance customers’ on-line shopping behavior (e.g. purchase intension, return visit, loyalty). Csikszentmihalyi and LeFevre [28] suggest that flow consists of four components – control, attention, curiosity, and intrinsic interest. In the last few years, flow has also been studied in the context of information technologies and CMEs and has been recommended as a possible metric of the online consumer experience [29].

**Customization as an improvement of customer value**
Porter [30] proposed that a business has been viewed as “the processes composed of value-adding activates”, and the output of firms’ activities are considered “value to the customer”. The value created by a firm can be measured by the amount that customers are willing to pay for it. A business is profitable if the value it creates exceeds the cost of performing the value activities. And in marketing area, perceived value is most commonly described in terms of the relationship between price and value [31].

The internet business can also be viewed as a new way of creating and providing value for the customer. Firm can create value for customers in a manner that is different from that which has been achieved in conventional business. Value creation and provision in the Internet business can be performed differently from the conventional business [32]. And decisions such as selection and development of business models and website construction and its operation, and other tasks should be made based on the value for the customer [33].

Jarvenpaa and Todd [34] derive four main groups of factors that affect customers’ attitudes towards on-line shopping, such as product perception (price, quality, and variety), shopping experience (effort, compatibility, and playfulness), customer service (responsiveness, assurance, reliability, tangibility, empathy), and consumer risk (economic risk, social risk, performance risk, personal risk, privacy risk). Later, Han and Han [35] developed a framework to analyze and evaluate customer values in the Internet Business, this framework is comprised of value components and value improvement directions. Customer value can be created and/or enhanced by changing two components: the “content” and “context”, and the value improvements of both can be achieved by quality enhancement, cost reduction, and customization. To review the previous studies, scholars have done several research related quality enhancement, and there is no doubt that reduce cost will enhance the purchase intension. However, we still full of curiosity about the issue of customization. Because of these factors will affect the customer and in order to clarify the relationship between customization improvements, flow experience and behavioral intention when provide customer co-design service. In this study, we applied Han and Han’s [35] framework to be the basis, and evaluate customization improvements of customer value by content customization and context customization.

**Concept Model and Hypotheses**
Base on the reviewing of existing literature, we propose a research model to examine the influence of content customization and context customization to flow experience and customer behavior intention, as shown in Figure 1.
Content customization, context customization and flow experience

Csikszentmihalyi [25] noted that flow experience usually not happen in a relaxing or enjoyment situation. It happens during people in venture situation instead. It emphasis on a participate process with all one's strength. He also argued that people obtain happy through flow experience but not directly. Hoffman and Novak [26] conceptualized flow on the web as a cognitive state during on-line navigation, which is characterized by a seam less sequence of responses facilitated by machine interactivity. Besides, the on-line navigation is intrinsically enjoyable, accompanied and telepresence. Piller et al. [4] argued that co-design also lead to a complex, risky and uncertain buying situation that could deter customers from participating in this process. Then Wu and Chang [36] accordingly theorized that only when consumers perceive that the hypermedia CMEs contains challenges congruent with their own skills can flow potentially occur. In the flow state, people become a absorbed in their activity. The concept has been extensively applied in studies in a broad range of contexts. Chang and Wang [37] examined online communication behavior, especially for the acceptance of online communication tools. They found that those users’ beliefs about interactivity, perceived ease of use, perceived usefulness, and flow experience are salient for online communication.

Han and Han [35] constructed a customer value framework can be evaluate the degree of value offered to the customer and to derive the value creating and enhancing alternatives in an internet business firm. And they mentioned that customization is enhancing by changing two components: the “content” and “context”. The content customization contains “customized offering” and “price customization”; the context customization contains “site customization” and “transaction customization”.

Interactivity has been found to deliver available information effectively by engaging the user’s attention, increasing his or her involvement and enriching his or her experience [38]. Ghose and Dou [39] also noted that the higher the interactivity level of a webpage, the more attractive it is. Therefore, interactivity is expected to have a positive influence of the web user’s perception of flow experience. Hoffman and Novak [26] pointed out that, when browsing the Internet, once an individual has had a series of seamless interactions with the machine, enjoyment, loss of self awareness, and a heightened sense of the self will ensue; that to say, the higher the intensity of interactivity, the more likely flow experience will occur [37]. Accordingly, we propose following hypotheses:

**H1:** There is a positive relationship between content customization and flow experience.

**H2:** There is a positive relationship between context customization value and flow experience.

**Flow experience and behavior intension**

Hoffman and Novak [26] indicated that key consequences of the flow experience for customers in hypermedia computer mediated environment (CME) are increased learning, exploratory and participatory behaviors, positive subjective experiences, and a perceived sense of control over their interactions. They also argued that Flow Theory to provide a better understanding of online communication behavior. The higher the perceived (expected) benefit (returns) from product compared to the (expected) cost, the higher the likelihood of a customer employing mass customization. One of the returns is possible rewards from the design process such as flow experience or satisfaction with the fulfillment of a co-design task [27]. Choi and Kim [40] also found that people continue to play online games if they have optimal experience because flow state had impact on consumer loyalty. Later, Shin and Kim [41] proposed that flow can be seen as reinforcement that user intention is strengthened, directed, and moderated. Users knowingly and unknowingly have flow feelings, and it increases the intention to use. Users in a flow experience may be deeply immersed in the process of activities. And Chang and Wang [37] argued that greater flow experience corresponds to a greater behavioral intention to use online communication tools. Thus, we propose the following hypothesis:

**H3:** There is a positive relationship between flow experience and behavior intension.

**RESEARCH METHODS**

**Measurement development**

A survey instrument was designed to ask participants if and how their behavior intentions...
might be influenced by content customization, context customization and flow experience when a website provides the co-design service. All constructs were assessed using 5-point Likert-type scales using very agree and very disagree as the anchors, unless otherwise noted.

Content customization was composed of six-item adopted from Anderson and Srinivasan [42], Oliver [43] and Han and Han [35]. Context customization was composed of six-items adopted from Han and Han [35]. Behavior intension including three components: purchase intension, revisit intension and attitude toward. These components were assessed using Bai et al. [9] three-item, Yoo and Donthu [43] two-item and Chen and Wells [44] four-item 5-point-Likert-type scales. For assessing flow experience, five-items were developed based on the flow theory conceptualized by Hoffman and Novak [26] and modified item by Chang and Wang [37]. Demographic data including gender, age, education, time of using internet/day and occupation. Altogether questionnaire included 31 questions.

Procedure and methods
A core concept of the study is customer co-design. The principle considered the product selecting in customization product design process as the stimulus in this study. Thus, we provided fifty customization product design process as the principle. The core concept of the study is customer co-design.

Procedure and methods

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The above findings suggest that content customization service and context customization service provided enhanced the flow experience occur. Yet, the flow experience was significantly associated with behavior intensification. Flow experience might be an important factor of customer to tend to use online communication tools to join the co-design process of customization product.

On the theoretical front, the study makes several contributions to the literature. First, this study deemed that customer as a co-design in the customization product producing process. Second, the study attempted to construct an evaluation of customization service provided. The study classified customization service into two groups as content customization and context customization. Third, we also had a discussion from static state to dynamic process. We examined the internal mind state (flow experience) and outer behavior intensification in the study. Further, for more clear and definite the behavior intensification, it also was separated into three parts to discuss – purchase intensification, revisit intensification and attitude toward the site. At last, this study constructed a simulate environment that allows participants join the co-design process on CMEs.

Furthermore, according the open question responses, it showed that most participants willing to be adopting customers of this kind of service. To be a co-designer of customization product was interesting experience to them. However, few participants indicated that the interface we provided was not easy to use for them, and this problem will reduce their willing to join or purchase this product, thus the usability of interface is also an important influenced factor.

For the future research, there are some factors could be have further discussion. For example: the involvement of products categories, the knowledge required proceeding with the customization and the interaction degree of B2C and C2C et al.

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POST-ADOPTION BEHAVIORS OF E-BOOKSTORE CUSTOMERS

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Abstract

Although trade costs for both sellers and buyers can be reduced through the usage of e-commerce, however low transfer costs and global competition cause that the e-bookstores have to maintain their customer loyalty is more difficult than traditional shopping stores. The formations of the customer loyalty of e-bookstores have been explored by many researchers from different points of view, such as service quality, satisfaction and trust. Nevertheless, the current bottleneck of e-commerce operation is that consumers are no longer continuing using e-bookstores. Based on the theory of Post-Acceptance Model, this study empirically tested using a field survey of e-bookstore customers. According to the deconstruction of online store environment, the factors of expectation-confirmation contain the confirmation of information contents, the confirmation of system platform and confirmation of web services quality. The results showed that satisfaction and perceived usefulness are significant predictors of continuance intention. The expectation-confirmation factors except the confirmation of system platform are significant predictor of satisfaction and perceived usefulness. The implications of these findings for e-bookstore continuance theory and practice are proposed in the final section.

Keywords: Post-Acceptance Model, Continuance Intention, e-Bookstore, Perceived Usefulness, Satisfaction

Introduction

One of the commercial activities for many Taiwanese is purchasing books in Internet. Take, for example, the sales volume for books.com.tw has 1.1 billion Taiwan Dollars (NT$) per year. This shows that e-commerce has unlimited potential in Taiwan, and many enterprises are also considering to develop online stores in order to open new digital route sales and new services to their customers. Since 1995, Amazon network shop (www.amazon.com), the initiator of e-bookstores, had been making good use of the information technology for its customers and building alliance for partnerships and the brand loyalty. Bill Gates, the founder of Microsoft, once pointed out in a magazine that all of his books are purchased online for he is very busy and it is a convenient way. With the providence of extremely broad options, this kind of website is also trustable.

Although trade costs for both sellers and buyers can be reduced through the usage of e-commerce, the low cost and global competition made it more difficult for network stores to maintain their customers’ loyalty than the traditional shopping stores [1]. Furthermore, the development of new customers and the maintenance of old customers are similar to the leaky bucket theory. This needs the cut in of two sides at the same time; in other words, what network stores or operators face is a bucket with many holes. Therefore, through the elevating of the website quality and various advertisements and promotions, the attraction of new customers is like uneasingly pouring running water into the bucket. On the other hand, the maintenance of old customers is the same as striving to mend the holes in the bucket and to reduce the leaking water as much as possible, so that the water level can rise gradually.

There are differences between attracting new customers to accept the usage of online bookstore and maintaining the old customers to continue using online bookstore. Researchers have discussed this according to different viewpoints and factors and interpreted the leading factors for the new customers to adopt network shopping, such as Technology Acceptance Model, Theory of Reasoned Action, and Innovation Diffusion Theory. However, some scholars regard that the initial adoption of online store is different from the continuing usage of it [2]. In other words, attracting internet users to accept online shopping is only the beginning of success for e-commerce, a truly successful management for online stores depends on its members’ continuing usage. As a result, the maintenance of the old customers’ continuing usage of online stores is more important than the initial adoption of using online stores by the new customers [2][3][4][5][6][7].

According to recent website consumption
investigation given by yam.com, it shows that the consumption of network shopping in Taiwan is mainly the purchase of books, magazine and other publication, which is approximately 35%, the highest of all kinds of purchases. Its market scale surpasses one billion NT dollars. In addition, presently, Chinese e-bookstores are mainly occupied by books.com.tw, ylib.com, kingstone.com.tw, silkbook.com, eslite.com and so on. There are still other more online publishing bookstores that allow customers to order professional books (e.g. computer books) online, which include San Min Book Company, Flag Publishing and Kings Publishing. Speaking of most network bookstores, book discounts (price reduction strategy) is the major way to maintain customers’ loyalty [8]. Therefore, many network bookstores design new functions (e.g. membership and accumulate points, books recommendations, extending reading, shopping cart, electron books and newspapers and so on), friendly interface (e.g. series of changeable website colour, the one-click function), information rapid renewal service (e.g. ranking the best-selling books, new books channel), the book friends and interactions (e.g. online book summary sites, personalized bookstore, and discussion area), safe diverse payments and delivery selections (e.g. home-deliver, deliver to convenience store, paying by ATM, on-line credit card payment etc.) in order to both attract more new customers and maintain old customers. The purpose of this research is to study whether those innovations are conducive to increase the continuance intention of the customers, and with a further approach to discover the crucial causes of the factors (e.g. user’s satisfaction, value factor). The research will examine the correlation hypothesis by using empirical researching technique, and then the proposal of several management opinions and suggestions will be based on the results of the hypothesis diagnoses.

**Literature Review**

This study explores Taiwan’s online bookstore users’ intention of continuing to purchase books online. Adopting Post-Acceptance Model [6] as the base of the theory and using IS success model of Delone and Mclean (2003)[9] as the confirmation of it. Therefore, relating researches based on Post-Acceptance Model and IS success model will be reviewed.

**Adopting Post-Acceptance Model**

Bhattacherjee [6] regards that the expectation of the customer differs before and after the purchase of a product. With the consideration of this theory, this research modifies Expectation Confirmation Theory and adds in the factors of perceived usefulness from Technology Acceptance Model [10]. Therefore, Post-Acceptance Model takes shape in Figure 1.

The confirmation in Expectation Confirmation Theory comes from the comparison between the previous expectation (t1) and the present result (t2). Positive disconfirmation is a term when the present result surpasses the previous expectation, while negative disconfirmation is a term when the present result is lower than the previous expectation. On the other hand, confirmation is a term when the two factors (t1 and t2) are equally balanced.

**IS Success Model**

Online bookstore is both a website platform and a retail store, so the way of measuring customers’ confirmation of the website platform quality can be
made through the adoption of information content quality, information system quality and website service quality [9][17]. In the measurement of the customers’ satisfaction rate, McKinney et al.[18] also indicates that the expectation and the comparison of consciousness result of information content quality and information system quality will turn out to be disconfirmation (IQ disconfirmation and SQ disconfirmation), and this will in turn affect the customer’s satisfaction rate.

DeLone and McLean[9] integrated the effective viewpoint and process influence of the system and information to develop IS Success Model. Additionally, the six construction side, including system quality, information quality, information usage, user’s satisfaction, personal impact and organization impact, was proposed. It is regarded that system quality and information quality will influence both the satisfaction rate of the user and the usage. What’s more, the usage rate will also positively or negatively influence the user’s satisfaction rate, which will become a personal impact and then influence the organization. In 2003, DeLone and McLean also renewed that the model should be added into the servicing quality, so as to become a more complete IS Success Model shown in Figure 2.

Information content quality concerns with the relevance, instance, reliability, correctness and wholeness of the supplied information content [5][9][14][18]. Internet service quality includes the interaction quality of the staffs, substantial environment quality and results [9][19][20][21].

The Research Models and Hypotheses

The goal of this research is to probe into the influencing elements of the continuance usage of purchasing books online. With the inheritance and adoption of Post-Acceptance Model as the base of the theory, the adoption of information content quality, system quality and service quality from the confirmation in Post-Acceptance Model, and through the IS Success Model of DeLone and McLean [9], the satisfaction and perceived usefulness of the system are developed through the influence of these three qualities. According to the previous relating literature reviews, this research develops a model given in Figure 3 and the following nine researching hypotheses

Figure 3: The Research Model

H1 : Users’ satisfaction positively influences the continuance intention of using e-bookstore.
H2 : Perceived usefulness in purchasing books online positively influences the continuance intention of using e-bookstore.
H3 : Perceived usefulness in purchasing books online positively influences the user’s satisfaction.
H4 : Informational content confirmation in purchasing books online positively influences the user’s satisfaction.
H5 : Website platform confirmation in purchasing books online positively influences the user’s satisfaction.
H6 : Website service quality confirmation in purchasing books online positively influences the user’s satisfaction.
H7 : Informational content confirmation in purchasing books online positively influences the perceived usefulness of using e-bookstore.
H8 : Website platform confirmation in purchasing books online positively influences the perceived usefulness of using e-bookstore.
H9 : Website service quality confirmation in
purchasing books online positively influences the perceived usefulness of using e-bookstore.

Research Methodology
This paper investigates online consumers’ continuance intention of using online bookstore, and an empirical study will proceed by using questionnaires. Additionally, structure equation model (SEM) is adopted to verify the path relations of variables of the model. The research steps are to explain as follows.

Sampling Source and Data Collection Procedure
Empirical data for this study was collected via a convenience sampling survey, and the survey respondents were students of a polytechnic university in southern Taiwan. They were either full time or part time students. The students were inquired whether they had any experience of purchasing books or other products online before answering the questionnaire. The survey respondents are only those who had the experience before. 240 surveys were collected and 150 of them were valid after weeding out incomplete or failure surveys through the visual examination. 90 surveys are invalid but 62.5% of surveys were valid samples.

The majority of the survey respondents are females (60%) who are between 20 to 24 years old. Using convenience sampling, the sampling sources are mainly university students. The difference of their resident areas and their school records are not big. Most of their income are 3,000~6,000 and 21,000~24,000 NTS per month due to the reason that the income differs between full time and part time students The online bookstores often used by 150 survey respondents are buy.yahoo.com.tw (51/150), 24h.pchome.com.tw (46/150), books.com.tw (37/150), eslite.com (6/150), and other online bookstores (10/150).

Measurement Constructs and Question Items
The constructing question items in this research are referred from Bhattacharjee [6][7] and other related articles [17][21], adopts its operational definition to develop measurement question items, and these are given in appendix. The previous survey of the questionnaires in this research had been held for three weeks before the formal survey. 20 consumers who had the experience of using online bookstore were invited as survey respondents to answer the questions. The results show that composite reliability (CR), average variance extracted (AVE) and factor loading are higher than the suggested values.

The questions of the questionnaire had been examined one by one by 2 information management professors and 3 doctoral candidates. The questions that had ambiguous meaning, easily confused or repetition sentences have been corrected or revised, in order to promote the content validity of the questionnaire. Seven-point Likert scales are used to measure each question and 1 is labeled as extremely disagree, 4 is labeled as neutral and 7 is labeled as extremely agree.

Data Analysis and Result
This research adopts Smart PLS version 2.0 M3 as the statistical analysis instrument. Smart PLS is graphical software for structural equation statistics that is similar to LISEREL. Comparing with LISEREL, Smart PLS is less restrictive in the request that variables must be normal and random distribution. Also, when estimating the path coefficient, it has fewer requirements about the sample size. The sample size of this research is 150 that are appropriate to adopt Smart PLS as the statistical analysis software.

Measurement Model Analysis
Under the consideration of the overall model, the purpose of measurement model analysis is both to test whether all measured variables have correctly measured its latent variables and whether they correspond with the complex measured variables under different circumstances. This research uses convergence validity and discriminate validity to represent construct validity. Convergence validity means using different measuring methods to measure variables from related variables, and it will be the measurement of same object when the correlation degree is high; thus, the score of measurement and the result should be the same. In a certain construct, the variance of measured variables should be highly interpreted or that measured variables should possess convergence, and this research uses factor loading (see Table 1) and average variance extracted, AVE (see Table 2) to represent it. The factor loading scale of all questions in this research is shown in Table 2. The scale is between 0.70~0.90, all of which are higher than the suggested scale 0.70. Therefore, the convergence validity of this research is within an acceptable range.

Table 1. Reliability analysis of all variables in measured model
Post-Adoption Behaviors of E-Bookstore Customers

Discriminate validity means the measuring of two different concepts, no matter the same or the different method the researcher uses, the relating analysis after the result of measurement shows that the correlation degree is lower. This research table is shown in Table 2. A VE scale is between 0.62 and 0.75, and the radical expression of any two constructs of AVE is larger than the coefficient relationship of these two construct. Therefore, the discriminate validity of this research is within an acceptable range.

Table 2: Correlation of Constructs and AVE

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Item</th>
<th>Mean</th>
<th>STD.</th>
<th>Factor Loading</th>
<th>CR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuance intention</td>
<td>CI1</td>
<td>5.25</td>
<td>0.96</td>
<td>0.873</td>
<td>0.89</td>
</tr>
<tr>
<td></td>
<td>CI2</td>
<td>5.39</td>
<td>0.92</td>
<td>0.870</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CI3</td>
<td>5.22</td>
<td>0.85</td>
<td>0.829</td>
<td></td>
</tr>
<tr>
<td>Satisfaction</td>
<td>SAT1</td>
<td>5.15</td>
<td>1.01</td>
<td>0.808</td>
<td>0.90</td>
</tr>
<tr>
<td></td>
<td>SAT2</td>
<td>5.01</td>
<td>0.98</td>
<td>0.853</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SAT3</td>
<td>5.05</td>
<td>0.96</td>
<td>0.809</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SAT4</td>
<td>5.05</td>
<td>0.98</td>
<td>0.830</td>
<td></td>
</tr>
<tr>
<td>Information content confirmation</td>
<td>CON1</td>
<td>5.03</td>
<td>1.05</td>
<td>0.807</td>
<td>0.90</td>
</tr>
<tr>
<td></td>
<td>CON2</td>
<td>4.97</td>
<td>1.06</td>
<td>0.856</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CON3</td>
<td>5.13</td>
<td>0.90</td>
<td>0.820</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CON4</td>
<td>4.89</td>
<td>0.82</td>
<td>0.842</td>
<td></td>
</tr>
<tr>
<td>System platform confirmation</td>
<td>SYS1</td>
<td>4.82</td>
<td>1.04</td>
<td>0.822</td>
<td>0.90</td>
</tr>
<tr>
<td></td>
<td>SYS2</td>
<td>4.78</td>
<td>1.10</td>
<td>0.904</td>
<td></td>
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<tr>
<td></td>
<td>SYS3</td>
<td>4.88</td>
<td>1.15</td>
<td>0.867</td>
<td></td>
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<tr>
<td>Service quality confirmation</td>
<td>SEV1</td>
<td>5.09</td>
<td>1.04</td>
<td>0.820</td>
<td>0.87</td>
</tr>
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<td></td>
<td>SEV2</td>
<td>5.17</td>
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<td></td>
<td>SEV3</td>
<td>5.27</td>
<td>1.04</td>
<td>0.703</td>
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<tr>
<td></td>
<td>SEV4</td>
<td>4.98</td>
<td>0.98</td>
<td>0.833</td>
<td></td>
</tr>
<tr>
<td>Perceived usefulness</td>
<td>PU1</td>
<td>4.92</td>
<td>1.03</td>
<td>0.814</td>
<td>0.90</td>
</tr>
<tr>
<td></td>
<td>PU2</td>
<td>4.90</td>
<td>0.99</td>
<td>0.801</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PU3</td>
<td>4.73</td>
<td>0.96</td>
<td>0.855</td>
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</tr>
</tbody>
</table>

Note: CI = Continuance Intention, SAT = Satisfaction, PU = Perceived Usefulness, CN = Informational Quality Confirmation, SY = System platform Confirmation, SE = Service Quality Confirmation.

This research adopts composite reliability (CR) as the reliability measurement. The latent variables of CR is consisted by all measuring variable reliability, it indicates that the inner coherence of construct index and its suggesting scale is higher than 0.6 [22]. High reliability means that there is high relation between the indices so that researchers will be confident to regard that the measuring item of this construct is coherent. The CR of this research construct (see Table 1) is in between 0.87~0.90, all of which are higher than the suggested rate 0.6. Therefore, the CR of this research construct is within an acceptable range.

Structural Equation Analysis

This research uses Structural Equation Model (SEM) to examine the proposed research model, and it adopts Smart PLS to make statistical analysis. Since PLS lacks the generation of overall goodness of fit index, it is represented only with the explained variance (R²) of endogenous constructs, path coefficient between constructs and its statistical significance (see Figure 4).

The variance explanation for continuance intention is 30%, the variance explanation for user’s satisfaction is 38%, and the variance explanation for perceived usefulness is 28%. Of the nine proposed research hypotheses, only satisfaction rate of systemic quality confirmation have not achieved an significant level, while the
path coefficient of other eight hypotheses are between 0.19~0.39 and are statistically significant.

**Figure 4 : PLS result of the research model**

**Conclusion and Managerial Implications**

According to the adoption of Post-Acceptance Model, this research develops continuance purchasing books online model, and the testament shows that the influence of perceived usefulness and user’s satisfaction on continuance intention are quite evident. The path coefficient ($\beta=0.39$) of continuance intention to perceived usefulness is larger than the path coefficient ($\beta=0.27$) of continuance intention to user’s satisfaction. This result is different from the testament of Bhattacherjee [6][7], which indicates that with the rapid development of e-store, many consumers already have mature online shopping experience. Therefore, the influence of continuance intention on the perceived usefulness of purchasing books online (the convenience, completeness and effectiveness) is higher than the influence on user’s satisfaction. Moreover, the explanation of variance extent of continuance intention in this research (31%) is lower than the explanation of variance extent of Bhattacherjee [6] (41%). This indicates that the causes of customer’s repurchasing behavior may be more complicated through the influence of the development of e-store and marketing strategies. Lin et al. [23] regards that perceived playfulness is an important considering element. What’s more, in the research, Yen and Tsai [24] have deconstructed perceived usefulness as functional usefulness and social usefulness and added the concept of Web 2.0 into e-commerce. (p<0.01). Therefore, the model of this research can be accepted to make further analysis. This is also the probable direction to promote the explanation of variance extent of continuance intention in the future.

This research adopts Post-Acceptance Model as the base of the theory and uses IS success model of DeLone and McLean [9] to deconstruct the confirmation of Post-Acceptance Model. The result shows that systemic quality confirmation does not have evident influence on user’s satisfaction; in other words, the website platform response rate, the easiness of using and the usability of website functions are more difficult to reach a convergence concerning on the influence of user’s satisfaction ($\beta=0.01, t=0.18$). This may be because those who have filled out the questionnaire have different opinions about each e-bookstore platform, so it is worthy to make further study on the brand loyalty.

Carr [25] indicated that IT changes swiftly the business operations’ strategy. However this advantage will be vanished if the IT has been imitated by competitors. Additionally, consumers are gradually dissatisfied with the platform functions that are developed by e-store using some other web techniques. The competition and imitation of website platform functions lower the uniqueness of web resources. With the concern of users’ post-adoption behavior in purchasing books online, this study discovers that even though the confirmation of website platform shows influence on consumers’ value, it, however, does not affect consumers’ satisfaction. Therefore, under the premise of maintaining consumers’ satisfaction, it is suggested that companies should lay emphasis on elevating the service quality.

The deconstructing confirmation element of this research indicates that website service quality has more evident influence on user’s satisfaction ($\beta=0.38,t=4.65$), and information content quality has more evident influence on perceived usefulness ($\beta=0.32,t=4.34$). Thus, this research suggests that the vendors of e-bookstores need to specially recruit service staffs and operate valuable web content after the website platform is stabilized. Also, they should increase book commentary and book information and reader interacting site in order to attract more customers to visit again.

With the more online purchasing experiences of Taiwanese, this research have not included the discussion of risk and trust problems of internet trade into the model. The main purpose of this research is to clarify the influence of continuance intention on perceived usefulness. This is also an issue that companies need to lay emphasis on. Even though low price is still the main promotion strategy for many stores, it will, nevertheless, not
help the long-term continuance intention project, and the research also lacks the discussion of this issue. In this study, survey respondents are students of a polytechnic university, while the result possesses reliability yet it is still inadequate concerning the inference of external validity. As a consequence, the authors suggest that a larger scale of investigation can be made in the future under the circumstances of enough budgets and the cooperation of portal sites.

Appendix
Measurement Question Items

Continuance Intention:
C1. I tend to continue using e-bookstore rather than discontinue their use.
C2. My intentions are to continue using e-bookstore rather than any alternative means.
C3. If I could, I would like to discontinue using e-bookstore.

Satisfaction:
ST1. I am satisfied with my decision on using e-bookstore.
ST2. It is a wise choice for me to purchase books online.
ST3. I am very delighted to purchase books online.
ST4. I am satisfied with the usage of e-bookstore.

Confirmation of Information Context:
CN1. The book information provided by e-bookstore fulfills my needs that are better than I had expected.
CN2. The book information provided by e-bookstore is more up-to-date than I expected.
CN3. The book information provided by e-bookstore is more complete than my expectations.
CN4. The book information provided by e-bookstore is more reliable than my expectations.

Confirmation of website platform:
SY1. Every function provided by e-bookstore can always be properly used that is better than my expectations.
SY2. The information shown on the screen of e-bookstore is faster than I expected.
SY3. Every function provided by e-bookstore is easy to use that is better than my expectation.

Confirmation of Website Service Quality:
SE1. Website services provided by e-bookstore being accomplished as scheduled is better than I expected.
SE2. Purchasing products on e-bookstore is relieved that is better than my expectation.
SE3. E-bookstore actively assists customers in choosing and buying products is better than my expectation.
SE4. Particular requirement of customers being adequately taken care is better than my expectation.

Perceived Usefulness:
PU1. It is more convenient for me to purchase books and other products online.
PU2. E-bookstore service allows me to find more products that conform to my interest.
PU3. Using e-bookstore service enhances my time arrangement effectively.

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References


The Effects of Language Difference on Operational Performance and Satisfaction with B2B E-Marketplace Interface

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Abstract

This study integrated the user interface and information content of the business-to-business (B2B) electronic marketplace (e-marketplace) with language to analyze whether language differences affect the definition of good interface design and the information content that should be provided via an e-marketplace. An experimental design was adopted for collecting data from tasks, and then the Questionnaire for User Interface Satisfaction (QUIS) was used to ascertain how satisfied subjects were with regard to using the B2B e-marketplace interfaces. Study results showed that the language, the e-marketplace interface the subject used, and a combination of the two predict a person’s operational performance and satisfaction with a B2B e-marketplace. This study’s results provide a better understanding of whether B2B e-marketplace service providers should develop interfaces based on specific languages.

Keywords: Language Difference, Usability, e-Marketplace, User Interface

Introduction

An electronic market is an inter-organizational information system through which multiple buyers and sellers interact to accomplish one or more of the following market-making activities: (a) identifying potential trading partners, (b) selecting a specific partner; and (c) executing the transaction [6]. Electronic marketplaces (e-marketplaces) have a profound influence on the way in which organizations manage their supply chains. Supply chain management encompasses the coordination of order generation, order taking, and order fulfillment/distribution of products, services, or information [10]. Business-to-business (B2B) e-marketplaces that use Internet protocols as communication standards have gained widespread application in supply chain management [9]. The goal of supply chain management is to link the marketplace, the distribution network, the manufacturing process, and the procurement activity in such a way that customers are serviced at higher levels and a lower total cost [3]. B2B electronic commerce (e-commerce) can contribute to lower purchase costs, reduced inventory, and enhanced efficiency of logistics, as well as to increased sales and lower marketing costs [3].

By bringing together huge numbers of buyers and sellers and by automating transactions, Web markets expand the choices available to buyers, give sellers access to new customers, and reduce transaction costs for all parties involved [13]. During transaction processing, the value added, business opportunity, and management mechanism created by B2B e-marketplaces are unequalled by others transaction media [7]. From the purchasing company point of view, B2B e-commerce facilitates procurement innovations to result in reduced purchase price, reduced cycle time, and improved supplier sourcing [15]. Electronic business (e-business) enables organizations to reduce costs, increase demand, and create new business models. It has the potential to benefit all consumers through reduced prices and improved products and information flows [8].

B2B site goals are substantially more complex than those of the typical business-to-customer (B2C) site. This is the one excuse B2B sites have for their subpar usability. In reality, however, the more complex the scenario, the higher the need for supportive user interfaces. Thus, B2B sites subpart emphasize usability more, not less, because they must help users accomplish more advanced tasks and research more specialized products [19]. Although usability guidelines (eg., [18]) have been developed by observing users in the United Sates and, to a lesser extent, in Europe, the extent to which guidelines developed for one cultural and/or linguistic group will be able to predict usability for another becomes a concern [28]. The Web now is truly worldwide, and so designers from every country are becoming concerned with usability, in addition, concerned about usability, specifically a site’s usability for international users [28]. This is particularly important for B2B e-marketplaces whose goals are to facilitate online trades between exporters and importers from around the world.

This study integrated the user interface and information content of the e-marketplace with languages to analyze whether language differences...
affect the definition of good interface design and the information content that should be provided via an e-marketplace. This study asked subjects recruited in Taiwan to use four popular B2B e-marketplace sites: Alibaba.com (English), Alibaba.com (simplified Chinese), Made-in-China (English) and Made-in-China (simplified Chinese). The two languages and the two B2B e-marketplace sites were manipulated in a 2x2 factorial design to collect the operating time, number of screens, and accuracy of online transaction tasks. Subjects were then asked to complete a questionnaire that elicited information concerning their satisfaction with the sites. The main research questions addressed in this study were whether the differences between the languages have an impact on the definition of good interface design and whether manufacturers should develop interfaces based on languages. Section 2 contains a review of the literature related to B2B e-marketplace sites, the human-computer interface, and language differences. Section 3 contains an explanation of the study methods and experimental design, and Section 4 provides an in-depth description of the results derived from statistical analysis. The final section summarizes the findings and includes discussion of their implications and recommendations for further research.

Literature review

E-marketplace

Markets (electronic or otherwise) have three main functions: (a) matching buyers and sellers, (b) facilitating the exchange of information, goods, services, and payments associated with market transactions, and (c) providing an institutional infrastructure, such as a legal and regulatory framework, that enables the efficient functioning of the market. In a modern economy, the first two functions are provided by intermediaries, while the institutional infrastructure is typically the province of governments. Internet-based electronic marketplaces leverage information technology to perform the above functions with increased effectiveness and reduced transaction costs, resulting in more efficient, “frictionfree” markets [2]. An electronic market system can reduce customers’ costs of obtaining information about the prices and product offerings of alternative suppliers as well as suppliers’ costs of communicating information about their prices and product characteristics to additional customers [2].

Human-Computer Interface

To users, the human-computer interface is an input language; to computers, it is an output language; in terms of human-computer interaction (HCI), it is a communication protocol [4]. Interactive techniques and tools can support information exploration and knowledge construction only if users can use these instruments properly [1]. Shneiderman and Plaisant [24] suggested that an effective interface can make users feel positive and can promote usability and stimulate thinking. When interacting with a well-designed interface, users frequently do not notice the existence of the interface and thus can focus on jobs, searches, and pleasure in using the equipment. In contrast, interfaces with insufficient functions frustrate users, and some users will refuse to use them.

Nielsen [17] demonstrated that concise interfaces reduce users’ response times. Teitelbaum and Granda [26] contended that one of the most critical interface guidelines involves positional constancy. Positional constancy prescribes that usability is enhanced if the physical screen location of a particular piece of information remains constant for all of the episodes that belong to the particular application. An interface that does not have an explicit exit function does not maintain exactly a view-state between two usage episodes. In addition, word length can cause problems with HCIs [22].

Chin et al. [4] suggested that the depth of the menu tree should be held constant while the breadth should vary with level. In general, explicit targets take less time to find and have fewer frames to traverse than scenario targets. Jacko and Salvendy [12] examined the relationship between task complexity and performance for menus of various breadths and depths. They found that response time and number of errors increased as menu depth increased. Users found deeper menus to be more complex.

Usability

ISO 9241 defines usability as the effectiveness, efficiency, and satisfaction with which specified users achieve specified goals in particular environments. Usability is concerned with “optimizing the interactions people have with interactive products” and is achieved by defining user experience goals. These goals aim to promote products that are effective, easy to learn, and enjoyable to use. Some aspects commonly tested in defining usability metrics for use in usability testing include learnability, speed of task execution, errors made, and likeability (attitude toward the software) [17] in defining usability metrics for use in usability testing. Users are becoming less willing to tolerate difficult or uncomfortable interfaces of computer products since experience with some current interfaces has shown them that a product can indeed be easy to learn and pleasant to use. Thus, an attempt to evaluate the usability of user interfaces would be seen as an intrinsic element [20].
Usability is a general concept that cannot be measured, but it is related to several usability parameters that can be measured. Measurable usability parameters fall into two broad categories: objective performance measures, which measure how capable the users are at using the system, and subjective user preference measures, which assess how much the users like the system [17][20]. User friendliness is a broad criterion for evaluating user-system interaction. More specific measures have been developed (e.g., [24]) including (a) time needed for the user to learn specific information representation functions, (b) speed of interaction, (c) rate of errors by the user, (d) retention over time, and (e) the user’s satisfaction.

Language Difference
Software development for international users has always been a challenge. However, with the explosion of the Internet use, the need for user-friendly, global Web sites has become important for international business. Consequently, interest in the influence of culture on user interface design has grown within the HCI community [21]. To what extent will guidelines developed for one cultural and/or linguistic group be able to predict usability for another? There are several difficulties. The first problem is that translation of a computer interface into other languages is not always feasible or appropriate [14]. This is particularly true of translating English into Asian languages such as Chinese. Written Chinese uses a semantic-based logography in which the structure-meaning relationships of linguistic elements are much closer than in English. On the other hand, English is phonologically based, so its visual form can be used as a cue for pronunciation, but a word’s meaning cannot be derived merely from its structure [28]. The difference in language systems between Chinese and English may produce differences in cognitive functioning [23][27]. Chinese is a logographic writing system in which the written symbols represent lexical morphemes. Whereas an alphabetic system uses a small number of abstract elements to represent the phonemic structure of the language, Chinese words are represented by a large number of different visual symbols. It is estimated that a child must learn at least 4,000 different characters by the time he or she reaches age 12. Consequently, it would appear possible that, whereas learning to read English depends on phonological skill, learning to read Chinese may depend more on the ability to make appropriate visual distinctions than on phonological skills [11].

The second problem with generalizing standards derived from one culture to another comes from differences in socio-cultural norms and cognitive styles. Many aspects of psychological functioning, from aesthetics to interpersonal dynamics to motivations, will vary from culture to culture. Therefore, behavioral rules derived from one culture may not transfer to another [28]. People from different cultures are different in their perceptions, cognition, thinking styles, and values. Thus, it is important to thoroughly understand different cultural traits in designing computer interfaces for international users, rather than simply translating language [21]. The American way of thinking tends to be analytic, abstract, and imaginative beyond the realm of the immediately apprehended; in contrast, the Chinese way of thinking tends to be synthetic, concrete, and remain within the periphery of the visible world. The Chinese prefer to categorize on the basis of interdependence and relationship, whereas Americans prefer to analyze the components of stimuli and to infer common features [5]. One of the major differences between analytical and relational styles of thinking involves how subjectivity is treated. The analytical style separates subjective experience from the inductive process that leads to an objective reality. The relational style of thinking rests heavily on experience and does not separate the experiencing person from objective facts, figures, or concepts [25]. The use of the thematic cognitive mode by the Chinese is probably associated with field dependence. The Chinese people tend to display a cognitive style of seeing things or phenomena in wholes rather than in parts, while Americans tend to do the reverse. When first using a software system, Chinese users may tend to need a concrete representation of the system to help them develop accurate mental models and perform the interaction tasks properly and efficiently [21].

Moreover, not only English is very different from Chinese. Simplified Chinese and traditional Chinese characters are one of two standard sets of Chinese characters of the contemporary Chinese written language. They are based mostly on popular cursive forms embodying graphic or phonetic simplifications of the traditional forms that were used in printed text for over a thousand years. Simplified character forms were created by decreasing the number of strokes and simplifying the forms of a sizable proportion of traditional Chinese characters. Some characters were simplified by applying regular rules; for example, by replacing all occurrences of a certain component with a simpler variant. Some characters were simplified irregularly, however, and some simplified characters are very dissimilar to and unpredictable from traditional characters. Although many characters were left untouched by simplification, and are thus identical between the
traditional and simplified Chinese orthographies. It is still difficult for people to convert such Simplified Chinese characters to Traditional Chinese characters without misunderstanding. In June 2009, Taiwan leader Ma Ying-Jeou proposed an approach to improve understanding between the Taiwanese people and the people across the Straits—"write the traditional Chinese characters and know the simplified version." He pointed out that the traditional characters, widely in use in Taiwan, Hong Kong, and many other Chinese communities around the world, are representative of the Chinese culture, but the use of the simplified version is standard on the Chinese mainland. Therefore, this study incorporated the B2B e-marketplace with the two most popular languages, English and simplified Chinese in response to the following hypotheses:

H1a: Various interface designs affect e-marketplace operational performance.

H1b: Various interface designs affect e-marketplace operational satisfaction.

Research method
This study adopted an experimental design to investigate whether the interface design of e-marketplaces leads to differences in user performance, and then employed the Questionnaire for User Interface Satisfaction (QUIS) (see Appendix) to ascertain how satisfied novice users were with regard to using the different e-marketplace interfaces. This section provides an explanation of how the data were collected for testing the hypotheses presented in the literature review section.

Experimental design
This study conducted a laboratory experiment to ensure an undisturbed environment in which subjects could focus on the operational performance of e-marketplace sites. The test sessions were conducted in an isolated room at the National Cheng Kung University in Taiwan. Subjects were randomly selected to participate in the study and randomly assigned to one of the four groups to use one of the four e-marketplace interfaces. This section provides an explanation of how the data were collected for testing the hypotheses presented in the literature review section.

Results
The 60 subjects recruited for testing B2B e-marketplace usage all had online shopping experience, but had never previously browsed a B2B e-marketplace. All participated in the experiment voluntarily. Table 1 presents the subjects’ profile. Among the 60 participants, both genders were well represented. Most subjects attended an orientation session. The objectives of the investigation and instructions for browsing the e-marketplace interface were presented.

2. Task performance: To randomly assign subjects to one of the four e-marketplace interfaces, subjects were asked to select a piece of paper from a shuffled pile of papers. Each paper had the name of one of the four e-marketplace interfaces on it. After selecting a piece of paper from the pile, each subject participated in a 10-minute acclimatization session before executing the actual test tasks. This session provided subjects with a general introduction to e-marketplace interfaces. Subjects were asked to complete three consecutive tasks and the operating time/number of screens and accuracy of the result for each task were recorded by LogSquare [16].

3. Post-task questionnaire: Participants were asked to rate the items presented in the QUIS shown (see Appendix) [4][24], in order to express their perceived level of satisfaction with the e-marketplace interface. Each response was measured using a five-point Likert scale.

Task description
This experiment adopted three tasks. The basic task was for subjects to become familiar with the e-marketplace interfaces via basic browsing operations, and the advanced tasks were based on online transaction processes. A detailed description of the three tasks is presented below:


Task 2. Suppose your company wants to order printers. Please key in the keyword printer and locate some printer sellers and add one seller to My Contact. Suppose your company also wants to order laptops. Please key in the keyword laptop and locate some laptop sellers and add one seller to My Contact. Please click My Contact and make sure both sellers were added.

Task 3. Suppose you want to join as a premium member. Please find out the specific term and services provided for premium members in this B2B e-marketplace.

Results
The 60 subjects recruited for testing B2B e-marketplace usage all had online shopping experience, but had never previously browsed a B2B e-marketplace. All participated in the experiment voluntarily. Table 1 presents the subjects’ profile. Among the 60 participants, both genders were well represented. Most subjects attended an orientation session. The objectives of the investigation and instructions for browsing the e-marketplace interface were presented.
(91.7%) considered that their searching online information frequency was high. However, about 72% of the subjects evaluated their computer ability as low. Furthermore, although all subjects had online shopping experience, only 3.6% shop online more than three times per month. Table 2 presents the mean and standard deviation of the number of screens operated for carrying out all tasks, the operational time taken to accomplish all tasks using the four B2B e-marketplaces, and the frequency of subjects asking for help while conducting the experiment.

Table 1. Users’ profile

<table>
<thead>
<tr>
<th>Gender</th>
<th>Sample size</th>
<th>Frequency distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>23</td>
<td>38.3%</td>
</tr>
<tr>
<td>Female</td>
<td>37</td>
<td>61.7%</td>
</tr>
<tr>
<td>Searching online information</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>5</td>
<td>8.3%</td>
</tr>
<tr>
<td>High</td>
<td>55</td>
<td>91.7%</td>
</tr>
<tr>
<td>Computer self-evaluation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>43</td>
<td>71.7%</td>
</tr>
<tr>
<td>High</td>
<td>17</td>
<td>28.3%</td>
</tr>
<tr>
<td>Shopping frequency per month</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-1</td>
<td>46</td>
<td>80.7%</td>
</tr>
<tr>
<td>2-3</td>
<td>9</td>
<td>15.8%</td>
</tr>
<tr>
<td>4-5</td>
<td>1</td>
<td>1.8%</td>
</tr>
<tr>
<td>More than 5</td>
<td>1</td>
<td>1.8%</td>
</tr>
</tbody>
</table>

Table 2. Group statistics for e-marketplaces

<table>
<thead>
<tr>
<th>e-marketplace operation</th>
<th>Sample size</th>
<th>Mean (STD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total operational time for tasks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alibaba (E)</td>
<td>15</td>
<td>826.8 (188.9)</td>
</tr>
<tr>
<td>Alibaba (C)</td>
<td>15</td>
<td>777.3 (195.8)</td>
</tr>
<tr>
<td>Made-in-China (E)</td>
<td>15</td>
<td>554.1 (163.8)</td>
</tr>
<tr>
<td>Made-in-China (C)</td>
<td>15</td>
<td>477.5 (105.6)</td>
</tr>
<tr>
<td>Total number of screens for tasks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alibaba (E)</td>
<td>15</td>
<td>25.5 (5.8)</td>
</tr>
<tr>
<td>Alibaba (C)</td>
<td>15</td>
<td>27.7 (6.2)</td>
</tr>
<tr>
<td>Made-in-China (E)</td>
<td>15</td>
<td>16.9 (3.3)</td>
</tr>
<tr>
<td>Made-in-China (C)</td>
<td>15</td>
<td>16.1 (3.5)</td>
</tr>
<tr>
<td>Frequency of asking for help</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alibaba (E)</td>
<td>15</td>
<td>1.5 (1.2)</td>
</tr>
<tr>
<td>Alibaba (C)</td>
<td>15</td>
<td>1.2 (0.8)</td>
</tr>
<tr>
<td>Made-in-China (E)</td>
<td>15</td>
<td>0.7 (0.7)</td>
</tr>
<tr>
<td>Made-in-China (C)</td>
<td>15</td>
<td>0.3 (0.5)</td>
</tr>
</tbody>
</table>

Test for objective performance

Table 3 shows that the mean number of operation screens and operational time needed to complete all tasks differed among Alibaba (English), Alibaba (simplified Chinese), Made-in-China (English), and Made-in-China (simplified Chinese) users. Scheffé’s multiple comparison t-test was applied to ascertain the effect of the e-marketplace on operational performance. Table 4 shows that, on average, users of Alibaba (English) needed more operational time, more screens, and asked for more help to complete tasks than users of Made-in-China (simplified Chinese). Therefore, hypothesis H1a, Various interface designs affect e-marketplace operational performance, was supported.

Table 3. One-way ANOVA for operational performance by e-marketplace

<table>
<thead>
<tr>
<th>e-marketplace operation</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total operational time for tasks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between Groups</td>
<td>1291610</td>
<td>3</td>
<td>430556</td>
<td>15.37</td>
<td>0.000*</td>
</tr>
<tr>
<td>Within Groups</td>
<td>1568567</td>
<td>56</td>
<td>28100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2860177</td>
<td>59</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total number of screens for tasks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between Groups</td>
<td>1551</td>
<td>3</td>
<td>517</td>
<td>20.11</td>
<td>0.000*</td>
</tr>
<tr>
<td>Within Groups</td>
<td>1439</td>
<td>56</td>
<td>25.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2990</td>
<td>59</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency of asking for help</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between Groups</td>
<td>11.33</td>
<td>3</td>
<td>3.778</td>
<td>5.237</td>
<td>0.003*</td>
</tr>
<tr>
<td>Within Groups</td>
<td>40.4</td>
<td>56</td>
<td>0.721</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>51.73</td>
<td>59</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p-value<0.05

Table 4. Scheffé’s multiple comparison t-test for the effect of e-marketplace on operational performance

<table>
<thead>
<tr>
<th>e-marketplace (I)</th>
<th>e-marketplace (J)</th>
<th>Mean Difference (I-J)</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alibaba (E)</td>
<td>Alibaba (C)</td>
<td>49.60 (.882)</td>
<td></td>
</tr>
<tr>
<td>Made-in-China (E)</td>
<td>Made-in-China (C)</td>
<td>272.80 (.001)</td>
<td></td>
</tr>
<tr>
<td>Made-in-China (E)</td>
<td>Made-in-China (C)</td>
<td>349.33 (.000)</td>
<td></td>
</tr>
<tr>
<td>Alibaba (E)</td>
<td>Made-in-China (E)</td>
<td>-49.60 (.882)</td>
<td></td>
</tr>
<tr>
<td>Made-in-China (E)</td>
<td>Made-in-China (C)</td>
<td>223.20 (.007)</td>
<td></td>
</tr>
<tr>
<td>Made-in-China (E)</td>
<td>Made-in-China (C)</td>
<td>299.73 (.000)</td>
<td></td>
</tr>
<tr>
<td>Made-in-China (E)</td>
<td>Made-in-China (C)</td>
<td>-349.33 (.000)</td>
<td></td>
</tr>
<tr>
<td>Made-in-China (E)</td>
<td>Made-in-China (C)</td>
<td>-299.73 (.000)</td>
<td></td>
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<tr>
<td>Made-in-China (E)</td>
<td>Made-in-China (C)</td>
<td>76.53 (.668)</td>
<td></td>
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<tr>
<td>Made-in-China (E)</td>
<td>Made-in-China (C)</td>
<td>-76.53 (.668)</td>
<td></td>
</tr>
<tr>
<td>Total number of screens for tasks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alibaba (E)</td>
<td>Alibaba (C)</td>
<td>2.20 (.70)</td>
<td></td>
</tr>
<tr>
<td>Made-in-China (E)</td>
<td>Made-in-China (C)</td>
<td>8.53* (.00)</td>
<td></td>
</tr>
<tr>
<td>Made-in-China (C)</td>
<td>Made-in-China (C)</td>
<td>9.33* (.00)</td>
<td></td>
</tr>
<tr>
<td>Alibaba (E)</td>
<td>Made-in-China (E)</td>
<td>2.20 (.70)</td>
<td></td>
</tr>
<tr>
<td>Made-in-China (E)</td>
<td>Made-in-China (C)</td>
<td>10.73* (.00)</td>
<td></td>
</tr>
<tr>
<td>Made-in-China (E)</td>
<td>Made-in-China (C)</td>
<td>11.53* (.00)</td>
<td></td>
</tr>
<tr>
<td>Made-in-China (E)</td>
<td>Made-in-China (C)</td>
<td>-8.53* (.00)</td>
<td></td>
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<tr>
<td>Made-in-China (E)</td>
<td>Made-in-China (C)</td>
<td>-10.73* (.00)</td>
<td></td>
</tr>
<tr>
<td>Made-in-China (C)</td>
<td>Made-in-China (C)</td>
<td>80 (.97)</td>
<td></td>
</tr>
<tr>
<td>Frequency of asking for help</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alibaba (E)</td>
<td>Alibaba (C)</td>
<td>-9.33* (.00)</td>
<td></td>
</tr>
<tr>
<td>Made-in-China (E)</td>
<td>Made-in-China (C)</td>
<td>-11.53* (.00)</td>
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<tr>
<td>Made-in-China (C)</td>
<td>Made-in-China (C)</td>
<td>-80 (.97)</td>
<td></td>
</tr>
</tbody>
</table>

The Effects of Language Difference on Operational Performance and Satisfaction
Tables 5 and 6 show that the mean operational time and the mean frequency of asking for help needed to complete all tasks differed between users rating low and high on computer self-evaluation. The independent samples test was applied to ascertain the effect of e-marketplace on operational performance. On average, users with low computer self-evaluation needed more operational time and asked for more help to complete tasks than users with high computer self-evaluation.

Test for subjective performance
This study then measured the internal consistency reliability of QUIS, which surveyed how subjects perceive satisfaction with using the e-marketplace interface. Cronbach's $\alpha$ in this study was as follows: overall reactions to the B2B e-marketplace interface 0.90, on the B2B e-marketplace screen 0.5, terminology and system information 0.7, learning 0.83, and system capabilities 0.59. It was found that Cronbach's $\alpha$ values were all well above the recommended acceptable criterion.

Table 7 shows that user reactions to the five categories in the QUIS differed among users of Alibaba (English), Alibaba (simplified Chinese), Made-in-China (English), and Made-in-China (simplified Chinese).

The Schefé method was applied to compare mean differences between perceived satisfaction with these items for the four B2B e-marketplace interfaces to ascertain the effect of e-marketplace interface design on operational satisfaction. Table 8 shows that, on average, users perceived the items in “Overall reactions to the B2B e-marketplace” as more satisfactory when using the Made-in-China (English) or Made-in-China (Simplified Chinese) interface than the Alibaba (English) or Alibaba (Simplified Chinese) interface. On average, users perceived the items in “On the B2B e-marketplace screen” as more satisfactory when using the Made-in-China (English) or Made-in-China (Simplified Chinese) interface than the Alibaba (English) or Alibaba (Simplified Chinese) interface. On average, users perceived the items in “Terminology and system information” as more satisfactory when using the Made-in-China (English) or Made-in-China (Simplified Chinese) interface than the Alibaba (Simplified Chinese) interface. On average, users perceived the items in “Learning” as more satisfactory when using the Alibaba (English) interface than the Alibaba (Simplified Chinese) interface; and users perceived the items in “Learning” as more satisfactory when using the Made-in-China (English) interface than the Alibaba (Simplified Chinese) interface; users perceived the items in “Learning” as more satisfactory when using the Made-in-China (Simplified Chinese) interface than the Alibaba (Simplified Chinese) interface. On average, users perceived the items in “System capabilities” as more satisfactory when using the Made-in-China (Simplified Chinese) interface than
the Alibaba (Simplified Chinese) interface. Therefore, hypothesis H1b, Various interface designs affect e-marketplace operational satisfaction, was supported.

### Table 7. The one-way ANOVA for operational satisfaction by e-marketplace

<table>
<thead>
<tr>
<th>e-marketplace satisfaction</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall reactions to the B2B e-marketplace</td>
<td>503.933</td>
<td>3</td>
<td>197.978</td>
<td>9.336</td>
<td>0.00**</td>
</tr>
<tr>
<td>On the B2B e-Marketplace screen</td>
<td>284.333</td>
<td>3</td>
<td>94.778</td>
<td>6.908</td>
<td>0.00**</td>
</tr>
<tr>
<td>Terminology and system information</td>
<td>255.250</td>
<td>3</td>
<td>85.083</td>
<td>9.156</td>
<td>0.00**</td>
</tr>
<tr>
<td>Learning</td>
<td>501.783</td>
<td>3</td>
<td>167.261</td>
<td>15.897</td>
<td>0.00**</td>
</tr>
<tr>
<td>System capabilities</td>
<td>107.067</td>
<td>3</td>
<td>35.689</td>
<td>4.659</td>
<td>0.006*</td>
</tr>
</tbody>
</table>

*p*-value<0.05

### Table 8. Scheffé’s multiple comparison t-test for the effect of e-marketplace on operational satisfaction

<table>
<thead>
<tr>
<th>Overall reactions to the B2B e-marketplace</th>
<th>e-marketplace (I)</th>
<th>e-marketplace (J)</th>
<th>Mean Difference (I-J)</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alibaba (E)</td>
<td>Alibaba (C)</td>
<td>1.2000</td>
<td>0.916</td>
<td>.304</td>
</tr>
<tr>
<td>Made-in-China (E)</td>
<td>Made-in-China (C)</td>
<td>-5.133*</td>
<td>.034</td>
<td></td>
</tr>
<tr>
<td>Made-in-China (E)</td>
<td>Alibaba (C)</td>
<td>-6.0667*</td>
<td>.008</td>
<td></td>
</tr>
<tr>
<td>Made-in-China (E)</td>
<td>Made-in-China (C)</td>
<td>-1.2000</td>
<td>0.916</td>
<td></td>
</tr>
<tr>
<td>Made-in-China (E)</td>
<td>Alibaba (C)</td>
<td>-6.333*</td>
<td>.005</td>
<td></td>
</tr>
<tr>
<td>Made-in-China (E)</td>
<td>Made-in-China (C)</td>
<td>-7.2667*</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td>Made-in-China (E)</td>
<td>Alibaba (C)</td>
<td>5.133*</td>
<td>.034</td>
<td></td>
</tr>
<tr>
<td>Made-in-China (C)</td>
<td>6.333*</td>
<td>.005</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Made-in-China (E)</td>
<td>Made-in-China (C)</td>
<td>-9.333</td>
<td>.958</td>
<td></td>
</tr>
<tr>
<td>Made-in-China (C)</td>
<td>Alibaba (E)</td>
<td>6.0667*</td>
<td>.008</td>
<td></td>
</tr>
<tr>
<td>Made-in-China (C)</td>
<td>Alibaba (C)</td>
<td>7.2667*</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td>Made-in-China (E)</td>
<td>Made-in-China (C)</td>
<td>9.333</td>
<td>.958</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Alibaba (E)</td>
<td>Alibaba (C)</td>
<td>-5.333</td>
<td>0.984</td>
<td></td>
</tr>
<tr>
<td>Made-in-China (E)</td>
<td>Made-in-China (C)</td>
<td>-4.4667*</td>
<td>.018</td>
<td></td>
</tr>
<tr>
<td>Made-in-China (C)</td>
<td>5.333</td>
<td>.984</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Made-in-China (E)</td>
<td>Made-in-China (C)</td>
<td>-3.9333*</td>
<td>.047</td>
<td></td>
</tr>
<tr>
<td>Made-in-China (E)</td>
<td>Alibaba (E)</td>
<td>4.4667*</td>
<td>.018</td>
<td></td>
</tr>
</tbody>
</table>

### Conclusions

This study has demonstrated the presence of differences in the definition of good interface design among B2B e-marketplaces. An experimental design was adopted for data collection to test whether interaction exists between the operational performance of B2B e-marketplace interfaces and language and whether either main effect predicts a person’s B2B e-marketplace satisfaction.
operational performance. Two results were recorded: (a) different interface designs affect B2B e-marketplace operational performance and (b) different interface designs affect B2B e-marketplace operational satisfaction.

The primary limitation of this study is that respondents used traditional Chinese interfaces and a sample of young people familiar with interacting with computer interfaces. Thus, the ability to generalize the results to other populations with different languages or of different ages may be limited. Future studies should recruit subjects familiar with languages other than traditional Chinese.

Acknowledgement. This research was supported in part by the Global Logistics Research Center at National Cheng Kung University in Taiwan under the "Promoting Academic Excellence of Universities" program.

Appendix 1

<table>
<thead>
<tr>
<th>QUIS</th>
<th>Overall reactions to the B2B e-Marketplace</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>terrible 1 2 3 4 5 wonderful</td>
</tr>
<tr>
<td></td>
<td>Difficult 1 2 3 4 5 easy</td>
</tr>
<tr>
<td></td>
<td>frustrating 1 2 3 4 5 satisfying</td>
</tr>
<tr>
<td></td>
<td>inadequate power 1 2 3 4 5 satisfying</td>
</tr>
<tr>
<td></td>
<td>adequate power</td>
</tr>
<tr>
<td></td>
<td>dull 1 2 3 4 5 stimulating</td>
</tr>
<tr>
<td></td>
<td>rigid 1 2 3 4 5 flexible</td>
</tr>
<tr>
<td></td>
<td>On the B2B e-Marketplace screen</td>
</tr>
<tr>
<td></td>
<td>hard to read 1 2 3 4 5 easy to read</td>
</tr>
<tr>
<td></td>
<td>highlighting simplifies task</td>
</tr>
<tr>
<td></td>
<td>not at all 1 2 3 4 5 very much</td>
</tr>
<tr>
<td></td>
<td>organization of information</td>
</tr>
<tr>
<td></td>
<td>confusing 1 2 3 4 5 very clear</td>
</tr>
<tr>
<td></td>
<td>sequence of screens</td>
</tr>
<tr>
<td></td>
<td>confusing 1 2 3 4 5 very clear</td>
</tr>
<tr>
<td></td>
<td>Terminology and system information</td>
</tr>
<tr>
<td></td>
<td>use of terms throughout B2B e-Marketplace</td>
</tr>
<tr>
<td></td>
<td>interface</td>
</tr>
<tr>
<td></td>
<td>inconsistent 1 2 3 4 5 consistent</td>
</tr>
<tr>
<td></td>
<td>terminology is related to the task you are doing</td>
</tr>
<tr>
<td></td>
<td>never 1 2 3 4 5 always</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Learning</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>position of messages on screen</td>
</tr>
<tr>
<td></td>
<td>inconsistent 1 2 3 4 5 consistent</td>
</tr>
<tr>
<td></td>
<td>messages on screen which prompt user for input</td>
</tr>
<tr>
<td></td>
<td>confusing 1 2 3 4 5 clear</td>
</tr>
<tr>
<td></td>
<td>keep you informed about what it is doing</td>
</tr>
<tr>
<td></td>
<td>never 1 2 3 4 5 always</td>
</tr>
<tr>
<td></td>
<td>System capabilities</td>
</tr>
<tr>
<td></td>
<td>difficult 1 2 3 4 5 easy</td>
</tr>
<tr>
<td></td>
<td>exploring new features by trial and error</td>
</tr>
<tr>
<td></td>
<td>remembering names and use of commands</td>
</tr>
<tr>
<td></td>
<td>difficult 1 2 3 4 5 easy</td>
</tr>
<tr>
<td></td>
<td>task can be performed in a straightforward manner</td>
</tr>
<tr>
<td></td>
<td>never 1 2 3 4 5 always</td>
</tr>
<tr>
<td></td>
<td>supplemental reference materials</td>
</tr>
<tr>
<td></td>
<td>confusing 1 2 3 4 5 clear</td>
</tr>
<tr>
<td></td>
<td>System capabilities</td>
</tr>
<tr>
<td></td>
<td>system speed</td>
</tr>
<tr>
<td></td>
<td>too slow 1 2 3 4 5 fast enough</td>
</tr>
<tr>
<td></td>
<td>system reliability</td>
</tr>
<tr>
<td></td>
<td>unreliable 1 2 3 4 5 reliable</td>
</tr>
<tr>
<td></td>
<td>correcting your mistakes</td>
</tr>
<tr>
<td></td>
<td>difficult 1 2 3 4 5 easy</td>
</tr>
<tr>
<td></td>
<td>experienced and inexperienced users’ needs are taken into consideration</td>
</tr>
<tr>
<td></td>
<td>never 1 2 3 4 5 always</td>
</tr>
</tbody>
</table>

References


Development of an instrument measuring user satisfaction of the human-computer interface, ACM New York, NY, USA.


PROCURING INNOVATION ON INTERNET-BASED MARKETS

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Abstract
The Internet-based market is rising as a viable venue for the procurement of innovation solutions. There are two major procurement mechanisms existing in the market practices: contest and RFP. We investigate the factors that affect a firm’s preference of one mechanism over the other. We divide innovation problems into two categories: exploitive innovation problem and exploratory innovation problem. For an exploitive innovation problem, technologies used in solutions already exist, and the outcome of the solution is determined by the type and the effort of a solver. For an exploratory problem, technologies are not available; solvers need to go through an exploratory process but the result of his effort is uncertain. We establish the boundary condition for solution seeker’s decision on procurement mechanism. For an exploitive innovation problem, RFP is preferred in an open-participation market unless the distribution of the solvers’ type has a big variance; for an exploratory problem, contest will be preferred in most cases except that the solver pool of the market is small. Moreover, the amount of a cash award, the effort coefficient, and the degree of the randomness endowed in a technology exploratory process all have effect on seekers’ decision.

Keywords: Internet-based innovation markets, contest, RFP, open innovation

Introduction
In a world of the distributed knowledge, firms and institutions need to leverage outsiders’ wisdom to solve their own innovation problems. Instead of solving the problem completely in-house, they have begun to either work with outside partners or procure solutions from market. This movement is termed as open innovation by Chesbrough (2002). With the involvement of the Internet, the open innovation has grown more open to participants and to various scopes, because the Internet not only creates a viable environment for innovators to communicate and collaborate with each other but also incubates a variety of markets to embrace all sorts of innovation problems.

Some procurement markets for innovation have emerged in recent years. InnoCentive, as one of the best-known online innovation markets, takes up innovation problems in a broad range of domain such as computer science, chemistry, physical sciences, life sciences, etc. The problems that come from the “seekers” who are either companies, or non-profit organizations or public sectors are opened up to the “solvers” who are scientists, researchers or innovators. As of 2008 InnoCentive had 64 of these seekers posting more than 800 problems in 40 disciplines. More than 300 of them have already been solved by over 165,000 solvers.\textsuperscript{1} Contest is the main transaction mechanism used in InnoCentive, in which the solver with the best solution wins cash award. Another transaction mechanism is RFP (known as eRFP in InnoCentive) which allows a seeker to submit a Request for Proposal to the solver’s community. After a number of solvers turn in RFP responses, the seeker will select the best RFP response by his evaluation and contact its submitter for further development.

Contest and RFP are the most common mechanisms for innovation procurement. Some markets apply both of them (e.g. InnoCentive), while others adopt only one (e.g. Innovation Exchange uses Contest and NineSigma uses eRFP). Specifically, contests used in these markets are tournaments that reward the provider of the best solution on a specific date. In the tournament, a solution is pre-prepared by a solver. If it does not rise as the best solution, all the costs spent on the solution will be sunk. In contrast, RFP eliminates the sunk costs by choosing proposals rather than fully completed solutions. The provider of the best proposals will be rewarded with a contract to develop his proposal into a solution. Although to prepare proposals generates cost, it is much less costly than the full development of a solution.

Economists have long believed that innovation is uncontractable because its inputs are unobservable and its outcomes can hardly be verified by a court. Though, the adoption of RFP by real innovation markets reveals that at least some of the innovations can be contracted, and under certain circumstances, RFP works better than contest as an innovation procurement mechanism. However, it is unclear in which types of innovations and under what circumstances RFP

\textsuperscript{1} en.wikipedia.org/wiki/InnoCentive
In an exploratory innovation problem, the main influential factor is the number of solvers and the randomness of the exploratory process. The trade-off behind the choice between contest and RFP is related to the advantage and the side-effect a contest has in a given setting. When the advantages overwhelm the side-effects, contest is preferred, otherwise, RFP wins out.

The remainder of this paper is organized as follows. We first review the relevant literature, then develop the models and establish our main results. Finally, we conclude the paper.

Literature Review
There is a set of papers focusing on the optimal tournament design in R&D settings (e.g., [2] [4] [5] [8] [11]). All of these papers find that allowing open participation in tournaments mitigate sponsors’ profits, because the fierce competition between solvers causes their underinvestment in effort. To reduce this inefficiency, Taylor (1995) suggests sponsors restricting participation by taxing contestants through an entry fee [11]; Fullerton and McAfee (1999) demonstrate that an all-pay auction for the entry fee is efficient to select the most qualified contestants for competition [4]; Fullerton et al. (2002) shows that conducting auctions at the end of research tournaments will generally reduce the sponsor’s prize expenditure relative to fixed-prize tournaments [5]. However, Terwiesch and Xu (2008) have an arguing result. They analyze three types of innovation project: a) expertise-based project, b) ideation project and c) trial-and-error project, and demonstrate that for all the types of innovation, the seeker can benefit from open-participation contest “because he can obtain a more diverse set of solutions, which mitigates and sometimes outweighs the effect of the solvers’ underinvestment in effort” [12]. Unlike this stream of literature, our paper not only discusses the effect of the number of participants on seekers’ profit but also provides a new insight into the effect of the distribution characteristics of participants.

Moreover, Terwiesch and Xu (2008) compared the quality of the solutions and the seekers’ profits in a contest and in an internal innovation. They suggested that the benefit of contest is enabling seekers to find solvers with low effort cost, while the inefficiency of contest is causing the underinvestment in the solvers’ effort. They further demonstrated if the external solver’s effort cost is lower than certain level, open contest is a better choice than internal innovation. On and beyond Terwiesch and Xu (2008), our paper concerns seekers’ choice between two procurement mechanisms: contest and RFP. Assuming that seekers are able to find solvers at the same effort cost in these two mechanisms, to reach the low cost solver is no longer the only benefit out of contest.
Thus, the reason behind a choice decision on contest or RFP is different from that on contest and internal innovation.

Another relevant literature stream is related to the research on RFP. In the real world, RFP is widely used in product procurement. The process is usually regarded as a multi-attribute auction in academy (e.g. [1] [10]). However, in our paper, we abstract the process into a model of price-only auction in which seekers set compulsory quality requirements for all the bidding solvers to accept. Based on our observation, the problems posted in real innovation markets are describable with the explicit quality requirements on solutions. Therefore, we believe that our price-only model does not reduce the explanation power of our results. More specifically, we assume that solvers compete for contract via the Vickrey second-bid auction in RFPs. This assumption is based on two facts. First, we have observed many English auctions in real innovation markets. Second, the outcome of the English auctions can be achieved by Vickrey auction, and it is customary to model an English auction as a Vickery auction [7].

Model Development
A seeker procures a problem solution from n solvers. All parties are risk-neutral. The value of a solution is determined by three variables, solvers’ type, solvers’ effort and a random noise. A solver’s type is a combination of all his/her endowed characteristics related to solving the problem, such as experience, education, intelligence, etc. A solver’s effort is the investment s/he puts into the problem, which usually refers to time and research resources. Besides the type and effort of solvers, all the other factors that influence the value of a solution are regarded as the random noise.

Formally, the value of a solution \( V_i \) can be written as a linear function of solvers’ type \( \beta_i \), solvers’ effort return \( r(e) \) and a random variable \( \xi_i \):

\[
V_i = \beta_i + r(e_i) + \xi_i, \quad i = 1, 2, ..., n
\]  

\( \beta_i \) is independently distributed across solvers with a commonly known, continuous and increasing cumulative density function \( F(\beta_i) \). \( r(e) \) is either linear or concave in \( e \). The cost of the solution is linear in effort with a constant unit cost \( c \). \( \xi_i \) is an IID Gumbel random variable with mean zero and scale parameter \( \mu \). A higher \( \mu \) means a higher degree of randomness. \( \beta_i \) is private information of solver \( i \); \( c \) and \( \mu \) are commonly-known information.

A contest has three stages. Firstly, a seeker posts a problem and announces a cash award, \( A \), for the best solution. Secondly, solvers first decide how much effort to exert on the problem and then work out the solution. Finally, after all the solvers submitted their solutions, the seeker selects the best solution and pays the prize to its solver. Let \( V_1, V_2, ..., V_n \) denote the rank-ordered values of solutions, where \( V_1 \geq V_2 \geq ... \geq V_n \). The profit of the seeker (the subscript \( c \) stands for contest) is

\[
\Pi_c = V_1 - A
\]  

In a RFP, which is assumed as a Vickrey auction in our paper, a seeker firstly posts a problem and specifies the standard value, \( V^* \), of the solution. Then, according to the value requirement, solvers decide how much to bid for the problem. The seeker will choose the lowest bidder as the winner and pay him the second lowest bid. A solver’s optimal bidding truly reveals its cost. Let \( C_1, C_2, ..., C_n \), denote the rank-ordered costs of the solvers, where \( C_1 \leq C_2 \leq ... \leq C_n \). The profit of the seeker using a Vickrey auction (the subscript \( r \) stands for RFP) is

\[
\Pi_r = V - C_2
\]  

As we can see, a seeker’s profit function is the value of the winning solution minus the reward paid to the winner. Assuming the seeker pays the same rewards to the winners in contest and RFP \((A=C_i)\), we can compare the performance of the two mechanisms by examining the expected values of their winning solutions \((V_1 \) and \( V^* \)). For consistency, we denote \( V^* \) as the value of winning solution in contests and \( V_1 \) as the value in RFP.

Mechanism Comparison in Exploitative Innovation
As we defined, an exploitive innovation problem has available technologies and the uncertainty of the quality of its solution lies on the characteristic of its solver. Assuming the value of a solution equals to its quality, we believe that the solution value in an exploitive innovation problem is only driven by the type and effort of solvers. Terwiesch and Xu (2008) define this kind of innovation as expertise-based projects.

\[
V_i = \beta_i + r(e_i)
\]  

In a contest, for a given solver \( i \), the probability for him to win the contest equals to the probability that the solver offers the solution with highest value. Let \( P_i(\beta_i, F(\beta_i), n) \) denotes the probability of the solver \( i \) offering the best solution. Thus, each solver solves:

\[
\begin{align*}
\max \quad & E[\pi(\beta_i)] = \pi_i = AP_i(\beta_i, F(\beta_i), n) - c e_i, \\
\text{s.t.} \quad & \pi_i \geq 0
\end{align*}
\]  

We assume \( e_i \) is increasing with \( \beta_i \) and \( r(e_i) = \theta e_i \), in which \( \theta \) is defined as effort coefficient. \( V_i \) increases with, therefore,

\[
P_i(\beta_i, F(\beta_i), n) = F^{n-1}(\beta_i)
\]
The problem of solver i can be written as

\[ \text{Max } \pi_i = AF^{n-1}(\beta_i) - ce_i(\beta_i), \quad \text{s.t. } \pi_i \geq 0 \]  

(7)

The first order condition of solver i’s problem is

\[ A(n-1)F^{n+2-1}(\beta_i)f(\beta_i) \frac{\partial \beta_i}{\partial e_i(\beta_i)} = c = 0 \]

which can be rearranged as

\[ e_i(\beta_i) = \frac{A(n-1)F^{n+2-1}(\beta_i)f(\beta_i)}{c} \]

(8)

We assume \( \beta_i \in [\beta_0, \beta_1] \). Since \( V_i \) increases with \( \beta_i \), the solver with the lowest type has no probability to win and will not exert any effort in equilibrium, i.e., \( e(\beta_0) = 0 \). Solving the differential equation with this boundary condition, we have the symmetric Bayesian equilibrium strategy for a solver as

\[ e_i^*(\beta_i) = \frac{A(n-1)}{c} \int_{\beta_0}^{\beta_i} F(x)^{n+1} f(x) dx = \frac{A}{c} F^{n+2}(\beta_i) \]

(9)

Since \( F(\beta) \) is continuous and increasing in \( \beta_i \), we can verify that \( e(\beta) \) is increasing in \( \beta_i \), which is consistent with our assumption. Substituting (8) into (7) yields

\[ \pi^*_i = AF^{n+2-1}(\beta_i) - c \left[ \frac{A}{c} F^{n+2}(\beta_i) \right] = 0 \]

(10)

Let \( \beta_1, \beta_2, \ldots, \beta_n \) denote the rank-ordered types of the solvers, where \( \beta_1 \geq \beta_2 \geq \ldots \geq \beta_n \). Since \( V_i \) increases with \( \beta_i \), the solver whose type is \( \beta_i \) creates the solution with the highest value \( V_i \):

\[ V_i = V_i(\beta_i) = \beta_i + e_i(\beta_i) \]

(11)

In a RFP, the expected value of submitted solutions is equal to the standard quality requested by the seeker. Therefore, the expected effort a solver will exert to solve the problem can be written as

\[ e(\beta) = \frac{V - \beta}{\theta} \]

(12)

So, the expected cost of solver i is

\[ C_i = ce_i(\beta_i) = c \cdot \frac{V - \beta}{\theta} \]

(13)

Therefore, the payment for the winner in the Vickrey auction, which is equal to \( C_i \), can be written as

\[ C_i = c \cdot \frac{V - \beta_i}{\theta} \]

(14)

As we supposed before, we compare the expected value the seeker obtains when s/he pays the same reward to the winners of the two mechanisms. The condition can be written as

\[ A = C_i \]

Substituting (13) into the above equation yields:

\[ V_r = V = \beta_i + \theta \cdot \frac{A}{c} \]

(15)

For tractability, we make a specific parametric distributional assumption. In the following text, we assume that the solvers’ types are distributed uniformly on \([R-s, R+s]\), where \( R \geq 0 \). As shown in most statistic texts, the density of the \( k \)th order statistic is given by

\[ f_{x_n, k}(x) = \frac{n!}{(k-1)! (n-k)!} F(x)^{k-1} (1-F(x))^{n-k} f(x) \]

Based on this density, we can derive the expected value of \( \beta_i \):

\[ \beta_i = (R-s) + 2s \cdot \frac{n-i+1}{n+1} \]

Substituting (15) into (10) and (8), we have

\[ V_i = V_i(\beta_i) = \beta_i + e_i(\beta_i) \]

(16)

\[ V_i = \frac{A}{c} \frac{\theta n}{n-1} + \frac{A}{c} \frac{n}{n-1} + \frac{A}{c} \frac{n}{n-1} \]

(17)

\[ V_r = V_r(\beta_i) = \frac{A}{c} \frac{\theta n}{n-1} + \frac{A}{c} \frac{n}{n-1} + \frac{A}{c} \frac{n}{n-1} \]

(18)

Proposition 1. For a exploitive innovation problem, let \( r(e_i)=\partial e_i / \pi_i \) be the solvers’ effort return function and consider a market with n solvers whose types are distributed uniformly on \([R-s, R+s]\), where \( R \geq 0 \). Given the award to winner is A, and the unit cost of solvers’ effort is c, (a) the seeker can get the highest solution value, \( R+s+\theta A/c \), by using RFP mechanism in a market with a very large solver pool; (b) the condition for contest outperforms RFP is

\[ 1 - \frac{n}{n+1} \cdot \frac{2s + \theta}{\theta} \cdot \frac{A}{c} \cdot \frac{1-n}{2n-1} > 0 \]
Figure 1. The Seeker’s Optimal Choice for Exploitive Innovation Problems

Illustrated in Figure 1 is the seeker’s optimal choice of the procurement mechanism for exploitive innovation problems. As demonstrated in Proposition 1 and Figure 1, for certain number of solvers, there is a threshold level of the variance of solver’s type. When the variance of solver’s type is below the threshold, RFP will help the seeker get a better solution than contest does. The threshold increases in a growing number of the solvers implying that the larger the size of a solver pool, the more likely RFP outperforms contest. In addition, Figure 1 reveals that the ratio of the payment to winner to the unit cost of effort (A/c) has an effect on the seeker’s choice. If we normalize the unit cost to 1, the ratio equals to the payment amount. Thus, we may conclude that the more a seeker is willing to pay for a solution, the more likely s/he prefers RFP to contest. In addition, the effort coefficient (θ) has the similar effect, i.e., the bigger the effort coefficient, the more likely the seeker chooses RFP.

Equations (7) and (8) demonstrate the co-existence of the advantage and the side-effect in contest. The advantage is that it can exploit the highest type value of solvers in a pool while RFP only gets the second highest. The side-effect is the underinvestment of effort due to solvers’ fear of sunk costs. When the advantage exceeds the side-effect, Contest is preferred; otherwise RFP. In contest, the increase in the number of solvers weakens the chance for a solver to win and causes the solver to be more cautious to invest. Thus, the enlargement of a solver pool will aggravate the side-effect of Contest. On the contrary, the increase of the variance of solvers’ type will enhance the advantage of the contest, because with a larger variance, the gap between the highest value and the second highest value is more significant. We conclude that both the size and the diversity of a solver pool will affect the performance of contest and, consequently, seeker’s preference to contest or RFP.

As discussed, contest is superior in solver’s type while RFP is superior in solver’s effort and consequently superior in the return of the effort. Therefore, if the return of the effort accounts for the most value of the solution, RFP will probably outperform contest. The more to be paid for the solution, the larger the solvers’ effort is induced. Ceteris paribus, the return of the effort will have a larger proportion in the solution value. Meanwhile, the increase of the effort coefficient will also enlarge the proportion. Therefore, in a setting with large rewards and high effort coefficient, RFP outperforms contest.

Mechanism Comparison in Exploratory Innovation

In an exploratory innovation, there are huge technology uncertainties. To emphasize the technology uncertainty, we assume all the solvers are identical. The difference of the value of solutions mainly depends on the random noise existed in the process of technology exploration.
Terwiesch and Xu (2008) define this kind of innovation as ideation projects.

\[ V_i = \beta + r(e_i) + \xi_i \]

In a contest, the winning probability of solver \( i \) is

\[ \Pr \{ \text{solver } i \text{ wins the contest} \} = \frac{1}{1 + (n-1) \exp \left( \frac{r(e_i) - r(e_j)}{\mu} \right)} \]  (16)

\( e \) is the effort exerted by all the other solvers except solver \( i \). We assume they exert the same effort. As for the detailed explanation of Equation (16), we refer interested readers to Terwiesch and Xu (2008). Consequently, the profit of the solver \( i \) can be written as

\[ \pi_i = A \cdot \frac{1}{1 + (n-1) \exp \left( \frac{r(e_i) - r(e_j)}{\mu} \right)} - ce_i \]

Assuming symmetry \( e_i = e_j \) and \( r(e_i) = \Theta \ln e_i \), we have the first-order condition

\[ e_i^* = \frac{A \Theta (n-1)}{c \mu n^2} \]

The winning solution of the contest has the highest value of random variable, thus

\[ V_c = V_i = \beta + \theta \ln e_i + \max(\xi_i) = \beta + \theta \ln \frac{A \Theta (n-1)}{c \mu n^2} + \mu \ln n \]  (17)

As shown in the above equation, the competition introduced by contest produces two effects. On the one hand, it causes underinvestment of effort, which has been discussed before. On the other hand, it exploits the advantage of multiple solver trials which may produce a random value larger than the zero mean.

With the strategy \( e_i \), the profit of the solver is

\[ \pi_i = A \left( \frac{1}{n} - \frac{\theta}{\mu} \right) \cdot \frac{n-1}{n} \]

In order to make sure that the profit of the solver is no less than zero, we obtain solvers’ participation constrain

\[ \frac{\theta}{\mu} \leq \frac{n}{n-1} \]

In a RFP project, since all the solvers are identical, the seeker can choose anyone of them to procure a solution of value \( V \) with a payment of \( c \exp[(V-\beta)/\Theta] \), thus

\[ V_R = V = \beta + \Theta \ln \frac{A}{c} \]  (18)

Proposition 2. For an exploratory innovation problem, let \( r(e_i) = \Theta \ln e_i \) be the solvers’ effort return function and consider a Gumbel random variable with mean zero and scale parameter \( \mu \). In a market with \( n \) solvers, (a) only when \( \Theta / \mu \leq n(n-1) \), the solvers will consider participating in a contest; (b) the condition for contest outperforms RFP is

\[ \frac{\Theta}{\mu} (n-1) - \frac{n-1}{n} > 0 \]

Figure 2. The Seeker’s Optimal Choice for Exploratory Innovation Problems

Figure 2 shows that in an exploratory problem, only when the number of solvers is very small, seekers will prefer RFP to contest. Meanwhile, if the random variable has a higher degree of randomness, contest is more likely to outperform RFP. However, with the increase of the effort coefficient, the chance for RFP to win is enhanced.

Comparing Equation (10) and (11), we find the advantage of a contest is that a seeker gets higher value of the random variable because s/he selects the best one from many proposals proposed by a group of contestants, while in a RFP a seeker merely accepts the result produced by one contracted solver. However, in this case, contest has the same side-effect as it has in exploitive problems. The solvers who participate in the Contests may underinvest their efforts because they fear of getting no reward at all. Although the size of solver pool has positive effect on both the advantage and the side-effect, it will induce more
advantage than side-effect when it is sized up, thus, the advantage will be dominant. Moreover, when the effort coefficient increases, the effort will account more for the value of the solution and consequently the side-effect of the contest becomes more influential to the solution value. Then, RFP will have more chances to win contest when other factors are fixed.

Discussion and Conclusions
A growing number of firms have embraced the idea of open innovation: looking for ideas and solutions from the outside world. The Internet provides an unparalleled venue for the exchange of virtual knowledge products. E-market has emerged for firms to procure solutions for their innovation problems. However, these markets support different procurement mechanisms and hold solver pools with different quality and quantity characteristics. It is critical for firms to understand which procurement mechanism they should use under certain circumstances.

In an exploitive innovation problem, if a market has a small number of diversified solvers, the seeker (the firm) should use a contest to exploit the full value of the highest solver type. On the contrary, if a market has a large number of similar solvers, the seeker should adopt RFP to obtain solvers’ full investment of efforts. Moreover, if the seeker is willing to pay a high reward to the best solution, s/he should choose RFP, since it can induce the best solution of much higher level than contest does. For an exploratory innovation problem, in most cases, a seeker should choose contest unless the size of the solver pool is really small (e.g. \( n < 5 \)), or the value of the solution is mainly determined by the effort of solvers rather than the random outcome of the exploratory process.

Although we obtain some explicit results in this paper, there are more questions open to further research. We have observed that solvers’ profit varies in different procurement mechanisms. It causes solvers’ preference to certain mechanism. It will be interesting to find how this preference influences market structure and seekers’ behavior. Moreover, in exploitive innovation problems, seekers’ decisions on procurement mechanisms heavily rely on their knowledge of the distribution of solvers’ type. An attention is worth in how the information disclosure policy increases seeker’s knowledge on the solver’s type distribution which in return affects seekers’ decisions. Empirical research may be conducted to analyze how seekers choose procurement mechanisms in practice and which factors affect their decisions. We believe that the Internet-based innovation markets will play a significant role in open innovation, but merely a little of these markets has been fully explored. The vast grey portions on the map of the innovation market are left to continuous endeavoring efforts.

References
THE RESEARCH OF ONLINE SERVICE RECOVERY BASED ON KANO’S MODEL

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Abstract
To identify customer requirements regarding e-retailing service failures, this study applied Kano’s model to sort the e-retailing compensation elements into various categories for identifying the key elements, maximizing customer satisfaction and minimizing customer dissatisfaction based on investigation of the sample of 167 e-retailing customers. The result indicates that a psychological compensation is the basic requirement of e-retailing customer and a refund can improve customer satisfaction when any service failure is occurred. Moreover, an economic compensation is indifferent for a dissatisfied customer. The result can help the e-retailer to understand what different compensations would have diverse effects on customers and provide effective guidelines to reduce customer’s dissatisfaction caused by the service failure.

Keywords: Online Retailing, Service Failure, Service Recovery, Kano’s Model

Introduction
No matter what it is in traditional or online business models, to maintain a long-term relationship with the customers is one of the essential factors to determine whether the enterprise can run its business continuously. Plenty of researches show that the cost to keep the original customers is much lower than to attract the new ones [10]; therefore, it is more important to keep the original customers than to find the new ones for an enterprise. The enterprise may provide a series of services during the dealing process with the customers. As the service is invisible, indivisible, variable, perishable and the like [9], the service failure becomes unavoidable. Therefore, it is quite important to carry out the recovery strategy after the service failure. A good recovery will significantly influence the service effects, which include the customer satisfaction, repurchase intention and positive word-of-mouth reputation [4] [11] [14] [24]. When the service failure happens, the enterprise should provide a good compensation, which would greatly enhance the customer satisfaction [11]. The research of [29] [33] finds that the customers received the compensation by the enterprise should have higher satisfaction than those who never encounter the service failure. However, to everyone’s surprise, the customers encountered the service failure always cannot receive a satisfied compensation [18]. Furthermore, the research indicates that nearly 50% of the compensations deepen the negative emotion of the customers. Therefore, the provided compensation right after the failure may be the key factor to determine whether the enterprise can continuously maintain a good and long-term relationship with the customers or not.

The relevant researches of the previous online service compensation include to find out the compensations of online service against the critical incident method and further classification; some researchers also discuss the relationship between the compensation strategy and customer satisfaction. However, these researches all assume that the relationship between the compensation and customer satisfaction is a linear relationship; that means the more the compensation you provide, the more the satisfied customers will be (or may decrease the dissatisfaction). Apology is required if the error occurs, but the customers might not be satisfied just because of your apology. Therefore, an apology is one necessary (hygiene) factor but not a motivation factor. Furthermore, it is required to provide the return service, which belongs to the hygiene factor. The customers will not be satisfied with your services without the return service. If this service is not provided, the customers will therefore be dissatisfied. Consequently, different customer compensations are with different properties provided. What’s more, this study discusses that the online service compensations should provide with different properties in order to make up for the customer dissatisfaction in accordance with the Kano’s model of the Motivation-Hygiene Theory [19]. The result can be taken as the reference for the online retailers regarding the compensations, which would enhance the customer satisfaction and distribute the efficiency effectively.

Theoretical Background
Online Retailing
The popularization of the Internet has become a
new media of corporate marketing and stimulated the development of an e-commerce in recent years. The retailers have also encountered extreme impact in the tide of informationization and gradually transformed the entity store into the virtual web store [13]. The basic concept of online retailing is based on the virtual web store. The customers can purchase the commodities by entering the virtual web store through the public or private Internet. The definition of online retailing is the website which provides the commodities or services on the Internet and allows the customers ordering directly through online. Moreover, the following types are divided in accordance with the different commodities. 1. Single store: you have to handle many things, including the website building, commodities selling, customers encounter and so on. 2. Specialty store: it mainly provides one single kind commodity with abundant information. 3. Online store: this kind of website directly provides the sales service on the Internet against the method of electronic catalog. 4. Shopping center: it is composed of many online stores; therefore, it provides many kinds of commodities.

The Institute for Information Industry (1997) proposes the definitions of web-store are divided in the broad sense and narrow sense. The broad sense means it provides not only the commodities and service but the purchase order on the Internet; meanwhile, it allows the consumers to order online directly. If the website can only provide the static information like an advertisement, commodity display and so on and must be ordered through the phone, transfer and the like; strictly speaking, it can not be called as a web-store. However, the narrow sense means all the trading procedures, such as the commodities browsing, ordering, paying and the like must be completed on the Internet and this can finally be called a web-store.

For example, the entity retailing store Barns & Noble, it not only set up the bookstore on the Internet but integrate many information technology to support the customers, such as e-paper, electronic greeting card and the like. Amazon.com is one another successful example. As the application of the information technology in the retailing industry is more and more common, the retailing industry has gradually transformed into the virtual and the informationization has been found in the operation of some enterprises. The enterprises are also aware that the activity cost of the value chain has extremely changed during the conversion process.

**Service Failure**

As the service possesses the same characteristics of production and consumption and the “people” plays an important role in the service, however, the service failure is unavoidable. The definition of service failure: it means to make the customers feel dissatisfied during the process of service delivery and this process is called the service failure [28]. The service failure can also be said that the service requirement of the customer has not been achieved, delayed or lowered than the acceptable range during the service process. Since 1980, there are plenty of scholars have discussed the reasons of service failure from different viewpoints and it can be mainly divided into two categories, one is to discuss the failure and influence, such as [1] [3] [23] [32] and the like; the other is to find out the failure type against the Critical Incident Technique (CIT), such as [3] [20] [24], and the like.

Bitner et al. [3], exploits CIT to collect 699 failure events occurring in restaurants, hotels and airline companies and further divides the failures into three categories: 1. The reaction of the failure is to the employee during the service delivery process, such as the reaction of delayed service and other core services; 2. The reactions of the requirement and demand of the customer are to the employee during the service delivery process, such as the reactions of the special requirement and hobby to the customers and the reactions that the customer admits the mistake and disturbs other customers; 3. The spontaneous behaviors of the employee during the service delivery process occur, such as the consideration for the customers, the unusual behaviors, which are under the cultural norms and the like. Many scholars consider that the more serious the failure is, the lower the dissatisfaction will be [8] [12] [20]. The serious failure will result in more complains and lower loyalty. In such case, the service will be influenced against the subjective and objective cognitions of the customer and includes various requirements and people involvement; therefore, the failure becomes unavoidable.

Holloway & Beatty [21], proceeded with two researches against the failure event of online shopping. They first interviewed 30 consumers who had ever shopped online within the past six months and at least experienced one service failure and then further divided the service failure into seven categories. Afterwards, they broadened the sample information at the second time. They interviewed 314 consumers who had ever shopped online within the past six months and experienced one service failure and finally received 295 effective samples. The failures will be divided into seven categories, including 1. Delivery problems: the late delivery, undelivered and wrong delivery; 2. Website design problem: the on-line problem, incomplete product information, undisclosed inventory and wrong product information; 3. Customer service problems: the bad
communication, unfair return policy and unclear return policy; 4. Payment problems: the overcharge, undefined purchase procedure and payment difficulty; 5. Security problems: the risk of credit card payment and disclosure of the personal information; 6. Miscellaneous: the response failure, overcharge to some certain customers and lack of personal information; 7. Others. The delivery is the most common problem for online shopping within the seven categories.

No matter what it is an entity shopping or online shopping, the different failures will occur during the service process, including the ineffective service, delayed service and other relevant failures. Sometimes it may influence the feeling of the consumer because of the time, seriousness and failure frequency. Therefore, it is required to further classify the service failure. The service failure can be generally divided into subjectiveness and objectivity. Referring to the subjectiveness, Bell et al. [2], considered that if the service process is not the same as what he or she expects, that is a failure; when it refers to the objectivity, Palmer et al. [33], considered that the service provider is unable to grant the appointed service and finally result in the failure, such as the deferred delivery, discrepant specifications and so on.

We can know from the reference that once the failure occurs, the appropriate compensation is required. The dissatisfaction and complain of the customer and the negative influence to the enterprise will be decreased due to the compensation. Therefore, the service provider shall invest the cost of compensation in order to maintain the relationship with the customers and further avoid the current customers turning to other competitors.

Service Recovery
Klaus & Christine [26], considered that the service provider should strive for the zero defect and make the correct decision at the very time. The failures in e-commerce and online shopping are unavoidable and the existence of failure will bring lots of lethality to any company. Therefore, the compensation is extremely important [1] [5] [6]. However, the definition of the service recovery is that the service provider tries to decrease the harm during the service delivery process [17] [18], or it may be said as the action that the enterprise carries out against the failure [15]. The intention is to turn the dissatisfied customers into satisfied and expect to retain the customers in the future.

Kelley et al., [24], chose the retail industry as the panels and figured out 12 compensation strategies. They are the discount, failure correction, failure correction and compensation, commodity replacement, apology, refund, correction demanded by the customers, coupon, correction method if dissatisfied, deteriorating treatment, no treatment and entity retailer replacement. Among all, the commodity replacement is the most common compensation, the correction demanded by the customers is the least common one; the failure correction brings the highest repatronage rate and if there is not any action taken, the repatronage rate will be the lowest. Forbes et al., [10], exploited the classification of the compensation proposed by Kelley et al., [24], to discuss the compensation strategy of online shopping. They interviewed the consumers who had ever experienced the service recovery and received 382 key events, in which the customers experienced the service failure can only be retained by the entity retailer replacement. However, the customers might turn to other competitors if carrying out other compensation strategies. Therefore, the service compensation is extremely important.

Holloway & Beatty [21], interviewed the customers who had ever shopped online and indicated that only 5% customers are satisfied with the service recovery provided by the enterprise. Those dissatisfied with the compensation may think the compensation is too inflexible and the customer service quality is bad. Furthermore, they may feel unfair. However, the main reasons why the customers dissatisfied are: they need more compensations, they do not receive any reply from the enterprise, bad interaction relationship, lack of apology or they even consider the enterprise provides not enough measures to make up for the failure. When people shop online, they are lack for the communication chance with people. This might result in some problems because of different from the entity environment; hence, the customers may not be satisfied with the compensation. If the customer encounters the failure, the compensation provided by the service provider may belong to the concept of one-dimensional quality and it is said that when there is the compensation, the customer satisfaction will be raised up; on the contrary, when there is no compensation, the customer will be dissatisfied. However, the truth is, if any failure occurs, an apology is required but the customer would not be satisfied with that. This belongs to the hygiene factor and the customer would not be satisfied with the hygiene. Furthermore, they think the compensation is too inflexible and the customers dissatisfied are the least common one; the failure compensation, the correction demanded by the customers is the least common one; the failure correction brings the highest repatronage rate and if there is not any action taken, the repatronage rate will be the lowest. Forbes et al., [10], exploited the classification of the compensation proposed by Kelley et al., [24], to discuss the compensation strategy of online shopping. They interviewed the consumers who had ever experienced the service failure and received 382 key events, in which the customers experienced the service failure can only be retained by the entity retailer replacement. However, the customers might turn to other competitors if carrying out other compensation strategies. Therefore, the service compensation is extremely important.

Kano’s Model
The concept of two-dimensional quality derives from the Motivation-Hygiene Theory by Herzberg.
Herzberg calls these factors, which can remove the dissatisfaction of the hygiene factors, if equipping with this element. Even though it would be accepted by the customers, it is still unable to enhance the satisfaction. However, if not equipping with this element, the customers will feel dissatisfied. The motivation factors mean if equipping with this element, it enables you to win the fancy of the customers. If not, the customers will still accept but feel satisfied.

Noriaki Kano [22][35], (in Figure 1) develops the two-dimensional quality model against the Motivation-Hygiene Theory by Herzberg. The quality attribute is divided into six categories: 1. Attractive Quality Element: If equipping with this element, it enables you to win the fancy of the customers. If not, the customers will still accept and feel satisfied. 2. One-Dimensional Quality Element: If equipping with this element, you will receive the satisfaction of the customers. Moreover, the more the element is, the more the satisfied customers will be; on the other hand, if not equipping this element, it may cause the dissatisfaction of the customers. 3. Must-Be Quality Element: If equipping with this element, it enables you to win the acceptance of the customers but not any satisfaction will be raised up; however, if not equipping with this element, the customers will feel dissatisfied. 4. No Interest-Indifferent Quality Element: No matter what this element exists or not, it will not influence the satisfaction or dissatisfaction of the customers. 5. Reverse Quality Element: If equipping with this element, the dissatisfaction of the customers may be raised up; however, if not, the customers may feel satisfied instead. 6. Questionable Result: It means the question may take place at the time of the inquiry or data gathering. However, the must-be quality belongs to the hygiene factor and the attractive quality belongs to the motivation factor. One-Dimensional Quality: If the commodity is defective, the return service is required. This action belongs to the hygiene factor and the consumers will not feel satisfied just because of any further service. This is because the return service is necessary and if there is no such service, the customers will therefore feel dissatisfied. Two-Dimensional Quality: If the commodity is perfect and the seller also includes along with an elegant gift or a discount coupon for the next consumption; however, if no such gift or coupon is given properly because the commodity is perfect. This action belongs to the motivation factor. Kano tries to investigate the demand to the depths of the customer’s heart from the point of view of psychology and further analyze under the consideration of cost to enable the enterprise to enhance the customer satisfaction and distribute the efficiency effectively.

The Research Method

Object of Research

The main studying object is the online retailing industry, such as Ruten, Yahoo, Books, PChome and the like, which are all our studying objects. The paper questionnaires to the consumers in middle Taiwan, who have ever made use of the online retailing.

Questionnaire Design
The research purpose is to investigate the key of strengthening the quality for the service recovery. We design the questionnaire against the two-dimensional quality model of Kano and analyze the return data to grasp the opinions of the customers towards the compensation elements and then further sort out the elements into six categories: attractive quality element, one-dimensional quality element, must-be quality element, no interest-indifferent quality element, reverse quality element and questionable result. Afterwards, analyze the compensation elements and dimensions against the different properties in order to make an appropriate decision, distribute the compensation resources and make up for the dissatisfaction caused by the failure effectively. In addition, we can figure out the questionnaire of online service recovery elements, including correction, correction plus, discount, replacement, store credit, apology, refund, unsatisfactory correction, failure escalation and nothing, counting up to ten dimensions and twenty-one questionnaire items against the online retailing failure and recovery strategy proposed by Forbes et al. [10], and category framework proposed by Kelley et al. [24], in order to further design the Kano’s online service recovery questionnaire.

The particular part of Kano’s model is to design the questionnaire, which is usually designed not only positively but negatively to meet the two-dimensional concept. The most important purpose of this design is to find out the response of the respondent when some certain quality element exists or not. Here we further sort out the five grades, including like, must-be, neutral, live with and dislike to indicate the satisfaction of the customer. The intention is to enable the respondents upon filling in the questionnaire more easily and allow us to analyze the status of the satisfaction. Please refer to the table 1.

Table 1: A pair of Customer Requirement Questions in a Kano Questionnaire

| Only wrong delivery commodity correction but without any other compensation, how do you think? | 1. I like it that way. | 2. It must be that way. | 3. I am neutral. | 4. I can live with it that way. | 5. I dislike it that way. |
| Exclude any wrong delivery commodity correction and any other compensation, how do you think? | 1. I like it that way. | 2. It must be that way. | 3. I am neutral. | 4. I can live with it that way. | 5. I dislike it that way. |

Afterwards, categorize the positive and negative quality elements replied by the respondents against the Kano’s method. Please refer to the table 2:

Table 2: Kano’s Evaluation Table

<table>
<thead>
<tr>
<th>Functional Requirements</th>
<th>1. like</th>
<th>2. must-be</th>
<th>3. neutral</th>
<th>4. live with</th>
<th>5. dislike</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dysfunctional</td>
<td></td>
<td>O</td>
<td>A</td>
<td>A</td>
<td>O</td>
</tr>
</tbody>
</table>

Notes: A: Attractive; O: One-dimensional; M: Must-be; I: Indifferent; R: Reverse; Q: Questionable

For example, the dimension of failure correction can further be divided into wrong delivery commodity correction, the commodity maintenance acceleration and the failure explanation. The respondents may tick the options against the questions of “only wrong delivery commodity correction but without any other compensation” and “exclude any wrong delivery commodity correction and any other compensation” and then compare with the Kano’s Evaluation Table. The research mainly exploits the Kano’s model to investigate the feeling of the customers to each compensation property in order to ensure the service quality of the online retailing industry.

Table 3: Example of Kano’s Evaluation Table

| Only wrong delivery commodity correction but without any other compensation, how do you think? | ■ I like it that way. | □ It must be that way. | □ I am neutral. | □ I can live with it that way. | □ I dislike it that way. |
| Exclude any wrong delivery commodity correction and any other compensation, how do you think? | □ I like it that way. | □ It must be that way. | □ I am neutral. | □ I can live with it that way. | ■ I dislike it that way. |

Table 4: Respondent Example of Kano’s Evaluation Table
The research Result and Conclusion
Sampling Data Analysis
Total 167 questionnaires are retrieved in this research and the duration is two weeks (2009/03/09~2009/03/23). After omitting the invalid questionnaires by the labor screening, there are total 162 valid questionnaires remained. The basic background information of the respondent is as follows: the proportion of male to female is 51.8% and 48.2% separately; the major age range is 20-30 years old (56.7%) and then above 30 years old (39.5%); as to the occupation, students are the major part (42.6%) and then the military servants, government employees and teachers (27.8%); when it comes to the level of education, the graduate school (47.5%) and then the college (42.5%); as to the monthly income, the major part is under twenty thousand (48%) and then twenty to forty thousand (31%). The proportion with highly acceptance of the online shopping is 37.6%. This sampling structure conforms to the research that is to investigate the domestic B2C behaviors and the development trend proposed by III (Institute for Information Industry), 2007, in which the proportion of male to female is 50.2% and 49.8% separately. The major age range is 20-29 years old and the students and the officers are the major occupations (82%). The major level of education is college (77%) and the average monthly income is NT$20,000.

Two-Dimensional Quality Element Analysis
Figure out the table 5 for the results of the online retailing industry equipping or not equipping with the service recovery quality element against Kano’s model. The service recovery quality element can be divided into six categories: Attractive Quality Element (A), One-Dimensional Quality Element (O), Must-Be Quality Element (M), No Interest-Indifferent Quality Element (I), Reverse Quality Element (R), and Questionable Result (Q).

Table 5: Kano Category for Online Service

<table>
<thead>
<tr>
<th>Customer Requirements</th>
<th>Dysfunctional</th>
<th>Recovery Quality Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. like</td>
<td>Q</td>
<td>Wrong Delivery</td>
</tr>
<tr>
<td>2. must-be</td>
<td>A</td>
<td>Correction</td>
</tr>
<tr>
<td>3. neutral</td>
<td>I</td>
<td>Speed up the</td>
</tr>
<tr>
<td>4. live with</td>
<td>I</td>
<td>Commodity Maintenance</td>
</tr>
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<td>Caused by the Buyer</td>
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Notes: A: Attractive; O: One-dimensional; M: Must-be; I: Indifferent; R: Reverse; Q: Questionable

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According to the answers of the respondents, “Wrong Delivery Commodity Correction”, “Speed up the Commodity Maintenance” and “Oral Apology” are the required quality elements (M). It represents that only the three items are included, the customers will be satisfied; however, the customer satisfaction will therefore be raised up by the three items. On the contrary, if the three items are not included, the customers will feel dissatisfied. “Refund to the Buyer” belongs to one-dimensional quality (O). Refund can satisfy with the customers or the customers will feel dissatisfied. “Upgrade the Product for Free”, “Gift for Free”, “Wrong or Defective Commodity for Free”, “Purchase the Commodity with Lower Price”, “Purchase the Commodity with Free Freight Charge”, “Select the Commodity with the Same Price as the Substitute”, “Select the Commodity with Higher Price as the Substitute”, “Cash Discount for the Next Consumption”, “Free Freight Charge for the Next Consumption” and “No Compensation If the Failure Is Caused by the Buyer” belong to the No Interest-indifferent Quality Element (I) and the consumers do not care if the seller provides these recoveries or not after the service failure. Its proportion of male to female is 43.2% and 44.4% respectively, the majority of age range is 20-30 years old (51.8%), the majority of occupation is the students (38.2%), the major part of education is from graduate school (41.9%) and the major part of monthly income is under twenty thousand (41.3%).

Moreover, “Buyer Take Charge of the Freight Charge of Commodity Replacement”, “Too Much Time Wasted Whilst the Commodity Replacement or Maintenance”, “Seller Blame for the Failure on the Customer”, “Mark the Negative Evaluation on the Buyer”, “Face the Buyer with the Worst Attitude” and “Time (Money, Mind) Wasted” belong to the Reverse Quality Element(R). The six elements are reverse questions; therefore, the customers will be dissatisfied if equipping with these elements but feel dissatisfied if not equipping with them.

**Conclusion and Discussion**

Referring to the relevant researches of online service recovery in the past, we can find that some may find out the recoveries of online retailing industry and further sort out. Some scholars may investigate the relationship between the recovery strategy and customer satisfaction [16] [27] [30]. However, these researches all presume that the relationship between the recovery strategy and customer satisfaction is a linear relationship. That is the more the recovery is, the more the satisfied customers will be. However, the truth is not like this. In such case, this research combines the recovery strategy of online retailing proposed by Forbes [10], and the Kano’s model to investigate if the recovery provided by the enterprise can satisfy with the customers or not. This can be the reference of the service recovery for the online retailing industry in order to rise up the customer satisfaction and distribute the enterprise resource effectively.

This research investigates 167 consumers who have had online shopping experience in the past six month. The result shows that it is not each compensation method could satisfy with the customers; that mean the different compensation method will result in the different influence on the consumers. Among the twenty one compensation elements, one is part of the one-dimensional quality (Refund to the Buyer), three elements belong to the must-be quality (Oral Apology, Wrong Delivery Commodity Correction, Speed up the Commodity Maintenance), six elements belong to the Reverse Quality (Buyer Take Charge of the Freight Charge of Commodity Replacement and the like) and there are 11 elements included in the No Interest-indifferent Quality (Failure Explanation, Upgrade the Product for Free and the like). We can master the above result upon any service failure occurred the seller should face, admit and handle it with a responsible attitude. Therefore, the consumers consider that the oral apology and prompt recovery are required. That is the seller should deal with the failure like as abovementioned; however, the consumers might not feel satisfied just because the seller does not take any correction. Moreover, if the seller can refund the payment to the consumers, the consumers may feel satisfied because of this behavior. On the contrary, if the seller cannot face the failure properly and even worse to blame the buyer, refuse to replace, repair the commodity or ask the buyer to pay for the replacement postage, the consumers would feel unsatisfied because of the attitude of the seller.

The research result conforms to the outcome proposed by Kelley [24], and Forbes et al., [10]. The other findings of this research are that the “Correction”, “Correction plus”, “Discount”, “Replacement”, “Store credit”, “Apology”, “Refund”, “Unsatisfactory correction”, “Failure escalation” and “Nothing” are the most application method for the recovery for the e-commerce retail[10]. However, the compensation methods, such as the failure explanation, discount and so on after the service failure will not effect the satisfaction of the customer. We can know that if the seller only explains the reasons for the failure, it imply that the seller does not admit the failure; therefore, the consumers will ignore this and reject by any economic compensation method provided by the seller.
We can find through this research that the compensation methods, which satisfy with the customers, are the compensations in reality and mind, such as apology, quick commodity maintenance and wrong commodity correction. The economical compensation does not play a lot of influences on the customer satisfaction. In such case, we can know that the consumers consider that once the failure occurs, the seller shall take action positively and express their sincerity in order to enhance the trust and faith of the customers. Moreover, the economical compensations are usually the recoveries after the failure and may result in dissatisfaction and lower reliability because it is hard to carry on at the very time. In addition, it may be because the consumer might spend a lot of times in searching for the commodity to make the decision, but he still cannot receive the commodity appropriately. The best solution to this is to refund the payment to the consumer and this may rise up the customer satisfaction; however, any discount replacement cannot really influence the customer satisfaction.

The consumers may feel dissatisfied because the gaps between the expectation and result. This difference can be analyzed against the Perceived Justice theory [4, 25, 26, 34], and further recovered, such as the buyer may feel dissatisfied because he has not received the commodity. According to the result, the buyer hopes that the enterprise can apologize orally, correct the wrong delivery commodity and speed up the commodity maintenance. The three compensation methods are required for the buyer (must be done but the buyer may not feel satisfied because of this); however, a refund may satisfy with the buyer. If the buyer only takes charge of the replacement payment instead of the refund, the buyer will feel dissatisfied. Once if the customer encounters the service failure whilst shopping online, the repurchase intention will be very low even any service recovery is carried out then. Some scholars investigate the consumers after the compensation strategy proposed by the enterprise or only focus on the negative emotions resulted from the compensation discussion but ignore if the negative emotions are due to the wrong compensation methods. Furthermore, people seldom exploit the Kano’s model to discuss the online service recovery. The enterprise can satisfy with the customers against the compensation methods proposed by this research and raise up the repurchase intention through the equity theory.

Follow-up Research and Suggestion

This research proposes the following follow-up research and suggestion against the shortage of the time, questionnaire, reference review and experimental analysis and discussion:

1) The compensation strategies can not all satisfy with the customers. It seems very important to find out the difference of the compensation through the two-dimensional model. We suggest not applying the compensation method of the entity shop on the online compensation because the consumption models of the both are really different. We can also put the emphasis on how to avoid any failure occurring.

2) This research exploits positive and negative questionnaire to meet the Kano’s model. Furthermore, we lay down the questions one positive by another negative in order to receive a better result and reliability.

3) Within the limitation of the labor power and material resources, we only focus on the consumers of middle Taiwan who have ever experienced the online retailing. We can expand the sampling range in the future and further present against a tales’ situation to enable the respondents to realize the real condition in order to receive a more realistic result.

4) The time change will also alter the result from the Kano’s model. The attractive quality elements may transfer into the one-dimensional quality elements, even may transfer into the must-be quality elements. Therefore, a regular investigation is required in order to master the condition of the psychological cognition of the customers.

References


VIRTUAL SOCIAL IDENTITY DEVELOPMENT FOR CUSTOMER ELECTRONIC WORD-OF-MOUTH PARTICIPATION

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Abstract
Electronic Word-of-Mouth (eWOM) plays a persuasive role in influencing consumers’ attitudes and purchase decision. There are many efforts to identify the effect of eWOM on the customers’ purchase decision. However, few studies on the intrinsic motivation of eWOM participation in online shopping malls have been published to date. The main goal of this study is to identify the factors that motivate customers to participate in eWOM and to suggest relevant strategies for leading customers’ eWOM participations. To accomplish this goal, we propose a structural model mainly based on social identity theory. In addition, customer citizenship behavior (CCB) which has been extended from organizational citizenship behavior (OCB) is considered. And the effect of perceived extrinsic incentives such as; e-money or e-point on eWOM participation in the online shopping mall is contrasted with the effect of intrinsic motivation.

Keywords: Electronic Word-of-Mouth, Virtual Social Identity, Customer Citizenship Behavior

Introduction
As e-commerce markets have grown, the competitions in the online markets also become very intense [1]. In such severe market conditions, firms are proactively trying to encourage consumers to “spread the word” about their products or services in online space [2]. eWOM has higher credibility, empathy and relevance to customers than marketer-created sources of information [3]. Therefore, it has a significant influence on customers’ purchase behavior [4]. And the number of reviews on products also strongly affects the purchasing decision of Internet shoppers because it means that many people purchased the product [5].

Although there have been many studies emphasizing the importance of eWOM, only a little effort or research has been extended towards identifying the intrinsic forces that motivate eWOM. As offline word-of-mouth can have an effect on sales [6], if the owners of online markets know the factors leading eWOM, they can operate proper eWOM marketing strategies. The purpose of this study is to investigate the psychological, social, and economic motivations of eWOM participation in the e-commerce site.

The questions being addressed in this paper are ‘What are the intrinsic factors that motivate eWOM participation in online shopping malls?’ ‘What features of the online shopping mall sites can encourage the factors?’ and ‘What factors affect more strongly on eWOM between virtual social identity and economic incentives?’ To answer these questions addressed here, a research model is proposed based on psychological and behavioral theories.

Literature Review

eWOM
Electronic Word-of-Mouth (eWOM) is defined as “any positive or negative statements made by potential, actual, or former customers about a product and company via the Internet [7].” eWOM commonly includes the form of online review describing the good and ratings consist of numerical score evaluating the good [5]. eWOM provides consumers the options for gathering unbiased product information and advices from other consumers. As offline word-of-mouth has been shown to play a major role for customers’ buying decision [8], the influence of online product review on consumer choice has also been extended with exponential growth of internet usage [9].

As the impacts of eWOM becomes greater, there have been many efforts and studies that conduct the correlation between eWOM and purchasing decision of customers or sales of the online shopping malls. In the past, the researchers investigated the effects of positive or negative reviews within specific purchasing situations, such as eBay.com. The current studies have focused on the impacts of eWOM on purchasing decisions of consumers across multiple product categories [10]. For instance, Amblee and Bui found the impacts of additional reviews on sales of digital micro-products [5].

However, there have been few studies identifying the intrinsic factors that motivate customers to produce eWOM in online shopping malls. One of the only a few relevant studies uses a survey methodology that respondents were
explicitly asked to report the motives of their e-WOM behavior. Henning-Thurau looked at what motivates consumers to post online reviews in general [7]. They found that consumers’ desire for social interaction, desire for economic incentives, their concern for other consumers, and the potential to enhance their own self-worth are the primary factors. However, these are not enough to map out the real business applicable strategies that can motivate eWOM participations.

Theoretical Framework

In order to identify the factors that motivate eWOM participations of online shopping mall customers, this study mainly applies two frameworks. First the social-psychological framework based on customer citizenship behavior and social identity theory, and the other, the economic framework related with extrinsic incentives.

Customer Citizenship Behavior

Customer citizenship behavior (CCB) [11], also referred to as ‘extra role behavior’ [12], or ‘customer voluntary performance’ [13], or even ‘pro-social behavior’ [14], offers a means by which an organization can gain a competitive edge without any cost. Customer citizenship behaviors may be described as helping behaviors directed towards the service organization or other individuals, such as service employees or fellow customers.

There are mainly eight types of customer citizenship behaviors: positive word of mouth participation which means favorable, informal, person-to-person communication between a perceived non-commercial communicator and receiver regarding a brand, a product, an organization, or a service. [15], [16] displays of relationship affiliation [11]; making suggestions for service improvements [17]; policing of other customers [18]; voice [19], [20]; flexibility [11]; participation in organization events/activities [18], [11] and benevolent acts of service facilitation [17].

The customer citizenship behaviors can be revealed not only in offline communities but also in online communities as eWOM participation. And these also can be applied to online shopping malls because online shopping mall is one of the virtual communities. Without extrinsic incentives or punishment, eWOM benefits the operators of online shopping malls and the customers.

According to [21], there are correlation coefficients among three types of social identity and the participation behavior of members in e-communities. Those behaviors can be transferred to member loyalty to the service providers in online space [22].

Social Identity Theory

Social Identity is defined as the individual’s knowledge that he/she belongs to a certain social group, with some emotional and value significance of him/herself to the group membership [23]. According to [24], social identification is basically the perception of belongingness to a group classification. The individual perceives him/herself as an actual or symbolic member of the group. A core tenet of social identity theory is that, defining them in terms of a particular social identity, individuals act to maintain or enhance the positive distinctiveness of the group with which that identity is associated [25]. Bagozzi and Dholakia addressed that people who have high level of social identity tend to desire to, at least, maintain their positions in the group [26]. They are more likely to expand their social networks because they want to maintain the structure of their groups and their own positions in the group as well. It implies that a person who has strong social identity more tends to vigorously participate in the activities related with the group or community for expanding their social network as their social capital.

Ellemers and Bergami and Bagozzi pointed out that there are three aspects of social identity: cognitive social identity, affective social identity, and evaluative social identity [27], [28]. These three social identities can be referred to as self-categorization, affective commitment, and organizational-based self-esteem, respectively, and have been regarded as sub-constructs of the concept of social identity [29]. Table 1 presents definitions of these three aspects of social identity.

Tajfel and Turner identified that feelings of social identity emerge through three consecutive processes [30]. The first process of social identity is self-categorization, which refers to group members, so that members can have positive distinctiveness in terms of ‘we’ rather than ‘I’. This can be seen in that people tend to classify themselves and others as belonging to various social categories based on favoritism. The second process is social comparison, which is related to social categorization in the previous process. According to Tajfel, social comparison refers to “how positive or negative is his evaluation concerning this group membership” [31]. The last process is social identification, and it is the extent of his/her emotional investment both in his/her membership awareness and evaluations base on the first and second process [31]. Mael and Ashforth define social identification as “the individual perceives him or herself as an actual or symbol member of the group” [24].
There have been many studies showing that strong social identity affects individuals’ job satisfaction [32], leadership [27], [33], and loyalty to the organization. According to studies based on interaction theory, an individual in a particular group/organization can develop three different aspects of social identity through appropriate social interactions with other members [34]. The findings from studies in the area of e-community support imply that social identity can be developed in the online environment [26]. The virtual social identity can be developed through web features enabling communications and interactions among the members of virtual community [22].

**Extrinsic Incentives**

According to the ten principles of economics, people respond to extrinsic incentives [35]. Extrinsic incentives generally play an important role in decision-making of human [36]. The effect of extrinsic incentives on human participation has been studied in a number of papers. For instance, the empirical study by Allen strongly supports the view that financial extrinsic incentives have an important effect on the work attendance decisions of employees [37]. Brostrom also found that extrinsic incentives affect work absence behavior [38]. As the extrinsic incentives influence human behaviors in real space, it also has a strong effect in online space. Rafaeli found that the participation of experts in Google Answers, a fee-based information market where experts sell their expertise to askers for a price quoted by the askers is associated with extrinsic incentives [39]. This supports that extrinsic incentive is a motivation of participation in online forums in general and fee-based, public information markets.

Therefore, the extrinsic incentives can be the factors motivate eWOM participations.

**Research Methodology**

**Research Model**

Based on the two theories, customer citizenship behavior and social identity theory and extrinsic incentives; the research model for identifying the factors motivate eWOM participation in online shopping malls and relevant strategy is proposed in Figure 1. Organizational citizenship theory is also considered for explaining the online shopping mall customers’ eWOM behaviors as a virtual citizenship behavior that can benefit online shopping malls.

We hypothesize that through certain types of web features on an interface of online shopping mall sites, people can develop their virtual social identity. As a result, people who have higher social identity level in the shopping mall, they tend to leave eWOM more frequently.

**H1:** Perceived Interactions thorough the interface of online shopping mall positively influences virtual social identity in an online shopping mall.

**H2:** Increased virtual social identity positively influences eWOM participation in an online shopping mall.

We also hypothesize that the perceived extrinsic incentive for e-WOM is another factor that motivates eWOM participation.

**H3:** Extrinsic Incentives motivate eWOM participations in an online shopping mall.

**Construct Operationalization**

This study conducts the survey method to test the
research model. Survey instruments are developed by identifying appropriate measurements from a literature review. Some modifications are made to the existing scale to make those more suitable in the context of virtual space, especially online shopping malls.

The survey items for measuring Perceived Interaction thorough the Online Shopping Mall and Virtual Social Identity were adapted from previous study, [22] that is based on several literatures, such as [40], [28], and [27] were referred for measuring Virtual Social Identity.

For surveying perceived extrinsic incentives, the survey items of [7] are adapted to online shopping mall. And the most correct method measuring the frequency of eWOM is counting the number of reviews that the respondents left for a certain period in an online shopping mall site. All the measure items developed for this study are shown in Appendix 1

### Pilot Test

Before collecting the data, a pilot study is conducted to validate the measurement model of this study. We check out whether we developed relevant measurement instruments (see Appendix) through a reliability check and factor loadings. Likert scales (1-7), with anchors ranging from “strongly disagree” to “strongly agree,” were used for most questions pertaining to each construct.

A web-based survey form was developed and e-mails were distributed to facilitate online customers to participate in this pilot test. A total of 39 respondents joined for this pilot test, 23 responses were usable for the test among others. All respondents are customers of an online book/CD/DVD shopping mall, and all of them have experiences of posting eWOM at least once. 44.4% of them are male, and the average age is 35.17 year old.

First of all, Cronbach alpha was investigated as a reliability test. As shown in Table 2, all constructs passed the test where each alpha value is greater than 0.70.

However, it was found that when INT5, INT7, AS4, and ES3 are eliminated, the alpha value of each construct would be increased to .905 (INT), .898 (INT), .938 (AS), and .973 (ES), respectively. In addition to the reliability test, individual item loadings from the Partial Least Square method were investigated. An individual item loading of 0.70 or

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<tr>
<th>Constructs</th>
<th>Number of Item</th>
<th>Cronbach's Alpha</th>
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<td>Perceived Interaction through the Web Feature (INT)</td>
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</tr>
<tr>
<td>Cognitive Social Identity: Self-categorization (CS)</td>
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<td>.910</td>
</tr>
<tr>
<td>Affective Social Identity: Affective Commitment (AS)</td>
<td>5</td>
<td>.932</td>
</tr>
<tr>
<td>Evaluative Social Identity: Group-based Self-esteem (ES)</td>
<td>3</td>
<td>.938</td>
</tr>
<tr>
<td>Extrinsic Incentive (EI)</td>
<td>2</td>
<td>.943</td>
</tr>
<tr>
<td>eWOM (WOM)</td>
<td>1</td>
<td>N/A</td>
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</table>

Table 2. Reliability Values from Pilot Test
higher from the Partial Least Square method is considered adequate. Finally, it was found that all factor loadings, except for INT5 (.326) and INT7 (.455), are greater than 0.70.

After these quantitative analyses, several changes were recommended to improve the survey questionnaire; INT5 and INT7 are deleted from the measurement model, and AS4 and ES3 are reworded for the future data collection. In addition, one more measurement item will be added for Extrinsic Incentive (EI).

**Future Plans and Discussion**

The main goal of this study was to provide an integrated model of eWOM participation behavior based on socio-psychological theories. What facilitates online customers to leave reviews, opinions, and recommendations on products on the online shopping mall? To answer this research question of this study, we will collect more than 200 samples for structural equation modeling analysis using PLS. Several real online shopping malls will be used for the data collection, and the result will be used to develop effective eWOM strategies enhancing customers’ eWOM participation behavior.

**References**

Operationalization of Latent Variables

### Perceived Interaction through the Web Features

(Moon et al. 2006)

**INT1** I share ideas with other customers efficiently through the feature of the online shopping mall interface.

**INT2** I express my feelings or thoughts about the products I bought or will buy to other customers efficiently through the features of online shopping mall interface.
INT3 I can check what other customers buy and the opinion about the products in the online shopping mall without any difficulty.
INT4 I can check how many other customers have visited my blog provided by the online shopping mall and read my reviews.
INT5 I can find out who visited my blog in the online shopping mall.
INT6 Quick response is possible between I and other customers through features of the interface provided by the online shopping mall.
INT7 This online shopping mall does not impose a length (size) limitation on postings.
INT8 Overall I think I am satisfied with interaction with other customers through the features of the online shopping mall interface.

Virtual Social Identity (Moon et al. 2006)

Cognitive Social Identity

CS1 I believe I am similar to other customers on the online shopping mall site.
CS2 I perceive an overlap between my self-identity and customers group of the online shopping mall site.

Imagine that one of the circles at the left in each row represents your own self-definition or identity and the other circle at the right represents the identity of the customers group of the online shopping mall. Please indicate which case (A, B, C, D, E, F, G, or H) best describes the levels of overlap between your own and customers group’s identity.

Affective Social Identity

AS1 I am emotionally attached to the group of the customers on the online shopping mall site.
AS2 I feel feelings of belongingness towards the group of customers on this online shopping mall site.
AS3 I am happy to spend time with the group of customers on the online shopping mall site with people outside it.
AS5 The customers group of the online shopping mall site has a great deal of personal meaning for me.

Evalitative Social Identity

ES1 I am a valuable member of the group of customers in the online shopping mall site.
ES2 I am an important member of the group of customers in the online shopping mall site.
ES3 I feel that I am respected by other customers of the group in the online shopping mall site.

Perceived Extrinsic Incentives (Henning-Thurau T. et al. 2004)

EI1 The extrinsic incentives for the comments about products that I bought are valuable for me.
EI2 The extrinsic rewards that I can get when I leave comments about products in the online shopping malls are very useful for me.
EI3 I expect extrinsic incentives, such as e-money or e-point when I post review or comments on products on the site.(will be added)
IDENTIFYING USERS’ BEHAVIOR PURCHASING VIRTUAL ITEMS

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Abstract

Virtual asset has become more important in the virtual worlds. A growing number of users involve in the virtual worlds has created a new business phenomena. An online transaction on virtual goods involves real money. This research mainly focus on finding out what are the factors influence customers’ behavior and how to predict it toward purchasing in virtual worlds. There are thirty eight participants from different countries involve in this study. An online questionnaire is design to get necessary information from the users. The correlation and regression analysis applied in order to predict customer behavior toward purchasing in virtual worlds.

Keywords: Virtual Worlds, Users’ Behavior, Real Money Transaction, Human-Computer Interaction, Virtual Goods.

Introduction

Internet has created a lot of opportunities in the area of business. A growing number of users had contributed to a growing number of people use Internet for shopping. Aside from that, a new area of 3D Online Virtual World has been arising. Virtual World started as Virtual Game. The communities in the Virtual Games are considered one of the most promising online game models – integrating traditional computer games into the context of collaborative virtual environments [1]. There are several types of 3D Online virtual worlds; such as: THERE®, Moove®, Active Worlds®, Dreamworld®, Cybertown®, World of Warcraft®, Second Life®, Sims Online®, etc.

Virtual Worlds are not just games or character development for its “avatar”. It has been moved beyond that. Hemp in his article for Harvard Business Review said that the real-world marketing potential of online worlds is suggested by the active virtual commerce that already takes place within them [2]. This made possible as the virtual worlds have virtual currencies that allows participant to buy and sell online.

The avatar is the most conspicuous online manifestation of people’s desire to try out alternative identities or project some private aspect of them [2]. (The word, which originally described the worldly incarnation of the Hindu god Vishnu, was popularized in its ‘cybersense’ by Neal Stephenson in his 1992 cult novel Snow Crash.) Broadly defined, “avatar” encompasses not only complex beings created for use in a shared virtual reality but any visual representation of a user in an online community [2].

Second Life® (SL) is one of the most well-known 3D Virtual Online Games which has developed the business successfully. There are 13 million users since it launched in 2003 [3]. As the first Quarter (Q1) 2009, Linden Research Lab (the owner of SL) reports that user-to-user transaction increased 65% from Q1 2008. In Q1, Residents spent more than USD$120 million on virtual goods and services in Second Life, representing 20% growth over Q4 2008 [4]. SL includes an endogenously maintained currency exchange (known as LindeX) which allow users to trade between USD (US$) to Linden Dollar (LS).

Entropia Universe®, a popular Virtual World Game in Europe has entered Guinness World Book of Records for the most expensive virtual item ever sold (US $26,500) in 2004 using Project Etropia Dollar (PED) [5]. Cyworld®, a popular Virtual World Game in South Korea uses virtual currency called “dotori” which is literary translated to mean acorns. As in 2005 Cyworld reported to have 25% of the total population in South Korea with US $300,000 daily revenue [6].

Considering the opportunity and real money transaction involve, a new market has emerged for so-called ‘virtual assets’. Virtual assets are intangible valuables that exists solely in the computer systems known as virtual worlds – elements that may have a significant role in improving the overall competence or appearance of the characters owned by a player such as items (e.g., weapons or clothing), or virtual currencies. Elements constituting to the overall numerical competence of the character are the artefacts and wealth the player acquires for the character [7].

The research questions in this paper are what the factors influence customer’s behaviors are and how to predict it toward the shopping for the virtual assets. The questionnaire is designed for collecting data and the statistical analysis applied. Finally, discussion and future recommendation are made at the end.

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Business in Virtual Worlds

Residents in the Virtual Worlds are required to pay if they want to enjoy more features. Most of the virtual world game communities are based on a Massive Multiplayer Online Role-Playing Game (MMORPG). In a MMORPG, millions of participants are able to interact with each other as well as with computer-controlled creatures or non-player characters (NPCs) by assuming different personality (e.g., warrior, mage, animal, priest or thief). As the game continues, players can buy and sell their virtual assets to others using the virtual currency just as in the real world [1].

Trading virtual goods in the Virtual Worlds has created a new opportunity. Many SL residents have build seven-digit income (in real US dollar) from creating and selling virtual items (such as clothes for avatars) or virtual land development. Consumers like to purchase virtual items (as gifts or for themselves) to customize their experience, and Linden Lab recently acquired eBay-like web marketplace to help consumers find their key items and to expand the reach merchants [8]. Digital agencies and brands entered the virtual world in force in 2007, but the need for brands to control their context and reach a broad audience proved a challenge in the world of user-generated content. For real-world companies, the branding and advertising opportunities of virtual worlds are multiple. Not only can marketers reach out to young and tech-savvy audience – who are often impervious to traditional marketing techniques – but they can also engage with them more deeply to inspire brand loyalty. This is indicative of a wider online brand shift, with virtual world presence, multimedia outreach and apps on social network [8].

In November 2006, the first virtual millionaire was announced in Second Life® [6]. Anshe Chung, who is the virtual avatar of Ailin Graef, spent more than two years in SL developing virtual islands, crafting landscapes and providing virtual housing for paid participants with her real-world husband, Guntram Graef. With over L$ 270,000,000 (US $1,000,000) in assets, Anshe Chung was proclaimed by CNN and other news center as the first “Virtual Rockefeller” [6]. Her virtual company has more than ten real-world employees to help design virtual real estate, and is registered in the real-world in Hubei, China [6].

Considering a lot of real-money involved in the virtual world transaction, some countries have implemented tax for its real profits. In 2007, the United Kingdom’s HM Revenue and Customs department said that it was investigating people who were earning profits in social virtual worlds like SL and not paying taxes on the profits. Sweden also declared that it would tax profitable activities in online worlds. Until November 2008, USA has yet to issue any guideline on virtual income taxes. In fact, China has taken initial steps by issued a specific declaration regarding the taxation of profits derived from such sales – sales which China says fall under its provision for the taxation of “transfer of property” [9]. It is fall under the circular called “Circular on Further Strengthening the Administration on Internet Bar and Online Games”. The circular expressly prohibits the exchange of virtual currency for real world currency or the purchase of real commodities using virtual currency. Thus, even though such transactions may be illegal in China, if you nevertheless engage in and generate a profit from such transactions, you will be obligated to pay tax on those profits [9].

Recently in late February or late March, Second Life® has conducted a survey of business owner to learn how residents feel about the SL economy. The overall respondents are 2,645 business owners including 767 who run businesses but own no Land with 48% of respondents outside the USA. The findings are; 61% of business owners are optimistic that their revenue will grow and 68% are maintaining or increasing their investment to the last six months [10]. Overall, business in the virtual worlds has a good future prospect and potential to be developed as the real world business.

Theory of Reasoned Action

This theory developed by Fishbein and Ajzen, suggested that a person’s behavior intention is jointly determined by two independent factors, attitude towards behavior and subjective norms [11]. The attitude towards behavior is the factor refers to individual’s positive or negative feelings about performing specific behavior (e.g. using a new technology), and the subjective norms is determined as an individual’s normative beliefs which an individual perceives that important others believe he/she should perform a given behavior. This theory has been used as foundation for the development of Theory of Planned Behavior (TPB) and Theory of Acceptance Model (TAM).

Theory of Planned Behavior

This theory is an extension of TRA proposed by Ajzen by introducing a new factor, perceived behavioral control [12]. The additional factor added to address the inability of TRA to account for conditions where individuals do not have total volitional control over their behavior. Ajzen defined Perceived Behavioral Control as one person’s perceptions of how easy or difficult it is to perform specific behavior based on his/her ability (i.e., internal factor) or resources (i.e., external factors). He also argued that perceived behavioral control has a direct link with the actual behavior if perceived...
behavioral control, to some extent, is consistent with the actual behavior control [12].

Limayem et al. augmented this theory with two new factors: personal innovativeness and perceived consequences [13]. This theory is chosen not only because the TPB’s constructs are easier to operationalize, but also because this theory has received substantial empirical support in information systems and other domains as well (e.g., [14]–[17]). They argue that shopping on the Internet is an innovative behavior that is more likely to be adopted by innovators than non-innovators [13]. It is thus important to include this construct in order to account for individual differences. Its inclusion has important implications for both theory and practice. From a theoretical perspective, the inclusion of personal innovativeness furthers our understanding of the role of personality traits in innovation adoption [18]. From the perspective of practice, the identification of individuals who are more likely to adopt online shopping can be very valuable for marketing purposes, e.g., market segmentation and targeted marketing [13].

They hypothesized that personal innovativeness has both direct and indirect effects, mediated by attitude, on intentions of innovation adoption. The indirect effect implies that innovative individuals are more likely to be favorable toward online shopping, which in turn affects positively their intentions to shop on the Internet. The direct link between innovativeness and intentions, on the other hand, is meant to capture possible effects that are not completely mediated by attitude [13].

The other new links that Limayem et al. added to the TPB are the ones representing the potential effects of “perceived consequences.” This construct is borrowed from Triandis’ model [19]. According to Triandis, each act or behavior is perceived as having a potential outcome that can be either positive or negative. An individual’s choice of behavior is based on the probability that an action will provoke a specific consequence. The TRA and the TPB claim that beliefs such as perceived consequences are completely mediated by attitude. For this reason, Taylor and Todd modeled a similar construct, perceived usefulness, as an antecedent of attitude [20]. Triandis, on the other hand, modeled perceived consequences as a direct antecedent of intentions.

**Research Model**

This research uses Theory Planned Behavior extended model by Limayem et al. [13]. The hypotheses for this model are:

**H1**: There is a positive correlation between perceived consequence and intention to shop in virtual world.

**H2**: There is a positive correlation between perceived consequence and attitudes.

**H3**: There is a positive correlation between attitudes and intention to shop in virtual world.

**H4**: There is a positive correlation between personal innovativeness and intention to shop in virtual world.

**H5**: There is a positive correlation between personal innovativeness and attitudes.

**H6**: There is a positive correlation between subjective norms and intention to shop in virtual world.

**H7**: There is a positive correlation between behavioral control and intention to shop in virtual world.

The online 5 points Likert Scales questionnaire is design to the virtual world users. The questions cover demographic data and measurement variable to test the hypotheses. It includes these questions:

- I purchase on the virtual worlds because its risk of privacy violation
- I feel that I have ability to navigate in the virtual world
- I like the product description
- I must see other people using innovations before I consider them
- The Media (e.g., advertisement) influences me to purchase

Cronbach’s alpha coefficient test applied to the final data in order to test the reliability of the data. The data will be analyzed using SPSS. Pearson Correlation Co-efficient ($r$) used to test the correlation between the variable and Multiple Linear Regressions are run to examine the standardized beta co-efficient ($\beta$). The final conclusion is made based on the Pearson Correlation Co-efficient, the standardized beta co-efficient and linear relationship between the variables.
Data Collection and Result

The online questionnaire is published on http://www.surveygizmo.com/s/129049/customer-shopping-behaviors-in-virtual-worlds. There are thirty-eight respondents who completely filled the questionnaire. They are from Asia, Europe, USA, Australia, North America, Latin America and New Zealand.

Table 1. Demographic

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>34.29</td>
</tr>
<tr>
<td>Female</td>
<td>65.71</td>
</tr>
<tr>
<td>Age</td>
<td></td>
</tr>
<tr>
<td>Below 20 years</td>
<td>5.71</td>
</tr>
<tr>
<td>20 - 30 years</td>
<td>17.14</td>
</tr>
<tr>
<td>30 - 40 years</td>
<td>22.86</td>
</tr>
<tr>
<td>40 - 50 years</td>
<td>28.57</td>
</tr>
<tr>
<td>50 years above</td>
<td>25.71</td>
</tr>
<tr>
<td>Education background</td>
<td></td>
</tr>
<tr>
<td>High School</td>
<td>28.57</td>
</tr>
<tr>
<td>Undergraduate</td>
<td>42.86</td>
</tr>
<tr>
<td>Master</td>
<td>22.86</td>
</tr>
<tr>
<td>Doctoral</td>
<td>5.71</td>
</tr>
<tr>
<td>Years involving in Virtual World</td>
<td></td>
</tr>
<tr>
<td>Less than 1 year</td>
<td>28.57</td>
</tr>
<tr>
<td>1 - 3 years</td>
<td>28.57</td>
</tr>
<tr>
<td>4 - 6 years</td>
<td>25.71</td>
</tr>
<tr>
<td>More than 6 years</td>
<td>17.14</td>
</tr>
<tr>
<td>Hours spend in Virtual Worlds per week</td>
<td></td>
</tr>
<tr>
<td>Less than 10 hours</td>
<td>22.86</td>
</tr>
<tr>
<td>10 - 20 hours</td>
<td>28.57</td>
</tr>
<tr>
<td>20 - 30 hours</td>
<td>31.43</td>
</tr>
<tr>
<td>30 - 40 hours</td>
<td>28.57</td>
</tr>
<tr>
<td>More than 40 hours</td>
<td>14.29</td>
</tr>
</tbody>
</table>

Most of the users play Second Life® followed by Ultima®, Cyberlandia®, OpenSims®, World of Warcraft® and YoVille®. Majority of the users (80%) say that they have done purchasing inside the virtual worlds. From the 80% who has been purchased says that they purchase virtual goods (93.10%). As it has mentioned before that the data collected will be test for the reliability using the Cronbach’s Alpha before doing the correlation and regression test. Nunnally suggests that a coefficient of 0.7 or higher is considered “acceptable” [21]. The Cronbach’s Alpha for the data is 0.784. This means that the data collection reliable and accepted. Then, the Pearson’s Correlation Co-efficient of Bivariate Correlation is tested using the SPSS. The result is shown below.

Table 2. The Pearson’s Co-efficient of Bivariate Coefficient

<table>
<thead>
<tr>
<th>PC</th>
<th>BC</th>
<th>PI</th>
<th>SN</th>
<th>A</th>
<th>I</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.476(*) 1</td>
<td>1.191</td>
<td>.298</td>
<td>-.092</td>
<td>1.284</td>
</tr>
</tbody>
</table>

**Correlation is significant at the 0.05 level (2-tailed).**

The next step is to determine the relative importance or path coefficients of the variables using the Standardized Beta Coefficient (β); which used for the accuracy of prediction [22]. The result of the Standardized Beta Coefficient is shown on the table below:

Table 3. Regression Analysis Result

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum. of Square</th>
<th>Df</th>
<th>Mean Square</th>
<th>Adjusted R Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression 1</td>
<td>12.381</td>
<td>1</td>
<td>8.381</td>
<td>20.762</td>
<td>2.476</td>
<td>.381</td>
</tr>
<tr>
<td>Residual</td>
<td>.394</td>
<td>.25</td>
<td>.197</td>
<td>.405</td>
<td>-.040</td>
<td>.487</td>
</tr>
<tr>
<td>Total</td>
<td>10.126</td>
<td>2</td>
<td>10.520</td>
<td>.197</td>
<td>.405</td>
<td>.040</td>
</tr>
<tr>
<td>Regression 2</td>
<td>3.415</td>
<td>2</td>
<td>.369</td>
<td>.242</td>
<td>.263</td>
<td>1.524</td>
</tr>
<tr>
<td>Residual</td>
<td>.211</td>
<td>.215</td>
<td>.196</td>
<td>.979</td>
<td>.337</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>.404</td>
<td>.249</td>
<td>.304</td>
<td>.764</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Correlation is significant at the 0.01 level (2-tailed).**

The result of the Standardized Beta Coefficient is shown on the table below:

Table 4. Significant Predictors of Structural Model

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficient</th>
<th>Standardized Coefficient</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Constant)</td>
<td>.691</td>
<td>1.183</td>
<td>.584</td>
<td>.565</td>
</tr>
<tr>
<td>PC</td>
<td>.035</td>
<td>.246</td>
<td>.023</td>
<td>.143</td>
</tr>
<tr>
<td>BC</td>
<td>.817</td>
<td>.271</td>
<td>.524</td>
<td>3.018</td>
</tr>
<tr>
<td>PI</td>
<td>.580</td>
<td>.284</td>
<td>.332</td>
<td>-2.339</td>
</tr>
<tr>
<td>SN</td>
<td>.089</td>
<td>.170</td>
<td>.088</td>
<td>.526</td>
</tr>
<tr>
<td>A</td>
<td>.369</td>
<td>.242</td>
<td>.263</td>
<td>1.524</td>
</tr>
</tbody>
</table>

**Correlation is significant at the 0.05 level (2-tailed).**

Figure 2. Extended TPB with Pearson’s Coefficient

The next step is to determine the relative importance or path coefficients of the variables using the Standardized Beta Coefficient (β); which used for the accuracy of prediction [22]. The result of the Standardized Beta Coefficient is shown on the table below:
b. Dependent Variable: Attitudes  
c. Significance = 0.05

From the first regression analysis which has Perceived Consequence (PC), Attitudes (A), Personal Innovativeness (PI), Subjective Norms (SN), and Behavior Control (BC) as predictors and Intention (I) as dependent variable shows that the adjusted $R^2 = 0.505$. This means that 50.5% of the variation in Intentions is explained by the five predictors. Meanwhile the second regression analysis which has Perceived Consequence (PC) and Personal Innovativeness (PI) as predictors and Attitudes (A) as dependent variable shows that the adjusted $R^2 = -0.040$. It means that not even 4% of the variation in Attitudes is explained by the two predictors. This statement is supported by the Pearson’s Correlation Coefficient ($r$) and Standardized Beta Coefficient of Personal Innovativeness to Attitudes is negative. So, it can be concluded that H5 is rejected.

The hypotheses will be tested through the statistical analysis. The Pearson’s Correlation Coefficient ($r$) between Perceived Consequence (PC) and Intentions (I) is $0.284$, and the Standardized Beta Coefficient is $0.023$. It shows that there is a little positive correlation in between, therefore $H1$ is accepted. Then for the Pearson’s Correlation Coefficient ($r$) between Perceived Consequence (PC) and Attitudes (A) is $0.184$, and the Standardized Beta Coefficient is $0.196$. It shows that there is a little positive correlation in between, therefore $H2$ is accepted. For the Attitudes (A) and Intentions (I), the Pearson’s Correlation Coefficient ($r$) is $0.566$ and the Standardized Beta Coefficient is $0.263$. It shows that there is moderate positive correlation in between, therefore $H3$ is accepted. In the correlation between Personal Innovativeness (PI) and Intentions (I), the Pearson’s Correlation Coefficient is $-0.240$ and the Standardized Beta Coefficient is $-0.332$. It shows that there is a negative correlation in between, therefore $H4$ is rejected. The Pearson’s Correlation Coefficient between Subjective Norms (SN) and Intentions (I) is $0.412$ and the Standardized Beta Coefficient is $0.088$. It shows that there is a low positive correlation in between, therefore $H6$ is accepted. In the correlation between Behavioral Control (BC) and Intentions (I), the Pearson Correlation Coefficient is $0.621$, the Standardized Beta Coefficient is $0.524$. It shows that there is a strong positive correlation in between, therefore $H7$ is accepted.

Overall, from the analysis result and the hypotheses testing shows that $H1$, $H2$, $H3$, $H6$ and $H7$ are accepted while $H4$ and $H5$ are rejected.

**Discussions**

In the final result of this research, Personal Innovativeness does not have any correlation both to Attitudes and Intentions. In the questionnaire there are several questions being asked such as: I am generally cautious about accepting new ideas; I must see other people using innovations before I consider them; and I am challenged by ambiguities and unsolved problems. Consider that most of the users (57.14%) are newly involve (less than 3 years) in the virtual worlds; means that most of them still curious about what happening if they purchase virtual goods. This situation leads users to wait for their friends, family and media (subjective norms) in stimulating them for purchasing virtual goods.

The strongest correlation with the Intentions is Behavioral Control. This factor includes trust to the seller, familiarity to the virtual games and navigation. It means that users are very careful to do purchasing in virtual worlds. The situation reflects to the previous report saying that players consider virtual asset purchases as being cheating [23] [24]. Beyond that, users consider more likely to buy virtual goods for their avatars. In the virtual worlds, the important aspect is character development: the skill and ability of one’s avatar improve with play [25]. This will involve the real money transaction for the “achievement hierarchy” in virtual worlds [16] [23]. Bartle discussed that at least three reasons why virtual world’s players feel compelled to make virtual asset purchase [23]. First, experiencing all the content programmed into a world requires players to develop their characters to the highest level. That takes lots of time, which not everyone has. Buying a high-level avatar is a shortcut that gives immediate access to all the content [16:7-8]. Secondly, some parts of the content may be so inappealing that even players with enough time would rather skip them.
Thirdly, the virtual worlds are usually designed in such a way that players who wish to play together have to have avatars of approximately the same level of prowess [23:24].

Conclusions
There are opportunities of real money transaction inside the virtual worlds. Many of the potential users spend more than 20 hours inside the virtual worlds. In the other hand, the virtual world’s company owner has set a target for developing a good business environment. The Personal Innovativeness which is has fund no correlation to the Attitudes and Intentions. This can be decrease gradually as the users get other stimulant and get familiar with the virtual worlds. It is necessary to study in details about the future prediction of customer behavior.

References


THE IMPACT OF PERCEIVED VALENCE, PERCEIVED INFORMATION CREDIBILITY AND VALENCE INTENSITY OF ONLINE REVIEWS ON PURCHASE INTENTIONS

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Abstract
The purpose of this paper is to examine the influence of the quality of product recommendations on buying intentions. An online experiment was conducted testing both the effect of the two dimensions of review quality (perceived valence and perceived information credibility) and the influence of valence intensity of the review content on purchase intentions. Both dimensions of the review quality were found to have a significant impact on purchase intentions. This effect holds for books and hotels, which were chosen to serve as research objects to provide information for both search and experience goods. In a subsequent analysis, we compared the effect of moderate and strong valence intensity of the review content. Interestingly, we found no significant difference of the effects of positive versus negative product reviews on purchase intentions in the two groups with moderate valence intensity. Although the present study is rather exploratory in nature, these findings are novel and crucial for both marketing research and practice.

Introduction
The phenomenon of buying recommendations has been of considerable interest in the marketing world for decades. Katz and Lazarfeld (1955) were among the first researchers who analyzed the effect of interpersonal influence on consumer choice. They showed that word-of-mouth (WOM) communication is more effective compared to traditional instruments of marketing, personal selling and various types of advertising [1]. An impressive number of studies have been conducted since the ‘emergence’ of the topic. Empirical evidence for the effect of word-of-mouth (WOM) communication has been provided for various industries or product categories (e.g., books, movies, hotels) [2-7].

The fast diffusion of the internet has further increased the importance of product recommendations. Many customers check shopping bots and recommendation sites before they make their buying decisions. It is not surprising that electronic word-of-mouth (subsequently abbreviated as eWOM) became a major research stream in marketing and the IS discipline [8]. The information direction and the quality of recommendations are intensively discussed. For example, conflicting results have been found for the effectiveness of positive versus negative product reviews. Whereas Park and Lee (2009) propose a greater effect for reviews with negative content, East, Hammond and Lomax (2008) found positive WOM having a greater impact. Some scholars suggest testing for moderating variables, e.g., gender [9] product knowledge, involvement or interpersonal differences [10] to explain the above mentioned inconsistency of previous research findings, other authors argue that the simple dichotomization of product reviews in positive and negative recommendations is not grounded in reality. In fact, product reviews including ‘pure’ positive or negative information are hard to find. More often, product recommendations contain a mix of positive and negative product information chunks. Unfortunately, limited research effort has been given to the valence intensity of the content of product recommendations and their influence on consumer’s attitudes and buying decisions.

To fill this gap, this paper examines the influence of the quality and valence intensity of product recommendations on buying intentions. An online experiment was conducted testing the effect of the two dimensions of review quality (perceived valence and perceived information credibility) and the influence of valence intensity of online reviews on purchase intentions. 339 students of a large European Business School rated their purchase intentions. Valence intensity was manipulated for buying decisions regarding books and hotels. The findings of our experiment confirm the proposed relations. Both dimensions of review quality have a significant impact on purchase intentions. This effect holds for books and hotels as well. In a subsequent analysis, we compared the effects in moderate versus strong valence intensity conditions. Interestingly, we found no significant difference of the effects of positive versus negative product reviews on purchase intentions in the two groups with moderate valence intensity. From a managerial point of view, this is a crucial result given that in reality online reviews are usually a mix of positive and negative evaluations.
Theoretical Background and Hypotheses

Web-usage and e-commerce is growing constantly [11]. The fast expansion of the Internet has extended consumers’ options for gathering product and purchase information [6] and has also altered decision-making and search behavior. Since the inception of B2C and C2C e-commerce [12], marketing research has started studying online-decision-making intensively [see for an overview, e.g., 13; 14; 15; 16]. Next to a major research stream focussing on psychological constructs explaining online decision making such as perceived risk [17] or uncertainty [18; 19], studying the nature and the effectiveness of eWOM has become a crucial issue [see 20 for an extensive review of previous studies on eWOM]. Both traditional WOM and eWOM play the informant as well as the recommender role [21]. In most studies, eWOM related to the explanation of purchase intentions was addressed. In current scholarly literature on eWOM, the so called eWOM effect is of major interest. This effect occurs, if online-shoppers exclusively base their purchase intentions and/or behavior on online recommendations. From a scientific point of view, it is interesting to study the eWOM effect in combination with variables relating to the customer such as motives or personality characteristics but also in combination with various characteristics of the eWOM message itself. Henning-Thurau and Walsh (2003), e.g., investigated motives for and consequences of reading customer articulations on the Internet [22], Goldsmith and Horowitz (2006) studied motivations for online opinion seeking [23] and Park and Lee (2009) examined how a website’s reputation (established versus unestablished) and the information direction (positive versus negative) contribute to the eWOM effect. They found that the eWOM effect is greater for negative eWOM than for positive eWOM [6], whereas East, Hammond and Lomax (2008) found the opposite effect of positive WOM having generally a greater impact than negative WOM, albeit in an offline context [3]. Furthermore, Lee, Park and Han (2008) discovered that as the proportion of negative online consumer reviews increases, high-involvement consumers tend to conform to the perspective of the reviewers depending on the quality of the reviews. In contrast, low-involvement consumers tend to conform to the perspectives of the reviewers, regardless of the quality of the negative online consumer reviews [24]. These results suggest the valence of onlinereviews (positive vs. negative), the level of involvement (search vs. experience goods) and the valence intensity of online reviews (strong/medium positive versus strong/medium negative) being critical issues for further and more detailed research in an eWOM context. C2C-online reviews are usually a summary of one’s positive and negative experiences with a good or a service. It is information from the consumer created for the consumer, presented from a subjective perspective including experiences, evaluations, and opinions [7]. They can be either very positive or very negative in terms of extreme values or something in between. As they are exemplified stories out of daily life experiences, in practice, the content of online reviews usually varies on a continuum from only positive, a mixture of positive and negative to only negative. As the perceived valence of the message has a significant impact on the eWOM effect [6] and online reviews in a real online-purchase setting are not necessarily exclusively positive or negative, it is necessary to have a closer look on the valence intensity (strong/medium positive versus strong/medium negative) of an online review and its influence on buying intentions. Recently, Cheung, Luo, Sia and Chen (2009) have suggested to examine positively vs. negatively framed reviews (valence) and one-sided vs. two-sided reviews (valence intensity) in an eWOM context in more detail [25]. Unfortunately, literature on this issue is still scarce. In the present experimental study, we aim at empirically testing whether valence intensity has an impact on purchase intention and is consequently reflected in the presence of an eWOM effect.

Based on our literature review, we assume the following hypothesized effects:

H1: Effects of perceived valence and valence intensity:
Perceived valence (measured by an explicit rating given by the respondents) and valence intensity (manipulated through experimental groups) have a significant effect on purchase intention for both search and experience goods. Based on previous, albeit conflicting findings, we expect strong positive reviews having the greatest impact, followed by strong negative ones. Regarding reviews of medium valence intensity, we expect the medium positive ones having a greater impact than the medium negative ones. This assumption is based on research regarding the persuasion effect of two-sided messages in advertising [see, e.g., 26]. This stream of research, based on inoculation, attribution and arousal theory, postulates that positive advertising messages mixed with an “optimal” proportion of negative information are amazingly effective for persuasion. This is due to the fact that two-sided messages are perceived as novel and lead to higher states of arousal and motivation to cognitively process the message [26].
H2: Effect of perceived information credibility.

Based on previous findings in literature [see, e.g., 27] perceived information credibility (measured by an explicit rating given by the respondents) is expected to have a significant positive effect on purchase intention for both search and experience goods.

As this paper is exploratory in nature, we also conducted further analyses especially regarding the impact of valence intensity among the different manipulation groups.

Method, Measurement and Procedure

The authors chose the method of online experiments for data collection. Online experiments have the advantage of experimenting around the clock, usually lower costs and a high degree of automation of the experiment which leads to low maintenance and can limit unwanted experimenter effects. A major disadvantage is the lack of control of the instructor during the experiment and a possible limitation regarding the coverage of certain demographic groups such as people without Internet connection [see for a methodological review, e.g., 28; 29; 30]. However, in the current research project the method of online experiments is appropriate since the test situation equals a ‘real’ product evaluation and purchase decision making process in e-commerce based on online reviews. In this case, choosing the Internet as the setting of the experiment enhances external validity. The usual limitation of the online experiment’s dependency on computers and networks is also a non-disturbing issue in our context as our test subjects would need to have an Internet access for both online-shopping and participating in the online experiment. For examples of prior studies which successfully used online experiments see [31-35].

In the present study, books versus hotels were chosen as the objects of investigation for comparison between search and experience goods as well as between high and low involvement purchase decisions. The buying-decision concerning books and hotels via the Internet was one of the early applications of e-commerce and has matured to become relatively stable [36]. Online-bookings of package holidays, flight tickets and hotels are booming. Second, books are typically a low-involvement product whereas the purchase decision-making process concerning hotels is certainly characterized as being medium to high involvement. Third, the majority of consumers are familiar with both books and hotels.

Two pictures (one book cover and one picture of a hotel) served as product stimuli. Four different online reviews (positive/negative vs. medium/strong valence intensity) were used as manipulations for each product type. Each review comprised subjective evaluations, product information and stories about the experience with the book or hotel, respectively. The product stimuli as well as the valence and the valence intensity of the online reviews were pre-tested in an online experiment (n=56). Additionally, technical issues such as randomization of respondents and data export were tested before the main study was conducted.

The main study was conducted two weeks after the pre-test. An electronic invitation to take part in the research project was emailed to students of a large European Business School. As many students buy books [36] or book hotels using the Internet, a student sample qualifies for being employed. 5 vouchers of a travel agency were promised to 5 randomly drawn students as incentives. Finally, 339 respondents participated in the online experiment. Respondents were randomly assigned to the control and the experimental groups for each trial. Table 1 shows the sample sizes for each group.

<table>
<thead>
<tr>
<th>Group</th>
<th>Book Reviews</th>
<th>Hotel Reviews</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control</td>
<td>Positive</td>
</tr>
<tr>
<td></td>
<td>Group</td>
<td>Online</td>
</tr>
<tr>
<td>Medium</td>
<td>114 (33.6%)</td>
<td>90 (28.5%)</td>
</tr>
<tr>
<td>Recommendation</td>
<td>119 (35.1%)</td>
<td>110 (32.4%)</td>
</tr>
<tr>
<td>Strong</td>
<td>129 (38.1%)</td>
<td>110 (32.4%)</td>
</tr>
<tr>
<td>Recommendation</td>
<td>129 (38.1%)</td>
<td>110 (32.4%)</td>
</tr>
</tbody>
</table>

Table 1: Sample Sizes of the Main Study

The distribution of the sample sizes across the eight sub groups is moderately homogenous.

Sample sizes vary between 90 (positive book review) and 135 (negative book review). The median sample size is 112. Based on our 2 (book vs. hotel) x 2 (positive vs. negative) x 2 (medium vs. strong valence intensity) factorial design we ended up with 8 manipulation groups. The control group was not included in the analyses at this stage of the project.

Purchase intention measured by the item “How likely will you buy the book?” and “How likely will you book a vacancy in this hotel?” respectively, was chosen as the dependent variable. We employed a seven point rating scale, $1=“very likely”$, $7=“very unlikely”$.
Additionally, we included two control variables measuring the perceived valence and the information credibility of the online reviews provided in the experiment. These control variables also served as independent variables in our statistical analyses for testing their explanatory power regarding the purchase intention. The measures for the two independent variables (perceived valence of the product reviews and perceived information credibility) were derived from explicit ratings given by the respondents answering a semantic differential scale (positive – negative, trustworthy – not trustworthy). Lower values indicate a more positive perceived valence and a more trustworthy evaluation of online reviews.

**Results**

The analysis of the data was carried out in two steps. As a first step, we ran a series of regression analyses testing for the effect of perceived valence and perceived information credibility on purchase intention for each experimental group separately (see for the results Table 2 and Table 3). As a second step, the purchase intentions of the different experimental groups were compared in an ANOVA to test for the eWOM effect.

<table>
<thead>
<tr>
<th>Stand. Coef.</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived Valence</td>
<td>.468</td>
</tr>
<tr>
<td>Perceived Information</td>
<td>.144</td>
</tr>
<tr>
<td>Credibility</td>
<td></td>
</tr>
<tr>
<td>Perceived Valence</td>
<td>.197</td>
</tr>
<tr>
<td>Perceived Information</td>
<td>-.267</td>
</tr>
<tr>
<td>Credibility</td>
<td></td>
</tr>
<tr>
<td>Perceived Valence</td>
<td>.358</td>
</tr>
<tr>
<td>Perceived Information</td>
<td>.237</td>
</tr>
<tr>
<td>Credibility</td>
<td></td>
</tr>
<tr>
<td>Perceived Valence</td>
<td>.123</td>
</tr>
<tr>
<td>Perceived Information</td>
<td>-.366</td>
</tr>
<tr>
<td>Credibility</td>
<td></td>
</tr>
</tbody>
</table>

**Table 2: Regression Analyses Book Reviews**

<table>
<thead>
<tr>
<th>Stand. Coef.</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived Valence</td>
<td>.468</td>
</tr>
<tr>
<td>Perceived Information</td>
<td>.144</td>
</tr>
<tr>
<td>Credibility</td>
<td></td>
</tr>
<tr>
<td>Perceived Valence</td>
<td>.197</td>
</tr>
<tr>
<td>Perceived Information</td>
<td>-.267</td>
</tr>
<tr>
<td>Credibility</td>
<td></td>
</tr>
<tr>
<td>Perceived Valence</td>
<td>.358</td>
</tr>
<tr>
<td>Perceived Information</td>
<td>.237</td>
</tr>
<tr>
<td>Credibility</td>
<td></td>
</tr>
<tr>
<td>Perceived Valence</td>
<td>.123</td>
</tr>
<tr>
<td>Perceived Information</td>
<td>-.366</td>
</tr>
<tr>
<td>Credibility</td>
<td></td>
</tr>
</tbody>
</table>

**Table 3: Regression Analyses Hotel Reviews**

The results of the regression analyses for books and hotels are outlined in Table 2 and Table 3, respectively. They show a homogenous picture for both independent variables across all sub groups. The p-values of the standardized regression coefficients of perceived valence are below the recommended .05 threshold in 6 out of 8 cases. A p-value of .073 was found in the group of medium negative hotel recommendation. A non-significant effect of perceived valence was given for the strong negative book recommendation group. Based on these results, we conclude that perceived valence has a significant effect on purchase intention for search and experience goods.

For information credibility the effect is significant in 6 out of 8 regressions. The remaining p-values are close to the widely accepted .05 levels. Both non-significant relationships are found in the medium positive recommendation group. Despite this fact, we follow the majority of significant effects and conclude a significant effect of information credibility on purchase intention.

Interestingly, the effect sizes for both dimensions of quality of recommendations vary heavily across the eight sub groups. Whereas standard coefficients for perceived valence are highest for medium positive recommendations (.648 and .468), information credibility has its greatest impact in regressions with negative review information for books (e.g., -.366 for strong negative purchase recommendation) and strong positive reviews for hotels (e.g., .398). Hence, perceived valence is more important for online reviews being of medium positive valence intensity for both search and experience goods. Information credibility becomes more critical in cases of strong product recommendations, even though the results are varying across product categories. These results perfectly fit the findings within the two-sided-persuasion-approach. Medium positive reviews (a mixture of positive and slightly negatively toned information) have the strongest impact on buying intentions.

Furthermore, the authors conclude that perceived valence and perceived information credibility can be regarded as ‘independent’
dimensions of recommendation quality. When studying the eWOM effect of recommendation quality, both dimensions have to be taken into account separately.

For testing the experimental effect of valence intensity (comparing the four different manipulation groups for books and hotels, respectively) in more detail, we followed a sequential approach. First, we plotted the various means of purchase intention, perceived valence and credibility of online reviews to gain a first feeling for various effects. Figure 1 and Figure 2 show the values of the three variables for book and hotel, respectively.

The main results visualized in Figure 1 and Figure 2 can be summarized as follows: The average purchase intentions of the respondents differ significantly across the manipulation groups (low values indicating a high purchase intention, as purchase intention was measured on a seven-point rating scale with end points verbalized as 1 = “very likely”, 7 = “very unlikely”). However, the difference of the manipulation effect between positive and negative online reviews is much smaller for the medium valence intensity group. This holds for the book and the hotel experiment. On the other hand, regarding strong purchase recommendations, the mean difference of the purchase intentions between positive and negative online reviews is dramatic for both book and hotel. Based on this qualitative assessment, the authors postulate an effect of valence intensity on purchase intentions.

A series of ANOVAs were run testing for the effect of valence intensity. Table 4 shows the results separated for book and hotel reviews. The results of the significance tests confirm the findings of the visual inspection. Whereas valence has a significant impact in three of four experiments, a post-hoc Scheffé test which compares the purchase intentions of the positive and negative manipulation groups yielded non-significant differences in the low valence intensity groups. On the other hand, the differences in purchase intentions are highly significant when respondents of positive and negative manipulation groups with strong product recommendations are compared. In other words, the effect of positive recommendations with medium valence intensity does not differ significantly from medium negative product recommendations. This could be mainly due to the fact, that both medium positive and medium negative reviews are a mixture of both positive and negative content. Whereas the individually perceived valence of the reviews (see table 2 and 3) has an impact on buying intentions especially within the medium positive valence intensity group, directly comparing the stated purchase intentions of the two medium valence intensity groups does not show a significant difference. Strong recommendations influence the preferences and purchase intentions of respondents. This effect is even greater for services (hotels, $r^2 = .384$) than products (books, $r^2 = .149$).

<table>
<thead>
<tr>
<th>F-value (df)</th>
<th>p-value</th>
<th>$R^2$</th>
<th>Scheffé-Test</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Book</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reviews</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>3.740</td>
<td>.173</td>
<td>.004</td>
</tr>
<tr>
<td>(2;336)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Valence</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intensity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strong</td>
<td>30.553</td>
<td>.000</td>
<td>.149</td>
</tr>
<tr>
<td>(2;336)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Hotel</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reviews</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>21.790</td>
<td>.001</td>
<td>.038</td>
</tr>
</tbody>
</table>

![Figure 1: Purchase Intention, Perceived Quality of Online Review, Credibility of Online Review](image1)

![Figure 2: Purchase Intention, Perceived Quality of Online Review, Credibility of Online Review](image2)
Conclusion and Outlook

WOM communication has a long tradition in marketing research. The research stream became even more popular and important since the emergence and rapid diffusion of the internet. Many empirical studies have provided empirical evidence for the effect of electronic WOM in general. However, as we stated in the theoretical part of this paper, findings about the quality and the valence intensity of online reviews is limited. Furthermore, previous findings about the direction of product evaluations are partly inconsistent and can be questioned for their simplification in either purely positive or purely negative reviews. This simple dichotomization is not grounded in reality. In fact, trade-offs between and within product recommendations can be found more frequently. We target the quality of product recommendation in general and the valence intensity in particular. Four experimental trials were conducted testing the hypotheses. The effects of perceived valence and information credibility on purchase intentions were significant in six out of eight tested relationships. Interestingly, the findings indicated that the influence of perceived valence is more important in situations where positive product evaluations occur. Information credibility becomes more critical in cases of strong product recommendations, even though the results are varying across product categories. Explaining these conflicting findings is subject to further research.

In a subsequent analysis, we tested for the experimental effect of valence intensity. As proposed, we found only a significant effect in the groups with strong product recommendations. Groups with manipulated moderate positive versus negative valence intensity did not show a significant difference in purchase intentions.

These findings are crucial for e-tailers. As consulting online consumer reviews has literally already became ‘state-of-the-art’ in online purchase decision-making, marketing practice should have a closer look not only on the valence of consumer postings but rather on the valence intensity.

The present study has also some limitations. First, business students were chosen as respondents. Further studies are already scheduled and will recheck whether our findings hold for a broader population. However, as prior research has shown that students are familiar with the internet, often buy online and use recommendation sites before they make their buying decisions frequently, our findings can be generalized at least for this important target group of e-tailers. Second, our findings are based on an online experiment. Whereas the technique has been criticized for limited control of situational effects during the experiment, we are convinced that the ‘test situation’ should be as realistic as possible. Hence, we think that online experiments are appropriate for a study on eWOM. For comparison of results we suggest conducting a replication study carried out in a traditional offline experimental setting. Third, we have used only two products (books and hotels) which are typically bought online. Again, we think this approach is appropriate for an exploratory study since the research on this topic is still scarce. Finally, we have compared groups with moderate and strong valence intensity. We showed that the valence intensity of an online review is a crucial issue that has to be taken into account. However, we did not search for the threshold of strength when an ‘ineffective’ product recommendation tends to become effective. Although this threshold is certainly hard to determine, these findings are of considerable interest for researchers and marketing managers. Testing for this threshold would require a relatively high number of stimuli (reviews) that slightly vary in valence intensity. Given the advantages of relatively low set-up costs and the possibility to reach a broader population, applying an online experiment would be a proper environment. Chen, Shang and Kao (2008) found that individual differences in online-shopping experience and information processing abilities are having an impact on how effectively and efficiently online product information is processed [10]. Further research on online review valence and valence intensity should also address this issue of possible personal differences by including personality variables. In this regard, we suggest having a closer look on the latent constructs of susceptibility to interpersonal influence [37] or self-esteem [38]. We assume that these concepts majorly contribute to the understanding of the eWOM effect in a context of online-reviews varying in valence intensity. The explanatory value of other phenomena already found relevant in a broader context of eWOM such as information overload [10] or cognitive personalization [39] should also be taken into account when investigating the quality of online reviews.

### Table 4: ANOVA Results

<table>
<thead>
<tr>
<th></th>
<th>Valence Intensity</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Strong</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>258.315</td>
<td>.000</td>
<td>.384</td>
</tr>
</tbody>
</table>

1 This column shows p-values for the Scheffé-Test of group differences between positive and negative manipulation groups.
References


UNDERSTANDING ONLINE TRADERS: TRADING AND PERFORMANCE IN COMMON STOCK INVESTMENT

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Abstract
This paper analyzed the effect of online trading on investors’ trading behavior based on investors’ trading data provided by a major security firm in Taiwan. Our empirical findings are summarized as follows:
1. Male and the younger traders preferred online trading. Investors who had better gross return tend to switching to online trading mechanism.
2. Even though investors traded more actively after going online, their trade performance is not negatively affected.
3. Online trading does not significantly increase information-triggered trades (speculative trading), even though there is more access to information after going online.
4. Finally, the order execution efficiency of online trading is better than phone-based trading.

Keywords : online trading, trade performance

Introduction
Online trading has originally prospered in America, especially with Ameritrade being the pioneer and more and more securities companies involved in this market. Prior to the online trading phenomenon, the US securities market was primarily dominated by institutional investors. With rapid technology growth and widespread adoption along with the competitive lower transaction fees aggressively promoted by online trading brokerage firms, many retailer investors have shown tremendous interest in the online trading market. As a result, online investors have witnessed the growing trend of online trading towards the mainstream.

The online trading market in Taiwan has witnessed its dramatic growth in terms of overall trading volume since the adoption of online trading in 1997. In recent years, few researchers support the view that overconfidence of information caused by online trading leads to information-based trading and poor investment performance. It has become a worthwhile research topic to discuss the effect of such an online trading platform in the context of trading behavior and performance, specifically with aggressive promotion of competitive transaction fees and individuality by leading online trading securities firms.

Online trading platform is capable of providing extensive real-time market data and analysis to a large number of online traders. According to the investigation held by leading US investment web sites “Motley Fool” (1998) and “The Syndicate” (1998), approximately 70% interviewees indicated that research on the web was the primary channel to obtain market data and information for decision making. However, information overload without professional analysis may contribute to risky decision making process for certain investors (Barber and Odean 2002).

The primary source of the research data is from a major Taiwanese securities firm regarding its online trading activities from January 2004 through October 2005. This research is intended to investigate the behavior of online traders in the following areas:
1. What characteristics would lead traders to perform online trading?
2. What impact would online trading make to the online trading behavior and performance of the traders?
3. What effect would online trading have on information-triggered trades (speculative trading), provided that there is more access to market data and information?
4. What impact does online trading have on transaction efficiency of online investors?

Methodology
The primary data sources for this research are exacted from the intraday and the company’s price information from a major Taiwanese securities firm on the investment from January 2004 through October 2005. In addition, the weekly transaction volume for each common stock and rate of return emanate from Taiwan Economic Journal (TEJ). To analyze the weekly behavior in stock trading after going online, this research assumes that all investors deal with trade in the last day of the week and ignoring the intraweek trade.

We selected 1,247 samples as the first time online traders and selected 1,247 comparison samples of non-online traders. The research methods are stated as follows:

A. Descriptive Statistic
By dividing the total samples into online and non-online groups, this research analyzes investors’ attributes of becoming the online traders through descriptive statistics.

**B. The effect of online trading on total turnover rate**

The total turnover rate is calculated on the weekly basis to confirm investors’ personal behavior in Taiwan Stock Exchange. Also we calculate the turnover rate by summarizing market capitalization of purchase and sale (half) divided by weekly balance of market capitalization. The same methods stated above are used to calculate the total turnover rate of comparative samples (before and after going online).

**C. The effect of online trading on information triggered trading**

Investors can obtain the latest investment information from Internet; therefore, many securities firms provide free web information to attract investors. Barber and Odean (2002) think overconfident investors will overestimate the value of their private information obtained from Internet, causing them to trade too actively. In this research, we compare the trade reaction before and after going online. We measure speculative trading by total turnover rates. Under the circumstance of higher total turnover rate, investors trade more actively due to the impact of obtaining market trade information from Internet.

**D. The effect of online trading on investment performance**

It is very important to discuss investment performance of online trading. In this research, we measure investment performance by examining risk-adjusted excess return. The related calculation methods and definitions are as follows:

1. **Gross return**

   The gross weekly return is calculated as
   
   \[
   R_t^j = \frac{\sum_{i=1}^{n} W_{ij} R_{ij}}{\sum_{i=1}^{n} W_{ij}} \tag{1}
   \]

   Where \( R_t^j \) is the gross weekly gross return of stock \( j \) common stock in week \( t \), \( R_{ij} \) is the gross return of \( i \) common stock in week \( t \), and \( W_{ij} \) is \( i \) stock market price × \( j \) common stock position divided by \( \sum_j (i \text{ stock market price} \times j \text{ common stock position}) \)

2. **Calculate risk-adjusted return**

   This research uses Famma-French 3 factor CAPM to calculate benchmark risk-adjusted return on measuring performance.

   \[ r_{it} = \beta_i (RM_t - RF_t) + s_j SMB_t + h_{HML_t} + \epsilon_t \tag{2} \]

   \( r_{it} \): return for stock \( i \) in week \( t \)
   
   \( RM_t \): weekly rate of return of TAIEX
   
   \( RF_t \): risk-free rate by using 1 year certificate deposit rate
   
   \( SMB_t \): return of portfolio in week \( t \) for small Co. minus return of portfolio in week \( t \) for big Co.
   
   \( HML_t \): return of high book-to-market ratio portfolio in week \( t \) for small Co. minus return of high book-to-market portfolio in week \( t \) for big Co.
   
   \( \beta_i \): risk parameter for market
   
   \( s_i \): risk parameter for company size
   
   \( h_i \): risk parameter for book-to-market equity ratio

   \[ \beta_i = \frac{\sum_{j=1}^{n} W_{ij} [\beta_i (RM_t - RF_t) + s_j SMB_t + h_{HML_t} + \epsilon_t]}{\sum_{j=1}^{n} W_{ij} \beta_i} \tag{3} \]

   where

   \( R_{ij}^j \): benchmark risk-adjust return for account \( j \) common stock in week \( t \)

   \( W_{ij} \): Weight of market capitalization for account \( j \) common stock in week \( t \) on investment portfolio

   \[ [\beta_i (RM_t - FM_t) + s_j SMB_t + h_{HML_t}] \]: benchmark risk-adjust return for \( i \) stock in \( t \) week

3. **Calculate excess market return**

   \( ER_t^j \)
The effect of information-triggered speculative trading on performance before and after going online is calculated as

\[ R_{i}^{PB} = \frac{\sum_{i=1}^{n} w_{i} \cdot r_{i}^{PB}}{\sum_{i=1}^{n} w_{i}} \]  

(5)

where

- \( R_{i}^{PB} \): purchase before going online, the original return rate of portfolio for trade information triggered trading in week 2 before week t
- \( w_{i} \): \( i \) stock buying market price \( \times \) buying quantity
- \( r_{i}^{PB} \): purchase before going online, the return rate of stock \( i \) for trade information triggered trading in week 2 before \( t \) week

We will use the same method stated above to calculate \( R_{i}^{SA} \) (SA:Sales before going online) and \( R_{i}^{PA} \) (PA:Purchase After going online) and \( R_{i}^{SH} \) (SH:Sales After going online). (\( ER_{i}^{PB} - ER_{i}^{PB} \)) \( \times \) \( ( ER_{i}^{SH} - ER_{i}^{SA} \) \) means investors will buy better performing stocks and sell poor performing stocks because they can get more investment information such as trend analysis from online trading.

The order execution efficiency is calculated as

\[ \text{Efficiency of purchase price} = \frac{P_{i,H} - P_{i,B}}{P_{i,H} - P_{i,L}} \]  

(6)

\[ \text{Efficiency of sale price} = \frac{P_{i,S} - P_{i,L}}{P_{i,H} - P_{i,L}} \]  

(7)

Results

A. Descriptive Statistics

In Table I, we illustrate descriptive information on the trading information based on our sample. Male online traders are 56.6%, and male non-online traders are 49%. The mean and median ages for the online investor are 39 and 37 respectively. The turnover rate for the online traders is higher than non-online traders. The average volume for each transaction online is lower than non-online.

<table>
<thead>
<tr>
<th></th>
<th>Online(%)</th>
<th>Nononline(%)</th>
<th>All(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>56.6%</td>
<td>49.8%</td>
<td>52.8%</td>
</tr>
<tr>
<td>Age-Mean(%)</td>
<td>38.9%</td>
<td>40.8%</td>
<td>40.0%</td>
</tr>
<tr>
<td>Age-Median(%)</td>
<td>37%</td>
<td>39%</td>
<td>38.3%</td>
</tr>
<tr>
<td>Average account tenority(%)</td>
<td>4%</td>
<td>3%</td>
<td>3.5%</td>
</tr>
<tr>
<td>Average Volume/each(%)</td>
<td>107,964%</td>
<td>115,062%</td>
<td>110,518%</td>
</tr>
<tr>
<td>Turnover/year(%)</td>
<td>60.31%</td>
<td>43.43%</td>
<td>53.83%</td>
</tr>
</tbody>
</table>

B. The effect of online trading on total turnover rate

In Table II we outline the change of turnover rate before and after transferring to online account based on our sample. The annual turnover rate has risen to 69.8% for online traders. After transferring to online, the rate changes from original 1.3 (40.0% and 50.9%, \( p<0.000 \)) times to 1.5 times (69.8% and 47%, \( p<0.010 \)).
C. The effect of online trading on trade information triggered trading

From Table III, the annual turnover rate for online traders before transferring is 50.2%. It comes to 20.3216%, decreases to 29.9% (p<0.000), different from expected.

D. The effect of online trading on investment performance

This research measures investment performance by looking into gross return and risk-adjusted return. This research employs three-factor model (Fama and French) to calculate $\alpha$, constant for excess return $\beta$, parameter for market risk $\beta$, parameter for company scale $\beta$, and $h$, parameter for book-to-market) as risk-adjusted return. The return rates for online and non-online before and after transferring account are shown in Table IV.

E. The effect of information-triggered trading (speculative trading) on performance before and after going online

The net excess return for sales before online ($ER_{SB}^t - ER_{PA}^t$) is -1.3162 (p<0.000). The net excess return for sales after online ($ER_{SA}^t - ER_{PA}^t$) is -1.3144 (p<0.000). Both of them are negative, which means online traders are not able to achieve better return on investment though there is more access to information after going online.

F. The effect of online trading on investor’s order execution efficiency

In Table V, the efficiency of purchase price is 0.5954 by Internet, and 0.4498 by phone. The difference is
0.1456 (p<0.000). The efficiency of sale price is 0.5023 by Internet, and 0.3964 by phone. The difference is 0.1059 (p<0.000). That means the order execution efficiency of online trading is better than phone-based trading.

Conclusions
The previous studies have focused on the effect of investors’ turnover rate and performance on online trading. However, few studies have been done on the effect of order execution efficiency on online trading. This research further discusses the effect of order execution efficiency since it provides valuable information for investors for selecting trading methods in a timely manner. The paper also provides managerial implication for securities firms since it analyzes gender, age and investors’ behavior of online traders.

This paper analyzes the effect of online trading on investors’ trading behavior and return performance based on investors’ trading data provided by a major security firm in Taiwan. Our empirical findings are summarized as follows:
1. Male and the younger traders preferred online trading. Investors who had better gross return tend to switching to online trading mechanism and reinforcing the behavior of over confidence.
2. Even though investors traded more actively after going online, their trade performance is not negatively affected.
3. Online trading does not significantly increase information-triggered trades (speculative trading), even though there is more access to information after going online.
4. The security firms offer online interface for investors to place stock orders and investors can trade quickly and conveniently with an online trading mechanism.

With the empirical study we find investors can obtain price and real time information through the online system and the order execution efficiency of online trading is better than phone-based trading.

Due to research constraints that complete investors’ beginning portfolio account data could not be obtained, we can use logic inference to calculate it, which is sufficient to validate the hypothesis.

As for the research suggestions, this paper obtained investors’ trading data provided by a major securities firm in Taiwan, including gender, age and tenure. In order to protect investors’ personal information, we selected the virtual customer number. If we can get further detailed data (e.g., investors’ education, marital status, income and investment experience….etc.) through securities firms to implement questionnaire, we can understand investors’ behavior more.

References
CRITICAL SUCCESS FACTORS ON E-GOVERNMENT APPLICATION-FROM THE VIEW OF GOVERNMENT WORKERS IN GUANGDONG

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Abstract
This study used a sample of 293 government workers from Guangdong Province of Peoples Republic of China. Based on Delone and McLean's IS success model, we constructed the measurement scale for evaluating E-Government Applications success. We also examined impacts of five critical success factors (i.e. internal organization and management, quality of product and technology of suppliers, external technical environment, the external policy environment, and coordination and supportive ability of information center) on E-Government Applications. Some government characteristics and personal backgrounds were also included and explored as control variables.

It was found that these five critical success factors are significantly related among themselves. It was also found from the Pearson correlation coefficients that all but external policy environment were statistically related with E-Government Application. The level of government (the City government level) and personal role as a top leader were also found to be important government and personal factors associating with E-Government Application success.

A multivariate regression analysis was conducted to test five factors and two control variables. It is found that the model was statistically significant. Since the correlation among independent variables, it was found that internal organization management, external policy environment, City level government (a dummy variable) and user as a top leader (a dummy variable) were final significant variables.

This was a paper originated from a doctoral dissertation. Time and resources were limited. Some potential areas for improvements and suggestions for further study were also presented.

Keywords: E-government, E-government application success, Critical Success Factors (CSFs) for E-government application, E-government in China

Introduction
With the global political and economic integration, government management and service functions become more electronic, automation, and paperless. E-government is rapidly developed in a number of countries especially in developed countries. Using the internet technology to improve government organization; reorganizing the public process and management; changing management functions of government agencies; improving work quality and efficiency had a profound impact in establishing an efficient, well-coordinated, and standardized administrative system [24]. E-government plays an important role in promoting national government reform, improving government efficiency, enhancing the effectiveness of the role of government work. E-government in many developed countries has entered a relatively mature development period. In contrast, China is lagging behind in either progress or research. Though Chinese e-government has developed for 20 years with a wealth cumulating of experience, a lot of problems still arise. We can clearly see that the increasing investment in construction of e-government in many parts of China, but these projects did not produce a corresponding efficiency or effectiveness. Furthermore they brought more new problems. Over the years, people spent more time in building e-government projects and less attention to the research in application process. In fact, only the successful application of e-government can truly demonstrate the practical significance of e-government and its goals. Application is the last stage and, thus, will determine the success of e-governance and its progress.

This study was conducted on different government departments to assess success on e-government application process. Various influencing critical success factors were examined. Case studies, detailed field interviews, and questionnaire survey were applied to this research. We tried to explore the critical success factors model for e-government application. We hope our results can guide all levels of government departments to promote e-government and to provide practical guidance and recommendations to e-government practice. The study also hopes to provide to the government with e-government measures and policies that will serve as a basis to further develop and promote e-government application and practice.

Review of Literature
E-government can be defined as government
agencies using modern information and communication technology to integrate management and services through web technology to achieve optimization of the re-structure and re-organization of government work processes [14]. It is through the internet information technology, use of modern science and technology, to achieve the goals of government performance improvement: First, we must facilitate public participation and the government management, and keep government information open to the public; Secondly, to provide various types of high-quality government services and ensure citizens, social organizations and other institutions to get access to public information and services conveniently; Thirdly, to improve administrative efficiency and enhance the competitiveness of the government [25]. From the review, we can see that the most important focus of e-government application is to enhance government performance. This study was focusing on establishing an evaluation system for e-government.

Research on e-government applications, especially within different Chinese governments, has not yet been studied in a systematic way. It is rather difficult to find studies in this area. In comparison, it widely found the implementation and evaluation of the ERP projects for business world. They could be from the view of information technology applying to the resources, on processes and/or activities, or on cross-sectional integration. The entire application and process for business is actually consistent with the e-government applications. The difference between the government and enterprises is the ownership and institutional differences. The mechanism itself is similar and is information system applications. Thus this study is based on the critical success factors of ERP applications. With proper adjustments for governmental characteristics and situational factors, this study will examine its hypotheses and assessment.

In the field of evaluate application of information system the landmark work was done by American scholars DeLone and McLean. In 1992 they proposed a six-dimension information system success model: i.e. system quality, information quality, system use, user satisfaction, personal influence and organizational impact. Eleven years later, they further improved the model by adding a new dimension: i.e. service quality. They also combined personal influence and organizational influence and merged them into a single new dimension, net benefits. However, because China has a different political system, the concern of e-government applications was placed on effectiveness instead of benefits.

The dependent variable of this study, the success of e-government system application, is based on the successful model developed by DeLone and McLean. The assessment system used six dimensions: system quality, information quality, individual impact, organizational impact, user satisfaction and system usage. Through the interview of 16 experts, we assign certain weights to every measurement.

For explaining factors, this study based on the implementation of critical success factors for ERP, with special consideration of specific patterns and factors applicable to the government sector. The use of critical success factors for e-government, from a global view, can be summarized as external factors and internal factors. The external environment includes four factors, the change of government, social development, laws and regulations, and economic progress. For internal environment, there are six major factors; the internal influence, the internal demand, technical capacity, standards, management methods, and information security. If these elements have commonality, it is the Chinese government management style. Chinese bureaucracy will be an additional special factor [16]. Among studies for the ERP application, Holland believed that the successful implementation of the ERP requires enterprises to process-oriented and that all departments must follow the same, unified process [5]. The real benefits of ERP can only be obtained from the organizational change. Therefore, the implementation of the ERP should be a business project rather than technology projects. Holland's ERP critical success factors for system implementation included tactical and strategic dimensions. The former one included senior management support, business vision, project schedule, legacy system, and ERP strategy. The later one included client consultation, personnel, client acceptance, trouble shooting, and configuration. Estsve argued that the high failure rate of ERP was due to the fact that project managers usually concerned about the technical and financial issues ignored non-technical issues. Therefore, Estsve used four dimensions to assess ERP system application: strategic, tactical, organizational and technical [4].

By reviewing researches of successful model in ERP implementation, e-commerce and e-government, this paper proposes a critical success factors model for e-government application. Please see Figure 1 for critical success factors for e-government applications.
The characteristics of companies could be another important factor [11] [1] [7]. So characteristics of different government units are not the same and will affect success of their applications of e-government projects. A description of the basic characteristics of government departments can be categorized into:

1. Situational factors: unit level, management style, location of the units, positions, and application roles;
2. Personal factors: time using application, gender, age, background, and academic qualifications.

These two areas have affected the degree of awareness of key success factors, so the actual impact of the various critical success factors will change accordingly. It is important to assess these variables and control for them.

**Methodology**

Pilot study was conducted in February and March of 2009. We interviewed some experts to assure validity of questions. After modifications of questions, we conducted the questionnaire survey from April to May of 2009. Judgment sampling procedure was used to select appropriate units [15]. Random selection of staff was done in each unit. That is, the researchers according to their knowledge structure and research purposes subjectively determined sampled units. The provincial, city, district and other levels of government were all included to select a typical application of a certain unit. In Guangzhou city, 5 provincial units, 15 city level units, and 15 district level units were selected. Furthermore, the samples covered approximately 25 municipal level units from Zhuhai City, Yunfu City, Dongguan City, Jiangmen City, and with a total of about 40 government departments. Questionnaires were sent in two ways, electronically via QQ or MSN and in paper by mail. About 800 questionnaires were sent to different level government offices. We received 403 cases (about 50 percent respond rate.) Among them, 319 were from emails and 84 were from paper copies with response rate of 64% and 17% respectively. After carefully reviewing and examine them, we eliminate those incomplete, non-government end users, some duplicated copies, we were able to use 293 valid cases or about 70% of responded cases.

Questionnaire included a total of 6 parts with a total of 60 Questions. The survey took about 15-20 Minutes to complete. The first part of the questions is the basic characteristics of the respondents, including respondents situational factors such as unit level, management style, where the office is, positions and application roles. Personal factors including gender, age, educational level, professional and relevant work experience were also included in this part.

Second and third part is the main body of questionnaire, including "the success of e-government applications", measurements of total 6 questions [9], and the measurement of key success factors. Measurement of critical success factors which are divided into part four with 43 questions. They were the measurement of external environmental factors [22]; the measurement of internal organization and management [6] [10]; measurements of business understanding, organization and coordination, and supporting capacity of IS department [12] [10], and the measurement of level of vendor and its technological level [20]. Most of questions were designed by using Likert scale with five choices.

Reliability tests were conducted. Measurement items of all reliability testing Cronbach á Coefficient 0.950; Each side of a research structure Cronbach's á Coefficients was larger than 0.8. This signified a very good internal consistency reliability. The success of e-government applications has a Cronbach's á Coefficient of 0.780 that is within the acceptable range [8]. This study had a total of 43 items, all samples KMO Value is 0.910, Bartlett'S Test of sphericity chi-square value of 8223.147, It reached a very significant level, indicating that the sample data suitable for factor analysis.

For construct building, we used principal component analysis on 43 items, we were able to extraction six main factors. Orthogonal rotation was conducted to 43 items and identified five factors. Table 1 shows the final results of critical success factors. Five factors were extracted with the cumulative explained variance 66%. Among them, five Alpha Coefficients were examined. Specifically, 0.890 for internal organization and management; 0.915 for the supplier's level, the impact of external technology environment; 0.792 for external information technology; 0.849 for supporting ability of IT department; and 0.777 for...
external policy and regulations were found.

Results

From Table 2, we can find that relationships between the dependent variable and four success factors are statistically important. Only the relationship with external policy environment was not statistically important to the dependent variable. However, it was found that external policy environment variable is highly correlated with internal organization and management variable and IT support ability. The relationships among five independent variables are all statistically significant. It implies that independent variables cannot be co-existed in the multiple regression analysis even most of them are statistically correlated with the dependent variables.

Internal organization and management dimension has a statistically significant relationship with the success of e-government application. To assure the success of e-government, it is required that government officers must first have "consciousness", especially, the leaders, including department heads and various business leaders should put this in priority [16]. Top government level should mandate a dedicated department to promote e-government applications and provide adequate funding and resources. End users at all levels of government should truly utilize the application programs. CIO's and IT offices have good administrative and resource coordination capabilities. Internally, a sound management and consistent policy on e-government should be one crucial success factors.

External provider (product, technical level and application) is also found to be significant with the correlation coefficient of 0.21. From the point of view of external technology, it is clear that software flexibility, easy to adjust for process and new features, and etc. are important. It is also important that the e-government should be easy to achieve subsystems integration, good performance and high security. From the development and application point of view, the supplier must have a high level of technology and the project manager must have extensive experience in project management and communication as well as coordination capabilities.

External technological environment is also found to be statistically significant with the dependent variable with a correlation coefficient of 0.15. The popularity of e-commerce will push the government to use the e-government system. Willingness and readiness of people and business have a positive impact on the application. People and business may also demand government to improve its efficiency and effectiveness. Thus, it is found that external technological environment, including people and business, will have a positive relationship with e-government success.

IT departments and its effectiveness related measures have an important impact on the success level of e-government with a correlation coefficient of 0.22. It is also found that characteristics and effectiveness of IT is highly correlated with other independent variables. IT department is the primary factor that connects the internal management that includes the senior managers, end users and different units of the government sectors. It also coordinates and communicates with external providers. The services that IT offices provide and the abilities to solve problems will also significantly contribute to the success of e-government applications.

The direct relationship between external policy environment factors and the success of the system is relatively low with a correlation coefficient of only 0.04. However, its significant relationships with other independent variables are found. This implies that indirect relationship on the dependent variables via other independent variables may exist.

In order to compare five Critical success factors simultaneously and with situational factors (organizational level and individual lever), a stepwise multiple regression was conducted. In addition to five critical success factors, we also included eleven different situational factors, i.e. the level of the units, management style, the nature of the units, the location of the units, positions, application roles, time using application, gender, age, professional background, and academic background.

When all five critical success factors and situational factors are considered together, it is found the model is statistical significant at 0.000 level. Furthermore, it is found that the model explained 11.1% of the variance of the success of e-government applications. Please see the Table 3 for the results.

From the parameter test, shown in the Table 3 we found that four variable are statistically important to the dependent variables. Internal organization and management and external policy environment variables along with City level, and top leader were found statistically important. Internal organization and management including end users, top management, and CIO’s and project managers abilities had a relatively higher correlation (see Table 2) with the dependent variables and shows a significant contribution in the multiple regression analysis. The external policy environment was not statistically significant with the dependent variable according to the bivariate analysis. However, when we ran multivariate analysis, it was statistically significant. As discussed previously, this variable is correlated with other independent variables. Thus, it is possible that external policy environment, though did not have a direct, have an indirect affect on the success of e-government via other critical success factors. As a matter of fact, the external policy factor is associated with policies and e-government structure that relate to the legitimacy
and necessity of the e-government system. A sound policy will also provide a guideline for e-government system and assure security, safety and other aspect of the e-government. Thus, it is one of the important factors to the success of e-government application. Further exploration should be done to answer the effect of external policy environment.

Two situational factors were found to be important in the final regression model. One is the City level with a significant level of 0.024. It means that level of government has different impacts on the success of e-government system. Specially, the City level units are more likely to contribute to the success of the e-government. Because, most of the systems are development at the City level government and may provide better communication and services to the end

Table 1 Factor Analysis of Five Critical Success Factors

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Dimensions</th>
<th>Items</th>
<th>Component 1</th>
<th>Component 2</th>
<th>Component 3</th>
<th>Component 4</th>
<th>Component 5</th>
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<td>Policies and regulations</td>
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<td>Internal organization and management factors</td>
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<td></td>
<td></td>
<td>X28</td>
<td>0.684</td>
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<td>Information technology departments of business understanding, organization and coordination and support services capacity</td>
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<td></td>
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<td>Department of information technology project manager capacity</td>
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<td>Information technology sector to support service capabilities</td>
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<td></td>
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<td>X39</td>
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<td>Supplier Project Manager Competency</td>
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<td>Degree of product operations for compliance with</td>
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<td>Total Variance Explained</td>
<td>Rotation Sums of Squared</td>
<td>Total</td>
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<td>2.143</td>
<td>1.519</td>
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<td>Cumulative%</td>
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<td>Cronbach's Alpha</td>
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<td>45.344</td>
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<td>0.915</td>
<td>0.792</td>
<td>0.849</td>
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Table 2. Means, Standard Deviations, and Pearson Correlation Coefficients of Variables (n=293)

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<thead>
<tr>
<th></th>
<th>Succes diffy applied</th>
<th>Internal organization and management</th>
<th>Supplier standards</th>
<th>The external technical environment</th>
<th>Information technology sector capacity</th>
<th>External policy environment</th>
<th>Municipal Units</th>
<th>Top leader</th>
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<tr>
<td>n</td>
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<td>293</td>
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<td>Mean</td>
<td>3.62</td>
<td>3.86</td>
<td>3.97</td>
<td>3.45</td>
<td>3.75</td>
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<td>Std. Deviation</td>
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<td>0.63</td>
<td>0.69</td>
<td>0.76</td>
<td>0.60</td>
<td>0.80</td>
<td>0.50</td>
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</table>

| Internal organization and management | Pearson | 0.25       |       |
|-------------------------------------|---------|------------|
| Sig.                                |         | 0.00       |

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<thead>
<tr>
<th>Supplier standards</th>
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<tr>
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<th>External policy environment</th>
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<tr>
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<tr>
<th>Top Leader</th>
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<tr>
<td>Sig.</td>
<td></td>
<td>0.21</td>
</tr>
</tbody>
</table>

Table 3 Multiple Regression Analysis of Five Critical Success Factors and Situational Factors

<table>
<thead>
<tr>
<th></th>
<th>A Coefficients</th>
<th>T</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Constant)</td>
<td>2.733</td>
<td>13.203</td>
<td>0.000</td>
</tr>
<tr>
<td>Internal organization</td>
<td>0.184</td>
<td>2.191</td>
<td>0.029</td>
</tr>
</tbody>
</table>

The 9th International Conference on Electronic Business, Macau, November 30 - December 4, 2009
users in the government. Further analysis is recommended. Another important personal factor is the top leader. If the end user has a role as the top leader of the unit, it is more likely that the success of e-government will be higher. Top level commitment is one of the critical factors to the success of many different information systems including e-government in this study.

**Suggestion**

This research was designed to study the e-government success and critical success factors associated with it. It is from a government workers’ perspective. We did not cover the public or companies who may use the e-government system. We examined 43 items and found five dimensions who may contribute to the success of e-government. There five factors are correlated among themselves. Therefore, in the final multivariate analysis, only two of them are found to be statistically significant. We also found that the level of the government unit, i.e. the City level and top leader of a unit will contribute to the success of the e-government system in Guangdong province of China. This research was originally coming from a doctoral dissertation. Due to limited time and resources, some improvements may be done in the future studies.

This research is focusing on the government workers. It does not cover other potential users from the public or business. It may be more complete in the future to include some external users.

We used the same set of questionnaires for end users who work for the government. It is arguable that some parts of the survey may have validity problems. For instant, it is rather difficult to ask government workers about their perceptions or evaluation of external providers. It will be ideal to develop some different questions to measure some external and internal factors by investigating these issues from other ways.

The independent variables are highly correlated among themselves. Multiple regression analysis may not be the best approach to test the multivariate model. A linear structural relational model or other techniques should be considered in the future.

In the situational factors, unit-level and application roles were found to be significant. Personal characteristic variable, especially the "number one" in the unit has a negative relationship with the success of e-government application. It looks like the top leader may use more "harsh" way to evaluate the performance and assigning lower ratings for success e-government application. Therefore, it is recommended that top support will be an important issue for future research.

Another situational variable, the level or type of government, is found to be also significant. In this research, it is found that the end user from the City level is more likely to give good evaluation to the system. Apparently, in the future, it is important to further explore this variable.

**References**

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Appendices

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<th>Table 4 Internal Organization Management</th>
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<td><strong>End-users intention: Top Leader Focus</strong></td>
</tr>
<tr>
<td>x21 Unit authorized by the Government is responsible for e-government program</td>
</tr>
<tr>
<td>x22 Sufficient funding is provided to ensure the implementation of e-government program</td>
</tr>
<tr>
<td>x23 &quot;Top leader&quot; focuses on application, has provided adequate funding and resources</td>
</tr>
<tr>
<td>x24 Top leader attends e-government program himself</td>
</tr>
</tbody>
</table>

| **End-users’ intention** |
| x25 Units leaders attend e-government program theirselves |
| x26 Staff uses actively |
| x27 Staff supports e-government program |
| x28 Staff works coordinating with each other |

| **CIO Resource Coordination ability** |
| x32 CIO’s administration and coordination ability |

| **Information Center’s Project Manager’s Ability** |
| x34 Project manager’s administrative operations and system requirement analysis ability |
### Table 5 Suppliers’ Product & Technical Service

<table>
<thead>
<tr>
<th>Suppliers’ Product &amp; Technical Service</th>
<th>Suppliers’ Technical Service</th>
<th>X42</th>
<th>A high level of technology suppliers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suppliers’ Project Manager’s Ability</td>
<td>X43</td>
<td>Suppliers’ project manager has extensive project experience</td>
<td></td>
</tr>
<tr>
<td>X44</td>
<td>Suppliers’ project manager communication and coordination ability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Products Matching Business</td>
<td>X46</td>
<td>Software has high flexibility, can facilitate the adjustment process and develop new features</td>
<td></td>
</tr>
<tr>
<td>Government Information Resources</td>
<td>X47</td>
<td>System has high security</td>
<td></td>
</tr>
<tr>
<td>Integration</td>
<td>X48</td>
<td>Subsystem enables multiple business information resource integration</td>
<td></td>
</tr>
<tr>
<td></td>
<td>X49</td>
<td>System performance is good, fast and stable operation</td>
<td></td>
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</table>

### Table 6 External Technical Environmental Factors

<table>
<thead>
<tr>
<th>External Technical Environmental Factors</th>
<th>Application Technical Environment</th>
<th>X16</th>
<th>The level of development and application of e-commerce</th>
</tr>
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<tbody>
<tr>
<td>X17</td>
<td>Business of e-government public services and willingness to accept</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X18</td>
<td>Citizens of e-government public services and willingness to accept</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 7 Information Center Coordination & Supportive Ability

<table>
<thead>
<tr>
<th>Information Center Coordination &amp; Supportive Ability</th>
<th>Information Center’s Supportive Ability</th>
<th>X38</th>
<th>Information center’s engineers to provide on-call support services</th>
</tr>
</thead>
<tbody>
<tr>
<td>X39</td>
<td>Information center’s engineers are skilled, on-site problem-solving ability</td>
<td></td>
<td></td>
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### Table 8 External Policy Environmental Factors

<table>
<thead>
<tr>
<th>External Policy Environmental Factors(X0)</th>
<th>Policies, Regulations and System’s Security System</th>
<th>X11</th>
<th>Sound policies and regulations or normative systems that use system</th>
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<tbody>
<tr>
<td></td>
<td>X12</td>
<td>Administrative system in the vertical business systems and dependencies between the Government Management Platform named “Fragmentation”</td>
<td></td>
</tr>
</tbody>
</table>
TIME-DECAY-BASED REPUTATION METHOD FOR BUYERS MAKING DECISIONS IN ONLINE SHOPPING

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Abstract
Trust and reputation is considered a significant part of the Internet marketing. Internet transactions or interactions involve anonymity of participants, which are more risky on account of uncertainty about the quality of service or identity of service providers. Reputation system is a mechanism to determine who is trustworthy and induce Internet marketing’s participants to maintain a good reputation while performing Internet activities. We consider that the evaluation of service provider’s reputation or participant’s honesty and responsibility constrained in some way by three factors, they are service quality, transaction time, and dollar value involved in the transaction(s), we called them as triple constraint. Very little research had done to pinpoint the relationship between trust and reputation with this triple constraint, especially when trust decay and time decay factors involved in the reputation evaluation process. We propose and investigate a novel dynamic trust and reputation framework based on the three factors mentioned above to reflect the more realistic reputation of the service providers in the Internet market.

Keyword: time decay, feedback, reputation, trust, online shopping

Introduction
The Internet is profoundly affecting almost all businesses and commerce paradigms [14]. It not only provides the opportunity for companies switching from “brick-and-mortar” traditional behaviour to “brick-and-clicks” businesses style, but also opens up new opportunities to provide quality products and improved customers services in the most efficient way as traditional businesses provide. In addition, Internet marketing also offers several benefits such as timing, immediacy, less expensive, targeting and scalability. Some studies have showed that people worldwide are making greater and more diverse use of the Internet meanwhile Internet sales continue to grow up [16][20]. According to Statistics Canada report, that more Canadian used the Internet to purchase goods and services in 2007, which totally worth $12.8 billion of orders, up 61% from 2005 [21]. Internet has become a supplement to traditional retail shopping more than a substitute. In fact, Internet marketing has become an essential part of today’s electronic business since its core value is its ability to promote productivity and efficiency.

For doing successful business on the Internet, effective marketing strategies and necessary evaluation procedures must be established and one of them is the implementing feedback mechanism or reputation system. Reputation system is considered a significant part of the Internet business. Since Internet transactions involve anonymity of participants, which are more risky on account of uncertainty about the service of quality or identity of service providers, people would like to deal with honest merchants and reputation system is how to determine who is trustworthy. We consider that that the evaluation of service provider's reputation or participant’s honesty and responsibility constrained in some way by three factors, they are service quality, transaction time, and dollar value involved in the transaction(s), we called them as triple constraint.

Since Internet marketing is prosperous growing up, fraud on the Internet is also developing into a major threat for consumers, business and governments [8]. We consider that Internet market and frauds as well as being developed or used reputation systems are close combined together, it is necessary and worthy to treat them as a whole while doing study to gain a significant understanding from the reputation system.

Trust and Reputation Systems
Trust and reputation are considered pure abstract concepts. They can become more meaningful only after applying to certain physical participants or entities. Trust and reputation are tightly coupled and platform-independent components that allows communications being carried out during processes between participants. They have led to new breed of systems, which are quickly becoming an indispensable component of every successful online trading community: online feedback mechanisms [4], also known as reputation systems [17]. Reputation system provides a virtual platform which combining these two components together to address individual participant’ past behaviour and to predict future behaviour.
The Internet marketing have created numerous opportunities to interact with strangers; these processes are also obviously raising a number of challenges such as lack of quality of services or even fraud during transactions, which may form asymmetric information flowing and lead up to the lemon problem [1] and finally only the lowest quality goods are traded and thus opportunities to achieve better profits from trading high quality goods are forgone [23].

The concept of trust is generally considered having broad-based meaning and varies between disciplines. Therefore, researchers in psychology, sociology, history, political science, economics and information technology area have done lots of research work to create suitable definitions for this abstract and crucial concept.

Lewicki and Bunker (1996) based on previous researchers’ work [2][19] consider trust development to be an iterative process and a dynamic phenomenon that takes on a different character in the early, developing and mature stages of a relationship with each participant involved [12]. Wang and Vassileva (2003) define trust as a peer’s belief in another peer’s capabilities, honesty and reliability based on its own direct experiences [22]. Dillon, Chang, and Hussain (2004) also consider that trust has a dynamic aspect in the virtual world [6].

In information technology field, Marsh (1994) is among the first to introduce a computational model for trust in the distributed artificial intelligence [13]. His model is complex, but draws on many relevant real world phenomenons based on social and psychological factors. He defines trust in three categories which are basic trust, general trust and situational trust. Although his work is widely cited, but the model is theoretical and often considered too difficult to practically implement [9][15].

Sabater and Sierra (2001) define reputation as the opinion or view about something [18]. This opinion can be updated direct interactions or indirect experiences from other members while Resnick et al. (2000) point out that reputation to be the community opinion of a subject’s standing [17]. Jøsang, Ismail and Boyd (2007) define reputation as generally said or believed about a person’s or thing’s character or standing [11].

Reputation system collects, distributes, and aggregates feedback about participants’ past behaviour [17]. Generally, in order to operate reputation system effectively and to provide incentives for honest and trustworthy behaviour, several properties must be taken into account [7][17], they are:

1. Entities are long-lived, so that there are chances of future interaction;
2. Feedback about current interactions is recorded and distributed, such information must be visible in the future;
3. The costs for submitting and distributing feedback should be reasonable low;
4. Feedback information must be aggregated and presented in a suitable way to guide trust decisions;
5. Showing clear guidelines on how the rating system operates and how potential conflicts can be resolved;
6. The reputation system provider itself must be reputable and trustworthy.

The most significant feature of Internet market is that it has implemented the reputation system or feedback system. The Internet market’s giant, eBay firstly introduced reputation system into the Internet market and enables its online auction system. This revolutionary pioneering spirit has been greatly absorbed by many other companies since then and significantly promotes the healthy development of Internet market. Several literature or books have tried to establish methods or framework to make comparisons possible between these reputation systems current in use in the Internet market. Based on previous researches [3][5][10], Table 1 at the end of this paper summarizes several noteworthy examples of Internet market reputation systems in use today.

**Time-Decay Trust Function**

As described previously, trust and reputation are crucial to a service participant or a service provider’s success. Service providers closely work with service participants and the other people involved in certain reputation system to meet individual goals and vice versa.

Every service provider or participant’s reputation is often considered consisting of a series of discrete points or values and constrained in different ways by several factors, such as quality of service, transaction time, and dollar value involved in evaluating process of provider or participant’s honesty and responsibility. We call these three factors as the triple constraint. To create a successful reputation system and give a reasonable result, quality, time and dollar value must be reflected in the reputation system.

Here, we give their operational definitions which will be frequently used in our dynamic trust and reputation framework described below.

1. **Definition 1** (Quality of service): The satisfaction level of unique product or service received by service participant from committed service providers. Normally, it involved two dimensional evaluation criteria,
2. Definition 2 (Transaction time): It denotes the time period during which a transaction take place. Since our model especially focuses on decay, the date after service participant receives product or service will play an important role, because it would affect reputation of the service provider in the future.

3. Definition 3 (Dollar value or Transaction value): The amount of money spent for the product or to complete the service.

Due to the page limit, in this paper, we propose and investigate a new dynamic trust and reputation framework based on the two factor mentioned above for improving rating service to reflect the more realistic reputation of the service providers in the Internet market. Actually time factor will play an important role on the obtaining the reputation of service providers at different length of time windows.

The level of trust relationship between service provider(s) and participants after each transaction or interaction can be represented numerically or linguistically by different scale systems. Sometimes these representations can be mutually exchangeable. It is reported that eBay provides three scales such as positive, neutral, and negative (i.e. 1, 0, -1) to allow buyer and seller to rate each other. The advantage of eBay’s mechanism is that it is simple and easy to be understood by average users. However, due to its primitive, this led to a vague image of the service provider’s reputation [11]. Amazon and Elance use five scale rating system to evaluate the seller’s trustworthiness through buyer while ignore seller’s feedback on ratings. The latter approach is a step further to detail ratings scale than eBay’s method. Apparently, a reputation system with five scale levels is better than a system with three levels. However, it doesn’t mean the more scale levels the better. In our proposed model, we also use five scale rating system, the difference is that our defined rating levels are distributed over the most positive aspects as listed in Table 2.

Since we want to quantify representing the trustworthiness of the service provider, it is unavoidable that we mathematically calculate the trust values. The value of trustworthiness is computed based on past experiences given by the service participants for a specific service provider and it can be converted into five scale star system. Therefore, we also give the corresponding reputation levels versus the values of trustworthiness. These calculated numerical values called trust values that ranges from [1...5] can be interchanged to linguistic representations such as “Excellent”, “Very Good”, “Good”, “Fair” and “Poor”.

The reason that we leave only one scale to represent the reputation level “Poor” is that, in Internet market, people would like to deal with honest merchants or in other words, no one would like to conduct business with service provider(s) only having 50% possibility or even lower success rate. Therefore, there is no point to define extra scale ratings such as “Very poor” or “Extremely poor”. Since most transactions involved in the Internet market are participants with anonymity, there are certainly possibilities that uncertainty and risk accompanying online trading course. We encourage people to deal with only the service providers with higher reputations to reduce these potential risks to the minimum level.

The reputation of the service provider is considered consisting of a series of discrete numeric values given by the service participants in the reputation model. These values can change from time to time. They are accumulated together at a given length of time to generate an average value which is used to determine the trustworthiness of the service provider. For each individual transaction, the given value of trustworthiness of service provider may not in a stable stage which means it might go up or down after this transaction. We call this as trust shifts or trust transient phenomenon as Figure 1 shows.

In business environment, once the service provider accumulate enough “trust” from service participants and keep momentum on good customers service, their reputation will maintain certain level or even go to upper level. However, this process can go in the opposite direction if service provider loses confidence from service participants, their reputation level will go down.

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In business environment, once the service provider accumulate enough “trust” from service participants and keep momentum on good customers service, their reputation will maintain certain level or even go to upper level. However, this process can go in the opposite direction if service provider loses confidence from service participants, their reputation level will go down.
Time based decay function is a concept which can be used to model trust decay phenomena and leading to the question about the realistic trustworthiness about the reputation of service provider. Actually, trust decay is the tendency for trust to weaken or disappear over certain period of time. For instance, if customer John trusts restaurant A at level B based on personal experience ten years ago, the trust level today is very likely to be lower or to be faded from his mind unless he has provoked one or more return visits to his venerable one since then. In this research, we introduced time stamp into the decay function to enhance trust aggregation and reputation representation. In reality, the decay process may take either exponential or linear format. In our research, we use simple linear depreciating function which decays the trust value by passed months relative to current month. The decay rate based on time $R_{time}$ can be represented as following:

$$R_{time} = \text{desired percentage of decayed rating} \div (\text{number of months involved} - 1)$$

For instance, we consider that the desired decay rate after one year decay is one star (20 percentage of rating change based on five star rating scale levels), and there are 11 months (current month does not have any contribution to the decay process) for one year run, the decay rate would be calculated as: $R_{time} = 0.2/11$ or 1/55.

Once we have decided to consider decay factor in obtaining the trustworthiness of reputation, furthermore, we also consider the time weighting factor and assign different weight to different time slot’s feedbacks. Where, time slot is a period of time that corresponds to an academic cycle, and during which various feedbacks can be collected. We assign equal weight to all transactions’ feedbacks at the same time slot. Different time slot may have different period of time. The more recent time slot, the more weigh for feedbacks.

**Conclusions**

In this paper, a novel application of dynamic trust and reputation system framework is presented for Internet marketing. The algorithm takes into account three factors or called the triple constraints, i.e., quality of service, transaction time, and transaction value which are involved in evaluating process of provider or participant’s honesty and responsibility; therefore, the system can give more reliable and reasonable trustworthiness value of the service providers or participants. The core idea of the framework’s algorithm is to express quantitatively representing the trustworthiness of the service providers or service participants.

There is still some work needs to be done to make this feasible system in practical in Internet market environments. Those are:

1. Consider the third factor, transaction amount, when design the time-decay trust function;
2. Evaluate the performance of the proposed system framework with realistic data; and,
3. A further refine work related to decay algorithms may be modified. Since we adopt the linear depreciating function in this paper, exponential depreciating function may also be used if applicable.

The proposed dynamic trust and reputation system framework will be helpful and an alternative approach to overcome some limitations of reputation systems or feedback mechanisms currently in use and give more realistic trustworthiness value to reflect the reputation of the service providers.

**References**


**Appendix**

Table 1. Examples of Internet Market Reputation Systems

<table>
<thead>
<tr>
<th>Business Name</th>
<th>Summary of Reputation System</th>
<th>Format of Solicited Feedback</th>
<th>Format of Published Feedback</th>
</tr>
</thead>
<tbody>
<tr>
<td>eBay&lt;sup&gt;1&lt;/sup&gt;</td>
<td>Buyers and sellers rate one another following transactions; PowerSeller: 98% total positive feedback in terms of consistent sales volume and customer satisfaction;</td>
<td>Positive, negative or neutral rating plus short comment; Rated party may post a response</td>
<td>Sums of positive, negative and neutral ratings received in the last 1, 6, and 12 months; Members can be authorized colored star based on earned feedback score from yellow star (at least 10) all the way to a red shooting star (above 100,000)</td>
</tr>
<tr>
<td>Elance&lt;sup&gt;2&lt;/sup&gt;</td>
<td>Business employer and service provider rate one another following transactions</td>
<td>Numerical rating from one to five plus comment based on the satisfaction received by business employer; Service provider may post a response</td>
<td>Rating calculated based on same criteria with different weighed factor; Average of ratings received during past six months and lifetime</td>
</tr>
<tr>
<td>Epinions&lt;sup&gt;3&lt;/sup&gt;</td>
<td>Users write reviews about a variety of different products/services; Other members can also rate the usefulness of reviews</td>
<td>Users rate multiple aspects of reviewed items typically on a scale of one to five; Readers rate reviews based on a scale of four ratings, from very useful to useless, etc.</td>
<td>Averages of item ratings; % of readers who found a review “useful”</td>
</tr>
<tr>
<td>BizRate&lt;sup&gt;4&lt;/sup&gt;</td>
<td>Users write reviews and rate products; Offering &quot;Customer Certified&quot; identification logo based on some criteria</td>
<td>Four BizRate Smiley Scale about a store's capabilities; Five star rating about a product; 16 quality ratings applied to evaluate the produce and service</td>
<td>Store Ratings and Reviews updated on a weekly basis and based on last 90 days data;</td>
</tr>
</tbody>
</table>

<sup>1</sup>eBay. http://www.ebay.com  
<sup>2</sup>Elance. http://www.elance.com  
<sup>4</sup>BizRate. http://www.bizrate.com

Table 2. Schematic Diagram of Trust Value and Its Star Rating

<table>
<thead>
<tr>
<th>Trust Value (%)</th>
<th>Stars Rating</th>
<th>Reputation</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 (95 ~ 100)</td>
<td>★★★★★</td>
<td>Excellent</td>
</tr>
<tr>
<td>4 (85 ~ 94.9)</td>
<td>★★★☆☆</td>
<td>Very Good</td>
</tr>
<tr>
<td>3 (70 ~ 84.9)</td>
<td>★★★☆</td>
<td>Good</td>
</tr>
<tr>
<td>2 (50 ~ 69.9)</td>
<td>★★☆</td>
<td>Fair</td>
</tr>
<tr>
<td>1 (0.1 ~ 49.9)</td>
<td>★☆</td>
<td>Poor</td>
</tr>
<tr>
<td>0</td>
<td>No Rating</td>
<td>New Service Provider or Participant</td>
</tr>
</tbody>
</table>
THE ROLE OF ESPoused NATIONAL CULTURAL VALUES IN FACEBOOK ADOPTION: A REPLICATION WITH ARABIC SAMPLE

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Abstract
With about 30% increase over three months, Facebook has become a major online venue among Arabic young generation. However the understanding of its adoption as well as the cultural influence remains in its infancy. In recent study, Srite and Karahanna [1] examined the cultural impact at the individual level and, built upon Hofstede’s framework, conceptualize it as espoused national cultural values, which were proposed to moderating the effects of TAM variables, i.e., perceived usefulness, perceived ease of use and subjective norms, on IT acceptance. Although insightful, the conceptualization of espoused national cultural values and its impacts requires further validation with subjects from different cultural backgrounds and IT artifacts which may be more subject to cultural influences, e.g., social networking sites. Therefore, this study is aimed to validate and extend the work by Srite and Karahanna [1] by examining the role of espoused national cultural values in Facebook adoption among Arabic female college students. Considering the cultural differences, we extended the original cultural dimensions in [1] to incorporate long-term orientation and also explicate the dimension of collectivism/individualism along two directions, e.g., horizontal vs. vertical. Different from the IT artifacts (PC and PDA) examined in [1], the IT artifact examined in this study is Facebook and its usage may be subject to more cultural influences than using PC and/or PDA, since Facebook involves a lot of social interaction and socialization.

A survey study with 200 college female students in Abu Dhabi, the capital city of UAE was conducted to validate the research model. 127 students returned the valid responses. At the moment of data collection, all respondents were new users of Facebook. Data collection involved two stages. The first stage was to collect the response for TAM variables and espoused national cultural values; while the second one, after one week, was for Facebook adoption. Smart PLS was used for data analysis. We expect that the results not only provide further empirical validation of Srite & Karahanna’s theory [1] with Arabic sample, but also extend the original research by demonstrating complete range of cultural dimensions. Currently, we are in the stage of finalizing data analysis results. By the time of the conference, we shall be able to provide the complete results.

Keywords: Facebook, Adoption, Cultural Impacts

References
AN EMPIRICAL INVESTIGATION OF BIDDING STRATEGIES AND THEIR EFFECTS ON ONLINE SINGLE-UNIT AUCTIONS

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Abstract
Online bidding strategy is one of the most discussed topics in online auction research. This research aims to empirically confirm online bidding strategies in single-unit auctions and evaluate these strategies in the context of auction winning outcome, final price evaluation, and perceived enjoyment. Both objective and subjective data of online single-unit auctions were collected to validate our postulated hypotheses. Our findings suggest that there are three basic bidding strategies in single-unit auctions and they indeed have different impacts on auction biddings.

Introduction
In recent years, online auctions have received wide acceptance in electronic commerce. This new form of electronic shopping channel offers advantages of flexible pricing, convenient access, time saving, and diversified product offerings [36] that traditional sales channels could not offer. The success and popularity of online auctions have drawn many researchers’ interest in this research domain. Many researchers have devoted much to the investigations of such topics as Internet auctions development [11] [46], auction site technology and service [24] [40], bidding behaviour [8] [9] [12] [19] [31], reputation or trust [4] [22] [27] [40] [41], winner’s curse [6] [33], mechanisms [16] [23] [25] [28] [39]. Recently, some researchers performed a meta-analysis of eighty-three articles on online auctions and concluded that research on this topic can be categorised into three major areas – facilitating factors, consumer behaviour and auction outcomes [17].

Although much research has been carried out in an attempt to understand online auctions, not much effort has been devoted to investigate bidders’ bidding strategies. Of these limited investigations, some researchers [10] have thoroughly studied online bidders using objective bidding data extracted from Yankee auction websites. Through the analysis of these objective data, they found that bidders in Yankee auctions are not homogeneous in terms of their bidding behaviors. They also found that different bidding strategies will generate different auction outcomes, including winning likelihood and consumer surplus extraction.

Undeniably, the findings of Bapna et al. [10] contribute significantly to our understanding of bidding behavior and bidding strategy in online auctions. However, the Yankee auction they studied is one kind of multi-unit auction and another popular auction type in e-commerce is single-unit auction. There are some differences between these two kinds of auctions. For example, in Yankee auctions, bidders do not only bid on prices but also on units (can be more than one, but less than the quantity on auctioned). Bidding takes place progressively on a predetermined starting price and bid increment. Bidders with the highest bids won the auction. If there was a tie on winning bids and there were not sufficient units for all winners, the tie would be broken first by price, second by quantity, and third by time. Single-unit auction, on the other hand, follows English auction’s mechanism, which begins with the lowest acceptable price until no bidder will further increase the bid. With this auction mechanism, there is always one unit auctioned at a time and the winning bidder is always the one with the highest bid. Hence, time priority is not a concern in single-unit auctions.

With the difference between single- and multi-unit auctions, it is thus critical to investigate the applicability of bidding strategies identified in multi-unit auctions to single-unit auctions. In addition, findings based on objective data is limited in shedding light on the application rationale of these bidding strategies, their impacts on bidding outcomes, and their applications in fulfilling bidding motivations. An empirical survey of bidders in their adoptions of bidding strategies, thus, may complement and supplement the observations derived from objective data. In this regard, we proposed three research questions to investigate the bidding strategies in single-unit...
auctions and their impacts on biddings. These questions are:
1. In single-unit auctions, when bidders bid, do they really follow different bidding strategies?
2. What are the bidding strategies these bidders adopt?
3. How do these bidding strategies impact auction winning outcome, final price evaluation, and bidding enjoyment?

Research Background
A bidding strategy represents a series of interrelated types of bidding behaviour that a bidder adopts with a certain purpose or tactic in mind across different phases of an online auction [1]. Bapna et al. [8] [9] [10] have studied bidding strategies using bid time (including the entry and the exit time) and the number of bids as proxies, together with the observation of the bidding price. Based on these criteria, they clustered online bidders into five categories -- evaluators (early or middle), participators, agent bidders, opportunists, and sip-and-dippers. Evaluators refer to bidders who place just one bid at an early stage (or sometimes in middle stages) of an auction; participators are bidders who bid throughout the auction, thus increasing the price by the minimal bid increment; agent bidders use online bidding agents to bid at the minimal level required to outbid the current highest bidder until the bid exceeds the reserve price they set earlier; opportunists are late bidders who act only towards the end of an auction; and sip-and-dippers bid both in the early stage and near the end.

The classification shows that different bidders adopt different bidding strategies. Evaluators “evaluate” the auction through their sole bid that is usually increased by a “jump”, bigger than the minimal bid increment. This bidding strategy is called “jump bidding” [12] [19]. Participators follow other bidders and increase their prices by the minimal bid increment. This common strategy is called ratchet bidding (or nibbling) [15] [21]. Agent bidders employ online bidding agents in submitting their bids, which is called agent bidding [19]. Opportunists only bid near the end of auctions. The strategy taken by them is believed to be snipe bidding (or late bidding) [12] [31] [37]. Sip-and-dippers are also believed to adopt snipe bidding except that they have one bid in the early stage that is only for getting the time priority in some multi-unit auctions.

The research of Bapna et al. [10] does not only identify and describe heterogeneous bidder types in Yankee auctions, but also examines the auction outcomes of these bidders. In their study, winning likelihood and consumer surplus extraction are the two auction outcome variables they investigated. First, they found that the probability of winning amongst different bidder types is unequal. Their findings show that opportunists and sip-and-dippers have the highest winning likelihood, followed by participators, evaluators, and agent bidders. They also found that bidders have different ability of extracting consumer surplus, led by agent bidders, and trailed by participators, evaluators, opportunists, and sip-and-dippers.

Research Hypotheses
This study aims to identify the bidding strategies and their auction outcomes in the context of single-unit auctions. Based on literature review, bidders bid differently in Yankee auctions using different strategies. These identified strategies will be re-examined in single-unit auctions and extended to test their impacts on winning outcome, final price evaluation, and perceived enjoyment. Auction winning outcome investigates whether a bidder wins an auction. Final price evaluation is a winners’ subjective evaluation of her/his final auction price. Perceived enjoyment assesses the hedonic effect achieved through auction participation.

Bidding Strategies
Bapna et al. [10] have found the heterogeneity of bidders in their investigation of Yankee auctions. These bidders actually take four basic types of bidding strategies, including jump bidding, agent bidding, ratchet bidding and snipe bidding. Although Yankee auction supports multi-unit auction and its rules are different from those of single-unit auctions, we believe that the bidding strategies identified in Yankee auctions could be extended to single-unit auctions as well. Hence, we hypothesize that:

H1a: Online bidders in single-unit auctions, as in multi-unit auctions, are heterogeneous in their bidding strategies.

H1b: Single-unit auction bidders, like their multi-unit auction counterparts, also adopt similar strategies in their biddings.

Winning Outcome
Bapna et al. [10] found that bidders with different bidding strategies have different winning likelihood in Yankee auctions. Opportunists and sip-and-dippers were found to have the highest percentage of winning their auctions, followed by evaluators, participators, and agent bidders. Presumably, it is the bidding strategies that caused a difference in winning likelihood. Opportunists and sip-and-dippers, for example, are more eager to win, thus motivating them to adopt snipe bidding strategy. With this bidding strategy, bidders snipe just before
the end of auctions, leaving other bidders little time to respond, which highly increases their chance of winning. Bidders with jump bidding strategy submit bids that are much higher than required, thus intimidating their competitors and creating a better chance for their winning. This strategy has been found to be preferred by experienced bidders [12] and effective in auctions with fewer overall bids [3] [10] [19]. Ratchet bidding, on the other hand, requires bidders to observe and act continuously during auctions, thus increasing their commitment and consequential winning likelihood. Of the four bidding strategies, agent bidding is the most mechanical and the least flexible. This strategy also involves the least commitment, time, and resources from the bidders, which probably could have a reverse effect on winning likelihood. Based on the above findings and discussions, we propose that:

**H2:** Different bidding strategies have different auction winning outcomes in single-unit auctions.

**Final Price Evaluation**

Bapna et al. [10] validated that bidding strategies have differential effects on the extraction of consumer surplus. In multi-unit Yankee auctions, the winning bidders pay their own winning prices, which may be higher than the lowest winning price, called marginal price. The loss of consumer surplus is thus the difference of the actual price paid and the marginal price. In single-unit auctions, the winning bidders pay the actual winning prices that may be different from the maximum prices they are willing to pay for the auctions. Therefore, the logic of consumer surplus still exists in single-unit auctions, but is conceptualized and calculated in a different way. If a winning price is lower than what a bidder is willing to pay, this bidder has a positive consumer surplus. Given the findings that bidding strategies have differential effects on the extraction of consumer surplus, it is believed that bidding strategies could also have differential effects on the evaluation of final prices in winning auctions. Hence, we propose that:

**H3:** Different bidding strategies result in different evaluations of final auction prices in single-unit auctions.

**Perceived Enjoyment**

Different bidding strategies could have different effects on bidding process and consequence, which may affect the bidders’ perceived enjoyment during an auction. For example, sniping other bidders near the end of auctions could be exciting by offering just one bid, which could possibly bring success. Ratchet bidding could also be enjoyable by following the bids of others continuously and closely, which could turn an auction into a game. Jump and agent bidding strategies may also have different intensity of ‘fun’. Hence, we propose:

**H4:** Different bidding strategies result in different extent of bidders’ perceived enjoyment in single-unit auctions.

**Research Methodology**

**Instrument Development and Pre-test**

This study adopted an online survey approach in data collection. A three-stage validation process was performed to ensure the validity and reliability of our questionnaire. First, whenever possible, previously validated questions and generally accepted instrument construction guidelines [14] [20] [45] were followed. Second, the survey was pre-tested by four business professors with expertise in survey research, IS, and auction; and by six graduate students. The feedback from this phase resulted in some restructuring and refinement of the survey to improve its quality and content validity. Third, a pilot study of the questionnaire was administered to 25 online bidders randomly chosen from Taobao.com – a major online auction website in China. The Cronbach’s alphas for all question items in this pilot test were above or near 0.80, suggesting adequate reliability of the questionnaire [32]. The pilot test also resulted in a few changes in wording and sentence structure, which improved the survey’s content validity.

**Data Collection**

Both objective and subjective data in our research were collected from online bidders randomly chosen from the completed single-unit auctions in Taobao.com following a three-stage process. First, auctions completed recently in Taobao.com were randomly selected for our survey. Second, six hundred bidders were randomly chosen from the bidding lists of these auctions. Only validated bidders, whose identities have been validated by Taobao.com, were selected. Third, the chosen participants were contacted through an online instant messenger – WangWang. An online tool provided by Taobao.com was administered to 25 online bidders randomly selected. The chosen bidders were sent a brief introduction, including the research objective and requirements, and an invitation to participate in our study. They were also informed of a RMB¥10 reward if they successfully complete an online survey. A total of 186 bidders responded positively to our invitation. They were asked to complete an online questionnaire hosted in the website of a professional online survey company. The use of this service allowed us to deal with the problems of access control, authentication and multiple
responses associated with web-based data collection [44].

At the end of two months, after two rounds of reminding messages, 179 bidders completed the questionnaire. These respondents’ user IDs were then used to match the IDs of their auction information recorded in Taobao.com. Both subjective survey data and objective bidding data were used to evaluate the research hypotheses proposed in our study.

Variable Operationalization

The measure of \textit{winning outcome} was based on Bapna et al.’s [10] winning likelihood. The only difference is that winning outcome measures whether a bidder has won the auction as an outcome; while winning likelihood measures the percentage of winning auctions in one group. \textit{Final price evaluation} was adapted from Padula and Busacca’s study [34], which evaluated price from the dimensions of cheapness, fairness and variety. However, their study evaluates products that may have a variety of prices, which differs from our study that each auction has only one final price without any variety. Therefore, price variety dimension was dropped while the other two were kept. The measures of \textit{perceived enjoyment} were adapted from research on hedonic shopping, including adventure perception [2] and joy perception [5].

Data Analysis and Results

Respondent Profile

Among the 179 valid respondents, 77.1% of them are female and 22.9% male. Ninety-five percent of them are in the age range of between 19 and 38. They are mostly college/university educated (81%) and with a monthly income of less than 3000RMB (71.5%). Their occupations are also widely distributed, with government employees, free workers, students, and academics topping the list.

Reliability and Validity Analysis

This study has taken a number of measures to ensure the validity and reliability of the instrument. As far as the instrument’s construct reliability is concerned, a reliability test calculating Cronbach’s alpha values was performed. The alpha values of final price evaluation and perceived enjoyment were 0.909 and 0.865 respectively, which are significantly above the 0.7 threshold level.

The instrument was further assessed for its construct reliability using exploratory factor analysis (EFA). The initial factoring step involved the application of principal-component analysis to determine the adequate number of factors to explain the observed correlations. Kaiser's rule was then applied to remove the principal components whose eigenvalues were less than one; this resulted in a two-factor solution loaded in accordance with the \textit{a priori} theoretical expectation. Next, a two-factor solution was forced by utilizing orthogonal (Varimax) rotation. Only those items with factor loadings larger than 0.5 were then used in further analyses. The results of this two-step factor analysis are shown in Table 1.

<table>
<thead>
<tr>
<th></th>
<th>Perceived Enjoyment</th>
<th>Final Price Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>PE1</td>
<td>.688</td>
<td>-.177</td>
</tr>
<tr>
<td>PE2</td>
<td>.711</td>
<td>-.139</td>
</tr>
<tr>
<td>PE3</td>
<td>.796</td>
<td>.168</td>
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<td>PE6</td>
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<td>.264</td>
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<tr>
<td>FPE1</td>
<td>.079</td>
<td>.790</td>
</tr>
<tr>
<td>FPE2</td>
<td>.204</td>
<td>.821</td>
</tr>
<tr>
<td>FPE3</td>
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<td>.811</td>
</tr>
<tr>
<td>FPE4</td>
<td>.130</td>
<td>.892</td>
</tr>
<tr>
<td>Cronbach’s alpha</td>
<td>.865</td>
<td>.909</td>
</tr>
</tbody>
</table>

Table 1. The exploratory factor analysis results

The convergent validity of our constructs was also evaluated through its average variance extracted (AVE). The AVE values of these two factors are 0.54 and 0.70, all above 0.5, which surpassed the minimal recommended value. Furthermore, they are also higher than their shared variance, 0.11. In conclusion, the tests for both factor loading and AVE do not show any significant violations, thereby demonstrating adequate convergent and discriminant validity of our constructs.

Hypothesis Testing and Discussions

Five hypotheses were postulated in this study. The first two hypotheses on bidding strategies were validated with cluster analysis. The remaining three hypotheses that investigate the effect of bidding strategies on winning outcome, final price evaluation, and perceived enjoyment, were tested with ANOVA.

Cluster Analysis of Bidding Strategies

This study adopted a two-step cluster analysis method to identify the bidding strategies adopted in single-unit auctions. In Bapna et al.’s [10] investigation of bidder types, they selected time of entry, time of exit, and number of bids (NOB) as proxies in their cluster analysis. We adapted their approach and replaced the entry time and exit time with the sequence number of entry (SNOE) and the sequence number of exit (SNOX). The rationale for such changes was due to a large influx of bidders close to the end of auctions, resulting in many bidders having close entry time. The use of entry and exit sequence numbers could eliminate this
problem, but still preserved the logic of entry and exit time. In our cluster analysis, we also added a new proxy – number of agent bids (NOAB) – to help identify the frequency of agent use as a strategy. Because our sample auctions have different number of bids from each other, all selected proxies (SNOE, SNOX, NOB, and NOAB) were standardized (divided by the total number of bids in each auction) to eliminate any adverse effect on clustering.

In the first step of deriving bidders’ clusters, hierarchical cluster analysis was performed to generate a hierarchical dendogram and an agglomeration schedule table. The results suggest that the percentage of the change of and an agglomeration schedule table. The results performed to generate a hierarchical dendogram clusters, hierarchical cluster analysis was effect on clustering. This three-cluster solution of bidding strategies confirmed our proposal (H1a) that different bidders use different strategies in single-unit auctions.

Once the optimal cluster number was determined, our next step was to conduct a K-mean cluster analysis to generate this 3-cluster solution. The results, as shown in Table 2, suggest that Cluster 1 has the highest number of agent bids and could be interpreted as agent bidding. Cluster 2 has high SNOE and SNOX and low NOB and NOAB. It seems that bidders in this cluster bid late and infrequently, which are the major characteristics of snipe bidding. Cluster 3 suggests that bidders in this category are using ratchet bidding strategy due to earlier SNOE and more NOB than Cluster 2 but less NOAB than Cluster 1.

<table>
<thead>
<tr>
<th></th>
<th>Cluster 1 (n=53)</th>
<th>Cluster 2 (n=88)</th>
<th>Cluster 3 (n=38)</th>
<th>F-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNOE</td>
<td>0.314</td>
<td>0.799</td>
<td>0.242</td>
<td>173.79**</td>
</tr>
<tr>
<td>SNOX</td>
<td>0.932</td>
<td>0.964</td>
<td>0.450</td>
<td>36.47**</td>
</tr>
<tr>
<td>NOB</td>
<td>0.405</td>
<td>0.176</td>
<td>0.197</td>
<td>50.77**</td>
</tr>
<tr>
<td>NOAB</td>
<td>0.143</td>
<td>0.014</td>
<td>0.058</td>
<td>241.36**</td>
</tr>
</tbody>
</table>
* Significant at p<=0.1 level
** Significant at p<=0.05 level

Table 2. The Results of the Cluster Analysis

Our cluster analysis suggest that the strategies identified in the three-cluster solution shared similar characteristics with those strategies identified in previous studies [10] [12] [15] [19] [21] [37], thus supporting our hypothesis (H1b) that bidders in single-unit auctions also adopt similar bidding strategies, such as snipe bidding, agent bidding, and ratchet bidding.

Characteristics of Bidding Strategies
ANOVA analysis was then performed to compare the means of winning outcome, final price evaluation, and perceived enjoyment across the bidding strategies. The results suggested that the differences in the means of winning outcome and perceived enjoyment of the three bidding strategies were significant, thus supporting hypothesis (H2) that bidding strategies have differential impacts on auction winning outcome and hypothesis (H4) that bidding strategies have differential impacts on perceived enjoyment. We, however, did not find bidding strategies to have significantly different effect on final price evaluation (H3). Therefore, this hypothesis was not supported in our study.

Conclusions and limitations
This study aims to confirm the research findings of Bapna et al.’s [10] study on bidding strategies in a single-unit auction context and explore the impacts of these strategies on auction outcomes. Our research findings confirm most of our postulated hypotheses, which could shed some light on suggesting avenues for future e-auction explorations. In addition, we improved the cluster analysis by modifying and adding proxies to identify bidder clusters more objectively. However, this research has its own limitations. First, the data were collected from one online auction website, which may cause a bias in sampling. In future research, data from multiple auction websites have to be collected for theoretical validation and confirmation. Second, our sample size was not large enough for theoretical validation and development. Future studies should generate a larger sample size to validate and extend our research findings.

References


FUTURE ACHIEVEMENT IN ONLINE GAMES

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Abstract
Online games are popular electronic business applications and received considerable attentions from recent studies (Lim & Lee, 2009; Teng, 2008; Teng et al., 2008). Some gamers switch to other games, indicating the necessity to investigate antecedents of gamer loyalty. Achievement attainment is one key motivator of online gaming (Yee, 2006). Strong desire to attain achievements may shape future achievement as a relevant goal with a clear end-state. The goal-setting theory (Locke, 1996) posits that a relevant goal with a clear end-state can effectively motivate individuals to attain the goal. Applying this theory to online gaming, strong desire for future achievement is likely to motivate gamers to play online games repetitively for attaining future achievements.

This study thus investigated if desire for future achievement predicts gamer loyalty. The sample comprised 307 online gamers. The study measure exhibited satisfactory reliability and validity by satisfying the criteria in the literature. This study utilized regression analysis with gamer loyalty as the dependent variable. Independent variables were desire for future achievement and flow. Control variables were gender, age, education, income, gaming history (in months), and weekly usage (in hours). The analytical results indicated that gamer loyalty was positively related to desire for future achievement ($\beta = .46, t = 8.45, p < .01$), supporting the study hypothesis. This study also echoed the literature (Choi & Kim, 2004) by indicating a marginally positive relation between flow and gamer loyalty ($\beta = .07, t = 1.36, p < .10$).

This finding suggests game providers maintain gamer desire for future achievements. Game providers may demonstrate hard-to-see spectacular sound and light effects for attracting gamers to trigger and experience such effects by themselves.

Keywords: Online games, achievement, desire for future achievement, flow, gamer loyalty

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References
A FRAMEWORK FOR ANALYSIS ON THE PROCESS OF INFORMATION SYSTEM EVALUATION AND INVESTMENT DECISION

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Abstract
Information System (IS) investment evaluation has long been issue in the IS research. Traditional positivistic research dealt with cost-benefit rationale regarding why and how evaluate. Afterwards social and political view added issue to this stream by embedding the organizational context that makes evaluation more fraught with difficulties. The purpose of this paper is to provide a theoretical foundation and justification of the various organizational aspects of IS evaluation and decision process. By reviewing recent research that adopts institutional theory perspective on this issue and we develop two-staged evaluation process model constructed by the interaction among stakeholders and their roles. Participants of the process are two groups: IS evaluator group who evaluate the benefit of investment, and decision makers who examine suggestion of evaluator group and finally determine to invest or not. We argue that, during this interaction process, the organization’s institutional context influences the extent of the formality of evaluation criteria and the procedural rationality. From this dynamic process perspective, we propose a multidimensional analysis framework that constitutes four types of evaluation orientation: Mixed, Positive, Negative, and Control Evaluation Orientation. With this framework we discuss how stakeholders behave and affect investment decision under each evaluation orientation. Likewise, we also discuss how financially justified IS investments can be sometimes rejected or otherwise accepted in the politically situated evaluation process. We believe that this framework expands our understanding of IS evaluation and decision process and therefore contribute to IS research in this field. Also to practitioners, this study provides several implications regarding how to maintain the formal/rational evaluation procedure and how to acquire organizational consensus under socially complex organizational environment.

Keywords: IS evaluation, IS investment decision, Institutional Theory, rationality, organizational context

Introduction

In order for an organization to achieve a success in information system (IS) accompanied by a substantive amount of financial capital and human resources, thorough planning and management of IS investment are needed. This process is becoming more important nowadays as competitive economic environment has forced organizations cut costs significantly. As the beginning process of the IS investment management, evaluation of benefit against cost and subsequent decision of certain IS investment are usually exercised. Besides, the IS investment evaluation and decision usually consists a series of portfolio based managerial process regardless of private or public organizations. They have to choose some of the multiple investment alternatives after considerations of various aspects of cost and benefit of each alternative. Therefore, it can be the key issues whether decision makers have complied with the rationally justified evaluation criteria and the decision procedure based on consensus among investment proposers.

In this context, the study of IS investment evaluation and decision has carried out various forms of feasibility studies or investment appraisals, typically, using traditional cost-benefit analysis [2] [58]. This paradigm considers IS decision makers as rationalists who would choose one of the IS investments if it has the highest score of cost-benefit analysis.

However, the increasing complexity in the IS context challenges the traditional technical economic approaches. It is because IS evaluation is a socially embedded process in which formal assessments intertwine with the informal assessments by which actors make sense of their situation. Thus, they cannot explain the uncertainties and contextual dependencies concerning the value of IS investments. Therefore analyzing and understanding their role, interactions, under organizational context should be main concern of this research issue [17] [49].

Meanwhile, like many authors have argued, ‘interpretive’ research perspective would provide some ways to explain this complex issue rather than positivistic perspective [17] [19] [51] [55]. To our knowledge, however, this research stream had not been much studied in IS evaluation area, which especially focusing on the organization context and
social aspects during is investment priority selection.

Accordingly, this article aims to provide a theoretical foundation which structurize the IS investment evaluation and decision process and encompass the various organizational aspects of the process. The following section summarizes and examine previous research on IS evaluation and outline some of the assumptions made. Afterwards we suggest a conceptual framework which provide rationale to explain how evaluation diverge during the process participated by decision makers and related stakeholders.

**Literature Review**

**Rational Behavior Approach**

In the rational model approach, human behavior is assumed to be logical and consistent. Organization also pursues profitability and maximize utility[31]. Rationality in the organizational choice means one can identify all possible alternatives, and evaluate expected outcome from each alternative, finally select one of the alternatives which maximizes or optimizes the organization’s performance [6] [9] [28] [38].

This somewhat omniscience view of human ability applies to the early research in IS evaluation and investment decision [5] [17]. This conception sees evaluation as an external judgment of an IS which is treated as if it existed in isolation from its human and organizational components and effects. And technical and economic criteria were used to carry out project-driven, cost-focused evaluation [49].

In the same way, econometric analysis was used in the public sector. Following McFadden(1975,1976), bureaucracy comply economic principle with the Cost-Benefit Analysis(CBA), set investment priority by the result of the analysis which calculate the economic net benefits. The difference from private sector is that economic net benefits means more than financial, that is, social utility in macro level [34] [35].

Transaction cost theory supports this rational approach in a way that transaction costs can be measured, monitored and separated. Thus, the evaluation criteria for IS investment are organized to minimize transaction costs [57].

Contingency theory, although it focuses more on environmental uncertainty, has similar assumption to the rational model. While contingency theorists argue that there is no one best ‘fit’, they do posit that managers of organizations are able to rationally recognize the changing environment and then align their organizations to match the environment. It is also hypothesized that achieving fit leads to improved efficiency and performance. IS investments and its overall governance system would be implemented to achieve ‘fit’ [27] [54].

Agency theory and related research expand and extend the rational model theory. This theory emphasizes the problem in organization by adopting the concept of goal incongruence and information asymmetry between the principal and the agents. Agency theory provide useful implication to IS investment decision process with an idea that principle(decision maker) and some other internal stakeholders(agents) might have different interests during the decision process. However, it still assumes motivations are financial, thus still confines itself in the rational behavior theory [13].

To the extent that the traditional accountancy framework laid foundation of IS investment decision criteria, it still faces complicated issue on how to measure and evaluate the intangible and non-financial benefits. Therefore, this approach has been challenged for its problem of internal validity and external generalizability from social research [29]. One notable criticism is the argument that not every motivation is financial. We can observe many organizations have progressed from elementary cost–benefit analysis towards a more entrepreneurial approach which seeks to deliver long-term benefit while considering the intangible aspects and elements of risk and uncertainty [8] [56].

Also there are some criticisms about the limitation of the cognitive psychology of the rational model. Lamb & King(2003) argue the rational model describes an atomic individual with well-articulated preferences and the ability to exercise discretion in the ICT choice and use, within certain cognitive limits. Even though some extended rational models also describe how information from objects, the environment interacts with other atomic individuals, it is cognitively processed as feedback to fine-tune the preferences that influence discretion. Within this model, however, information is highly decontextualized [26].

From the social research perspective, which is the main interest in this paper, they criticize the rational model neglects the dynamic social influences that exist inside or outside the organizations. As per this view, the actions of individuals are embedded in concrete, ongoing systems of social relations [15]. Sociologists theorized this system as social structure, which describes the foundational structures of social institutions in terms of domination, legitimation, and signification [14]. Following section discuss
the sociological approaches to the organizational process of IS.

Political Behavior Approach
In the political behavior approach, organizational decision is assumed to be a political, social process [1] [11] [12] [44]. It defines political behavior as socially influencing behavior in order for individual or organization to protect or increase self interests [1].

Political approaches have following some characteristics regarding organizational decision. First, political behavior is focused on gaining organizationally sanctioned ends through non-sanctioned means or obtaining ends not sanctioned by the organization [33]. Second, while political activities are self-serving, leading to desired outcomes for the individual, perhaps at the expense of others and the organization, the real motivations behind the behaviors are often hidden from others. Third, in the political process, conflicts of interest and unequal power among members are assumed to be the rationale for political behavior [11]. Therefore, organizational actors try to exercise their power to achieve partisan goals rather than the organizational goal [46]. Finally political behaviors tend to occur in the competitive environments with unclear rules about how resources and outcomes are allocated [24].

Also to the IS field, researchers have long recognized the important role of power and politics [22] [32] [47]. Generally to the relationship between IS and organization, power determines the capability of an organizational unit and has to influence the behavior of other units and the organizational decision process [30]. Therefore, power activated during the IS decision process needs to be approached by multidimensional perspectives. Sillince and Mouakket(1997) provided five perspectives about power: zero sum, processual, organizational, structurally constrained, socially shaped(constructed) power [50]. While their concepts of structurally constrained or socially shaped power are more sophisticated way of dealing with power than earlier functionalistic approach, such disciplinary diversity rather makes it difficult to generate continued discussion and to accumulate a foundational body of research.

Institutional Theory Approach
In the diversified and complex IS investment evaluation and decision process, rational approach has difficulties to explain why and how rationally justified investments sometimes are rejected at the final decision stage. On the contrary, political/power approach, if we could ever parsimoniously simplify its core concept, failed to clearly explain rationally justified investments are still held in the high priority under politically conflicted situation. To colligate these two approaches from both extreme ends, we suggest Institutional theory as a baseline for comprehensive framework.

The Institutional theory is essentially concerned with how organizations are influenced by wider cultural and social environments and how organizational processes by which structures, including schemas, rules, norms, and routines, become established as authoritative guidelines for social behavior. Therefore it is capable of explaining factors that circumscribe individual and organizational behavior by various interactions between external environment and internal structure [39].

Institution are highly resilient social structures that have attained a high degree of resilience, which are composed of the cultural-cognitive, normative, and regulative elements that, together with associated activities and resources, provide stability and meaning to social life [48]. In the Institutional theory approach, organizations do not adopt organizational structures, instead adopt societally rationalized (institutionalized) structures to achieve legitimacy, regardless of the impact on efficiency [37].

DiMaggio and Powell(1993), focusing on the environmental institution, posited three forms of institutional isomorphism – coercive, mimetic and normative. Coercive isomorphism comes from legal pressures, political pressures or the kind of intense pressure of which powerful organizations are able to exert on less-powerful, dependent organizations. Mimetic isomorphism – the tendency to mimic other organizations, is posited as a response to uncertainty; in the uncertain environments organizations will mimic those organizations seen to be successful. Finally, normative isomorphism is associated with the professionalism associated with formal education and professional networks [10].

Scott(2001) categorized the literature into three ‘pillars’ of institutional theory – regulative, normative and cultural-cognitive. These pillars broadly match DiMaggio and Powell(1983)’s isomorphic pressures, more focusing on the internal structures of legitimation. The regulative pillar has expedience as its basis of compliance. Legitimacy is legally sanctioned and indicated by the presence of rules, laws and sanctions. Under the normative pillar, compliance is a social obligation and the existence of certification and accreditation among organizational fields points to a morally governed legitimacy. Cultural-cognitive is based on a shared understanding. Common beliefs and shared logic lead to a recognizable and culturally supported
basis of legitimacy [14] [48].

**IS Research with Institutional Theory Approach**

It seems not much research work has been done on IS investment decision from Institutional Theory perspective, study of Teo et al.(2003) and Miranda & Kim(2006) are considered distinguishable works on this perspective. Teo et. al(2003)’s work provided some empirical support for institutional-based variables as predictors of adoption intention of IS. In the article, institutional theory posits that mimetic, coercive, and normative pressures existing in an institutionalized environment could influence organizational predisposition toward an inter-organizational information linkage system, specifically, FEDI(Financial Electronic Data Interchange) [53]. Although he introduced Institutional variables into a theoretical framework of IS investment decision, its focusing on the external institutional pressure has some limitation of deterministic view to IS investment decision

In a different but advanced way, Miranda & Kim(2006) suggested more dynamic view considering how the appropriation of the logic of transaction cost economics is contingent on decision makers’ institutional context. They contextually interpreted Scott(2001)’s three institutional pillar and dichotomized into two institutional contexts - professional versus political contexts.

In professional contexts, the cognitive structures of procedural knowledge are central to the coordinated action, Regulation in its conventional sense is unnecessary, as uniformity is effected through consensus on the values of procedural rationality, Normative structures reference the procedural rationality and focus on its diffusion, In political contexts, regulation via political authority is key to the coordinated action. Unlike the ideologically homogenized professional contexts, interests and values can be diverse in political contexts. Cognitive structures play a weak role in these institutional contexts since shared meaning is not essential to ordered activity and is difficult to attain in the presence of varied interests and values. Normative structures legitimate the exercise of authority by those vested with it. While a level of the procedural rationality may still appear in such political contexts, it is not legitimated and its incidence is minimized with the increased incidence of the political behavior [42].

The work of Miranda & Kim(2006) provides significant hint to our research question. The dichotomous approach to professional/political context enables flexible explanation which was insufficient in either rational or political theory approach. Along with this contextual basis, following two exploratory studies may further develop our research idea.

A case study of Serafeimidis & Smithson(2003) used institutionalization as a new way to explain social interaction process while an organization initiates IS evaluation and its diffusion. The study divides IS evaluation related stakeholders into two groups – the strategist and the evaluator.

The ‘strategist for evaluation’ is involved in the creation, implementation and institutionalization of evaluation norms, principles, structures and methods. The tasks of a strategist, in general terms, include the analysis of the situation, the production and reproduction of normative values, and the maintenance and change of power relations. In a more unconventional way, a strategist can encourage and facilitate others to question conventional wisdom and increase awareness. The organizational status and power of the strategist should provide the authority to question traditions and to make commitments for change [49].

‘Evaluators’, on the other hand, receive the ‘evaluation strategy’, including the evaluation methods, tools and techniques, from the strategists and enact the strategy according to their interpretations. Every stakeholder from the evaluation party can act as a evaluator and evaluators cannot be considered as isolated from the evaluation action. They are recipients of the changes they initiate and, therefore, either beneficiaries or victims themselves [16]. The evaluator can be viewed and interpreted by his audience in various ways. In the case of a formal/rational evaluation exercise based on technical and economic criteria, the role of a formal evaluator includes not only the quantitative assessments, but also a ritual element of demonstrating management competence [49] [55].

Next, based on the two groups’ perception of objectives of the IS investment and impact on organization, four types of organizational institution are identified – Control, Sense-making, Social learning, Exploratory. Control evaluation refers to the cases where the expected outcomes of the investment, usually quantitative, are fairly certain and there is an organizational consensus around them. In cases where the objectives of the investment are not clear or predictable (e.g. a decision support system, a groupware system), a sense-making evaluation would form the basis of attempts to reach consensus. When expected objectives are usually clear, but there is uncertainty of their achievement, Social learning evaluation contributes to decreasing uncertainty of strategic changes. Exploratory evaluation is needed when the social learning faces a lack of consensus in terms of the objectives and/or the sense-making
cannot deal with the strategic nature of the change and its uncertainty (e.g. major outsourcing decisions, just-in-time manufacturing systems) [49, pp 257–258] If we see four types of evaluation orientation from the dichotomy view of formal/informal evaluation, three other types of evaluation except control evaluation deal with unpredictable evaluation results depending upon how strategists and evaluators informally interact with each other.

The concept of role division and distinctive evaluation orientation from Serafeimidis & Smithson(2003) is noticeable considering both the final approval authority and those with pre-decision involvements such as the initiation and development of IT investment proposals [60].

Overall, our study focuses on the informal process based on the taxonomy of institutional context from the study of Miranda & Kim(2006) and justification types from Irani(2002). We also hold the evaluation role concept of Serafeimidis & Smithson(2003) as well. In the next section, we propose new framework which encompass each distinctive form of IS evaluation and decision making process among stakeholders.

Analysis Framework
Based on the implication of previous research we developed a new analysis framework to analyze information systems investment evaluation process. The framework shows that when certain IS investment proposals are evaluated, four type of evaluation orientation are expected to be observed according to the evaluation role and the institutional decision context. These four types of evaluation changes are shown in the Figure 1

<table>
<thead>
<tr>
<th>Decision Context</th>
<th>Political Context</th>
<th>Professional Context</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concept Justification</td>
<td>Mixed Evaluation</td>
<td>Negative Evaluation</td>
</tr>
<tr>
<td>- Positive</td>
<td>- Positive when interests united</td>
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<tr>
<td>- Negative</td>
<td>- Negative when interests conflict</td>
<td></td>
</tr>
<tr>
<td>Financial Justification</td>
<td>Positive Evaluation</td>
<td>Control Evaluation</td>
</tr>
</tbody>
</table>

< Figure 1 - Research Framework >

Staged Evaluation Process
In the first step of the analysis, we are to premise that IS investment evaluation process passed through the staged process. We also assume that during the staged process, particular forms of Institutional structure are generated by the participant's social interaction until final decision is made. In general, following Mintzberg et al(1973) IS investment evaluation process has three step of procedure: Initiation, Development, Decision [40] [41].

At the initiation stage, the investment objects(Information system development, hardware and software procurement, etc) are recognized by the organization necessity or strategic directions. Development stage seems to be the starting point to identify information system's characteristic and functionality through defining detailed contents. At this stage, one can speculate stakeholders interpret the cost and benefit of the investment contents with their diversified organizational interest. At the last step, decision stage, based on the way of communication formed in former stage, investment is decided to be approved or not.

Justification Type
Irani(2002)’s work emphasized the role of stakeholders, whose benefit consideration is incongruent according to the organizational position. Depending on where the stakeholders posit in senior manager, middle manager, or even lower operational level, they might focus on different attribute of the cost and benefit.

Therefore, within the corporate policy and strategy, IT/IS benefits can be classified into strategic, tactical and operational benefits, with financial or non-financial and intangible natures. Financial benefit justification is the traditional appraisal procedures including the setting of project costs (direct) against quantifiable savings and benefits predicted to be achievable. Because this traditional view usually discourages long-term strategically important projects that typically offer intangible and non-financial benefits, he argues the practice of Concept Justification. Concept justification requires a softer, more persuasive approach, and is one that is predominantly interpretive in nature. This approach is likely to be sought by those with executive responsibilities, and is one of aligning the projects’ proposal with the medium/long-term strategic and financial business plan(s) of the company [20].

Although he concluded the search for an integrated generic technique impossible because of a wide variety of interacting social and technical factors, he provided some insightful implication; first we need to note that investment justification is subjective in nature rather than objective. Second, we need to focus on the interaction among stakeholders and various aspects of organizational context in order to see how the subjective interpretation occurs.

Evaluator Group
At each stage of IS evaluation process, we may
consider there are certain types of stakeholders’ roles who might outline institutional schema. Accordingly, we define the roles of two groups - Evaluator group, Decision making group. The following details the role of each group.

- Evaluator group evaluate the benefit of investment at the development stage.
- Decision making group examine the investment proposal evaluated by evaluator group.
- At the decision stage, Evaluator group and Decision making group proceed sense-making communication and reach mutual agreement on whether to invest or not.

Next, we further categorize evaluator group into two subgroups following the classification of evaluation role from Serafeimidis & Smithson(2003): strategist for evaluation and evaluator.

The role separation mechanism is generally found in both private and public sector. For example, enterprise-wide IS investment board is constituted and their assessment is used to make an overall decision. During the group discussion process, whether role of the leader is prominent or not, some participants may take the initiative role. At this time, participants who take the initiative execute strategist’s role, whereas others execute evaluator’s role. In this process, depending on the property of an IS cost and benefits and organizational context, IS investment proposals follow respectively different justification type. We use the concept justification and the financial justification dichotomy which are suggested by Irani(2002).

From these two justification types, our assertion is that Evaluator Group, as a socially collective identity, have disposition to choose one of the justification type. This orientation is formulated under communication and interaction of each member of the evaluator group, in accordance with the way they interpret IS tangible and intangible benefit, based on each personal background.

**Decision Making Group**

Final decision making group is constituted by high-ranking officials (e.g., CEO, CIO, and Board of directors) who have authority to approve investment. Decision making group interpret evaluation result and its context reported by evaluator group and at the same time meditate on another context that they are encountered.

These contexts are classified by the political context and the professional context, and it seems more dominant in public sector[42]. We assumed that within each context, final decision making result is shown as an approval or disapproval of the IS investment proposal, or change of the priority of suggested investment proposal set by evaluator group beforehand.

**Evaluation Orientation**

Because the four evaluation orientations of Serafeimidis & Smithson(2003) extend over the entire process from the IS adoption to the post-implementation evaluation, we need to adjust their perception into focused area of the initial evaluation.

Under certain circumstance, positive results of evaluation of IS investment could lead to the approval or its priority rise. Negative results of evaluation, on the other hand, could lead to the rejection of investment or drop in priority. We propose the evaluation results of certain IS investments are expected to have distinct directions under the circumstance between justification type of evaluation group and decision context of decision making group. Then we propose four types of IS evaluation orientations: Mixed, Positive, Negative, and Control Evaluation.

1. Under political context, Evaluator group and Decision making groups are subjected to take complex judgments about the investment proposal which has been through the concept justification. Because of the nature of the political context, mutual consensus between Evaluator Group and Decision Making Group are hard to be predicted. If strategic and politic propensities of the investment proposal align with each groups’ interest, then positive evaluation is expected and it leads to execution of investment, on the contrary case negative evaluation devaluate its value. The followings are related research proposition.

P1-1: Concept justification will face positive evaluation under political context when interests united

P1-2: Concept justification will face negative evaluation under political context when interests conflict

2. Even Under political context, it is hard to turn down the proposal which has been officially and objectively evaluated from Financial Justification. Decision making group, therefore, will accept or estimate the evaluation result affirmatively and tries to align expected benefit of the IS investment with their political interest. The
following is related research proposition

P2: Financial justification will face positive evaluation under political context of evaluation process

(3) Under professional context, IS investment proposal which has been through concept justification has high chances to have a negative evaluation. Both Evaluator Group and Decision Making Group have no clearly agreeable evidence of the value of the investment, the proposal is easily to be devaluated. The following is related research proposition.

P3: Concept justification will face negative evaluation under professional context of evaluation process

(4) Under professional context, lastly, IS investment proposal which has been through financial justification will have a sophistication process together with positive evaluation. It is exactly same with the control evaluation suggested by Sefafeimidis & Smithson (2003).

In this case, to enhance the feasibility of successful implementation of the information system and to spread the information system over the organization easily, business goals have to be set up first. Moreover, in order to accomplish the goal this process further relates to concretize the investment plan and schedule, as well as to prepare the various methods to treat the expected issues. The following is related research proposition.

P4: Financial justification will face control evaluation under professional context of evaluation process

Research Method

Because the conceptual model is introduced with deductive reasoning, empirical data needed to support the analysis framework and propositions. The multiple case study [61] is designed and we are in the process of collecting data from public sector. The unit of analysis is each investment proposal and we will examine about more than 50 of IS investment evaluation results performed by public agency for the past two years.

Base on the content analysis of data from the evaluation sheet (e.g., internal/external evaluation report) and the interview sheets with the stakeholders, we will trace each proposal regarding how evaluator group evaluated and how it goes through a phase of final decision process. And the next we will categorize each case by four evaluation orientation proposed at our analysis framework. Then we could verify whether each justification type is related to justification type and decision context.

Summary

In summary, this paper proposes a theoretical model for studying IS investment evaluation and decision process. The framework articulates two-staged evaluation process and its institutional orientation constructed by the interactions among stakeholders and their roles. Some of the expected contributions of the research are to be mentioned.

In terms of theoretical contribution, our research may provide starting point of future research that attempts to theorize this undiscovered area. So far, mostly from the rational research, much of the studies have mainly discussed the technical and utility issues on IS evaluation. Thus limitation exists when trying to explain irrational-looking IS decision process. On the other side, political research focuses on the nature of power in organization and the way of power being organized, just leading more unpredictable and unexplainable research issue. We try to address this issue focusing on IS evaluation process itself, and the integrated approach of the institutional theory would provide new way of understanding of the process.

Also, there are several implications to practitioners. First, proposers or planners who take the role to justify the necessity of certain IS investment to the decision making group could achieve their goal effectively through a proper consideration of our framework. That is, in order to get a final approval of investment, the justification type (concept justification/financial justification) have to be considered as a persuasion strategy, and the decision context (political context/professional context) among members of decision making group have to be identified as well.

Second, to the final decision makers, if an approved investment is from the concept justification under the political context, he or she needs to elicit a consensus to the investment from other organizational member (e.g., user, middle manager). It is because although information systems are invested under the necessity of strategic importance, it has still some risks to fail because of no use of system by organization’s member [59].

Finally we suggest some possible research issues from our framework. When an organization frequently performs IS investment decision under the circumstances closely related with strategic and political judgment, consideration of whether to establish more formal process and institutionalization is needed. With this issue, the
optimal point of configuration of IT Governance can be arguable research agenda. Next, further multiple-case study of private sectors compared to public sector cases might help raise the generalization level of the hypothetical theory. Thereafter, quantitative analyses can clearly recognize difference between reality and ideal norm with regard to IS evaluation process.

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THE ROLE OF GOVERNMENT TO BRIDGE DIGITAL GAP BETWEEN URBAN AND RURAL AREA IN KOREA

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Abstract
The Ministry of Food, Agriculture, Forestry and Fisheries (MIFAFF) in Korea has made an abundant effort to develop agricultural/rural informatization since the 1990’s. Initially, it focused on the development of three different types of infrastructure to bridge the gap between rural and urban areas: household personal computer (PC) penetration, Internet use, and broadband Internet connection accessibility. The 81% of broadband accessibility in 2002 increased to 100% in rural areas in 2007. In addition, from 1998 to 2002, a total of 241,356 farmers took diverse education programs provided by MIFAFF. As a big effort from MIFAFF, Food and Agro-product e-commerce of Farmers has also increased continuously; as of 2009, its transaction is estimated as 1.89 billion USD. Many projects on u-Farm have been launched for future intelligent farming. However, MIFAFF are now facing new challenges.

Keywords: Digital Divide, Rural Informatization, Korean Government, agro-product e-Commerce

Short History of Agricultural/Rural Informatization in Korea
Control over the quality and quantity of products in the food and agriculture business is known to be very difficult. A predictable and manageable output is desirable for most businesses. That is, managers should be able to control the quality and quantity of their products. Predictable outputs help managers plan their marketing, sales, and inbound and outbound logistics, but these are not easy problems in the food and agriculture business. Various industries have adopted different levels of automation and utilization of information systems for quality/quantity control; informatization of the food and agriculture industry has been behind other industries.

In addition, South Korea is known as one of the leading countries for high-speed broadband access and for the high rate of Internet use in the world. However, there has been a significant digital divide between urban and rural areas in South Korea. This digital divide issue is related to quality of life in rural areas, and is also known as an important factor of rural-urban migration.

In this regard, the Ministry of Food, Agriculture, Forestry and Fisheries (MIFAFF) in Korea has made an abundant effort to develop agricultural/rural informatization since the 1990’s. The history of agricultural/rural informatization stems from the establishment of the Center for Agriculture Forestry Fisheries Information Service (AFFIS) in 1992. The vision of AFFIS is to develop rural/agriculture informatization for vital rural life and competitive agriculture industry. Since then, AFFIS, founded by MIFAFF, along with the Rural Development Administration (RDA), attempted to bridge the digital divide and develop informatization of the food and agriculture industries. About 70 staffs are working for rural/agriculture informatization in AFFIS.

Responding to the government efforts, Korean food and agriculture industries are now attempting to adopt ICT in order to satisfy diverse needs from consumers through quality/quantity control.

Infrastructure Development
The Ministry of Food, Agriculture, Forestry and Fisheries (MIFAFF) has focused on the development of three different types of infrastructure to bridge the gap between rural and urban areas: household personal computer (PC) penetration, Internet use, and broadband Internet connection accessibility.

In 1997, the rate of household PC penetration was just 18.7% in the rural areas of Korea. MIFAFF established several policies to supply PCs to rural areas at a low price or for free. For instance, MIFAFF, collaborating with other organizations in 2000, launched a campaign named “Sending PC to the Rural Area” to supply PCs to households in rural areas for free. Many companies, as well as individuals, responded to the MIFAFF campaign by donating new or used PCs. Due to their efforts, the rate of household PC penetration in rural areas sharply increased up to 50.2% in 2006. While it is still lower than that of urban areas, 79.6%, its gap has been diminished.
The Internet use rate in rural areas has been continuously increasing since 1998. Only 0.6% of those who worked in the agriculture industry used the Internet. As of 2006, the rate reached 29.4% and is still increasing. It should be addressed that between 1998 and 2003, a swift increase, from 0.6% to 16.2%, was accomplished; this was not only due to the MIFAFF’s campaign of “Sending PC to the Rural Area,” but also to, for rural residents, a “Free Internet Connection Service,” which was carried out by AFFIS. Farmers could receive a PC for free or at a very low price and could connect with the Internet without any charge. These notable policies were accompanied with free education programs on computer/Internet use for those who live in rural areas. These customized informatization education programs were mainly designed and provided by AFFIS and RDA.

Broadband Internet connection accessibility in rural areas was another big concern of the Korean government from the perspective of the digital divide. MIFAFF and MIC (Ministry of Information and Communication) requested that network operating companies, putting up with low profitability, extend network access to rural areas. Finally, the 81% of broadband accessibility in 2002 increased to 100% in rural areas in 2007. This number implies that anyone who lives anywhere in Korea can access high speed Internet anytime he wants.

Informatization Education
As discussed earlier, AFFIS and RDA have provided diverse customized education programs for informatization in rural areas since 1998. At the initial stage of this education policy, farmers were invited and assigned to a few education centers for lectures. However, in 2000, moving education centers using buses were invented to provide on-the-spot education for farmers; that is, farmers did not have to leave from their farms for a long time. This attempt made it possible to provide informatization education programs to 64 different sites throughout the Korean peninsula. In 2001,
manage their own e-commerce sites. Now, many farmers in Korea are gaining high profit from their e-commerce sites. In 2008, MIFAFF announced that about 67,000 of farmers are likely to take those courses this year. Web-based e-learning systems have also been launched for farmers. Farmers can access all content for free. The contents of the e-learning systems are not just limited to informatization, but are extended to diverse production techniques and business management.

**Information Services and Software Development**

Relevant information is necessary for efficient decision making in business management. Farmers also need relevant information for their diverse decision-making in sowing, weeding, irrigating, use of fertilizer/pesticides, harvesting, and so forth. MIFAFF and its related organizations launched Internet-based information services to support farmers’ decision-making in farming in 1993. The first information service through the Internet provided by MIFAFF was an “Agro-products Price Information System,” which was operated by AFFIS in 1993. Price information of 20 different crops was presented day-by-day for farmers. Farmers could make a decision efficiently using this system when considering the point of harvesting in order to maximize their profits.

Information services for farmers have been extended to diverse areas, including crop insect pests, crop quality certificate guidelines, geographical information, precision agriculture, rural tourism, etc. As of 2001, the number of information services for farmers increased up to 124. Since then, more services for farmers have been provided by 40 different government organizations.

In 2006, responding to farmers’ claims that too many information services made them confused, MIFAFF developed a new agriculture and food portal, “Green Net”, which converges 150 different information services provided by 40 different organizations. This portal is not only for farmers, but also for consumers, so that these two different groups can communicate on the site. Moreover, currently, many mobile services are being launched for farmers who do not have enough time to sit in front of computers.

In addition to these information services, the Korean government developed and distributed diverse software programs to farmers. These information systems were designed to support farmers’ decision making. In 2007, MIFAFF financially supported 33 ERP (Enterprise Resource Planning) system development projects initiated by agricultural corporate bodies and agricultural product processing centers. MIFAFF currently facilitates them to adopt RFID (Radio-Frequency Identification) and sensor network technologies for their supply chain management based on a budget of 50 million USD.

**Current Issues in Agriculture Informatization**

During the last decade, consumers have shown concern regarding safety due to the breakout of mad cow disease, and the recent dioxin crisis. According to the UK Food Standard Agency, a survey found that 75% of consumers are concerned with food safety. Also, with the increase of wealth, Korean consumers pay more attention to the quality and freshness of food. In addition, though consumers in urban areas have to pay more and more for fresh food, monetary benefits to farmers have not increased satisfactorily in Korea.

The Korean government is considering how to overcome these challenges using ICT. What information and technologies are available (or can be developed) that can mitigate consumers’ concerns on food safety? How do we provide consumers with fresh food at a lower price, while guaranteeing reasonable monetary benefits to farmers? Since the 2000’s, the Korean government has newly focused on four areas to figure out these questions. In addition, inefficient logistics for agro-products has been pointed out as a chronic illness in Korea; middlemen have profiteered between farmers and consumers. MIFAFF has attempted to innovate the conventional manner of agro-product logistics.

**Agro-product e-Commerce**

In 1999, MIFAFF selected 106 farms that produce high-quality agro-products and supported their homepage constructions on the Internet. An additional 200 homepages were developed in 2000. Theses farms are facilitated to use their Internet homepages for their product marketing. AFFIS then developed an e-marketplace and hooked up farmers’ homepages to the e-marketplace. Following MIFAFF and AFFIS’s movement, RDA and the local government also developed farmers’ homepages and associated e-marketplaces. Up to 2001, a total of 3,000 farmers’ homepages were developed, and more than 1,500 homepages among them are hooked up to those e-marketplaces for online marketing.

The Korean government financially supported the costs of web hosting and mass-marketing for farmers. Farmers simply needed to focus on updates related to their products on their web site, and product shipping. Even though not all farmers could succeed, many farmers made considerable money in their e-businesses. Those who launched agro-product e-commerce formed a new community called the
“Cyber Farmers Union,” and their membership is now more than 3,000. They have regular meetings several times each year, and share their experiences and knowledge for successful e-business. Table 1 shows the increase in food and agro-products purchased through e-commerce in Korea.

As shown in Table 1, the total amount of e-commerce transactions in Korea has sharply increased since 2001. Food and Agro-product e-commerce has also increased continuously, but not as fast as the total amount of transactions. In 2001, the amount of transactions in food and agro-products was about 203.6 million USD, but in 2009 it is estimated as 1.89 billion USD, which is 9.3 times larger than that of 2001.

### Food Safety & Traceability

As discussed earlier, the food and agricultural industries are presently facing several new challenges. Food safety, which has been at the forefront of the news recently, is regarded as one of the most important issues. For example, Korean consumers have the highest level of concern regarding the use of cloned animals, the use of antibiotics/hormones in meat, and food safety/hygiene.

The traceability of food is an emerging issue in many countries. Consumers would like to acquire sufficient information in order to make informed shopping decisions about food; however, they are unable to do so in most cases because information asymmetry exists between buyers and sellers. The Food Traceability System provides detailed information on food production, processing, transfer, and distribution, such as the birthplace of animals, feeding, medication, date of sale, slaughtering information, and other supply-chain-related information. In Korea, the Ministry of Food, Agriculture, Forestry and Fisheries (MIFAFF) has undertaken the traceability system on agro-products since 2004. Before the ministry began acting on traceability issues, RDA (Rural Development Administration) developed the first public Food Traceability System (www.atrace.net) in 2003. In September 2004, the ministry announced guidelines for traceability, and in October 2004, a beef traceability system (www.mtrace.net) was launched. In August 2005, it amended and promulgated ‘Agricultural products quality management law.’ Expectations toward the traceability systems are enhancing the international competitiveness of Korean agro-products by securing food safety and gaining credibility through organized management and a fast response to the food safety problem in the food supply chain by tracing backwards and forwards. It is also expected to fulfill consumers’ right to know by providing instant and accurate information on production, distribution, and merchandising of agro-products. Since January 2006, farms can voluntarily adopt a traceability system.

Information generated from traceability systems includes the name of the producing unit, field location, name of the product, amount of the product, fertilization and chemicals used, equipment used, transferring place, date of delivery,
name of seller, and so forth. Such information is identified using a label, barcode, or RFID tag. Consumers can easily access the information through a wireless mobile phone, computer via the Internet, or an on-site kiosk.

Currently, the Korean government focuses more on the beef cow traceability system because of Korean consumers’ special concerns over the quality and the origin of beef due to mad cow disease. As of July 2009, all beef produced in Korea is forced to register to the traceability system by law. Consumers in Korea can inquire all information about beef at www.mtrace.net.

In addition, advanced technologies, including RFID and USN (Ubiquitous Sensor Network) have been applied to new traceability systems in diverse areas in order to generate relevant and reliable information for food consumers in Korea.

**Ubiquitous Farming**

Since 2004, the Korean government has enhanced all industries to adopt USN (Ubiquitous Sensor Network) and RFID (Radio Frequency Identification) technologies. The logistics industry was the first mover, rather than other areas, because RFID technology is known as a substitution for the use of bar codes. USN is known as an epochal technology for efficient object monitoring and controlling, including environment, production, etc.

In 2007, MIFAFF decided to adopt USN/RFID technologies in the food and agriculture industry and launched six “U-Farm” projects that apply these technologies to traceability systems, barn and green monitoring, and so forth. A total of 6.4 million USD was invested to these U-Farm projects; the budget was developed and allocated by MIFAFF and MIC (Ministry of Information and Communications), and it also includes local governments’ matching funds. These U-Farm projects are outsourced to several consortia of SI (System Integration) companies, RFID companies, USN companies, middleware companies, and Food companies or Farmers’ unions. Local government supervised each project and MIFAFF and MIC superintended all the projects. This year MIFAFF launched twelve U-Farm projects, as shown in Table 2. As of 2009, MIFAFF are initiating diverse plans to develop new technologies for intelligent green house and stall.

**The Future of Agriculture Informatization in Korea**

**Roadmap of Agriculture Informatization**

Today, the food and agriculture industries are more integrated than ever in an attempt to reduce risks and improve processing costs, from farm to table. Since its operations including production, processing, storage, distribution, and management are dispersed all over the world, the food and agricultural industries now depend more on ICT. Responding to this trend, MIFAFF’s policy is more focused on competitive food and agriculture industry development and welfare in rural areas, where it has focused on infrastructure construction and content development to bridge the digital divide. To achieve its future goals, MIFAFF developed a new policy, ‘2007-2011 Agriculture/Rural Informatization Basic Plan’ and set a new vision as ‘U-ACTIVE pursuing Global Top Food & Ago-products, and Rural Area.’ The plan proposes 34 new projects in 5 different areas to accomplish the U-ACTIVE vision. Figure 4 illustrates the U-ACTIVE vision prepared by MIFAFF. This vision will be the future for agricultural and rural areas of Korea.

**New Challenges**

MIFAFF currently considers establishing a TV channel for agriculture and rural communities based on IPTV and Digital cable technologies. This project stems from the world megatrend of “Convergence of telecommunication and Broadcasting.” But, who is the target of the TV channel? Rural residents? Urban consumers? Moreover, MIFAFF needs to develop feasible profit models to establish sustainable TV channel.

Farmers who have taken big advantages from agro-product e-Commerce are pointing out the importance of the agriculture and rural community TV channel. They expect more benefits from t-Commerce based on IPTV. However, t-Commerce requires each farmer to produce consistent quality-controlled products and the amount should be sufficient, which is not a simple problem to

<table>
<thead>
<tr>
<th>Title</th>
<th>Product</th>
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<tr>
<td>U-high-end brand “G-mark Mushhart” Traceability System</td>
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<tr>
<td>U-IT based “Red Dragonfly” Traceability System</td>
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<td>U-IT based Korean Traditional Food Quality Control System</td>
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<td>Jeju High Quality U-Fishery Support System</td>
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<td>RFID/USN based High Quality Fishery Production Support System</td>
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<td>RFID/USN based Jeju Pork FCG Monitoring System</td>
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<tr>
<td>U-IT based Fruit Insect Monitoring System</td>
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<tr>
<td>U-IT based Fishery Logistics Information Portal System</td>
<td>Fishery</td>
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</table>

Table 2. U-Farm Projects launched in 2008

Figure 4. Vision and Goal of Agriculture/Rural Informatization
(Source: Agriculture/Rural Informatization Basic Plan, MIFAFF, 2006)
currently, MIFFAF is reconsidering the role of AFFIS (Center for Agriculture Forestry Fisheries Information Service). As discussed earlier, AFFIS has been doing well for agriculture/rural informatization in Korea. However, business environment has been changed since 2000. To date, the core competence of AFFIS is to provide diverse useful information for farmers via the portal site, and present education opportunities for farmers. Currently, there exist more than these kinds of expectation from farmers; many of them graduated from collages and their business is not limited to mere cultivation. They want professional business consulting rather than just management or technical education. In addition, some people raised a question, “Is it necessary for AFFIS to operate the portal site for Farmers? It can be outsourced in lower cost.” What will be AFFIS’ future core competence?

Acknowledgement

All material about MIFAFF’S policy presented in this article was supported by Informatization Support Team of MIFAFF
TOWARD KANSEI ENGINEERING MODEL IN SERVICE DESIGN: INTERACTION FOR EXPERIENCE IN VIRTUAL LEARNING ENVIRONMENT

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Abstract
Service design is an emerging trend shifting from product design era. Internet provides effective and efficient service media reaching customer at the exact time. Online media has become social network providing wide opportunity for business, pleasures, and education. This study is focusing on applying kansei engineering model for service design in virtual learning environment (VLE) as learning is concerning with experiencing the process. Various virtual world studies discover that VLE can provide powerful experience in learning. On the other hand, learning styles and learning space potentially enhance experiential learning. Experiential learning theory defines learning process as transformation process from experience to knowledge. Experience is one of important element in service design principle. In addition, experience can be engineered by utilizing kansei engineering approach. Therefore, experience can be designed and engineered to achieve knowledge as service result. This study expected can guide service designers and learning curriculum designer in designing effective experiential learning method. The model developed from the analyzing and reviewing literature shows that kansei engineering can be utilized in experiential transformation process into knowledge and also in service in learning theory context.

Keywords: Kansei Engineering, Service Design, Experiential Learning Theory.

Introduction
Service is new frontier in business, as providers expand and extend their core propositions to embrace and explore new opportunities. It is about experience as a whole package including expectation, needs, feelings, atmosphere, and environment. Design thinking takes into consideration those whole packages. Fundamental concept of service design is similar with product design concept. The difference between them only takes place on the form, where service is an intangible object. Customer expectation and experience are the focus of service and product design. Kansei engineering, which has been developed in Japan, is an ‘affective engineering’ method to translate feelings and impression into form of product. This user-driven method has been proven can provide quality product that design feelings into product. This paper is transferring, adapting and extending Kansei engineering method to immaterial products. Virtual environment becomes the trend exchanging the web 2.0. The environment is promising to provide experience for the user better than web 2.0. Second life, built by Linden Lab, provides online learning such as e-mail and instant messaging. One of the virtual environments is Second Life. Numbers of universities and education organizations open their Second Life URL. Furthermore, many researchers have been performed in the context pedagogical. Some early research suggest that virtual world, in particular Second Life, may provide pedagogical advantages for specific learning styles and learning groups and for particular subject areas (Slator, Chaput et al. 2005; Bradshaw 2006; Roussou, Oliver et al. 2006; Community 2007).

Service Design
In a service oriented business, high quality customer service is becoming a key differentiator for any kind of organizations. In order to keep customer loyalty high, fully content and committed services need to be useful, usable and desirable. Proactive service development directs to significant and strategically essential innovation value creation. Service design strategy determines the customer satisfaction and sales. High customer satisfaction will motivated the employee that is followed by improvement in productivity and efficiency. Service design is useful for any category of services.

A service is not just what customer get. It is a matter of how they get and how they feel about it. Organization created something that customer willing to pay. Customer may be internal or external; if external, the term consumer (or end user) will be used for clarification purposes. Some services consist of a single process, e.g.: dry cleaning. On the other hand there is service consist
of multiple services linked together. At each process, transactions and interaction occur. The transactions typically consist of an input, procedures, resources and resulting output. The resources, such as people, machines, and the procedures, can be documented, learned or digitized in software code. Thus, it is an experience per se. Design thinking takes into consideration the whole services experience packages, there are needs, expectation, feelings, atmosphere, and environment. Like product service can be designed. Phillip Kotler define service as any activity or benefit that one party can give to another, that is essentially intangible and does not result in the ownership of anything. Its production may or may not be tied to physical product. Service

On the other hand design is a process to create value for people. According to Stefan Moritz, service design helps to innovate (create new) or improve (existing) services to make them useful, usable, and desirable for clients and efficient as well as effective for organizations. It is a new holistic, multidisciplinary integrative field. In addition, service design is the application of established design process and skills to development of new services. It is a creative and practical way to improve existing services and innovate new ones.

Relationship between organization as service provider and customer is separated by service interface boundary (Figure 1). In this boundary customer employ certain process or procedure represents by touchpoint. This point is a customer journey to experience the service. Efficient and effective customer journey will let service user to draw image toward the service their encounter.

### Kansei Engineering Concept

The intention of Kansei Engineering is to produce a new product based on the consumer’s feeling and demand (Nagamachi 1995). In order to achieve the aims, there are four points refer to this technology:

1. How to induce and grasp the consumer’s feeling (Kansei) regarding the artifact in terms of ergonomic and psychology,
2. How to identify the design characteristics of the product from the consumer’s Kansei,
3. How to build Kansei Engineering as an ergonomic technology, and
4. How to adjust product design to the current societal change of people’s preference trend.

As an answer to those Kansei’s purposes three styles of Kansei Engineering methodology

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**Figure 1. Service Interface**
are classified as follows (Nagamachi 1995):

Type I means category classification from zero-to nth-category,
Type II uses the computer system,
Type III utilizes a mathematical model to reason the appropriate ergonomic design.

Incorporating customer requirement and needs into product development process has become main focus in quality engineering. Various methods in product development have been invented to identify accurate customer requirement in product design. Kansei Engineering is the first method which involves emotion as an input in the product design process. Kansei Engineering doesn't have particular words in English; however, it can be interpreted as sensibility, feeling, or aesthetic. The main purpose of Kansei Engineering method is to help designers make decisions and emphasize on the design elements which make the product better suit to human feelings.

Schutte (2005) composed kansei engineering model to design feeling into product design (Figure 2). In this model, product can be described from two different perspectives: the semantic description and description of product properties. These two descriptions each span a kind of vector space. These two space have a relation which is analyze in the synthesize stage identifying which product properties evokes which semantic impact. Depart from this stage, it is possible to conduct validity test, including several types of post hoc analysis. The results of synthesis stage, both vector spaces are updated and synthesis stage is run again. When the iteration is satisfactory, the model can be built describing how the Semantic Space and Space of Product Properties are associated.

**Choosing the domain.** Choice of domain stage is selection of target market, market niche, and specification of new product. According to this information, product samples are collected representing the domain. In other words, this stage defines the domain and find representatives (product, drawing, samples, etc) covering as big as possible part of the domain.

**Spanning the semantic space.** The semantic space is the theoretical construction referring to C. E Osgood in the early 50ties (Osgood, Suci et al. 1957). His research question whether the way American citizen perceived political propaganda depended on semantic description. Utilizing semantic scale method it is possible to determine whether and to what content a verbal description is or acts as a sign for certain objects. Spanning the semantic space conducts by collecting number of words that describes the product in question as first step from available source such as literature, commercial, interview, opinions, etc. Then, categorize those words by selecting that are having the highest impact on human’s mind. Technically this can be done by conducting pilot study and making factor analysis or applying affinity diagram. Those words then combined with the unique image of the product that distinguishes the product from other competitors.

**Synthesis.** This stage is the most important pace in this Kansei Engineering Model. The unique of this step is connecting the product properties space with semantic space. The difference to other method is the data gathered from the customer and evaluated mathematically. This decreases inaccurate result since there are no subjective interpretations. Numbers of non mathematical and mathematical tools have been developed connecting product properties and semantic space, they are: Linear regression (Ishihara 2001), General Linear Model (GLM) (Arnold and Burkhardt 2001), Quantification Theory Type I (QT1) (Komazawa and Hayashi 1976), Neural Network (Ishihara, Ishihara et al. 1996), Genetic Algorithm (Nishino, Nagamachi et al. 1999), and Rough Set Analysis (Nishino, Nagamachi et al. 2001).

**Test of Validity and Iterations.** At this point of the Kansei Engineering Model it is possible to by using (Weinreich 1958) idea about semantic space. The idea is applying factor analysis from the data gathered and compares the results with Kansei Words delivered from Semantic Space. Among

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![Diagram](image-url)
those words, it is possible to filter the words along with product properties that have no effect on Kansei. It is feedback to the Semantic and Product Properties Space.

Guidelines. When the validity stage provides satisfaction result, the data from the synthesis model can be presented as guidelines. These guidelines are function depending on the product and predict the kansei score for a certain word $y_{\text{kansei}} = f(\text{product properties})$.

Virtual World

The vast growing of available internet connection assembled it as social interaction media. Millions of people access the internet establish friendships, buy and sell things, and also form large social networks and organizations. The shifting from Web 1.0 to Web 3D make it possible to create virtual space where people can do activity toward virtual things, such as trading virtual properties and assets.

Virtual world is a place where people “co-inhabit” with millions of other people simultaneously. Virtual worlds are not just games, as there are no levels, no scores, and there is no “game over”. They exist in real time where individuals communicate, cooperate and collaborate with each other, like in real world. It can be assumed that the behavior of the users is very similar to real world behavior (Fetscherin and Lattemann 2007).

Users represent by avatar, build a business, establish a social club, marry a partner, or travel to exotic locations with other avatars. They use virtual money to purchase property, giving rise to realistic, integrated economies as more users participate in the Virtual Worlds. In some cases there is even a real exchange rate between the virtual money and a real currency as it is the case with Second Life (SL) with the Linden Dollar.

Recently there are many notable SL’s challenges competitors, including Active Worlds, There, and newcomers such as Entropia Universe, Dotsoul Cyberpark, Weblo.com, Red Light Center, and Kaneva. The following tables comes from Oz (2005)1 compares three of the most discussed, well known, and well-established Virtual Worlds along various dimensions.

This manuscript is focusing on Second Life as an example of Virtual Worlds. According to collected data data of Linden Research’s Grid Status, an analysis of Residents Online (RO) and Total Residents (TR) was performed for every hour for the period between August 2006 and March 2007. The daily of average of RO quadrupled from 6,000 to 24,000. This growth was correlated (coefficient of 0.75) and total residence grew twice as fast from 450,000 to 4 million. Forecasts using fitted second-degree polynomial trends projected a daily average of 150,000 residents online and 25 million total residences by March 2008.

One of application of virtual world is providing learning style and space in digital world. can be identified based on following features (Dillenbourg, Schneider et al. 2002):

A Virtual learning environment is a designed information space
A Virtual learning environment is a social space: educational interactions occur in the environment, turning spaces into places.

Analyzing Interaction for Experience in Virtual Learning Environment

Experiential learning theory provides conceptual theory in transforming experience into knowledge through learning process. Experiential learning theory formed by six proposition (Kolb and Kolb 2005) that developed by prominent 20th century scholars who gave experience a central role in theories of human learning and development – notably Hohn Dewey, Kurt Lewin, Jean Piaget, William James, carl Jung, Paulo Freire, Carl Rogers and others . The propositions are as follows:

1. Learning is best conceived as a process, not in terms of outcomes. The quality of learning is determined by the process. It needs an interaction between learner and ecology of learning system. In the context of learning in virtual world, the learning interaction is different with learning in virtual world. Student and teacher are in the same level, since the avatar may be different with physical appearance with the representative. This situation bring forward the issue regarding level and ethic in cultural context. How the academician deals with ethic issues? How user from various study culture adapt to the virtual environment? What the tutor/teacher do to maintain the similar level between student and teacher in the virtual learning environment?

2. All learning is relearning. Learning process should become facilitator to draws out students’ beliefs and ideas about a topic so that they can be examined, tested and integrated with new, more refined ideas. It is a notion that learning process basically are seeing, listening, memorizing. Learner has original beliefs and perception toward particular knowledge and skill. Through process, all experience in learning, student is obtaining new knowledge, then, compare-connecting- conflicting-adding with original knowledge they have. In this context, it needs to understand the effect of learning process in virtual world compare to the
real world. Since, the interaction between tutor and learner in virtual world so obvious so that tutor may identify the lack of understanding among student through learner behavior. On the other hand, student study in virtual world by following the teacher action in explaining theoretical knowledge. The atmosphere teacher created is important to bring student involve in understanding the knowledge. Learning atmosphere in virtual world is limited by computer graphic and user can perceive the environment through eyes. Therefore, virtual environment designer should consider about interactive design of virtual world that support learning atmosphere.

(3) Learning requires the resolution of conflicts between dialectically opposed modes of adaptation to the world. Driven factors of learning are conflict, differences, and disagreement. Those factors should solve by discussion where people involve together then brainstorming their opinion for solution. Interaction among learners or learner-tutor develops discussion’s atmosphere support. In the real world, the environment quickly creates and academian can involve immediately. In virtual world, user bridge by desktop tools (such as computer screen, keyboard, and mouse) that develop the gap in interaction. The way to closing the gap should support by the technology aspect which focus on supporting the swift of the discussion flow in virtual world.

(4) Learning is a holistic process of adaptation to the world. Not just the result of cognition, learning involves the integrated functioning of the total person – thinking, feeling, perceiving, and behaving. This proposition describe clearly that environment play important role in learning process. Adaptation as one process in learning should accomplish quickly to achieve efficient and effective learning result. Virtual learning environment provide unlimited environment as long as computer coding can support it. The gap in interaction with virtual world environment limited by how the user presence and immersion in the virtual environment. Their presence and immersion determine how experiential learning process can transform experience into knowledge.

(5) Learning results from synergetic transactions between the person and the environment. In Piaget’s terms, learning occurs through equilibration of dialectic processes of assimilating new experiences into existing concepts and accommodating existing concepts to new experience.

(6) Learning is the process of creating knowledge. Experiential Learning Theory proposes a constructivist theory of learning whereby social knowledge is created and recreated in the personal knowledge of the learner. This stands in contrast to the “transmission” model on which much current educational practice is based where preexisting fixed ideas are transmitted to the learner.

Above analyses describes that virtual have potentiality in delivering experience in learning. Serious game has been designed to help student in experiencing the learning encounter and let them educated, trained, and informed. In addition, interaction between user and environment is the important factor in creating ambient to support learning process. Therefore, in the future, virtual world as learning environment may be intensively use collaborates with learning activity world.

References
oach for Kansei analysis on milk carton design. Elsevier Science B. V.


Towards a Paradigm for Inter-Organization E-Collaboration: Collaborative Business

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Abstract

As the adoption of information technologies, especially the Internet technologies, there is an increasing interest on inter-organization collaboration in e-business. The 'collaboration's in the existing literatures often mean different. These diverse views make it difficult to understand what the collaboration is and to know what have been achieved and what still needs to be done. The paradigm of e-Collaboration has yet to be established. This paper provides a framework for Inter-organization e-Collaboration. The framework identifies the heart of e-Collaboration — joint intellectual efforts, which has seldom been explored by existing studies. Moreover, existing relevant literatures are organized and are analysed using the framework and future research directions are indicated based on the analysis.

Keywords: Electronic collaboration, Collaborative business, Inter-organization, Paradigm

Introduction

Collaborative activities are common when conducting business online. E-Business in the integrative era brings together different parties in an electronic environment, manifested in the Internet, to work closely with each other to drive towards values that are beneficial to these parties in ways that are crucial to each party. How ‘close’ they need to work with others is often determined by the collaborating parties and business processes that are involved.

In the past e-commerce era, industries mainly focused on conducting business transactions through electronic means, particularly on the Internet. However, to facilitate and enable buying and selling products/services is only the first step to benefit from the Internet. The value created for merely fixing an exchange agreement is limited; therefore e-commerce quickly reaches its limitation. To fulfill such an exchange agreement requires coordination and cooperation between the buyer and the seller. It often requires services such as financial and logistics arrangements provided by third party service providers. The real benefit of conducting business on the Internet would come from the ability of conducting and aligning business processes, sharing resources, or even intellectual exchange among these parties. We call these activities on the Internet, e-business. These different types of interactions (often referred to as collaborations) among buyers, sellers, and third party service providers are the main theme in e-business study [1] [2] [3]. Many researchers use two terms, collaborative commerce and collaborative business interchangeably to describe these interactions, while in fact the term commerce often refers to buy-and-sell activities only and collaborative business emphasizes the more extensive inter-organization interactions in e-business.

There are a number of empirical studies, theories and models building, and technologies and tools development works in Information Systems research, concerning the inter-organization collaboration in electronic environments (e-collaboration). The use of the term ‘collaboration’ varies widely, and in some cases the meanings are not the same even within the same context. For example, collaboration in ‘so and so’ is enabled by electronic communications (such as emails) and the effects can be felt throughout within the organization. Such kind of collaboration could not alone facilitate ‘inter-organization workflow integration or collaborative product design’ as the interactions among designers in different geographical locations call for more than just electronic communications, but more of interactivity that can be achieved among the designers in an any-to-any fashion. How should we distinguish these two ‘types’ of collaborations and if these types are some commonality and/or differences.

These views suffer from the same underlying need where interactions are required independent of the closeness, or integration that collaboration calls for. This inconsistent and interchangeable use of the term hinders the clear research directions to enable collaborations in e-Business. We can so far as to say that collaboration is about interactions...
between two or more organizations, if the interactions are the same in an electronic environment, or in the Internet.

Also, a sensible question to ask is that with the existing Internet technology, whether or not two organizations can collaborate electronically. The answer is “yes” if collaboration merely means sharing information among organizations. To many researchers who are working on inter-organization workflow integration or collaborative product design, their answer is “no.” Our next question would be what collaboration is. If we can facilitate workflow integration and/or collaborative product design, does it means we can facilitate collaboration? Last but not the less, we would like to know what have been achieved and subsequently what still needs to be done for inter-organization e-collaboration.

To answer these questions, we need to have a clear understanding of e-collaboration. It is important for the research community to reach a consensus on the understanding for the field to continue develop. An unambiguous paradigm can serve such propose therefore is crucial for the development of a scientific field [4] [5]. In this paper, we are proposing a paradigm for e-collaboration.

The rest of the paper is organized as the follows. In section 2, a literature review on the existing views related to inter-organization electronic collaboration is provided. A framework is developed in section 3, to describe the paradigm and establish terminologies for communications and knowledge accumulations. The framework is then used to organize the existing research outcomes systematically, followed by a conclusion section.

Existing Diverse Views
Collaboration has been broadly investigated in various fields, such as corporate governance [6], organization behavior [7], and marketing research [8]. Collaboration could develop as driven from technology advances, from inter-organization research, and/or from the push of e-Business. As the advancement of information technologies, organizations become easier to interact with others electronically. The online inter-organization activities ranges from simple data or document transmissions, information sharing to complicated virtual teamwork, knowledge sharing, or distributed joint decision making. Using the collaborative technologies to enable inter-organization collaboration has been extensively promoted by many researchers. It is believed to bring significant benefits in R&D [9], Business Process Reengineering (BPR) [10], supply chain [11] [12], logistics management [13], and so forth. However, the ‘collaboration’ in these Information Systems research often means differently. Here are some examples.

Collaborative learning. Computer-mediated collaborative learning among individuals emerged in the early 90’s [15]. It typically utilized such technologies as email, discussion board, file transfer, and chart room to enable participants learn as a group without physically meeting each other [16] [17]. The use of the technologies makes the learning process cooperative and group-oriented, resulting in enhanced student learning and evaluation of classroom experiences.

Collaborative filtering. Goldberg et al. proposed an experimental mail system, one of the early collaborative filtering applications, which allowed the people to help others by recording their comments to the documents they read [18]. Terveen et al. developed another experimental system that automatically recognizes and reuses recommendations from Usenet news messages. As more collaborative filtering systems emerge, the performance evaluation of the systems becomes important [19]. Herlocker et al. empirically examined a number of key factors that were used to evaluate the collaborative filtering recommender systems [20]. It is to note that these systems/tools feature the participants’ voluntary of providing their data or comments without constraints or expectation of direct rewards. Here, cooperation and group-orient are no long what the ‘collaboration’ stands for.

Collaborative business process. Going beyond the business document exchange between business partners, many inter-organization interactions, which are often labeled as collaborative process, have been investigated. Raghunathan and Yeh proposed an approach to determine the optimal number of retailers that a manufacturer should partner with in such a collaborative process as the continuous replenishment [21]. Furthermore, Welty and Becerra-Fernandez argue that computer-based interaction technologies (e.g. ActionsWork Metro, a so-called business collaboration software that records and manages the human interactions in a business process) can enhance the trust among supply chain partners [22]. The ‘collaboration’ in these studies implicitly means coordinating the activities of multiple business partners with their individual business interests.

Collaborative engineering or collaborative design. As production and operations becomes more specialized, there is an increasing need for organizations to form a team for joint design. Collaborative engineering allows individuals or organizations to compose a team of experts and work on a same project concurrently [23].
Computer-supported collaborative design was prompted to incorporate many interdependent design issues in the design process [24]. Typically, these systems/tools provide facilitations to the intellectual exchange among the participants involved in collaborative engineering or design. Moreover, collaborative design accentuates to reach a communal acceptable solution or design. The ‘collaboration’ mentioned above is endowed with diverse implicit connotations from different researchers. The ‘collaboration’ in collaborative filtering mainly means information posting by one person for others unknown people. It is in no need to actively form a group to achieve an explicit common goal. ‘Collaboration’ in collaborative learning primarily refers to working together via information sharing facilitators, which enables different kinds of interactions among parties in an electronic environment. But the prefix collaborative in collaborative design closely relates to the high-level intellectual interactions for joint design.

These diverse views on what the ‘collaboration’ should be and should do make it difficult to idea communication, theory development and knowledge accumulation within the research community of e-collaboration. Looking on the bright side, the various interpretations provide considerable insights to further conceptualize inter-organization electronic collaboration. In these studies, the involvement of multiple parties is frequently mentioned, group-oriented or working together are often required, and shared vision or a common goal are not rarely highlighted.

**Developing a Framework for Inter-Organization e-Collaboration**

Taylor-Powell et al. proposed a conceptual interpretation of collaboration and other related terms (e.g. coalition and cooperation) for evaluating the work of collaboratives (i.e. a group working together to achieve a shared vision) within educational programs [25]. The research also identified five types of relationships among parties (i.e. communication, contribution, coordination, cooperation, and collaboration, or 5-Cs) [25, p.4], and proposed some guidelines for evaluating the collaborative process of the educational programs. Using the set of terms (i.e. 5-Cs), we propose a framework for inter-organization e-collaboration (Figure 1) and identify the important features of the types of inter-organization interactions.

In our framework, communication is fundamental, supporting dialog and common understanding, while contribution benefits multiple parties by mutual support based on communication. Coordination further integrates parties by matching their individual needs and adjusting activities. To achieve common goals, cooperation, or working together is typically necessary. Furthermore, collaboration comes when exchange of intellectual thinking or share of knowledge is required.

Here e-collaboration refers to the process of working together with joint intellectual efforts in an electronic environment. Information technologies are used to facilitate the parties to work together and to contribute with joint intellectual efforts.

![Figure 1 Types of Inter-Organization Interactions](image)

**Figure 1** Types of Inter-Organization Interactions

e-Collaboration can facilitate the offering of existing or newly created common products or services with reallocation of controlled resources. With respect to each type of the interactions, different information technologies and tools are often required. For example, if an organization is going to communicate with others electronically, UDDI (Universal Description, Discovery & Identification) may be used to discover and identify other parties in an electronic environment, and such technologies as XML, DTD, and namespace can help establish common understanding with other parties. As two-party communication is established, SOAP may be used by an organization to contribute other organizations by offering information with direct rewards. With these bases, organizations may leverage such process management techniques as workflow description technologies to coordinate their business activities, or use such group support systems as CFPR (Collaborative Planning, Forecasting, and Replenishment) to cooperate with other parties and achieve a common goal as a group. Furthermore, organizations can collaboratively make decisions or design new products with advanced information technologies that allow them exchange intellectual thinking, and share knowledge.

**Organizing Existing Literatures**

In this section, we organize and analyze the existing relevant studies using the framework proposed.
Review methodology
We develop the following criteria for the types of the studies to be included in this analysis. Given that e-collaboration emerged driven by technology advancement and the push of e-business, we limited our literature search to those studies in information systems research. We searched relevant studies in the respected journals, including Communication of the ACM (CACM), Decision Support Systems (DSS), European Journal of Information Systems (EJIS), Information and Management (I&M), Information Systems Research (ISR), Journal of MIS (JMIS), and MIS Quarterly (MISQ). These journals are consistently ranked as leading MIS journals [26] [27].

Secondly, we examined each issue of each volume of the journals published in the last ten years (1999-2008).

Thirdly, we conducted the search using the phases, including electronic collaboration, collaborative technology, collaboration, collaborative commerce, and collaborative business. Several search engines, including Science Direct, EBSCO host, IngentaConnect, and ACM Digital Library, were used to ensure we do not overlook relevant articles. We found 137 relevant articles (Table 1). These studies were reviewed from the following aspects, such as research issues, research contexts, research methodology, information technology or systems involved, and relevant findings. Subsequently, we coded each study using the framework proposed.

Table 1 Number of Relevant Articles in Seven Leading MIS Journals

<table>
<thead>
<tr>
<th>Journals</th>
<th>CACM</th>
<th>DSS</th>
<th>EJIS</th>
<th>I&amp;M</th>
<th>ISR</th>
<th>JMIS</th>
<th>MISQ</th>
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<tr>
<td>Number of articles</td>
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<td>13</td>
<td>18</td>
<td>16</td>
<td>21</td>
<td>10</td>
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</tbody>
</table>

Some observations
In these literatures, a wide spectrum of research methodologies (listed below) has been used in examining inter-organization interactions. It indicates that electronic collaboration research grows as a cross-discipline area of Information Systems (IS), Computer Science (CS), and Organizational studies (OS).
- Empirical survey and interview
- Case study
- Experimental study
- Technology development or systems design
- Literature review study

Moreover, a large number of information technologies (listed below are some of typical ones) have been studied in different inter-organization contexts. These technologies can support respective functional requirements and business needs of types of inter-organization interactions in the framework proposed.
- fax, file sharing and transfer, and PowerPoint
- computer-mediated communication
- email conferencing and video conferencing
- groupware technology
- computer-supported cooperative work
- virtual team
- collaborative writing tool

The following themes of research issues were observed: (T.1) collaborative technologies (e.g. technology adoption and technology development), (T.2) inter-organization relationships (e.g. managing inter-organization virtual team), (T.3) intention of interactions (e.g. satisfaction of a group), (T.4) the impact of technologies on inter-organizations (e.g. the impacts of collaborative technology on inter-organization communication patterns), and (T.5) task-technology fit.

Conclusions
In this paper, the diverse existing views on inter-organization electronic collaboration are reviewed. A framework is proposed to make the views cohesive for the emerging field of e-collaboration. Moreover, the framework is used to organize the relevant literatures in leading MIS journals, followed by a preliminary analysis on the literatures.

For future research, a comprehensive analysis of existing literatures should be included. It would be interesting to see a mathematical illustration of the framework. Also, the future research directions for the emerging field would be identified.

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PRODUCT INTEGRATION FORMATS AND CONSUMERS’ EVALUATIONS OF THE ONLINE EXTENDED PRODUCT: A PRODUCT INTEGRATION PERSPECTIVE

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Abstract

After launching new products, firms are spending substantial amount of resources into cross-product integration to attract traffic. While customers place increasing value on product integration, little is known about the influence of product integration on consumers’ evaluation of extended product. Based on the product presentation perspective, this study proposed and validated a research model through a scenario-based experiment. The findings suggest that value added integration, rather than the data interface and add-on module integration, is associated with a higher level of perceived diagnosticity. Perceived diagnosticity had a significant influence on consumers’ evaluations of the extended product. This study contributes to the research and practice by providing insights about product promotion within the online context.

Keywords: Product Integration, Product Presentation, Perceived Diagnosticity, Human Computer Interface

Introduction

Competition is keen among online merchants and content providers. To remain competitive, online merchants have been adopting certain strategies to attract and retain customers. A common strategy is the multi-product competition. After gaining success in one market through flagship product, online firms often continue to launch new products to capture new markets. For example, after having great success in the search engine market, Google launched email (Gmail), instant messenger (GTalk), and electronic payment (Google Checkout) services. After the success of its web portal, Yahoo launched online instant messenger services (Yahoo messenger).

Web traffic is the key asset and indicator of an online Information Technology (IT) product success. Undoubtedly, after launching new products, firms are spending substantial amount of resources into online promotion to attract traffic. According to the Interactive Advertising Bureau, the expense on online advertisement in 2008 had rose to $23.4 billion in U.S [1]. In another study, conducted by the European Interactive Advertising Association, 70% of advertisers claimed that their allocated funds to online ads are projected to rise in 2009 [2]. Therefore, introducing a new product to existing as well as new traffic represents a critical opportunity for firms. Since cross-product integration has become an important tool to make use of existing traffic, this poses one important question: How would online product integration affect consumers’ intention to use the extended product?

Although, the practice of product integration in the online environment is expanding and customers place considerable emphasis and increasing value on cross-product integration, little is known about the effects of product integration and its artifacts on users. On one hand, as early as 1970s, software engineering researchers proposed the concept of coupling to measure the strength of association established by a connection from one module to another [3]. Later, software engineering scholars generally began to focus on the measurement of coupling in different contexts and from different perspectives [4, 5]. On the other hand, in innovation management field, researchers generally pay much attention on the antecedents of product integration and the influence of technology integration on product development performance [6, 7, 8].

In contrast to the proliferation of online cross-product integration worldwide, work by Information Systems (IS) researchers in this area is scant. There is little theoretical work in the literature that considers the relationships between product integration and the cognitive, behavioral, and decision measures of users. Success in devising multi-product competition strategies through cross-product integration depends on a clear understanding of its effectiveness. Research on product integration will provide online providers with a deeper understanding of the different product integration approaches that would maximize the benefits when entering new markets.
and business opportunities.

**Theoretical Development**

Given the importance of the cognitive stimulus as a catalyst in the online users’ decision-making process, environmental psychology has been a logical theoretical foundation for studying the influence of technology product integration on online promotion effectiveness. In particular, researchers have drawn from the stimulus-organism-response (S-O-R) paradigm and posit that environmental cues act as stimuli that affect an individual’s cognitive reactions which in turn affect behavior. In the next subsection, we propose that the technology product integration acts as a stimulus that influence the online users’ learning efficacy when interacting with the promotion environment, which ultimately affects their intention to use the extended product.

**Product Integration as Environmental Stimulus**

In the online environment, IT mediates the exposure of the online promotion. Thus, it is intuitive that not only the extended product characteristics but also the interaction between extended products and promotion environment (i.e., the focal product) would influence consumer evaluations of extended product. Technology product integration is the combination of different technology products, enabling them to interact with each other. According to the nature of coupling (external or internal) and extent of coupling (comprehensive/value added or minimal), Nambisan [8] identified three main types of technology integration: value added internal integration, add-on module integration, and data interface integration. Value-added integration refers to integrating internally the focal product with extended product and merging the data and the functions of the two products in a seamless fashion [9]. Based on the coupling between the two products, value-added integration offers additional product features. The second type of product integration, add-on module integration, involves the integration of the focal product with relevant product through an external module or component (i.e., separate from the focal product itself). While the integration is achieved externally, such an add-on module would still provide the requisite support for a comprehensive integration and sharing of data and functions of the two products [8]. The third type of product integration, data interface integration, involves the external integration of the focal product with a relevant product by defining the technical interface needed to affect the transfer of data across the two products [10]. Such product interface specifications provide only a minimal level of functional integration across the two products.

**Product Presentation and Learning Efficacy**

Interaction with the online environment leads to cognitive reactions. Cognitive reactions to the stimulus refer to the mental processes occurring in individuals’ mind when they interact with the stimulus [11]. Different concepts, such as learning efficacy, have been used to describe cognitive reactions that result from interacting with the environment. Online product presentations are designed to introduce products to consumers, to help consumers form a clear understanding of products, and, ideally, to impress consumers with superior or attractive product features [12]. In an attempt to facilitate consumers’ understanding of how a product performs, current online product presentations are typically pictorial or image-based, and use vivid visual effects encompassing products’ appearance, functionality, and behavior under different working conditions. Vessey and Galletta [13] suggest that different presentation formats significantly influence the quality of cognitive learning. The cue-summation theory can explain the efficacy of learning in the online environment.. The cue-summation theory posits that learning is more effective as the number of available cues or stimuli (either across channels or within channels) increases [14, 15].

Several recent education and electronic commerce studies have argued that the product presentation triggers active learning, consequently improving learners’ performance and learning experiences [16, 17]. For example, Mayer [18] suggested that meaningful learning occurs when learners actively process information presented to them, and when they actively construct mental representations. In another study, Mayer et al. [19] termed this process as constructivist learning. Both studies argued that active leaning includes paying attention to the processes of selecting relevant information, mentally organizing the information into coherent representations, and integrating the representations with one another as well as with relevant prior knowledge. Carroll et al. [16] suggested that active leaning typically takes the form of learning by doing, by thinking, and by knowing. Specifically, in an active learning mode, learners prefer to try things out rather than read or follow structured systematic formulae. They prefer to make sense of their learning experiences by developing and examining hypotheses rather than by depending on rote assimilation of information. They also tend to relate their learning experiences to prior knowledge or metaphors to figure out how to perform certain processes and to decide which processes to perform [20].
Research Hypotheses
Effects of Product Integration Formats
In their study of online product experience, Jiang and Benbasat [21] used perceived diagnosticity construct to represent consumers’ perceptions of a channel’s ability to convey relevant product information that can assist them in understanding and evaluating the quality and performance of products promoted online. Since enhancing consumers’ abilities to evaluate products is a prominent goal that drives design improvements in product presentations, perceived diagnosticity is particularly important in the present study [22]. Richer media are typically considered more capable of unambiguously conveying information; therefore, consumers’ perceptions of the richness of the interfaces are likely to determine their perceptions of a channel’s capability to help them learn product information [23, 24, 17].

As already mentioned, according to the cue-summation theory, learning is more effective as the number of available cues or stimuli increases [14, 15]. Value added integration involves integrating the products internally and merging the data and functions of two products in a seamless fashion [9]. Based on the coupling between the two products, value added integration offers additional product features [8]. The available cues or stimuli for learning the quality and performance of the extended product would increase. Hence, the efficacy of learning would be enhanced and consumers would be likely to improve product understanding. Although add-on module integration provides the requisite support for a comprehensive integration and sharing of data and functions of the two products, consumers can only learn the quality of the extended product through performing the shared functions. Therefore, the information presented to consumers in the value added integration format is perceived as richer compared to the information presented in the add-on module integration format.

H1a: Technology product integration in the value added internal format would lead to a higher perceived diagnosticity compared to product integration in the add-on module format.

Add-on module integration provides the support for a comprehensive integration and sharing of data and functions of the two products. This can facilitate consumers’ understanding of how the extended product performs by observing the product’s functionality and its behavior under integrated working conditions. Data interface integration only facilitates the transfer of data across the two products. Facing the minimal level of functional integration, users will have more difficulties to learn the quality and performance of extended product. Further, from the leaning curve perspective, the add-on module integration enables the process of integration to be transparent resulting in a lower learning curve. In the data interface integration situation, consumers can only learn through the transfer of data, which is hard to observe, and from learning experiences. Therefore, with more difficulties to learn the extended product, consumers’ perceptions of the ability of focal product to convey relevant information that can assist them in understanding and evaluating the extended products would be lower. Hence, the following hypothesis were made:

H1b: Technology product integration in the add-on module format will lead to a higher perceived diagnosticity compared to product integration in the data interface format.

Effects of Product Integration Formats
Research has shown that three evaluation criteria — utilitarian, hedonic, and social values — succinctly cover a broad set of factors that individuals consider important in the context of IT use [25]. The utilitarian value relates to the effectiveness and efficiency resulting from the use of an IT application [26]. The hedonic value is associated with the fun or pleasure derived from using the application [27]. The social value refers to the enhancement of social images of users by their use of the application [28]. The salience of utilitarian, hedonic, and social values factors varies according to the research context. Furthermore, some variables other than the three value factors may emerge as salient factors, depending on the research context [28]. However, this study examines only the essential set of user evaluations to focus on its core topic, that is, intention to use the extended product.

In the context of online technology product evaluation, perceived diagnosticity represents consumers’ cognitive belief that a channel facilitates their product understanding [21]. If consumers believe that a product experience is diagnostic, it is likely that their beliefs about the product will be stronger and held with more confidence [17, 29]. Higher perceived diagnosticity means that consumers are more capable of understanding products and can make decisions that are more informed. Prior research indicates that consumers’ cognitive evaluations of products are positively associated with the strength of their beliefs and confidence in their own evaluations of product attributes [30]. It follows that if the advocated product information is favorable, as is often the case when online firms promote their products, higher perceived diagnosticity would enable consumers to understand the positive product information more thoroughly, thereby, improving consumers’ cognitive evaluation of
products. Several studies have supported this assumption. For example, Kemph and Smith [29] observed that, in the offline promotion environment, perceived diagnosticity positively contributed to the cognitive evaluation of product attributes. Thus, it was expected that:

**H2**: Perceived diagnosticity will positively influence utilitarian value of extended product.

**H3**: Perceived diagnosticity will positively influence hedonic value of extended product.

**H4**: Perceived diagnosticity will positively influence social value of extended product.

Based on the theory of reasoned action (TRA) [31], evaluations, viewed as the positive antecedent beliefs, are expected to affect people’s attitudes, consequently influencing their behavioral intention [32]. In general, favorable product evaluations would lead to higher intentions to use the product simply because consumers can perceive the benefit of using the product [33]. Empirical studies on online services generally support this expectation of the positive relationship between evaluations and behavioral intention [34]. Accordingly, we expected the same logic to extend to our context.

**H5**: The utilitarian value of integration will have a positive influence on intention to use the integration.

**H6**: The hedonic value of integration will have a positive influence on intention to use the integration.

**H7**: The social value of integration will have a positive influence on intention to use the integration.

**Control Variables**

To account fully for the differences among brands and product categories, we also included two control variables that characterize our unit of analysis: attitude toward brand, and perceived fit. We selected these particular variables because of their potential influence on intention to use the extended product, as suggested by the extant literature.

Prior to product integration, consumers already possess established attitudes toward the original product. When the extended product is launched, consumers evaluate it based on their existing attitude toward the brand. The effect of existing attitudes toward brand on the attitude toward the extended product could be either positive or negative. If the brand is associated with favorable attitudes, the extended product should benefit; if it is associated with unfavorable attitudes, the extended product should be harmed [35, 36, 37]. To account for the variances attributable to attitudes toward brand, we considered the differences among consumers regarding their attitude toward the brand as a control variable.

In this study, a new extended product was defined as a new instance that can be more or less similar to the brand and existing products. The number of shared associations between the extended product and parent brand characterized the perceived fit [35]. If consumers perceive a good fit between the original and extended product, the new extension will be more easily matched with the original brand category. Therefore, with category-based processing, positive perceptions and evaluations would be transferred to the new extended product, and the new extended product would benefit. When the fit is weak, consumers will review the information available, evaluate each piece of information separately, and make a final decision [38]. In this situation, consumers may question the ability of the firm to launch the extended products [36, 39]. If the fit is incongruous, the extension may be regarded as humorous or ridiculous. Thus, we expected a positive relationship between perceived fit and intention to use the extended product. Figure 1 illustrates our research model and basic hypotheses.

![Figure 1 Research Model](image)

**Research Method**

To test the hypotheses in the present study, we conducted a quasi-experiment to test the hypotheses. A quasi-experimental design was adopted because this approach allows us to manipulate key variables and exercise control over extraneous variables. We used a 3 (data interface,
add on module, and value added integration) between-subject, full-factorial design. Product integration was the manipulated factor and randomly assigned to groups. A total of 114 students from a public university participated in the experiment. Prior to the study, the subjects were informed that they would each receive $5 as a reward for their participation. The subjects were randomly assigned to one of the three experimental conditions. All the experimental sessions were conducted in a laboratory with 60 identical PCs connected to the Internet.

**Manipulations**

We operationalized technology product integration by using a scenario-based method. The scenario-based method has been adopted in information system research [40]. Sheng et al. [41] justified the appropriateness of using scenario-based methods for studying ubiquitous computing applications, "the use of scenarios makes it possible for researchers to study the emerging [...] phenomenon without being constrained by the timing of the study or the state-of-the-art of technology". Therefore, we manipulated three types of integration (data interface, add on module, and value added) using different scenarios. A search engine and its promoted two new products (C2C website and online Chinese encyclopedia) were adapted in this study to yield different scenarios.

In the data interface integration scenario, the vendor just uses one hyperlink to promote the new products. When logging on the search engine, if users want to use the promoted products, they need to click the links. In add on module integration scenario, there exists a pop up messenger to promote the new products. When users log on the homepage of search engine, the messenger will pop up. If users want to use the promoted products, they can click the links appeared on the messenger. In the value added integration scenario, vendors supply additional features based on the coupling between products. In the case of integration between search engine and C2C website, when users search one product in the search engine, the relevant linkages about this product in the C2C website will appear as the search suggestion. Therefore, without logging on the homepage of C2C website, users can find the product in the commerce website directly. In the case of integration between search engine and online encyclopedia, when users search one concept in the search engine, the relevant links in the online encyclopedia will also emerge as the search suggestion. Hence, without logging on online encyclopedia, users can find the explanation about this concept in online encyclopedia directly.

**Procedure and Task**

All the participants were told that all instructions were provided online and that they should read the instructions carefully and complete the study independently. Because two product evaluation tasks were involved in the experiment, the order by which subjects examined products was randomized, such that half of the participants examined the search engine and C2C website integration first, while the other half examined the search engine and online encyclopedia integration first. After logon into our online system, as is commonly used in marketing research that investigates consumer behavior, a cover story was provided to all subjects. They were told that one new product (C2C website or online Chinese encyclopedia) has been introduced recently, and their feedback would be very important for the evaluation of the promotion strategy. Next, the subjects were randomly assigned one of the 3 treatment scenarios. Our Web-based system generated the scenarios randomly so that each respondent had an equal and independent chance of being put into any of the 3 scenarios. The subjects were asked to assume the role of potential user and were presented with the introduction of the integration used for promotion, which took the form of the website to enhance realism. The subjects were asked to read these materials and read as much of the information provided as possible. The experimental system logged the accesses made by the subjects to all the URLs to ensure that the subjects had actually read the manipulated condition. Finally, the subjects were asked to complete a post-session questionnaire on attitude toward the promotion and intention use the promoted products. After the experiment, 5 subjects were dropped from the sample for the following reasons: two subjects failed to complete the questionnaires. Three subjects reported inconsistent subjects. Hence, we collected 109 valid responses, which gave us 218 (109×2) observations in the following analysis.

**Measurement**

Theoretical constructs were operationalized using validated items from prior research. Minor changes in the wordings were made so as to fit them into the current investigation context. The measures for intention to use the extended product were adopted from Wixom et al. [42]. The measures of utilitarian value were based on Mathwick et al. [43] and Kim et al. [34]. The measures of hedonic value were based on Davis et al. [27]. Social value was measured using the three-item scale proposed by Perse [44]. Perceived diagnosticity was measured using the measurement from Jiang and Benbasat.
The questionnaires use the seven-point Likert scale (1 = strongly disagree, 7 = strongly agree).

Data Analysis and Results

Manipulation Check

to ensure that the subjects attended to their assigned product integration patterns, manipulation checks were included in the post-session questionnaire. An analysis of variance (ANOVA) was conducted with perceived integration level as the dependent variable and product integration patterns as the independent variable. Results revealed a significant effect of product integration patterns ($F(2, 215) = 21.19, p<.01$). The value added integration received significantly higher integration level perception ($M = 5.51$) than did the add-on module integration ($M = 5.04$) and data interface integration ($M = 4.47$). The add-on module integration received higher integration level perception ($M = 5.04$) than did the data interface integration ($M = 4.47$). These suggest that the product integration patterns manipulation was successful.

Measurement Model

Following the recommendation of Anderson and Gerbing [45], we tested the measurement model first before undertaking hypothesis testing. The measurement model was tested for all multi-item constructs to ensure instrument quality. Confirmatory factor analysis (CFA) was conducted to test the convergent and discriminant validity of items.

Convergent validity indicates the extent to which the items of a construct are related in actual data, and measures the correlation among items of a given construct. To assess this validity, Anderson and Gerbing [45] suggested three criteria. First, the standardized factor loadings must be statistically significant. Second, the composite factor reliability (CFR) and Cronbach’s Alpha should be greater than 0.7. Third, the average variance extracted (AVE) of each factor should be greater than 0.5. The results of applying these three criteria show that all the standardized factor loadings are statistically significant; the CFRs and Cronbach’s Alphas are greater than 0.7; and that AVEs are all greater than 0.5. Thus the convergent validity was supported.

We used the method proposed by Lastovicka and Thamodaran [46] to cross-check discriminant validity. They suggested the use of the Average Variance Extracted (AVE), which provides information about the amount of variance in items that are explained by the construct. For every construct, if the square root of its AVE is greater than its correlation with other constructs, discriminant validity is established [47]. The result shows that the square roots of the corresponding AVEs are all greater than their correlations with other constructs.

Results on Perceived Diagnosticity

The ANOVA analysis on the perceived diagnosticity suggests that integration formats significantly affect perceived diagnosticity. Post hoc analysis based on Scheffe test reveals (see Table 1): (1) value added integration is associated with higher level of perceived diagnosticity than the data interface integration and add on module integration; (2) add on module integration is not associated with higher level of perceived diagnosticity than data interface integration, thus providing partial support for H1.

Table 1 Results on Perceived Diagnosticity

<table>
<thead>
<tr>
<th>(I) group</th>
<th>(J) group</th>
<th>Mean Difference (I-J)</th>
<th>Std. Error</th>
<th>Sig.</th>
<th>95% Confidence Interval</th>
</tr>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lower bound</td>
</tr>
<tr>
<td>1 Data Interface (mean = 5.02)</td>
<td>2</td>
<td>-0.15</td>
<td>0.17</td>
<td>0.82</td>
<td>-0.60</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Add on Module (mean = 5.17)</td>
<td>1</td>
<td>0.15</td>
<td>0.17</td>
<td>0.82</td>
<td>-0.30</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>-0.43(*)</td>
<td>0.17</td>
<td>0.05</td>
<td>-0.88</td>
</tr>
<tr>
<td>3 Value Added (mean = 5.60)</td>
<td>1</td>
<td>0.58(*)</td>
<td>0.17</td>
<td>0.00</td>
<td>0.13</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>0.43(*)</td>
<td>0.17</td>
<td>0.05</td>
<td>-0.02</td>
</tr>
</tbody>
</table>

Impacts of Perceived Diagnosticity

Following the establishment of the measurement model, the structural model was assessed. The proposed model was tested through the structural equations modeling the (SEM) technique with PLS Graph Version 3.0. Tests of significance of all paths were performed using the bootstrap resampling procedure. Figure 2 presents the results of the analysis with estimated standardized path coefficients for this study.

As shown in Figure 2, all of the hypothesized paths in the research model were found to be statistically significant. As predicted, perceived diagnosticity has a significant influence on utilitarian value (0.672), hedonic value (0.647) and social value (0.456) of the new extended product. Utilitarian value (0.504) and hedonic value of extended product (0.238) both have a significant influence on intention to use the extended product. Hypotheses 2, 3, 4, 5 and 6 are supported. Among
the control variables, attitude toward brand has a significant coefficient in all of the paths. This is intuitive due to the fact that, when the extended product is launched, consumers evaluate it on the basis of their attitude toward the brand. If the brand is associated with favorable attitudes, the extended product should benefit. The R squares values showed that utilitarian value, hedonic value, and attitude toward parent brand explain 72.7% of the variance in intention to use the extended product.

![Figure 2 Standardized PLS Solutions](image)

**Discussion and Conclusions**

**Discussion of Findings**
Research to date on the technology product integration has ignored the individuals’ responses to product integration, which is an important consequence for product integration. Drawing on the online product presentations, active learning, and the concept of perceived diagnosticity, this research demonstrates that the integration between different online products influence perceived diagnosticity. Perceived diagnosticity positively influences customers’ evaluations of extended product, and consequently customers’ intention to use the extended product. When information is presented in value added integration format, consumers can learn about the quality and performance of the extended product through additional features, in addition to performing the shared functions. Compared to other forms of integration, value added integration offers more features, through which customers can obtain product information. Existing studies have found that visual and functional controls can increase perceived diagnosticity over picture-based product presentation [17, 21]. This research demonstrates that the product integration format can also positively influence perceived diagnosticity, and that this kind of influence can have an effect on customers’ intention to use the extended product consequently.

Social value did not have a positive impact on the intention to use extended product in this study, a finding that is consistent with Kim et al.’s [34] conclusions. Research has shown that utilitarian, hedonic, and social values succinctly cover a broad set of factors that individuals consider important in the context of IT use [25]. The salience of each factor will vary according to the research context. Using responses from actual users of two online news sites, Kim et al. [34] found that social value has little impact on usage intention, and this result did not vary with past use of the product. Considering that not all of the three components of value are expected to be relevant in a given context, this result is not surprising. Extant work has shown that a consumer’s choice is shaped by the context, in which humans process information. Therefore, the present results further suggest that the omission of the context from within any conceptual framework may be problematic.

**Limitations and Future Research**
This study is subject to several limitations. First, this quasi-experiment was based on the search engine, C2C website, and online encyclopedia. As a result, caution is required in generalizing these findings to other technology products. Other factors, such as the characteristics of the tasks or the background environment, may play a role in determining the intention to use the extended product. Therefore, the replication of this study in other contexts is necessary before the results can be generalized to other types of technology products and settings. Second, search engines, C2C website, and online encyclopedia are complementary products. This study may overestimate the role of product integration in the evaluations of the extended products because of the cross network externalities. Finally, in the last few years, holistic experiences with technology as captured by constructs such as enjoyment and flow, have been studied within the computer-mediated environments and have been recommended as an important metric for assessing online consumer behavior [48]. Future research should also examine
the influence of online product integration on consumers' subjective enjoyment of the interaction between technology products (i.e. the state of flow).

**Appendix**

**Measurement Items**

**Intention to Use the Extended Product**
I intend to use the extended product at every opportunity in the future.
I plan to increase my use of the extended product in the future.

**Perceived Diagnosticity**
The existing product is helpful for me to evaluate the extended product.
The existing product is helpful in familiarizing me with the extended product.
The existing product is helpful for me to understand the performance of the product.

**Utilitarian Value**
All things considered, this extended product would provide very good value.
Using this extended product would be worth my time and efforts.
It would be of value for me to use this extended product.

**Hedonic Value**
Using this extended product is fun.
Using this extended product is a joy to me.
Using this extended product is enjoyable.
Using this extended product is very entertaining.

**Social Value**
Using this extended product makes people hold me in high regard.
Using this extended product enhances the image which others would have of me.
Using this extended product helps me to show others who I am.

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E-GOVERNMENT FROM A WEB 2.0 PROSPECTIVE

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Introduction

“Web 2.0……refers to a supposed second-generation of Internet-based Services ……… that emphasize online collaboration and sharing among users.”  
[Wikipedia]

The proliferation of Web 2.0 has brought about drastic changes in the Internet culture worldwide. Today, users no longer only regard the WWW a globally distributed information-base, where they ‘surf’ for useful information; but also a timely information exchange platform for interactive communication. The operation of Web 2.0 is based on the philosophy of “evolution of knowledge”. Taking Wikipedia [1] an on-line encyclopedia as an example, any users can freely and openly contribute their ideas in the evolution process. Thus today information over WWW is practically owned by the users rather than by the information owners themselves as previously in Web 1.0.

Under the Web 2.0 culture, Internet users increasingly form groups and communities on-line based on their common interests and interact among themselves. Typical channels for this purpose include MSM for on-line interaction [2]; Friendster for establishing friendships [3]; Weblog for knowledge and ideas sharing [4]. These e-communities, large or small, are comprised of users with diversified education and cultural backgrounds. An ensemble of e-communities in turn comprises an e-society. Similar to real world societies, any environments populated with people with different beliefs, interests and values of judgment would inevitably lead to disagreements, arguments or even confrontations. Different e-communities may adopt different ways to express their disagreements and some of them may choose to do it violently, e.g. mail-bombs, virus, etc. To prevent violence and vandalism in a real world society, the government pays a crucial role. It often endeavors to understand the problems and needs of its citizens in order to design suitable services and facilities to fulfill them. The same applies to an e-society, the e-Government should discover the same of its e-communities and e-citizens; analyze them and provide appropriate e-services and e-facilities to establish a healthy and harmonious living co-existing environment.

How to understand the behavior of e-citizens? This lays down the objective of this article. The rest of this document introduces two key technologies, namely social network analysis and opinion mining for the said purpose.

Social Network Analysis

“Social Network……..Social networking also refers to a category of Internet applications to help connect friends, business partners, or other individuals together using a variety of tools. These applications, known as on-line social networks are becoming increasingly popular.”  
[Wikipedia]

Fundamentally, social network analysis is not a new concept. It has been widely applied in social science domain, where researchers design models to represent relationships among people and identifying properties about a network (i.e. community) or individual in the network [5], e.g.

Connectivity models how people are connected to one another in a network;
Centrality models how people influence others most in the network; and
Authoritativity models how people are referenced in the network.
And Etc.

On the WWW, networks of people and objects form an e-society. Within a network, people and objects interact dynamically. In general, the following types of interactions take place regularly:

People-People Interactions, e.g. users include each other as contacts in MSN messenger;
Object-Object Interactions, e.g. blog posts cites other blog posts in Weblogs; and
People-Object Interactions, e.g. users create bookmarks for uploaded photos in Flickr [6]
Object-People Interactions, e.g. on-line payment.

As people and object communicate, vast amount of data about the people, objects and their interactions can provide invaluable information in many applications. For example, information for suggesting a new book to potential customers in e-CRM (customer relationship management); for sales predication in e-business; for identifying people/communities with prejudice behaviors in e-security; for recommending authoritative domain experts/departments for better collaboration between e-citizens in e-government; etc.

Traditional social network analysis approaches, however, are mostly conducted subjectively based on interviews and/or questionnaires over a small population size. They are not directly applicable to investigating the WWW, which involves thousands,
or even millions, people, objects and their interactions. Similarly, classical statistical methods are also ineffective. Consider a “word cloud” maintained by flickr. The most important word (i.e. the biggest word in the cloud) is determined by how many users specify that word at that instant. In this way, simple word frequency count would reflect the ‘authoritativeness’ of an object. But flickr has not taken into account significance of the users contributing the keywords. Clearly an expert user should carry more weight than a novice. Thus, in on-line social network analysis, one must consider the semantic relationships between people and people; object and object; as well as people and object.

Consider another example, blog posting. If a blog post could arouse heated discussion and attracted many users, it would be considered ‘authoritative’. But a popular blog post may not always be positive hence authoritative. Some popular blog posts may invite negative comments from other bloggers on the posts rendering them ‘controversial’. Differentiation between positive/authoritative and negative/controversial blog posts is far beyond the capability of simple statistical methods. It requires good understanding of the content of the blog site.

Opinion Mining

“Opinion Mining is a recent discipline at the crossroad of information retrieval and computational linguistics which is concerned not the topic of the document is about, but the opinion it expresses.” [7]

Opinion mining [8] facilitates on-line content analysis. It is commonly used for automatic analysis of on-line evaluation. Evaluation is a popular social process for people to assess objects (or other people). Students evaluate their professors (or vice versa); consumers evaluate products/services; reviewers review conference/journal papers; etc. Famous on-line product review sites include www.amazon.com for books and http://www.imdb.com for movies. Effectively, evaluation is a kind of people-object (or people-people) interactions.

Previously under Web 1.0, products/services information is posted by the manufacturers/service-providers and they fully owned such information. For marketing purposes, the WWW is widely used as a propaganda platform for their products. For this reason, the credibility of the information is highly skeptical. In practice, opinions from expert users often influence consumers’ decisions. It has, however, been difficult to consult a large group of experts off-line. The advent of Web 2.0, e.g. Weblogs, has certainly overcome this predicament. Automatic analysis of Weblog is the target of opinion mining.

Conclusion

“A Government is obliged to look after her citizens. Web is a growing society The e-Citizen should be looked after by the e-Government. Otherwise, watch out for e-crime: e-vandalisms, e-riots, ... etc. leading to an insecure workplace ” [9]

The advancement in Web 2.0 has rapidly changed the landscape of e-government. Today, e-government is becoming more and more e-citizen centric. To serve its customers well, the behavior and culture of the e-citizens must not be undermined. For that purpose, two state-of-the-art technologies, namely social network analysis and opinion mining are introduced in this article. Effective adoption of these technologies can assist an e-government to provide the desirable e-services and e-facilities to her e-citizens. These in turn will prevent e-crime, e-vandalisms, e-riots, etc. leading to a healthy e-society where you and me harmoniously live and work together.

References

DESIGNING A SOCIAL NETWORKING PROTOTYPE: AN ACTION RESEARCH APPROACH IN BUILDING A USER-CENTRIC WEB 2.0 SYSTEM

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Abstract
In this paper we explore the possibility of using Web 2.0 technology to build a social networking tool, where users are the main participants during the design and implementation phases. Although Web 2.0-related research has gained momentum in recent years, much of the research focuses solely on studies where users only use the system instead of playing an integral part in the design process as well. Our study relies on both users’ input and usage patterns to drive each step of the design and implementation cycles. Hence, we employ both Soft System Methodology and Action Research to diagnose, evaluate, and provide guidelines and research instruments to examine various types of Web 2.0 technologies and services. We present a prototype, the purpose of which is to help users accomplish networking within a small group. We also discuss lessons learned from the project’s life cycle from the perspectives of both the system’s users and its designers.

Keywords: Web 2.0; Soft System Methodology, Action Research, Design

1. Introduction
The growing in popularity of Web 2.0 technology has garnered much worldwide attention from both researchers and practitioners [2]. The popularization of the Internet and the earlier generation World Wide Web (“Web 1.0”) during the 1990’s ushered in a new era, with several new and exciting ways for people to communicate and network with one another. Email, file sharing, and online chat were some of the main instruments that represented the first wave of technology starting to gain usage during the beginning of the Information Age [11]. Rapid advances in both information and communication technologies have transformed almost every aspect of people’s lives. The Information Age has seen a leveling of the playing field in terms of information creation and dissemination, as Friedman documented in his revolutionary book, The World is Flat [6]. Information is being created, synthesized, and disseminated by the average layperson as well as professionals.

Electronic social networking services such as MySpace, Twitter and Facebook have rapidly gained popularity in recent years. The protocol of yesteryears where people used the web only as a decentralized search engine to look for information or communicate with others is becoming obsolete. Instead, people harness network effect by using social networking tools to formulate their own personal network. People create a personal space where they are the centralized node – the center of their own universe in which everyone and everything revolves around them – instead of being bombarded with information overload, examples of which include spam and other unwanted services that show little or no value to their needs. The main difference of having such a personal space instead of joining or belonging to a public domain – such as discussion forum – is that having a personal space gives users a sense of ownership over their online persona. [10] [12]

Although, the trend in how people use Web 2.0 technology provides exiting ways for people to communicate, it is also very challenging for both researcher and practitioner alike in dealing with the puzzles one is confronted with in the new communication paradigm. Web 2.0 technology provides users with a personalized and integrative platform, which relies on mostly asymmetric information being exchanged through different technologies. People enjoy mimicking their persona online as a centralized node, which connects with others through the different channels of their mutually-shared online social networks. This phenomenon very much resembles the way people network in real life. In addition, the popularization of advanced IT gadgetry (e.g. smart phones) and new local networks (e.g. Metropolitan Area and Cellular Network) have led to a tremendous increase in the number of different communication channels available to people to start and build conversations ubiquitously. This represents a paradigm shift in how people use technology to further improve how they achieve communication in everyday life. Web 2.0 technology emphasizes how people converse, collaborate, and share knowledge amongst one another, instead of simply having a discussion within the public domain ala public discussion forums. Web
2.0 technology also focuses on user driven content, where whatever messages users convey within their conversation may not represent goal-oriented communication as it does in e-mail or chat. Simply put, people can use Web 2.0 technology to communicate in different ways, some of which do not require a receptor node to reciprocate the conversation back at the original node where the conversation started. Online diaries such as blogs, and micro-blogging such as Twitter, are some examples of the aforementioned technology. The emergence of different Web 2.0 technologies and the way people utilize them in their everyday lives provides several daunting tasks for both researcher and practitioner to postulate on how to deal with these fast-evolving types of technology.

1.1 Overview of this paper
This paper is organized as follows: First, the researchers examine the potential of using different Web 2.0 technologies within the realm of education. Second, we report on the research process where different technologies were designed, built, and used by a group of users. Lastly, we report on the lessons learned during the two Action Research cycles and suggested

2. Social Technology and Electronic Social Networking
The concept of ubiquitous computing, a model of human-computer interaction in which advanced IT artifacts, cloud computing infrastructure, and the popular middleware of Web 2.0 technology thoroughly integrates information processing into everyday activities as an anytime-anyplace network, is inching towards reality. Society and its inhabitants are more than ever connected to one another. The transformation of the world as we-know-it into the Global Village envisioned by Marshall McLuha advances ever onward because of easy-to-use technologies that allow people to achieve socialization via electronic means.

The concept of Global Village coined by Marshall McLuha, who portrays the world as a small village where its residents are connected and communicate via electronic means. In addition, [8] classified the trend in which people utilize different types of social technology to get the things they need (i.e., information goods) from each other rather than from an established entity such as a company or classroom as a phenomenon called The Groundswell. This phenomenon display the two Web 2.0 characteristics as first the users recognize the web as a service delivery platform and second the web as collective wisdom of the crowd [7]. People from all over the world can now-more-than-ever communicate with one another. People fully embrace the usage of new technology to connect with one another through services like MySpace, iTunes, Wikipedia, Facebook and Twitter. These technologies are few examples of the familiar technologies that have gained momentum in recent years. Others referred to them as Social Technology serving different purposes by its users. These technologies allow people to use their services to accomplish many things that have never been done before. People can upload their pictures or post updates on their life with just a few touches of their Internet-equipped mobile phones. An online personal space has become increasingly important, wherein people have their friends and family within their network.

Whatever purposes people use these services for in their lives, Social technology represents an undeniable force that builds and expands people’s ability to communicate and foster relationships with one another. Naturally, these technologies also attracted attention from many various disciplines. Educators attempts to use Web 2.0 technology to enhance learning for their students. Business practitioners use different application to increase sales, market share, and productivity in their organization. Although, the implementation of Web 2.0 technologies in many fields are still in their infancy, it is clear that the trend of Web 2.0 adoption will continues as long as there are needs for people to socialize.

2.1 Social Technology in Academia.
Educators have always been early adopters in using new or up-and-coming technology within academia. For years, educational technology such as Content Management Systems (CMS), Blackboard, and WebCT were used to help students perform better, as well as increase their productivity within the classroom. The aforementioned technologies enabled educators and students to better manage, distribute, and exchange information. Educators used technology such as file uploading and chat room services to streamline their work processes. Simple tasks and services such as giving out assignments electronically, online grading, and class note repositories were available through the usage of the web. These technologies were mainly designed and implemented to improve student learning in the classroom. However, the learning process in today’s world has becoming increasingly more complex. Learning not only occurs within the traditional classroom, but students as well as educators also reach out to the abundance of information and knowledge outside the classroom. For example, students can listen to a podcast being distributed from iTune University (iTunes U), one of the largest educational podcast databases in the world. Universities worldwide such as Stanford, UC...
Berkley, and Claremont Graduate University create and store their class lectures and distribute them free-of-charge through the iTunes Store. Student can download class lectures in MP3 format, watch videos of lectures online, or even review class materials at their leisure.

Another example is the possibility for learning that exists within the virtual classrooms of SecondLife [5]. Students can mimic a real-life learning environment by attending and participating in the learning process as it happens within a virtual classroom. Participants can interact with their teacher as well as other students through virtual personas called Avatars. This allows educators from different locations to attend class, converse, exchange knowledge, and learn within a common cyberspace as if they had gathered together in a brick-and-mortar classroom.

The aforementioned technologies such as Blogs, Virtual Classrooms, and Podcasts serve a common purpose in providing additional channels for students to network as well as to achieve learning electronically. Furthermore, they can be used to extend and reach out to learners who might not otherwise have a chance to be actively involved in the regular learning process. These tools can be used by potential learners who maybe less involved, introverted, or simply unable to show up to class. Hence, Web 2.0 technology serves as a terrific tool to reach out to those students who might otherwise have a difficult time getting involved in the learning process – in other words: a tool to reach out to the Long Tail of learners.

2.2 Social Learning and The Long Tail.

One of the main focuses of using technology to enhance learning is reaching out to an untapped demographic of learners. These students may be the ones that are uncomfortable with participating inside the classroom. Or, they could be parents, long-distance commuters, part-time students, etc. who simply do not have the time or resources to attend the class. Hence, these types of students cannot fully participate in the learning process. This problematic situation is akin to the concept of the Long Tail, a term famously coined by Chris Anderson [1].

The concept of the Long Tail, usually applied to the world of E-Commerce, refers to how given a large consumer population and high freedom of choice, the selection and buying pattern of the population results in a power law distribution wherein the upper 20% of items (the head) are favored over the other 80% (the long tail). Hence, the usage of Web 2.0 can enable the educators to reach out to as many learners as they possibly can: While 20% of a given classroom might already be willing to participate in class, there is 80% that are unwilling or unable to do so, but who might be able to via different Web 2.0 channels. Ullrich, et al. [11] suggested that students with common interests can use Web 2.0 technologies to achieve networking both inside and outside of classroom. Examples of the educational usage of Web 2.0 technologies to achieve such connections include iTunes U and Second Life, where university courses are being offered through different electronic channels. In this instance, we can imagine that long tail is the number of students who may not be able to speak up in class, or the one that don't have the channel to communicate effectively. It is the ‘out crowd’ that will not be able to participate due to various reasons, such as being introverts or living far away from the school.

The research will start by looking at how Social Technology can be designed to satisfy the users. For our research purposes, we look at the Long Tail as the students who we could prospectively reach out to in order to build a communication channel between their educators and themselves. The system will be of a design based upon what the users are familiar with and use in their everyday lives. With this in mind, the researcher attempted to build a Social Technology system from the ground up. Every step of the way, the researcher received input from the users. To assist in molding the conceptual model, we used the Soft System Methodology (SSM) to identify the research problems and research scope. After the problems are identified and a conceptual model is built, the researchers will follow the Action Research cycles in designing the artifacts from the ground up. Throughout the research process, users will be directly involved in helping to design the user-centric social technology system. This system will go through several iterations, incorporating each of the lessons learned from prior cycles. Finally, the prototype will be tested with the bigger group of users, where research results of the artifact will be analyzed and discussed.

Figure 1: Long Tail

3. Research Framework
This study aims to provide guidelines for building an educational system utilizing different Web 2.0 technologies. The system design and implementation focuses on a problematic situation existing within a group of graduate students. These users expressed their concerns about the lack of a centralized system where they can form a group and work with each other. They wished to have a centralized network system where they could share research insights, ideas, and progress with one another. The tentative timeframe for using such technologies is expected to be 8 months (July 2009 – May 2010). After the first brainstorming session, all users decided that they wanted to use existing technologies that they are already familiar with. The reason being that the users did not want to be burdened with learning a new set of technologies. By using the technology that most users were already familiar with, a smooth transition and a shallower learning curve for everyone involved is ensured. The research team had the users try different technologies to see which one fit the best with this criteria. Given all the potential requirements of the group, a Soft System Methodology (SSM) and an Action Research approach were chosen as research protocols. This methodology and approach allowed both the researchers and users to remain fully engaged and define the desired outcomes that best reflected users’ needs.

The researcher was an initiator and remained involved throughout the process. Users too, participated thoroughly throughout both the design and the implementation of the system. System prototypes were designed guided by theoretical concepts and user input. Actions and interventions led the changes during the intermediate versions and the final version of the system.

3.1 Soft System Methodology
Soft System Methodology is “an approach to inquiry into problem situations perceived to exist in the real world”[3] In our case, the researchers enter the situation as “actors,” whose main tasks were to identify and analyze a problem. Our main goals were to identify problems that existed before our entrance, inquire data and inputs from users, and complete two different analyses of the problems: 1) logic-based analysis and 2) cultural analysis of the problems. Equipped with an analysis tool in mind, the researcher worked closely with participants and gained insight by conducting both formal and informal interviews with all of the participants. Our goal was to generate a conceptual model of the situation. The model represents the conceptual findings from each of the SSM’s seven steps. Further more, the initial model was used to raise some questions regarding the troublesome situation, then it was used to suggest different courses of action for change. After the model was developed, we decided to experiment with different existing Web 2.0 technologies. A series of interventions and iterations of the model and technology use would be implemented. As the researchers started, this research approach followed these steps:

1) Enter the situation and identify the unstructured problems. We conducted a brainstorming meeting with the users. Together we examined the problematic situation: A lack of a centralized system where graduate-level students rely on a traditional apprenticeship model of learning where teacher and student relationship were strictly one-to-one and instead of a one-to-many relationship where everyone in the same group can easily help or collaborate with each other. Instead of helping each other both inside and outside of classroom, there was no easy way for each individual to network with each other and thus exchange knowledge and subsequently learn from each others.

Some of the problems were raised at the meeting. A student said:

“Each one of us are so busy with our works, family and also our commitment to other classes. I wish we would have a system that allow us to share what we learn as well as our research progress together. After all, everyone of us are doing this for the first time”

Another student noticed:

“I know that getting in touch with you (advisor) would be difficult since our working schedule are not match, can we try to have some kind of communication channels to communicate with each other effectively?”

These problems were written down as research notes and provide us with inputs for the following step.

2) Identify and express problem situation. After hearing the concerns raised by participants during our first session, we were able to identify a total of 4 original sets of problems: 1) the users’ inability to talk with their friends outside of classroom, 2) an inability for students to easily get in touch with their advisor, 3) the lack of a common place to setup and schedule meetings, 4) the existing systems were too time-consuming and had a high learning curve. Afterword, we decided to normalize the set into two problematic situations: 1) Lack of networking tools and 2) Lack of a knowledge sharing system among members. After the two problematic situations were identified, we held a second meeting to inform the users as well as inquire further inputs.

3) Formulate root definitions of relevant systems. Users came up with the idea of using existing
technologies to remedy the two problems. Instead of completely abandoning existing technology, all users decided to use existing services such as email and Instant Messaging (IM) as complementary to the new set of technologies. A Weblog was chosen as a knowledge sharing tool, and Facebook was chosen as a networking tool. The main reason for users to choose these technologies was familiarity. All users expressed their desire towards using a system that is familiar to them and that also allows them to network amongst themselves on a regular basis.

4) Build conceptual model from the system derived from root definitions. A conceptual model (figure 2) was developed to show how different technology can help users to lessen the problems they faced.

![Figure 2](image)

5) Comparing conceptual model (step 4) with real problem situations (step 2). We compared the conceptual model with the situations that we drew from the users from Step 2.

6) Identify and define the possible and desired changes - mainly, users want to have some positive changes in the way they can communicate amongst each other, both for networking and knowledge sharing.

7) Take action to improve the problem situation. After we achieved the above steps using SSM, we created a blog to be used among the users. Also, all users were encouraged to use Facebook and MSN Chat to network with each other. An email was sent out to remind users about the communication protocol.

3.2 Action Research
The goal of Action Research (AR) is to improve a problematic situation through change. At its core, AR relies on a different set of user-defined actions and several iterations to initiate changes according to the researcher and how the research participant desires. Essentially, AR is an iterative approach that allows the research team to be dynamically involved in the problem situation and the project, collaboratively changing experiments as the research team applies knowledge obtained in one iteration to the next.

Forth and Axup [4] suggested that AR usually “benefits from ‘soft’ methods that tend to pay particular attention to the fuzziness of research involving humans.” First, the problems must be identified and diagnosed (Step 1) by the researcher. Then, the next step in AR is Action Planning (step 2), where a series of actions are planned and ready to be implemented. The third step in AR involves action being taken, where researchers input different actions as well as make interventions in guiding the research outcome. Then, the researcher evaluates the results of actions and its intervention on the system (Step 4). The lessons learned during the first four steps are used as a foundation to provide iterations where additional actions are taken and evaluated. The researcher gains some insight and understanding of the action taken and its effects. These findings provide additional inputs for the researcher to achieve a reiteration of the earlier steps to further improve the situation. Finally, learning from all the steps are specified, and lessons learned are explain in the research findings, from which they become the researchers’ contribution to the knowledge field.

4. Research Findings
This study involved two AR cycles. In the first cycle, we diagnosed the problem situation following SSM protocol, enabling the researchers to utilize the SSM to identify the problems, build a conceptual model of the problem situation, design a set of expected changes and outcomes, and then begin series of actions and interventions to insinuate change.

The researchers started by entering the situation and getting involved with the different participants. We work closely with all participants throughout the research inquiry stage. All of the participants were eager to utilize different types of Web 2.0 technology to solve their problems. At the first meeting, they decided it would be best to come up with a way to use the technology to share and help each other to discuss their ideas and problems that they might have during their research process (i.e. knowledge sharing activities such as discussing about research problems and questions, literature review and research methodology) Also the technology was used to facilitate communication amongst one another. In addition relying on email and phone calls, the participants wanted to have a centralized system where they can collaborate together. Although each one of them had individualistic goals, due to their nature as graduate students many of them worked full time or had varying schedules, making it extremely hard to get together to discuss and help each other.

4.1 First Cycle
4.1.1. Knowledge Sharing Through Blog
The researchers created a Blog (http://msmis.blogspot.com), the main purpose of which was to serve as a common space for the users to share knowledge amongst one another. An invitation email was sent out to inform users regarding the common space. We encouraged all users to check the blog on a regular basis for updates, as well as to use the blog as a means to discuss and consult each other. In addition, the blog provided the users the chance to comment on each other’s blog postings. Initial activity started out on a high note, however, after the first month, usage levels had decreased. Hence, the researcher inquired about the reasons for this from a few users at one of our weekly meetings. Two of the users cautioned:

“I would read the blog more if more people keep updating their progress, but since most of us are so busy with our works and schools, we hardly have time to work on our progress, let's alone to share with others”

“The blog is not update on a regular basis, so I prefer to get-in-touch with others through other means such as IM or Facebook”

We concluded that while the blog served the purpose of Knowledge sharing. However, by having a blog with a very small user base, compounded with the inability of participants to update the content on their blog often, usage levels would be unmaintainable and would die down over time.

4.1.2 Networking through Facebook

During the first brainstorming session, most of the users felt comfortable with using Facebook as a networking tool. Thus, we sent out emails asking all users to add each other on Facebook. Facebook allows users to post their research progress, which is similar to what they can do via a blog. Hence, majority of users started using Facebook to communicate with each other instead of email. Once the early adopters started using the medium, they started to ‘refer’ their friends and encourage others to use Facebook as well. In total, seven out of ten users migrated from using a blog to Facebook

A user commented on using Facebook at an individual meeting:

“Facebook is very convenient for us to communicate with each other. You (the advisor) seem to be on Facebook a lot and I can always chat with you and leave some message on the Wall post where I can get respond quickly”

Another user voiced her approval of using Facebook to network with others during her leisure:

“I don’t have an access to computer at work, since my boss does not permitted it. I have to use the computer at home, at night and nobody seem to be online at night. So I prefer using Facebook to contact you and others”

Another example on how a user uses Facebook to post a research progress is:

“At Thammasat University Meeting with A.Peter (thesis advisor) : How to write the chapter 1 of thesis He suggest me that I. Use the dialogue from interview who involve the project (Lecturer staff at CHRSD, Mahidol University).”

4.1.3 Symmetric Communication Through Instant Messaging

In addition to using Blogs and Facebook, users wanted to be able to achieve instant communication through instant messaging (IM) as well. Some of the users wanted an instantaneous way to communicate. Thus, we sent out an email informing all users that Facebook also has a Chat feature, and encouraged them to use it to communicate with each other. A user voiced her preference on not having to post something on a public forum, but rather to communicate symmetrically with others through Instant Messaging.

“I like to be able to be able to chat with my friend and you (advisor) instead of posting something on Facebook and wait for the respond”

4.1.4 First Cycle Lessons Learned

The lessons learned from the first cycle allowed us to narrow down the scope of the research project. User feedback was obtained from interview sessions using both group and individual meetings. We learned that instead of using many Web 2.0 technologies to accomplish many tasks, it might be more convenient to use just a centralized social software platform – in our case, Facebook – to act as a centralized portal where users can share knowledge, network, and achieve symmetric communication. By limiting the software of choice to be just one platform, we are able to keep the original user requirements for a system that allows users to share knowledge and network with each other.

A user also voiced his concern regarding the privacy issue in using Facebook. Hence he proposed that instead of having the group communication on the public forum, a private group should be created so only the people in the same group can communicate in private. He added:

“Instead of having each other as only friend, we should create a research group so we can be group together and thus use Facebook as a knowledge
sharing tool instead of a Blog. This way, it’ll be very convenient to just come to one site and we can accomplish everything.”

Time management is also a very important issue that most users faced during our first cycle. Having multiple venues for users to use would only be too complicated, time-consuming, and cumbersome for most users. Thus, at the third group meeting, we agreed to use Facebook as the main tool to communicate with each other.

During the third meeting a user also cautioned that:

“It is very difficult for us to schedule a time for our individual meetings, since we don’t know each other schedules and sometimes our available times are overlap. Also, when we can’t make it to the meeting, we are unable to synchronize our appointment. So we should also have a centralized system where we can use for the scheduling purposes as well.”

Hence, taking from what we learn during the first cycle, we decided to shift our focus to complete the next two objectives: 1) Group building in Facebook and 2) Time management through Google Calendar.

4.2 Second Cycle
4.2.1 The Switch
Our group switched to Facebook as our centralized communication tool. We were able to achieve knowledge sharing and networking amongst members of our group. As per request by users, we also created a subgroup called “MSMIS,” enabling all users to be able to work privately inside a subgroup. An email was sent out to inform the users about the subgroup and encourage them to add themselves into the system. Once all the users joined the group they were able make a post, update, and chat with each other within the Facebook subgroup page.

4.2.2. Scheduling System through Google Calendar
Many users were concerned with scheduling individual meeting with their advisor. All participants have a full time job and have only a limited time table within which to meet with their advisor. Usually, they would call and make appointments over the phone. However, with the use of online scheduling systems such as Google Calendar, the advisor opens up different timeslots where he is available, and each student can electronically choose and update the appointment. Hence, all users can collaborate in choosing the time slots that are available to them, thus getting rid of the appointment overlap as well as streamlining the scheduling system where all users can see what others’ time slots are.

Another reason that Google Calendar was chosen was because most users already have a Gmail account, thus their familiarity with the technology was high.

4.2.3 Web 2.0 Appropriation
Table 1 shows how participants actually used different types of Web2.0 technology. Although all of the technology was chosen by the users, only Facebook and Google Calendar seemed to be the only two systems that all members used on a regular basis. These two technologies most consolidated the users’ needs for knowledge sharing, networking, and appointment scheduling.

<table>
<thead>
<tr>
<th>Technology</th>
<th>Number of Active Users</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Google Calendar</td>
<td>10</td>
<td>Second Cycle</td>
</tr>
<tr>
<td>Facebook</td>
<td>7</td>
<td>First and Second cycle</td>
</tr>
<tr>
<td>Instant Messaging</td>
<td>5</td>
<td>First and Second cycle</td>
</tr>
<tr>
<td>Email</td>
<td>6</td>
<td>First and second cycle</td>
</tr>
<tr>
<td>Blog</td>
<td>2</td>
<td>First Cycle</td>
</tr>
</tbody>
</table>

Table 1

4.2.4 Second Cycle Lessons Learned
The lessons learned from the second cycle reflect the users’ preferences in technological usage. Although there were many alternatives for users to use for educational purposes, users only want to use one single centralized system, which they are most familiar with. A user said:

“I like using Facebook to do all of the thing that I can do, since I already use them at my office and at home already. It’s a great way to communicate with you (advisor) and others in the same group, since once I made a short wall post, the rest can see and respond to them as well.”

Facebook was chosen by users as a system-of-choice. Most users already use Facebook and Google Calendar. However, they did not have a chance to use both applications for educational purposes. Mainly, they had used it for networking with their friends. During the first two research cycles, users experimented with using Facebook and Google Calendar to share knowledge on each other through features such as wall posts, and worked together in
5. Conclusion

5.1 Knowledge Contributions and Future Research

This paper made the following contributions: we showed that at the early stage, Web 2.0 can be used effectively as a networking tool within a small group of users. However to be successful, the main strategy in designing and building such system relies heavily on building the applications in such a way that it harnesses the network effects amongst its members. Simply said, applications such as Facebook, Blogs, or Google Calendar are only useful to their users if they can see value in networking with others in the same group. Thus, our next step is to use this model and our lessons learned within a bigger group. Facebook will be used as a knowledge sharing and networking system in three undergraduate courses during the second semester (November 2009 – February 2010.) During the courses, Facebook would serve as both a knowledge sharing device and networking tool for more than 100 students. Additional data will be collected using both surveys and interviews. Additional usage data and system iterations will be further examined and reported after the next round of data collection.

References

ELECTRONIC GOVERNMENT SERVICE ACCEPTANCE: THE E-GOV-SAM ASPECT OF THE E-REVENUE SYSTEM

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Abstract
Electronic services are important in government to citizen electronic commerce; however, little is known about electronic government service acceptance model (E-GOV-SAM model). This research aims to develop the determinants of E-GOV-SAM model in the context of e-revenue. The empirical survey results from personal income tax payers show that electronic government service quality has positive impact on building trust and intention to use e-government service. Results indicate that risks adversely affect trust and intention to adopt e-government service. Adoption influence has no impact on building trust but does have an impact on the intention to use.

Keywords: E-government service quality, risk, influence, efficacy, e-revenue, Thailand

Introduction
One of the success cases of e-government service is the Internet tax payment system - so called e-revenue - implemented by the Revenue Department. This system contributes to the enhancement of Internet-based tax payment service usage in Thailand. The major factor that influences users to adopt electronic service is the quality of the system. Electronic service quality has been examined in various models in recent years – for example, E-S-QUAL [10], SITEQUAL [21]. The service quality dimensions of these studies were conceptualized differently and found little unity due to the differing contexts of the studies. Thus, these results provide a fragmented view, and service quality in electronic service remains a relatively new issue requiring more in-depth studies to refine the theory. From the service chain perspective, current studies of electronic service quality do not address all the processes through the service chain. The service chain of electronic services consists of many processes starting from service design, service delivery through the web channel, customer support, and technology support through the whole process of electronic service.

However, the tremendous growth in e-service acceptance, it is often in conflict with perceived risks of adopting the e-revenue system. Some customers have shown unwillingness to complete the service via the Internet channel, primarily due to risk concerns [3,9]. Trust is one of the major factors related to risk that has an impact on technology acceptance. As a new form of government service, e-government service involves more risk than traditional service. The importance of trust for e-government service providers has to be considered.

Moreover, this research examines these issues in the framework of a modified form of the theory of planned behavior, a widely accepted theory for explaining individual acceptance of new technology by looking at adoption influences, such as subjective norm [1]. Further, usage readiness is one important determinant influencing new technology adoption. This research adapts the determinants of behavioral control, such as self efficacy and facilitating resources, as one construct of e-government service acceptance.

This research develops the electronic government service acceptance model – E-GOV-SAM model in the context of the Internet tax payment system, or e-revenue for personal income tax filing.

Literature review
Parasuraman et al. [10] developed the SERVQUAL model to measure service quality reliability, responsiveness, assurance, empathy, and tangibles. In the context of online commerce, service quality dimensions are different from the traditional service quality for which SERVQUAL was originally developed. Online service quality via the internet channel consists of additional issues besides human interaction, such as human and technology interaction, design and interface of the web page.

With increasing interest in online service quality, current studies of online service quality are wide-ranging, but offer little definitive guidance regarding electronic service quality via the web channel. For example, Yoo and Donthu [20] proposed SITEQUAL with four dimensions: ease of use, aesthetic design, processing speed, and security. Recently, Parasuraman et al. [10] developed measures of online service quality in the context of consumer shopping and the purchase process. They found two categories of online service quality: e-core service and e-recovery service quality. E-core service includes the following four dimensions: efficiency, fulfillment, system availability, and privacy. E-
recovery service has three dimensions: responsiveness, compensation, and contact.

These dimensions of online service quality were developed from a variety of different contexts and research methodologies, and show little commonality of online service quality dimensions. They cannot necessarily be applied to the very different context of electronic government service quality. This study focuses on electronic government service in the context of personal income tax filing and payment, or e-revenue. This is a different sort of service than those such as online retailing, often for products such as books or music, with the associated supply chain in the background. Further, most studies examine e-services in which users are customers, who have a choice about whether they even want to patronize specific companies. Taxes are different – users may choose to pay tax by traditional channels or by e-channels, but they cannot choose not to interact with the government.

To develop the appropriate service quality dimensions for electronic government service, in-depth interviews were conducted with 30 income taxpayers [16]. The results showed that electronic government service requires better perceived service quality than many other online services. The interviewees mentioned that the service design and service policy of the e-revenue systems are important, e.g., the service design needs fewer steps to complete the tax filing and payment, must cover all types of tax payment, and should provide motivation to users to adopt. The web design, which presents the service delivery channel, is also important, and must allow users to find relevant information, to link to related data, and should be aesthetic, and easy to use. In addition, technology support which enables the service design and web page to work effectively and handle any online transaction problems are critical factors for electronic service quality. Nevertheless, effective handling of customer problems through electronic service also requires more traditional customer support.

Citizens’ acceptance of e-government service adoption depends on not only service quality but also the perceived risk in making their personal income tax payment via the Internet channel. Perceived risk has been an interesting research topic in many fields. In the marketing literature, risk arises from unanticipated and uncertain consequences resulting from using a product or a service, generally causing an unpleasant feeling. In the electronic commerce environment, studies indicate that perceived risk is a main barrier towards adoption [3], and most of the risks are similar to the more general case, slightly adapted to fit the e-context. Featherman and Pavlou [3] found five indicators of electronic service risk: psychological, financial, privacy, performance, and time risk.

Specific to electronic service systems, the two prominent risks having a significant impact on electronic government service adoption are security and reliability of the system [5,11,13,14,15]. This technology performance issue is the customer’s perceived risk related to how well the system can perform efficiently [3,12]. In addition, Internet customers also perceive financial risk due to credit card fraud. In relation to this issue, the in-depth interview results indicate that Thai citizens are particularly concerned about the audit and financial risk of using the e-revenue system. The reason is that after a tax payment via the Internet they may be audited and requested for additional financial documents proving the transaction. The Thai government tries to motivate citizens to utilize e-revenue by applying the policy of faster tax refund to income tax payers using the Internet-based system. Many taxpayers do not adopt the electronic service because they have to keep all the income documents for five years in case the Revenue Department requests further audits in the future. They feel uncertainty about the risk of a fair audit and about legal support for their claims when filing tax via the Internet. In addition, e-revenue adoption is linked to privacy risk. This is the possibility that the authorities collect data about taxpayers and may use or disclose it inappropriately.

The qualitative research on e-government adoption did not reveal any worry about incurring social dangers or time-loss risks. This implies that taxpayers normally do not lose time by using the e-revenue website and do not show any behavior that is not accepted by other users. Thus, adoption of e-government services can be inhibited by the following risk issues: performance risk, fair financial audit risk, and privacy risk. If the perceived risk elements can be solved and reduced, citizens may be more likely to adopt an Internet tax payment system. In addition, trust in Internet technology is one of the most important barrier issues that customers reported in prior research [9,13].

Trust has been conceptualized in a variety of definitions. Previous research has viewed trust as general belief that another party can be trusted or a willingness to rely on an exchange partner in whom one has confidence [14]. In addition, many researchers view trust as the specific beliefs dealing with the ability, benevolence, and integrity of another party. McKnight and Chervany [16] defined four types of trust: disposition to trust, institution-based trust, trusting belief, and trusting intention.

In electronic commerce, the three main attributes that create trust in the service provider are benevolence, integrity and ability of the service provider [18]. Benevolence relates to the perception of the trusting party that the trusted party desires to do good things rather than maximize profit. Integrity
is the trusting party belief that the trusted party will be honest and make an acceptable set of policies. For example, customers do not want their information to be used in an inappropriate manner or misused by others over the Internet. This can be an element of integrity trust. Finally, ability consists of the skills and competencies of the trustees to do what needs to be done successfully, which enables consumer trust in the service providers. The customer’s trust is a confident belief in the service provider [14], hence, this research adopts three trust characteristics to measure trust in electronic government service providers.

Ajzen [1] indicated that the subjective norm has an impact on changing one’s behavior. The subjective norm means the individual’s perceptions of the social pressures to perform a certain behavior, such as information technology usage [19]. Social pressure creates a normative influence that occurs when one conforms to the expectation of others. Studies that investigated information technology acceptance found that interpersonal influence, such as friends, family, and organization played a major role in adoption [19]. In addition, technology image is one determinant that influences adoption aspects such as preference for self service, and preference to use new technology. Self reliance is one factor that e-revenue tax payers mentioned during the qualitative work. E-revenue tax payers said that they use e-government services because they want to try and self-volunteer. This is similar to a study by Moore and Benbasat [7], which found that adopters perceive the adoption decision to be non-mandated.

Computer self-efficacy means a belief in one’s capability to use the computer and is an important factor deciding to use a new technology [2]. In this context, the ability to use the e-revenue system via the Internet channel and knowledge about personal income tax to use the e-government service are the two major internal self-efficacy determinants. The external constraint is related to the availability of computers or Internet resources to facilitate electronic service usage. In other words, access to computers and Internet is an important issue of resource facilitation for citizens to adopt e-government service [19].

Trust is important in electronic service adoption [14]. Electronic service quality is an important antecedent of user adoption. Oliver and Shapiro [8] suggested that service quality is a more specific judgment that can lead to a broad evaluation of the service provider. So and Sculli [17] found that quality in conducting e-business can build trust. On the basis of these findings, the following hypothesis is considered in e-government service context.

H1: The higher the level of e-government service quality, the higher the level of trust in the e-government service provider.

Perceived risk in conducting electronic business has the major role in reducing trust [17]. The next hypothesis for this study is:

H2: The higher the perception of risk, the lower level of trust in the e-government service provider.

In electronic commerce contexts, the influence from media and interpersonal relationships are key determinants considered by the users in accepting service providers and forming intention to use.

H3: The stronger the adoption influence, the higher the level of trust in e-government service provider.

In the context of electronic service (e.g. Internet banking, Internet securities trading, customer trust has an impact on enhancing attitude [18]. Trust is another belief that has positive impact on attitude toward e-government service usage.

H4: The higher the level of trust, the more favorable the attitude toward e-government service usage.

Intention to use can be derived from many factors such as electronic service quality, adoption influence, usage readiness [2,18]. Conversely, perceived risk has negative impact on intention to use. Positive attitude is expected to increase intention to the adoption of electronic commerce [9]. The following hypotheses are:

H5: The higher the level of e-government service quality, the greater the intention to use e-government service.

H6: The higher the level of perceived risk of e-government service, the less the intention to use e-government service.

H7: The stronger the adoption influence, the greater the intention to use e-government service.

H8: The higher the level of usage readiness, the greater the intention to use e-government service.

H9: The more favorable the attitude toward e-government service usage, the greater the intention to use e-government service.

Methodology

The survey questionnaire items are measured by a Likert scale ranging from 1 to 5 (1 = “strongly disagree”, 5 = “strongly agree”). Survey respondents were selected by judgment sampling to cover a range of professions, income, and age. In addition to judgment sampling, the snowball sample method was applied in order to increase sample size and extend the range of professions. A total of 1,018 completed survey questionnaires were received.

Results

The results of confirmatory and path analysis in Figure 1 shows the structural parameter estimates and hypotheses testing results. Hypotheses 1, 2, and 3 examined the impact of electronic service quality, perceived risk, and influence on trust in e-government service providers. The results show that e-government service quality has strong positive
direct impact on enhancing trust \((\beta = .755)\). The analytical results show that electronic government service can be explained by four determinants: service design quality, website design, technical support, and customer support quality, which affect trust in electronic government service provider, providing support for H1 (Figure 1).

The risk factor has direct negative impact on trust in electronic government service providers \((\beta = -.197)\), thus H2 is supported. The results also suggest that the path from privacy risk \((\beta = 0.854)\) to trust as well as the path from fair financial audit risk \((\beta = 0.857)\) to trust, are highly significant. These findings suggest that both privacy risk and fair financial audit risk are the significant antecedents of reducing trust in electronic government service providers in the context of e-revenue system. Table IV shows that influence has no impact on trust \((\beta = .574)\) and H3 is rejected. Trust has a positive direct impact on creating attitude toward e-government service usage, H4 is accepted. H5-H9 relate to the impact of e-service quality, risk, influence, usage readiness, and attitude on intention to use. E-government service quality has positive impact on intention to use \((\beta = .288)\), therefore, H5 is supported. Additionally, perceived risk has negative effect on intention to use \((\beta = -.130)\), so H6 is supported. Influence has positive impact on intention to use \((\beta = .199)\), thus H7 is supported. Figure 1 shows the second order of three factors of influences: social influence, image, and self-reliance. Usage readiness has direct impact on intention to use \((\beta = .171)\), which supports H8. Resource readiness is a stronger determinant of usage readiness than knowledge readiness. Finally, attitude toward e-government service usage has a strong impact on intention to use, so H9 is accepted.

**Conclusion**

The model presented in this paper provides a comprehensive framework of E-GOV_SAM model and its components. The determinants of e-government service quality are presented in order of importance: technical support, website design, service design, and customer support quality.

Electronic service companies can use this model to assess the whole processes of e-government service quality and allocate their resources to crucial service quality attributes identified by this study. Particularly, these four electronic service qualities constitute a necessity for enhancing electronic service users’ acceptance, since these factors have strong associations with trust in electronic service providers and intention to use e-government service.

In addition, perceived risk is an important inhibitor to e-government service acceptance. According to the data, users or potential users recognize three components of perceived risks: privacy risk, performance risk and fair financial audit risk. The “privacy risk” factor comprised personal data may be used for other purposes, worry about privacy of information, worry about keeping all income documents for 5 years. Performance risk consists of inability to save the transaction, remaining unsure that the transaction has been submitted successfully, and worry about data being hacked. Fair financial audit risk is related to the risk...
of paying additional tax, being audited, and lacking fair legal support when using e-revenue.

To overcome the performance risk of e-service systems, the government agencies must establish high system reliability and capability. In the case of personal income tax payment, too many times the system cannot be accessed during peak periods. It is important to upgrade the system’s capacity and security infrastructure, especially for the website. Further, influence has an impact on intention to use e-government service but not as strong as e-government service quality. Social and image influences have the stronger powers in determining this influence than does the self-reliance dimension, although self-reliance is itself fairly strong. Media influence, one component of social influence, may be critical in generating awareness in the early stage of e-government service. Usage readiness shows the least positive impact on intention to use. This research suggests that E-government service providers need to drive better e-government service quality and reduce risk to retain future acceptance of current user and non-user citizens. E-government service providers need to be more market driven in their innovation to respond to perceived citizen needs and wants, rather than technology driven to just implement new technology service delivery to their citizens.

References


A DESIGN FRAMEWORK FOR ONLINE SUPPORT SYSTEMS OF E-GOVERNMENT IN CHINA

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Abstract
With development of e-government systems, there are many big changes in Chinese government’s efficiency. However, the SARS revealed low efficiency is still serious. After the analysis of the factors affected on the efficiency, we find that traditional DSS is hard to support decision maker and that online support systems may improve the officials’ work effectiveness better. Unfortunately, little attention has been given to the research. In this paper, we will discuss the cultural characteristics of Chinese government. And then, based on the theory of Time-based Competition in governmental workflow, we summarize the four characteristics of online support systems. Furthermore, we propose the design framework for online support systems (OSS) in context of e-government in China, which consists of three major parts: the single OSS, the collaborative OSS and the mobile OSS. Also the detailed function and procedure of the three parts are presented. Analysis shows that the OSS contributes to developing efficiency in the official decision making.

Keywords: Online Support Systems, E-government Systems, Time-based Competition

Introduction
In early 2003, SARS (Severe Acute Respiratory Syndrome) broke out and spread over the whole China. Superficially, it is the issue of medical field. In fact, it is a serious problem of low efficiency in government. In Hong Kong, some media accused local government of being “impotent” in handing this crisis [1]. Therefore, Wen Jiabao, the premier of the state council in China, said “SARS revealed the government should pay more attention to public service function and its efficiency, while keeping on strengthening the economic adjustment and social supervision,” [2].

On the other hand, Chinese government began to build the e-government system in 2001. Many departmental projects which contain the “Golden Customs”, “Golden Cards”, “Golden Tax Revenue” and other computerized communications systems to serve the governmental department with their names headed by the acronym “Golden”, obtain enormous success [3]. And same time, from regional government perspective, the local government institute realized the online working and created their portal site to release information and provide the access of event processing for citizen and enterprise. With the further development of e-government systems, through reengineering the governmental process, some processing service realized the collaborative work across different departments [4]. In order to avoid the “information island” and achieve information sharing, the country has gradually build government information resource catalog system and exchange system.

Although the governmental operation efficiency is significantly improved, with the continuing promotion of Chinese democratization process, more and more citizen and enterprise asked the government to enhance the efficiency and effect in event handling. The media and the mass response to SARS are merely “a tip of the iceberg”. It is necessary to deeply penetrate the inner governmental workflow to find out the major factors in daily work.

Through the investigation of decision node in governmental workflow, there are basically four main factors which affect the decision efficiency. Firstly, before dealing with an event, the official should take massive time to gather or confirm the correlative information by telephone or other e-government systems. Secondly, in practice, the problem need decision is often semi-structured or unstructured. Because the governmental policy is numerous and changeable, even the experienced official would spend massive effort finding the updating information. And the young officials are at a loss for inexperience although who have good capability of receiving new information. Thirdly, collaboration is inevitable in governmental workflow. Because government involves many departments, collaboration becomes more complicated and more information is required to support decision maker. Finally, in present China, it is difficult for the leader in government to have
enough time to deal with things in front of the computer. So, a lot of time is wasted in waiting for leader’s treatment.

From what has been discussed above, we may safely draw a conclusion that exploitation of certain system to support decision maker is in great demand, which can improve governmental workflow’s efficiency. Some research hit this point. Selber had proposed the concept of OSS and divided it into three classes. From the application perspective, he defined the OSS as “supporting users who must solve particularly pressing problems as quickly as possible and with a minimum of interruption” [5]. But it is unfortunate that further researches never show up.

The paper is organized as follows, in the theoretical background section, we discuss the tradition DSS theory and the culture of Chinese government, and based on the theory of time based competition describe the four characteristics of OSS. Next, we propose the design framework of OSS and explain every component in detail. Finally, we present the research contribution of OSS and future research.

Theoretical Background
In this section, we firstly discuss the DSS design theory and then prove traditional DSS is hard to support the decision maker in governmental workflow. Next, we describe the cultural characteristics of Chinese government. Through the application of the theory of Time-based Competition to e-government systems, we explain real-time supporting is OSS’s critical feature. Finally based on the above analysis we summarize the characteristics of online support systems.

Introduction to DSS
Since the early 1970s, model-based decision support systems (DSS) have evolved significantly. The advent of the Internet has given rise to many new applications of DSS [6]. Many technologies such as DW, OLAP, and DM applied in DSS greatly enhance the performance of distributed information processing and the ability of supporting decision makers who is dispersed in geography but collaborative with each other [6, 7]. However, “there are many well recognized examples of user resistance to model-based DSS in data-rich, uncertain environments” [8]. Similarly, decision support systems are rarely applied in the e-government systems. In some departments, the module with function of DSS is even ruled out. There are following reasons why traditional DSS is unfit for such governmental decision situation.

Firstly, Ujwal Kayande and his research group proved that the decision maker’s mental attitude impact on final decision. So, for lack of decision maker’s mental models of the decision environment embedded in the DSS, the traditional DSS always have been excluded [9].

Secondly, in the government workflow, every task cannot be accomplished by single official or department. The official came from different departments and need to collaborate with each other. In order to support the official to make decision, the module should take account of the collaboration among decision nodes, but traditional DSS absent the function.

Last but not least, traditional DSS’s models are hard to perceive the current decision environment. For lack of self-adapting ability, traditional DSS seemed to be in difficulty to apply in the governmental workflow, particularly with dealing with small decision.

Thus, in the context of decision nodes attached to daily governmental workflow, the traditional DSS fail to efficiently support decision making.

Culture of Chinese Government
No matter industry or academia has reached a consensus that any management information systems should be suit to local culture. Chinese culture has been regarded as typical eastern characteristics, which differs from the west [10]. The governments preserve the traditional Chinese culture [11]. Therefore, it is indispensable to take the local culture into account when studying the decision support in Chinese government.

In 1985, based on Hofstede’s original four dimensions model, he conducted a “Chinese Value Survey” (CVS) and then proposed the well known fifth dimension, Long Term Orientation (LTO), which is also called Confucius values [12]. In 2001, he divided this dimension into the positive pole and the negative pole [10]. Such classification indicates that everything in this world has positive and negative side. So the ideal status is balance between them, and furthermore attaining Hexie among collaboration with interactive person. Many Chinese researchers believe that Hexie is the basic principle of Confucian value [12]. Especially nowadays China is rebuilding the traditional cultural values and the symbolized concept “Hexie Society” was proposed by Hu Jintao, the president of China.

The Hexie culture puts emphasis on alleviating contradiction among various kinds of involved person and organization. And this reconciling prefers evolution rather than revolution when new thing appeared. Recently, the e-government systems develop rapidly and departmental and regional e-government systems are taking shape. However rare decision support
A Design Framework for Online Support Systems of E-Government in China

From the above analysis, traditional DSS is difficult to provide the information and knowledge to the official in time. Based on the analysis of the culture background of in China government, we address four characteristics of OSS based on TCB theory.

The first characteristic is that the decision problems are semi-structured or unstructured and can be solved by a person. If the problem is well-structured, the official’s intuition can help him to solve the problem. If the problem is unstructured, it is difficult to solve by a person, to assure accuracy, group negotiation is required.

The second characteristic is that the OSS is process-driven. It cannot exist without the process workflow, which embedded in the official’s daily workflow. When the process arrives, the OSS should provide effective information, knowledge or satisfying decision result. On the other hand, the OSS should be real-time to help the official to extremely save time.

The third characteristic is that the OSS can support the collaborative work. In e-government, for example, “Project Approval” needs more than one official to handle. If a system can provide the real-time and enough information and knowledge to decision maker in the process, it can enhance the decision-making efficiency.

The fourth characteristic is that OSS can support the mobile working. In government, there is a fact that the leader has rare time to deal with problems in front of computer and maybe unfamiliar with computer. So the mobile service in OSS is necessary.

As shown below, these characteristics make system designer feel it difficult to use traditional DSS theories to realize such systems. And then we define the online support system (OSS) as a design framework.

OSS Design Framework

In this section, we describe the architecture of OSS in context of e-government system, and then present every component in detail.

Architecture of OSS

As illustrated in figure 1, the architecture of proposed OSS consists of three major parts: the single OSS, the collaborative OSS and the mobile OSS.
It can be seen from the figure that knowledge flow model play important role during the whole architecture. The solid line represents knowledge flow, while the dotted line indicates invoked information or data in workflow. The single OSS serves official who can complete the process in the workflow without collaboration. The Collaborative OSS help the official cooperated with others in workflow by providing right information and knowledge at suitable time. In the light of the practical situation of leader working, the mobile OSS can provide the mobile information and knowledge to the leaders. The three parts would gain effective knowledge from the knowledge flow model, and then after accomplishing a process they would update the knowledge database.

Knowledge Flow Model
While workflow technology concerned the description and control of business process, knowledge flow model focus on the knowledge generation, transmission and application on workflow. Knowledge derives from the application scenario and previous solved problems. And representation and storage contributed the knowledge discover and reuse. Because knowledge is server for the person, the user play critical role in knowledge production and propagation. So, the primary question is to perceive the user’s situation which is also decision problem environment. In knowledge flow model it is knowledge requirement which is designed to gather the demand of user and decision problem. And same time, knowledge requirement became the critical factors of implicit knowledge and its propagation.

Combining with workflow and knowledge flow is a major feature of this model. The OSS is process-driven, which require the knowledge to provide for the decision maker by right way when the process arriving. “Push” technology is simple and effective method for knowledge transferring. This method can automatically deliver the knowledge to the user. Its advantage is to avoid the search cost and needless knowledge transferring.

The validity of the provided knowledge is another important problem. The case-based reasoning and another computerizing technology can help to enhance the accuracy of knowledge [20].

Single-OSS
When the official deals with a process in front of computer without collaboration with others, the OSS become the Single-OSS which automatically push suitable information and knowledge or decision suggestion to the decision maker according to the situation and preference. Figure 2 shows the basic building blocks of the procedure for online support systems. This is example of procedure for single-OSS. During the implementation, the practitioner can adjust the procedure according to the system situation. Although the procedure seems a little complicated, the effective information and decision suggestion can be pushed to user with the process arriving.

When an online process started, the single-OSS would identify the online requirement. The requirement is divided into pure information and knowledge requirement. The previous case, the official preference, and problem situation is all provided by knowledge database, the ingredient of knowledge flow model. And then knowledge requirement is acquired. Information requirement is formed according to the demand of workflow. The e-government systems gradually create the government information sharing mechanism. Authorized information requirement is permitted in e-government workflow. With the information and knowledge, the single-OSS begins to analyze the problem and receive the decision suggestion.
provided by the previous method stored on knowledge database. If the single-OSS or decision maker found information absent, then the procedure would return the stage of requirement identification. If the process demanded to collaborate with others, the single-OSS would jump to the module of Collaborative-OSS. If the official solved the decision problem, the solution would automatically form case and store on knowledge database.

**Collaborative-OSS**

With the development of e-government, more and more citizen and enterprise want the government to provide the “one-stop” or “collaborative” service. So cooperating with other officials even other department is unavoidable. The collaborative-OSS doesn’t focus on the collaborative process design. It concerns on how to help the official to make correct decision in the process node. Figure 3 shows the basic building blocks of the procedure for collaborative-OSS.

![Collaborative-OSS Diagram](image)

When a task needs cooperation, the collaborative-OSS could be triggered. According to governmental workflow, we can find the counterpart who is next decision node. Furthermore, we can identify the counterpart information requirement. Similar to single-OSS, the information requirement could be divided into two parts. One is knowledge requirement, and another is information requirement. Knowledge is derived from knowledge database, while information is provided by data collection from the single-OSS. Because it is common to move back and forth between the steps and even iterate the whole process several times, all these information could be store on local document system for the next iteration. With enough information and knowledge, the collaborative-OSS would compute and output the decision suggestion to push the decision maker by the predetermined model. At this point, the decision maker needs to determine whether this problem can be solved in this stage or need group negotiation. If the official find the problem is too complicated and cannot be solved in ordinary process, they can choose to enter the group decision support system. Otherwise, the official can make a decision and transfer the result to the next node. When the procedure accomplished, the solution would automatically form case to store on knowledge database.

**Mobile-OSS**

In China, governmental leader decision has own characteristics. On the one hand, the leader of government often hasn’t enough time to deal with the problems in front of the computer. On the other hand, they generally would rather be familiar with the mobile service such as mobile phone than computer. So, in order to serve for leader decision, the mobile-OSS would provide a way to support the decision by the mobile device. The critical issue of the mobile-OSS is how to represent the information in limited mobile device interface.

As we all know, the mobile device interface is smaller than computer’s and the data transmission speed of mobile communication is slower than the internet. In view of above factors, the interface for mobile device cannot simply be transplanted from the interface for computer. It should be adjusted to fit for the small display and limited network flow.

**Conclusion**

With development of e-government system and democracy, not only citizen and enterprise, the government itself required to enhance the governmental decision efficiency. In this paper, analyzing the traditional DSS, we find it is unsuited to support online decision in governmental workflow. After discussing the culture of Chinese government, we believe that giving up the existing systems and rebuilding the new one is impossible. So, based on TCB theory, we describe four characteristics of OSS, which can support the official decision in real time. Further, we proposed the architecture of OSS. It contains three parts, single-OSS, collaborative-OSS, and mobile-OSS. The single-OSS serves for the official who can complete the decision problem alone. The
collaborative-OSS is responsible for collaboration among different officials or departments. And the mobile-OSS support mobile decision handing for governmental leader.

In this paper, our main contributions are: (1) analysis of the main factors of low effective in government; (2) Form discussion of traditional DSS and Chinese culture, proposition of the OSS four characteristics based on TCB theory; (3) development of the OSS design framework. The further researches focus on how to realize such OSS and the crucial technology.

Acknowledgement. This research was supported by the National Natural Science Foundation of China under Grant 70533030.

References
AN EMPIRICAL RESEARCH OF THE NETWORK PUBLIC OPINION IMPACT ON THE INFORMATION OPENNESS OF GOVERNMENT AFFAIRS
—take "hide and seek" and "Deng Yujiao" events for example

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Abstract
The influence network public opinion on the information openness of government affairs is studied after comparing the events of "hide-and-seek" and "Deng Yujiao". The linear dependence relationship exists between variation of information publicity about government affairs and the total number of the network public opinion, moreover, variation of information publicity about government affairs and the ratio that negative comments in total number of the network public opinion presents linear relation. Both total number and negative comment ratio play an improving role in the process of e-government publicly: total number and degree of e-government information openness exists stable positive correlation, while the positive correlation relationship between negative comments ratio and e-government information openness is instability.

Keywords: Network Public Opinion, Information Openness of Government Affairs, Empirical Research

Introduction
The Internet is called "the fourth medium", which is next to the traditional main mediums such as newspaper, radio and television. It has become an important channel, through which Netizens complain, express their views, and supervise public affairs. Studies of the internet users have shown that: the emerging features of the Internet have increasingly become the expression of popular channels and places of public opinion.

Network public opinion will become more and more powerful and influential. Even government can not escape its effect. With the booming of network, it may have strong impact on the government, which promotes the government to open more information.

Yet, related researches have not answered the following two problems until now. First, does the reasoning positive impact between the two is true and common? Second, which factors of network opinion bring such effect? Most scholars study this phenomenon from the perspectives of Communication Studies and Journalism. Almost no one make quantitative study and empirical study. So this paper chooses two hottest events in 2009 as cases to research the impact of network public opinion from the empirical perspective.

Research on the case "hide-and-seek"

(1) The whole incident
January 28, 2009, Li Qiao-ming, under criminal detention for the crime of illegal logging in forests, was detained in Room No. 9, Jin Ning County Detention Center. He was put into the same room with detainees Zhang Hou-hua, Zhang Tao who had been there under various pretexts. Li Qiao-ming was beaten several times with fists or slippers, resulting in many wounds on the head and chest. Then he was beaten again by violent boxing. Later on, Li Qiao-ming was hit the wall and fell to the ground unconsciously. He died on February 12.

After the incident, police station in Puning County announced that Li Qiao-ming died due to a game accident without in-depth investigation and evidence collection. This announcement aroused strong public doubts. Yunnan Police has to reply these doubts. Totally they promulgate information nine times.

According to the time at which government opened

<table>
<thead>
<tr>
<th>time</th>
<th>announcement</th>
</tr>
</thead>
<tbody>
<tr>
<td>09.2.13</td>
<td>The police claimed that Li was hurt badly to death when played the game of &quot;hide-and-seek&quot;</td>
</tr>
<tr>
<td>09.2.20</td>
<td>Yunnan police claimed that &quot;hide-and-seek&quot; should be called &quot;Xiazimoyu&quot; and Li's death is an accidental death</td>
</tr>
<tr>
<td>09.2.21</td>
<td>Yunnan police claimed there is no misconduct of policeman</td>
</tr>
<tr>
<td>09.2.21</td>
<td>Police commissioner of Jining said that the police are responsible for Li's death</td>
</tr>
<tr>
<td>09.2.27</td>
<td>Investigation: Li died due to being assaulted by bullies in the same prison</td>
</tr>
<tr>
<td>09.3.04</td>
<td>Two policemen who involved in of &quot;hide-and-seek&quot; are arrested</td>
</tr>
<tr>
<td>09.3.06</td>
<td>China Supreme Procuratorate expose details and disposal of &quot;hide-and-seek&quot;</td>
</tr>
<tr>
<td>09.3.10</td>
<td>Deputy Chief Procurator of china supreme procuratorate claimed that bully phenomenon has exist for a long time</td>
</tr>
<tr>
<td>09.8.14</td>
<td>First-instance judgments sentences two policemen are condemned</td>
</tr>
</tbody>
</table>

Tab.1 proclaims of government at different times

The 9th International Conference on Electronic Business, Macau, November 30 - December 4, 2009
(2) Data Collection

In this paper, public’s reactions (comments on the network)\(^1\) on Government’s information at each time were divided into five categories, namely, criticism, doubt, support, neutrality and unsorted. Detailed data can be seen in Table 2.

<table>
<thead>
<tr>
<th>time</th>
<th>Total Comments</th>
<th>Displayed Comments</th>
<th>Criticism</th>
<th>Doubting</th>
<th>Supporting</th>
<th>Neutralizing</th>
<th>Unsorted</th>
</tr>
</thead>
<tbody>
<tr>
<td>09.2.13</td>
<td>5491</td>
<td>1817</td>
<td>1003</td>
<td>736</td>
<td>27</td>
<td>37</td>
<td>74</td>
</tr>
<tr>
<td>-09.2.20</td>
<td>297</td>
<td>135</td>
<td>57</td>
<td>69</td>
<td>3</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>09.2.21</td>
<td>2475</td>
<td>749</td>
<td>294</td>
<td>422</td>
<td>6</td>
<td>7</td>
<td>13</td>
</tr>
<tr>
<td>-09.2.2</td>
<td>974</td>
<td>333</td>
<td>241</td>
<td>22</td>
<td>23</td>
<td>3</td>
<td>13</td>
</tr>
<tr>
<td>09.2.27</td>
<td>10688</td>
<td>2692</td>
<td>1418</td>
<td>381</td>
<td>182</td>
<td>525</td>
<td>187</td>
</tr>
<tr>
<td>-09.3.04</td>
<td>2374</td>
<td>775</td>
<td>579</td>
<td>108</td>
<td>0</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>09.3.10</td>
<td>2851</td>
<td>595</td>
<td>271</td>
<td>182</td>
<td>144</td>
<td>80</td>
<td>62</td>
</tr>
<tr>
<td>-09.8.14</td>
<td>872</td>
<td>154</td>
<td>65</td>
<td>25</td>
<td>33</td>
<td>12</td>
<td>19</td>
</tr>
</tbody>
</table>

(3) Variable selection and configuration

When choosing variables, the following factors have been considered:

First, we need a variable which indicates the level of participation. As the attention is a latent variable which can’t be observed directly, so we have to choose another variable for substitution. The total number of comments is a right index. When collecting the relevant comments of each period, we can’t see all comments because some of them are not displayed. Therefore, this article had better use the actual number displayed online as explanatory variables, that is, \( x_1 \).

Second, we need a variable which indicates negative factor. This variable can be seen from the number of suspicion and criticism. From the table 2, we can see that the number of suspicion and criticism accounts a large proportion of visible comments, which is close to 90%. So we can not adapt the number of suspicion, the number of criticism and the number of comments displayed altogether. To avoid the multicollinearity, we have suspicion and criticism integrated into an indicator, that is, negative factor. Because criticism is much more intense than suspicion, they are given different weights. Here, we simply believe that a critical comment is equal to one and a half suspect comments. Thus, we can gain a new variable \( x_2 = (\text{number of suspicion} + \text{number of criticism})/ (\text{number of all displayed} + 0.5 \times \text{number of criticism}) \).

We should set a variable \( Y \), which represents the openness degree of government’s affair, at every phase. To express the effect of the public opinions, we make a new variable \( dY \) which drive from the difference between the adjacent \( Y \). The quantification of \( Y \) is from the Likert scale which investigate Netizens’ evaluation of the government’s dealing process. We believe that Netizens care about three factors. First, at which degree does the government description disclose the true scene; second, at which degree does the government explain the real reason of Li Qiaoming’s death; third, at which degree does the government deal well with the event. 50 questionnaires had been handed out and 50 reclaimed, 47 of them are useful and the effective rate is 94%.

Therefore, this article will set the public opinion as promoting factor (explanatory variable) and set the variation of Administrative Information Disclosure degree as being promoted factors (interpreted variables). The values of these variables are shown in Table 3.

\(^1\) Note 1: The investigation of comments of each stage were collected from Sina.com, the time from February 13, 2009 to August 16, 2009

(4) Constructing and analyzing of model

By using the Eviews, we make an OLS regression and the results are as follows:

\[
dY = -2.433563 + 0.001407 x_1 + 2.943143 x_2
\]

\[S.E (2.960029) (0.000301) (3.166710)\]
An Empirical Research of The Network Public Opinion Impact

The 9th International Conference on Electronic Business, Macau, November 30 - December 4, 2009

$t = (-0.822142) (4.668755) (0.929401)$

$R^2 = 0.842797$ \(\overline{R^2} = 0.754716\) \(F = 11.76915\)

1. Test of goodness of fit:

R-squared \(\overline{R^2} = 0.824797\)

adjust R-squared \(\overline{R^2} = 0.754716\).

This means that \(x_1\) and \(x_2\) together explain as high as 75.5 percent of the variation in \(dY\) and that the sample regression function fit the observed values of the sample at a good level and the function can accurately reflects the characteristics of population.

2. F test:

At the 5% significance level,

\(F = 11.76915 > F_{0.05} (3, 19, 3)\)

This means the SPR is overall significant, that is, the variables \(x_1\) and \(x_2\) are together significant.

3. T test:

Because

\[|t_1| < t_{0.025} (9 - 3) = t_{0.025} (6) = 2.447,\]

\[|t_2| > t_{0.025} (9 - 3) = t_{0.025} (6) = 2.447,\]

\(x_1\) is not significant, \(x_2\) is significant, that means the two variables are correlated. Therefore, by stepwise regression method, to test and solve the multicollinearity, make regressions with \(x_1\) or \(x_2\), the result can be seen in table 4.

Tab.4 unary regress result

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>(x_1)</th>
<th>(x_2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter estimation</td>
<td>0.001280</td>
<td>-3.728745</td>
</tr>
<tr>
<td>(t) statistics</td>
<td>4.816765</td>
<td>-0.624356</td>
</tr>
<tr>
<td>(R^2)</td>
<td>0.794529</td>
<td>0.061006</td>
</tr>
<tr>
<td>(\overline{R^2})</td>
<td>0.760284</td>
<td>-0.095493</td>
</tr>
</tbody>
</table>

When \(x_1\) is added to the regression, the adjust R-squared is most large. So, keep \(x_1\), and add other variable, make regression again, the result can be seen in table 5.

Tab.5 binary regression result

<table>
<thead>
<tr>
<th>(x_1) (x_2) (R^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.001407 2.94314 (4.668755) (0.929401) 0.754716</td>
</tr>
</tbody>
</table>

By comparison, if we add \(x_2\) to the regression, not only adjust R-squared decline, but the test parameters of \(x_2\) become not significant. This shows that serious multicollinearity had been arouse by \(x_2\) which should be removed. So final results are as follows:

\(dY = 0.001280 x_1 \)

\(t = (4.816765)\)

\(R^2 = 0.794529 \overline{R^2} = 0.760284 \ F = 23.20123\)

From the above result we can see that there is a linear relationship between variable \(dY\) and variable \(x_1\) and that variable \(x_1\) can spurs the government openness degree actively.

It can be concluded from the result above, the amount of Netizens who pay attention to the focus does spur the government opens provide more true information. So does the proportion of negative comments. But if we make regresses by setting \(dY\) as dependent variable and choosing either \(x_1\) or \(x_2\) as the independent variable, we will find the linear relationship between \(x_2\) and \(dY\) is not notable.

**Empirical research on case "DengYujiao"**

1. The introduction of the event

May 10, 2009, in the City of Badong County, Hubei Province, Deng Guida, 44, the director of the business promotion office in Yesanguan Township and Huang Dezhi, 41, who was the vice director of the office of business delegations went to a bathhouse with Deng Zhongjia, 45, another vice director of the same office. Deng Guida pulled out a stack of cash and tossed it at Deng Yujiao, a waitress of the bathhouse, and pushed her down twice on a sofa after she refused to provide "special services"(slang for sex). The waitress picked up a knife and fatally stabbed Deng Guida and injured Huang.

According to the government’s bulletins, "Deng Yujiao" event can be divided into ten phases, which can be seen from the table6.

**Tab.6 proclaims of the government at different times**

(2) Data collection

As in the last case, in this case, the whole event is divided by the times when the government announced. There are ten important announcements, so there are ten stages. We collect comments of each stage. And these comments are distinguished into five classes, namely: Criticizing, doubting, supporting, and maintaining neutral and the other. Detailed data can be seen from table 7.

**Tab.7 public reaction of each period**

<table>
<thead>
<tr>
<th>time</th>
<th>Total Comm-ents</th>
<th>Displayed Comm-ents</th>
<th>Criticizing</th>
<th>Doubting</th>
<th>Supporting</th>
<th>Neutral i-zing</th>
<th>Unsov -ted</th>
</tr>
</thead>
<tbody>
<tr>
<td>09.2.13</td>
<td>4505</td>
<td>4411</td>
<td>2053</td>
<td>1845</td>
<td>0</td>
<td>0</td>
<td>513</td>
</tr>
<tr>
<td>09.2.2</td>
<td>4505</td>
<td>4411</td>
<td>2053</td>
<td>1845</td>
<td>0</td>
<td>0</td>
<td>513</td>
</tr>
</tbody>
</table>

2. Note2: The investigation of comments of each stage were collected from Sina.com, the time from May12, 2009 to June 16, 2009
In this case, we choose variables with the same method which is applied in "hide-and-seek". Data of the variables we chosen can be seen in table 8.

Tab.8 data of dependent variable and independent variables

<table>
<thead>
<tr>
<th>time</th>
<th>announcement</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009.5.12</td>
<td>First case notification of Badong police</td>
</tr>
<tr>
<td>(02 : 47)</td>
<td></td>
</tr>
<tr>
<td>2009.5.13</td>
<td>Second case notification of Badong police</td>
</tr>
<tr>
<td>(02 : 45)</td>
<td></td>
</tr>
<tr>
<td>2009.5.18</td>
<td>Third case notification of Badong police</td>
</tr>
<tr>
<td>(15 : 20)</td>
<td></td>
</tr>
<tr>
<td>2009.5.20</td>
<td>Badong county Security Bureau Li-Yong Yang said that it was really a very ordinary murder case from the entire episode</td>
</tr>
<tr>
<td>(20 : 08)</td>
<td></td>
</tr>
<tr>
<td>2009.5.23</td>
<td>Badong county government spokesman informed the latest progress about the case</td>
</tr>
<tr>
<td>(01 : 37)</td>
<td></td>
</tr>
<tr>
<td>2009.5.27</td>
<td>Badong County in Hubei Province spokesman release information</td>
</tr>
<tr>
<td>(17 : 05)</td>
<td></td>
</tr>
<tr>
<td>2009.5.31</td>
<td>Committee of Badong County Commission for Discipline Inspection informed: Officials involved in the case were expelled from the party and detained</td>
</tr>
<tr>
<td>(21 : 28)</td>
<td></td>
</tr>
<tr>
<td>2009.6.1</td>
<td>Deng Yujiao case had been investigated completely</td>
</tr>
<tr>
<td>(10 : 12)</td>
<td></td>
</tr>
<tr>
<td>2009.6.5</td>
<td>Deng Yujiao be prosecuted to the Badong County Court on charges of wounding with intent</td>
</tr>
<tr>
<td>(08 : 05)</td>
<td></td>
</tr>
<tr>
<td>2009.6.16</td>
<td>Deng Yujiao was exempted from criminal punishment, sentenced by Badong court</td>
</tr>
<tr>
<td>(15 : 17)</td>
<td></td>
</tr>
</tbody>
</table>

This means that $x_1$ and $x_2$ together explain as high as 87.8 percent of the variation in $dY$ and that the sample regression function fit the observed values of the sample at a good level and the function can accurately reflects the characteristics of population. ② F test:

At the 5% significance level,

$$F = 29.79 > F_{0.05} (3, 10) = 4.74.$$  

This means the SPR is overall significant, that is, the variables $x_1$ and $x_2$ are together significant. ③ T test:

Because

$$|t_1| > t_{0.025} (10 - 3) = t_{0.025} (7) = 2.365,$$

$$\frac{|t_1|}{|t_2|} > t_{0.025} (10 - 3) = t_{0.025} (7) = 2.365.$$  

The intercept should be deleted, $x_1$ and $x_2$ are significant, so we regress again, the result can be seen as follows.

$$dY = 0.000238 x_1 + 0.826387 x_2$$

$$SE \ (3.67E-05) \ (0.252482)$$

(3) Constructing model and analyzing

By using the Eviews, we make an OLS regression and the results are as follows:

$$dY = -2.191533 + 0.000281 x_1 + 3.192260 x_2$$

$$S.E \ (1.057062) \ (3.66E-05) \ (1.159983)$$

$$t = (-2.073231) \ (7.672303) \ (2.751989)$$

$$R^2 = 0.908519$$

$$\overline{R^2} = 0.878025$$

$$F = 29.79359$$

① Test of goodness of fit:

R-squared $R^2 = 0.908519$,  

adjust R-squared $\overline{R^2} = 0.878025$.  

$\overline{R^2}$ is useful in avoiding the problem of overfitting where the goodness of fit is measured by a statistic that is too influenced by the number of predictors in the model, so it is used to judge the significance of the regression model. ② Test of multicollinearity

By using simple correlation coefficient test, we obtain the simple correlation coefficient $r_{12} = -0.240135$, which is less than 0.3. So we take it for...
granted that there is no multicollinearity.

2. Heteroscedasticity Test:

\[ \hat{\omega}^2 = \frac{1}{n} \sum_{i=1}^{n} (y_i - \hat{y}_i)^2 \]

\[ \hat{\omega}^2 = 0.05 \]

\[ \chi^2(0.05) = 9.2103 \]

By using White test, we gain
\[ \chi^2(5) = 11.0705 > \hat{\omega}^2 = 5.119104; \]

So there is no Heteroscedasticity.

3. Autocorrelation test:

\[ \begin{align*}
& F\text{-statistic} = 0.75060, \quad \text{Probability} = 0.51782, \\
& \text{Prob.} = 0.381084
\end{align*} \]

\[ \hat{\omega}^2 = 2.26701 \quad \text{and} \quad \chi^2(2) = 5.99147, \]

\[ \chi^2(2) = 5.99147 \]

there is no autocorrelation.

So the regression analysis of model should be:
\[ dY = 0.000238 x_1 + 0.826387 x_2. \]

The comparative analysis of the impact on e-government openness which comes from the public network opinion

From the analysis of the two events, we can make following conclusion:

1. When doing regress with \( x_2 \) which representing the proportion of negative comments, it is not notable in the "hide-and-seek" event, but notable in "Deng Yujiao" event.

The reasons may be as follows:

Firstly, when "hide-and-seek" event spreads on the net, almost all people felt angry at the government's malfeasance, so when the authority announced that this event was only a accident, it arouse strong criticism. Therefore, the value of proportion almost all are near 90%, which is similar to a constant.

On the contrary, in the "Deng Yujiao" event, the result of the judgment is that Deng Yujiao is exempted from criminal punishment, so the people can feel easy at some degree. And the local authority replies actively. So the proportion of neutral and suspicion is larger than that in the of "hide-and-seek" event. And this leads to the variety of the value of the proportion of negative comments.

2. The number of public comments displayed does have positive effect on the openness degree.

The variable \( x_1 \) which represents the number of public comments displayed passes the test in both models. According to this result, we can say that the positive relationship between \( x_1 \) and \( dY \) is true. Either event arouses a strong attention from the public since it is made public. Millions of people express their opinions by making comments on the line to the government announcements. And the government can know the attitude of the public rightly by reading the comments, so they will take more right measures to deal with the hail of angry and suspicion. By this way, the public can have effect on the government, and the communication between both sides gets strong which can make the government's decision-making more scientific and more timely.

Conclusions and suggestions

From the empirical research and analysis above, it is easy to get the follow conclusions. There is linearly relationship between \( x_1 \) and \( dY \); Not only the \( x_1 \) but also \( dY \) has positive effect on the openness degree; There exists a stable linear relationship between \( x_1 \) and the openness degree. But \( x_2 \) has no stable relationship with \( dY \). According to the conclusions mentioned, we can put forward some suggests as follows:

1. First, it is important for the public to pay attention to unfair events. Their attention and comments not only provide more messages that the government needs, but also have a certain press on the behavior and decision of the government.

2. The emergence and the formation of network public opinion provide the relevant decision-makers a more comprehensive, more focused reflection of public opinion channel. Therefore, the government should pay full attention to the public demands which are conveyed through the Internet. Especially for some hot events which bring the local government negative image, the government should investigate at the first time. Once the investigation is true, the government should solve the problem as quickly as possible to promote the construction of local government.

3. Internet public opinion is a "double-edged sword", which not only brings the government positive social eTects, but also some negative social eTects. For example, when some great serious public events took place, due to limited sources of messages, the report and dissemination of events may not be accurate. And this provides some people with ulterior motives spreading false news, rumors and misleading public opinion toward the space, which affect the social stability and development. Therefore, the government should popularize e-government widely in the country and strengthen government websites to inform the public in time the news which are related to great events or decision-making progress.

This article only extracts two hot spots of great public concerns in 2009. All the investigation, research and conclusions are about the two cases. So the
conclusions may not be universal, but the authors hope that the research work will be irraditive for the government to correctly guide public opinion and build a harmonious society.

Acknowledgement. This research is supported by Nation Nature Science Fundation Key Project< the Basic Research of E-government Management Theory and Methods> (code: 70533030).

References
ASSESSING THE FIT BETWEEN MOBILE TECHNOLOGY ON SELF-SERVICE AND INDIVIDUAL DIFFERENCE IN THE EXHIBITION INDUSTRY

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Abstract
The concept of self-service is getting popular. Many firms and users adopt the SST (Self-service Technology) due to its lower cost and saving time. Mobile technology is an emerging technology and because of its characteristics such as identity and location-sensitivity that it is quite suitable for Self-Service in terms of people can easily obtain information tailored for them. Individual difference is one the factors that affect the user adoption. This research is to find out what kind of mobile self-service fits with the certain individual characteristic that generates the better task performance. The result can guide service providers to develop attractive self-service through mobile technology.

Keywords: Mobile Technology, Self-service, Service Taxonomy, Exhibition Industry, Individual Difference

Introduction
The concept of Self-Service is getting popular these years. With appropriate technology support, customers can serve themselves to reduce the interaction time with service provider and without the limitation of the place and time, and therefore it is more convenient and saving time.

Mobile technology, such as cellular phone, PDA, or other hand-held mobile devices, is one of the service delivery channels of the Self-Service, and is in widespread use in the recent years Due to its characteristics of reachability and mobility as well as functions such as identity and location-sensitivity [9], mobile technology is quite suitable for Self-Service in terms of people can easily obtain information tailored for them. Many previous studies try to find out the factors that impact people’s adoption of SST (Self-Service Technology) and mobile technology. Among them, individual difference is one of the important factors that affect people using these emerging technologies, such as self-efficacy, demographics, or technology anxiety [12] [14]. With the impact of the popular information services provided by I-phone and G-phone, companies seek to develop many innovative and useful services on mobile device to attract people. For example, the exhibition department in TAITRA (Taiwan External Trade Development Council) requested SSRC (Service Science Research Center) in NCCU (National Cheng-chi University) for developing innovative services that can be used in exhibition environment. SSRC formed a team named U2EX to support the project and the team design several services on PDA which is called “Narvi”. You can use Narvi to help you collect DM, exchange business cards, search for products, and many other services in the exhibition place. This research is to find out what kind of mobile self-service fits with the certain individual characteristic that generates the better task performance. The result can guide service providers to develop attractive self-service through mobile technology. Below are the research questions:

1. How do alternative mobile self-services fit with individual difference to result in better task performance?
2. What are the critical mobile self-service characteristics that moderate the use of mobile technology on self-service?

Literature Review
SST is an interface created by certain technology and customers can use it to produce service independently instead of service employees involving [15]. It rapidly proliferates in our daily life, such as ATM, hotel reservation, and online shopping. Mobile technology is an emerging technology that is suitable for developing self service due to its unique features of identity [11] [20] and location-sensitivity [6] [19]. Many SST researchers focus on classifying the service [1] [8] [10]. [2] use the service taxonomy characteristics from previous research and multidimensional scaling (MDS) analysis to successfully classify 12 SSTs. Some other studies extend from TAM (technology acceptance model) to discuss the SST use intention [5] [3] [16] and consider the importance of individual difference [5] [14] [17]. This research exploits the fit as moderation [22] concept to test the fitness between self-service and individual difference and develop a map for self-service technology design. Service synchronously, which are instant. People always notice the interface design of the mobile device, but
they ignore that mobile devices might also be the medium that people use to interact with each other or devices could interchange information. These dimensions could properly categorize the services provided by “Narvi”.

Research Framework

Self-service taxonomy
Task performance is the dependent variable. We argue that different self-services will have various performances when used by different individuals and therefore propose that individual difference moderates the relationship between self-service and task performance. [2] found that customization can be used to appropriately categorize the chosen SSTs. Besides customization, we also choose instant and interaction types as the other two dimension of self-service taxonomy. As we know, the service cannot be saved when you interact with the service employee, but with self-services, it’s not so liminary. You can receive any service on the go when using some services, which are not instant and you might have to use and receive the other

Individual difference

Time pressure
Customers always think their time as valued resource and don’t want to waste [17]. Especially in the exhibition, buyers want to find business opportunity in the limited time so that they might have time pressure.

Technology anxiety
Technology anxiety is an important factor in the user acceptance literature. Some people believe that they can accomplish tasks without the assistance of the technology. They are unwilling to use the new technology because of their ability or mistrust of the technology [13] [14] [23].

Previous experience
The previous experience is rare to see in the past literature. With more experience could possibly increase the users’ confidence and ability of using the technology-related tools [13]. People who have much more experience in using the mobile device very often certainly will be easier to accept or get used to these mobile self-services.

Need for interaction
Some customers consider that it is more safety and reliable to interact with service employees instead of machines [3] [4] [5]. How to attract these customers

Figure 1. Research framework
to use the service we provide will be a challenge to the service design.

**Task performance**

When buyers attend the exhibition, they not only do routines like exchanging business cards or looking for new products but also maintain the relationship with business suppliers. Every buyer represents a firm. They must have to derive something from the exhibition. We measure the task performance from two dimensions, relational performance and operational relationship [21]. With relational performance, we consider the confidence, social and special treatment benefits [7]. With operational performance we derive the measure from [18], including improved speed, improved process efficiency, saved labor hours, technology reliability, real time accessibility, convenience, and quick help.

**Research Plan**

Exhibition is a newly-risen industry in the world. It’s a critical medium for firms to find customers and customers to find suppliers. People always get lost or couldn’t find target stalls in the exhibition place. Like the project mentioned in the introduction, SSRC (Service Science Research Center) in NCCU (National Cheng-chi University) designs several Self-services on PDA named Narvi for exhibition use. We are going to send questionnaire in the real exhibition to survey the people who use the Narvi. Then we can conduct statistical analysis to test the model we proposed.

**Expected Contribution**

We can find many interface and functionality design research in previous literature but less research conduct the service design choice [2]. With rapid developing technology, people have more and more choices that knowing what kind of self-service suit customers’ wants and needs is quite important. This research offer SST developers a way to design appropriate self-services for people with certain characteristics.

**References**


among Canadian business-to-business."
REALIZING THE VALUE OF MOBILE SERVICES IN THE EXHIBITION INDUSTRY -- THE VERIFICATION OF "LIMIT-TO-VALUE" FRAMEWORK

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Abstract
The MICE industry and the M-Commerce service recently become a popular issue since the mature internet environment. It will be a significant subject to realize the IT investment in the MICE industry. The study is to test and verify "the Limits to Value for IT Investments framework" [1] and to redefine and modify the constructs of model to examine the barriers of IT value, in the context of M-Commerce in the MICE industry. This reforming model can help us understand the critical value discounting factors and the impact about adoption and usage of the innovative IT in the marketplace.

Keywords: MICE, M-Commerce, valuation barriers, conversion barriers, U2EX

Research Objective
The MICE (Meetings, incentives, Conventions and Exhibitions) industry and the mobile commerce service recently become a popular issue since the mature internet environment. According to the development of existing theories of Information Technology (IT) valuation and technology adoption and diffusion, the research objective of our study is to test and verify "the Limits to Value for IT Investments framework" by Chircu and Kauffman [1] and to redefine and modify the constructs of model to examine the barriers of IT value, in the context of mobile commerce in MICE industry. This reforming model can help us understand the critical value discounting factors and the impact about adoption and usage of the innovative IT in the marketplace. To be more specific, the research addresses the following questions:
1. What critical factors will alter the perceived value of exhibitors of the U2EX service? What type of factors will let the value decrease?
2. What are the valuation barriers and conversion barriers that influence the U2EX service value before and after introduce?

Literary Reviews
In this study, we will examine the value barriers of IT-enabled mobile service in the MICE industry. So in this literature review, we focus on the IT value and the key factors of IT value barriers.

IT value has been conferred on various methods of analysis. We adopt the model developed by Bakos and Kemerer [3] and Davem and Kauffman [11] to distinguish IT value into two types, include potential value and realized value. The potential value represents the maximum value opportunity available to the investor if the IT is implemented successfully, while the realized value is defined as the measurable value that can be identified after the implementation ensues [1]. The investment decision must be based on a comparison of the potential value that management saw in the project with respect to the realized value following implementation, in light of the value conversion contingencies that intervene [11].

A number of authors have identified various kinds of barriers to adoption of technological innovations. In our research, the IT value barriers are divided into valuation barriers (industry and organizational barriers) and conversion barriers (resource, knowledge and usage barriers). Industry barriers are generated by the industry structure that may favor technologies that "plug in" to the existing systems to the detriment of other, nonstandard, but innovative technologies [5]. Organizational barriers are suggested by a number of organizational learning theories as well [1]. For example, the more complex a technology, the harder it is for untrained users to adopt [2]. The unique characteristics of firms, such as organizational routines and norms, market and product expertise, customer and supplier relationships, and human capital can lead to different potential value estimates for the same investment in IT [6] [7] [9]. With regard to resource barriers, IT requires additional investments in co-specialized resources, such as new organizational processes and human capital [4] [6] [7]. The resources limit to value of IT the most when they are single, but they do not ensure that the firm will realize potential value. Attewell argued that implementing a complex new technology needs both individual and organizational learning because the role of know-how and organizational learning are potential barriers to the adoption of innovations or technology [2]. The redesign of organizational processes requires employees to learn new skills and the organization to develop new routines, and thus creates knowledge
barriers [2]. Knowledge barriers also stem from a lack of absorptive capacity, which is developed over time by acquiring related knowledge and expertise in diverse areas [10]. Usage barriers are often related to user perceptions regarding the technology and the responsibilities that must be shouldered when it is used. Unfavorable perceptions will result in users not adopting the technology solution [8] [12] [15] [16].

The Research Framework
Industry background and U2EX introduction
MICE (Meetings, incentives, Conventions and Exhibitions) industry [13] is under recently rapid development. It has certain characters, including high growth potential, high value-added, high innovation benefit, greater output of value, and greater inter-industry relationship. Therefore, Taiwan government aims to help developing MICE industry through constructing a new Taipei World Trade Center Exhibition hall located in Nangang, Taipei city [14], while also assigning TAITRA (Taiwan External Trade Development Council) to form a new department – “Exhibition Department”, specialized in setting up strategies and making decisions among developing Taiwan's MICE industry. TAITRA exhibition department came to ask for support from the SSRC (Service Science Research Center) located in National Chengchi University. After being requested, the SSRC formed a special consulting team to help TAITRA’s exhibition department with setting up this new internet based system platform, and came out with the project named U2EX, it is a platform that can handle all the necessary works and as well as provide all the services online. In this research paper, our task is to study out the relationship between IT value and value barriers of U2EX.

Research Framework
This framework classifies IT value to potential value and realized value and identifies barriers specific to the valuation process, which including industry and organizational barriers, and to the conversion process, which involving resource, knowledge and usage barriers. The potential value will be in a given industry and organizational setting. Realizing the potential value depends on conversion contingencies [18]. In our research, potential value means the exhibitors’ expectation of the new IT service “U2EX”, and the IT value will be limited through conversion barriers become realized value. While we recognize that the assessment of value is subject to bounded rationality [17], we focus in our framework on a firm's ability to obtain value, and not its capacity to evaluate completely the corresponding value flows. The general framework is shown in figure 1.

Research Method
We plan to execute the research starting with the survey in the U2EX project. We will be scheduled with two steps of investigation involved in mobile commerce in MICE industry. We want to comprehend how the exhibitors evaluate the new IT service of mobile commerce.

The exhibitors will have a thought in mind after hearing about the new IT service, and the thought will initially influence the decision of pricing the U2EX service. Therefore, in the first step, we will send out the questionnaire to collect the exhibitors’ perceived value of the new technology of MC in the specific exhibition. That is to say, we will aim at assembling the expectative evaluation of the U2EX service from the exhibitors’ perception before the potential customer (buyer) use the U2EX. The data we will collect includes the unique characteristics of industry and organization, such as path-dependency of co-specialized assets, industry structure, complementary, organizational routines and norms, market and product expertise, customer and supplier relationships, human capital, etc.

After the exhibitors’ customers adopt and use the U2EX service, the exhibitors will have another assessment about the new IT service, and the thought will continue influence the decision of pricing the U2Ex service. Accordingly, the second step will focus on the evaluation of the U2EX service from the exhibitors’ perception after the buyers use the new service of MC. We will send out the second questionnaire, and to compare the difference of the U2EX service’s valuation, trying to find out the characteristics of the barriers which influence the value.

Expected Distribution
The final deliverable can divide into two parts. First, our research tries to verify “the Limits to Value for IT Investments framework” by Chircu and Kauffman [1], evaluating both valuation barriers and conversion barriers, and find out the critical factor which let the potential value change into realized value, even let the IT value decrease. Second, in the mobile commerce context, our study can create more
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valuable IT service value for exhibitors in exhibition industry, such as increasing buyer base, improving relationship with customers, and realizing marketing opportunity, etc.

References


BUILDING IT CHANGE-READINESS CAPABILITIES IN THE MOBILE SERVICE DELIVERY: A CASE STUDY IN THE EXHIBITION INDUSTRY

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Abstract
The mobile technology is applied in more and more aspects in our life. It is used not only in communication, but also business activities. As the great progress of wireless transmission, commercial information can be delivered to one’s handheld devices immediately, no matter where he or she is. Many companies attempt to introduce such convenient technology as their new strategy to perform their real-time services. Individual-oriented information delivery is also a beneficial function for these companies. This research will examine the organization star-model to find out the critical factors how an organization successfully adopts mobile technology. In-depth interviews will be provided for validation.

Keywords: Organizational Transformation, Mobile Technology, Change-ready IT Capability, U2EX

Research Objective
Mobile technology nowadays has played a more and more important role in our daily life. Almost everyone has at least one kind of handheld devices, such as cellular phones, notebooks, and PDAs. This circumstance creates a huge and potential service market. Mobile service has some advantages to offer users more helpful functions. First of all, mobile technology makes user have the real-time ability to receive information and transact their business everywhere. Second, people are no longer constrained by time or place to deal with their transactions because of using the wireless transmission technology. Furthermore, it makes possible that service providers can deliver location-based and individual-based services, i.e. customization services, to their customers. Many companies are trying actively to adopt mobile technology in order to change their business capabilities and be more competitive in their industries.

The goal of this research is to verify the star-model of an organization and modify the contents of the five elements. The reformed model can help us determine the critical factors and solutions of these five dimensions in an organization transformation which is caused by adopting mobile technology as a new strategy. Specifically speaking, this research examines the following two questions:
(a) What are the design elements of an organization which adopts mobile information system to build change-ready capabilities?
(b) How can such designs improve managerial effectiveness of organizational transformations?

Research Framework
This framework defines the capabilities of an organization and classifies them into five components (see Figure 1): (1) strategy: change-ready IT capability, (2) structure, (3) process, (4) people, and (5) reward system. There must be some organizational changes when a new IT is adopted to deliver new service. The framework determines the change-ready IT capabilities which an organization need to execute the strategy successfully. Structure and process redesign is necessary for efficient business operation and service delivery. Furthermore, employees should be integrated and trained different skills for their smooth work in the new organization. A good reward system, however, always encourages employees to work hard and to be loyal to their organization.

Figure1. The star-model of change-ready IT capability

Literature Review
The design starts from the star-model which developed by Galbraith [10] and Lawler [18]. They defined the five elements and conceptualized what capabilities an organization should have to be more effective and efficient. Clark, Cavanaugh, Brown and Sambamurthy [7] used their own experiences in an IS organization to reform the star-model and defined change-ready IT capabilities in strategy.
dimension. They also described what to do in organisational change to achieve different capabilities in the other dimensions.

The strategy component is graphically drawn at the top of the model. The core and organisational capabilities define the fundamental abilities of an organization [19]. IT capabilities enhance competitive agility by IT-based products, services, and business applications [4] [5] [18], and strategic information system (SIS) is one of the important information systems to achieve them [25]. Dynamic capabilities [9] [12] [23] [24] [27] make organizations change their business behaviors rapidly to accommodate to the changeable market. The leader should as well as rethink his role of the organization, and how he can lead it to success [2] [3] [6] [17] [20].

Organization structure redesign is necessary to be more effective [1]. A functional team which is composed of employees from different departments is significant in present companies [7] [10] [17] [22]. Processes among teams or departments show how they collaborate and their relationships [11] [16]. A good integrator has to communicate and coordinate teams to make sure the missions going smoothly [7].

Besides, an integrator needs to survey and integrate the existing skills, decide the required skills, and set up training plans for other employees [13] [15] [22]. However, a good reward system, which establishes flexible pay measurement based on one’s performance, is always a good way to encourage employees work hard and be loyal to their organizations [5] [7] [14] [18] [26].

Research Plan
We chose MICE (Meetings, Incentives, Conventions, and Exhibitions) industry to test our reformed design. The exhibition department of TAITRA (Taiwan External Trade Development Council) is developing a new wireless communication platform in the new-built Taipei World Trade Center Nangang Exhibition Hall. This project, as known as U2EX, allows exhibitors to deliver customized marketing messages to their clients, and clients to search information about the exhibition via the specific handheld devices. We will schedule three in-depth interviews with the representatives of MICE industry. The interviews will focus on their business capabilities before and those after executing U2EX project. We will classify the interview data to map to our model. We will include some of their customers in our follow-up sessions if necessary.

Deliverable
The final deliverable is first to examine the star-model for an organization transformation in MICE industry, and find out the critical capabilities when a new mobile IT strategy is adopted. It also defines the items needed to be done and processes about how to finish these goals in the five dimensions. Change-ready capabilities are the most important subjects in this research. The reformed model will assist companies to be a guidance of organization transformation when mobile service delivery is chosen as their strategy.

References


FACTORS INFLUENCING THE USAGE OF MOBILE VALUE-ADDED SERVICES

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Abstract
Mobile value-added services have drawn the attention of researchers and practitioners recently, due to the rapid development of the mobile telecommunications market. Various mobile-based services and applications have therefore been introduced in order to satisfy mobile phone subscribers’ needs. Facing intensive competition, service providers are eager to persuade mobile phone subscribers into using the mobile value-added services in the hope to expand market share and ultimately raise revenues. This study therefore intends to investigate the factors that influence mobile phone subscribers’ intention to use mobile value-added services in Taiwan by incorporating quality factors and perceived playfulness with the Technology Acceptance Model. A preliminary proposal is presented in this extended abstract, together with expected contributions for research and practice.

Keywords: Technology Acceptance Model, information quality, system quality, service quality, perceived playfulness

Introduction
Taiwan’s mobile market has been a remarkable phenomenon as it had reached the milestone of one mobile device for every person by early 2002. As of the end of 2008, there were 25.41 million mobile phone subscribers (covering 2G PHS, and 3G systems), a 4.6 percent growth from 2007. This gives the penetration rate of 110.3 percent in the Taiwanese market (NCC, 2008), showing a strong potential of the demand for both voice and mobile value-added services that drives the market energetically moving into the “next generation” of mobile services with the awarding of five licenses for 3G services in 2002 (BuddeComm, 2009). Therefore, abundant and diverse mobile value-added services such as game, ringtone, mobile Internet applications (including community, search engine, map, email, etc.), multimedia messaging, mobile commerce, remote surveillance, and location-based services, etc. have been introduced into the market.

With the various forms of applications, mobile value-added services serve both hedonic and utilitarian purposes. The former include multimedia message service, games, ringtone, and graphics downloads, etc., which provide entertaining or recreational values. In contrast, the latter make mobile phone subscribers consider the services as a stable and reliable source for fulfilling utilitarian demands such as location-based information, wireless network access, and mobile secretaries, etc.

Investigation into users’ behavioral intention to technology acceptance has always been an important topic in IS research. Among the many theoretical perspectives, the Technology Acceptance Model (TAM) (Davis, 1989) is a widely accepted framework for its parsimony and high explanatory power across a wide variety of contexts (Taylor and Todd, 1995). Besides the external variables considered by past research, intrinsic motivation such as perceived playfulness is believed to be influential when users consider whether to adopt a new system that addresses individual experiences (Moon and Kim, 2001). In addition, to reflect the quality concerns discussed earlier, quality antecedents based on DeLone and McLean (2003) were also considered as external variables to examine whether mobile phone subscribers’ perception of quality influence their attitude toward mobile value-added services and intention to use these services.

That is, this study intends to investigate the influence of mobile phone subscribers’ hedonic and utilitarian beliefs on their intentions to adopt mobile value-added services. The objectives of this study are to understand whether perceived playfulness as hedonic and quality as utilitarian factors influence mobile phone subscribers’ intention to use mobile value-added services, and to analyze the relationships between these factors and IT adoption determinants, based on TAM. The research model can be seen as an extension of TAM to include hedonic and utilitarian antecedents to explain the adoption of mobile value-added services.

Research Methodology
The hypotheses to be examined are as follows.
**H1:** Perceived ease of use positively influences perceived usefulness of mobile value-added services.

**H2:** Perceived ease of use positively influences behavioral intention to use mobile value-added services.

**H3:** Perceived usefulness positively influences behavioral intention to use mobile value-added services.

**H4a:** System quality positively influences perceived ease of use of mobile value-added services.

**H4b:** System quality positively influences perceived usefulness of mobile value-added services.

**H5a:** Information quality positively influences perceived ease of use of mobile value-added services.

**H5b:** Information quality positively influences perceived usefulness of mobile value-added services.

**H6a:** Service quality positively influences perceived ease of use of mobile value-added services.

**H6b:** Service quality positively influences perceived usefulness of mobile value-added services.

**H7:** Perceived ease of use positively influences perceived playfulness of mobile value-added services.

**H8:** Perceived playfulness positively influences behavioral intention to use mobile value-added services.

A pilot test will be performed. To ensure diversity in the research sample, the questionnaire will be administered to students from five departments of three different universities in Taiwan.

After evaluating the appropriateness of the measurement model with confirmatory factor analysis, the formal online survey will be carried out. The online mode of data collection is selected because of its advantages in expediency in data collection, ease of data tabulation, and the ability to reach a wide population of users (Bhattacherjee, 2002). The announcement for the event will be posted on the largest bulletin board system (ptt.cc) and the largest community portal (wretch.cc) in Taiwan. To attract a larger number of participants to this survey, those who finish filling in the questionnaire are entitled to enter a lottery. To avoid duplicated registration into the survey, however, the IP address of each respondent will be recorded to filter out opportunistic attempts.

**Expected Contributions**

Researchers have spent efforts on extending TAM with external variables or applying TAM to various IT adoption contexts (e.g., Hong et al., 2006; Hsu & Lu, 2004; Koufaris, 2002; Liao et al., 2007; Moon and Kim, 2001; Taylor and Todd, 1995; Venkatesh & Davis, 2000; Wu and Wang, 2005). This research further extends this stream of research by investigating the adoption of mobile value-added services. Take the use of 3.5G mobile Internet access service for example. Depending on mobile phone subscribers’ needs, the use may be either utilitarian or hedonic. If one intends to use the service to check for movie showtimes, the use is hedonic. Rather, if he or she needs to access the Internet to check for the latest stock quotes to ensure personal investment profitability, the use is relatively more utilitarian. That is, this research extends the applicability of TAM to IT services whose purposes are complex and contingent in nature, in contrast to the pure-purpose systems or services such as word processing programs, online games, or mobile commerce (Davis et al., 1989; Hsu and Lu, 2004; Yang, 2005).

From the viewpoint of information quality, information products that present features such as accuracy, meaningfulness, and timeliness, considered as the semantic level of success by Shannon and Weaver (1949), are able to convey the required content to mobile phone subscribers in an intended and clear manner. For example, location-based dining recommendation service delivers information from the operator to the mobile phone subscribers. Only clear, understandable, and meaningful information will be preferred. Suggestion of restaurant locations in the form of longitude and latitude or with only brief descriptions such as name, address, and phone number will be disliked, because the former, though accurate, is difficult to interpret and is thus meaningless, and the latter does not help much for the decision of dining places.

System quality regards the desired characteristics of the system such as high availability, reliability, adaptability, accessibility, and response time. Therefore, mobile telecommunications service providers are expected to provide dense coverage of signal and highly responsive and available infrastructure, especially during peak hours, so that the mobile value-added services can operate seamlessly, without mobile phone subscriber complaints for, for example, lagged transmission of video clips, long download time for ringtones, or delayed delivery of short messages. With high system quality, mobile phone subscribers may perceive the system to be easy to use and useful, thus are more willing to be continual subscribers of the services.

Giving mobile phone subscribers a positive service experience also contributes to the adoption of mobile value-added services. Positive service experiences may come from easy-to-access online help or instant assistance of and prompt response from customer service agents. Periodical and
frequent upgrade of services, such as adding new features, gives mobile phone subscribers the sense of surprises and reliability. Feeling that the service provider is willing to continually spend efforts on maintaining and improving their services, mobile phone subscribers are likely to generate positive perceptions of the effectiveness and promptness of user support as well as the reliability and trustworthiness of the services.

Further, although ease of use and usefulness have been conceived as important issues in traditional IS contexts, playfulness will play an important role with the popularization of mobile value-added services. Playfulness reflects the usage contexts beyond usefulness alone (Davis et al., 1992; van der Heijden, 2004). Motivated by playfulness, an intrinsic motivation that focuses on the process of performing the activity, mobile phone subscribers tend to form the feeling of flow or enjoyment with easy-to-use user interface, thus making them willing to adopt the services, and further introduce the services to more of their colleagues.

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References
A COMPARATIVE STUDY OF CONSUMERS’ INTENTION TO USE MOBILE INTERNET IN USA, RUSSIA AND CHINA

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Abstract
As the mobile Internet has been used explosively worldwide, the effects of cultural factors on mobile Internet usage have been an interesting issue. Cross-cultural studies on the mobile phone internet may improve our understanding of individuals’ attitude toward mobile phone internet in different countries and provide advantages for marketing of mobile internet services in different cultural contexts. This paper uses an extension model of Technology Acceptance Model (TAM) to provide the theoretical foundation for this study. The data was collected through a survey study of over 3000 consumer in 3 countries of USA, Russia and China. The findings present several insights into the position of mobile phone internet usage in the different market. Such insights allow mobile service providers and mobile markers to create more customized strategies to launch new internet based services or mobile marketing campaigns. This paper ends with both theoretical and practical implications and limitations of the study results.

INTRODUCTION
Advances in mobile technology have changed the business environment significantly. Devices and systems based on mobile technologies have become a common place in our everyday lives (Balasubramanian, Peterson & Järvenpää, 2002), increasing the accessibility, frequency and speed of communication. As a result, mobile technologies have the potential to create new markets, change the competitive landscape of business, create new opportunities, and change existing community and market structures (Stewart & Pavlou, 2002). New technological developments and fusion of two intense and global trends of the mobile/wireless and the Internet, allow permanent Internet access via mobile devices. However, it should be noted that from the system’s perspective, most mobile phone internet systems, especially cellular phones, have a lower level of available resources in comparison to those provided by the stationary Internet. While mobile phone internet devices are very portable and handy, they have smaller screens, less convenient input/output facilities, and lower multimedia processing capabilities than do desktop computers. As a growing proportion of the hundreds of millions of mobile handsets sold globally each year, is mobile Internet capable in one form of another, the importance of mobile Internet is inevitably going to rise worldwide. The spread of mobile Internet presents a solution to falling ARPs and presents many opportunities to operators, equipment manufacturers, content and service providers, new entrants from the Internet world and other mobile industry sectors.

Moving the Internet to mobile devices presents plenty of potential for consumers and businesses in the mobile environment by brand-new and yet unimaginable application areas. In general, the mobile Internet can be defined as the convergence of mobile communications and the Internet, providing the Internet through wireless connections (International Telecommunication Union Internet Reports 2002). Whereas, Hong and Tam (2006) defined the mobile Internet as a collection of mobile data services accessed only through a mobile communication network. This study adopts the definition of the mobile Internet by Chae and Kim (2003), “wireless access to the digitized contents of the Internet via mobile devices.” Therefore, for the purposes of the study, accessing the stationary Internet through the wireless LAN (Wi-Fi) of a laptop is not regarded as the mobile Internet. The mobile Internet shows that is more intended for personal and individuals’ needs and expectations. (Hong and Tam 2006, Kim and Chan 2007, Kim et. al. 2004, Lee et. al. 2005). The mobile Internet may be a suitable domain to investigate the effects of cultural traits on the individual user’s intention to use and behavior (Thong et. al. 2006). Understanding the effects of culture on the adoption of mobile Internet users, may help mobile Internet service providers to tackle low profit and consumer adoption issue (Kleijnen et al. 2004).

Mobile service is defined as “A radio communication service between mobile and land stations, or between mobile stations (ITU Radio Regulations, 2004). However, this definition does not fully capture the unique characteristics of next generation multimedia mobile services with wireless Internet connections. The increased number of mobile phone users has allowed for a growing variety of value-added services. Nowadays, with numerous individual values added mobile applications, the mobile service providers are attempting to enter this growing value-added...
service market. A more appropriate definition of mobile service, based on expectations of its end users, would be a service that is available through mobile radio access at anytime and anywhere possibly through heterogeneous mobile devices (Zhang and Zheng 2007).

Mobile Internet has received much attention, particularly as an infrastructure for the next wave of services. The use of the mobile Internet has been increasing rapidly (Francis 1997, Davidson et al. 2000). According to a new report released by ComScore (2009), the number of people, accessing Web on their mobile handsets doubled between January 2008 and January 2009. Interestingly, however, the adoption or usage patterns of the mobile Internet and popular mobile Internet services are significantly different by country (Pedersen 2001). In Asian countries, a mobile Internet-enabled phone has become recognized as a necessity in daily life, more than a communication device. Based on a ComScore study, (2008), conducted in Japan, the first country that launched mobile internet, it has been estimated that 53.6 million people in Japan are using a mobile device to access the Internet, a figure nearly equaling the 53.7 million who accessed the Internet from either a home or a work computer in June 2007. Popularity of mobile services varies in different countries, for example, download service is the most popular one in China, whereas email is the most popular one in Japan (Lee et al. 2002). However, in North America, the mobile Internet is not as popular as in Asian countries (Scully 2001). Based on the latest report of Nielsen Mobile, "The Worldwide State of the Mobile Web" as of May 2008, 15.6 percent of mobile subscribers in the US, makes regular use of the mobile Internet on their devices, totaling some 40 million subscribers. This is just a subset of the 95 million US mobile subscribers who pay for access to the mobile Internet (through data plans or some other setup) but do not use it quite so regularly. The UK is not far behind, with 12.9 percent actively using the 'Net' on their mobile devices. Such data, illustrates a different adoption pattern of mobile Internet in different markets. Such an outcome not only broadens the spectrum of technological applications and services but also presents plenty of potential opportunities for customized mobile Internet businesses. The current Internet applications and services will possibly be provided through novel application areas or mobile Internet browsers in the mobile environment. For operators and mobile equipment manufacturers, the spread of mobile phone internet presents new opportunities in the area of content and service delivery in the Internet world. This paper is composed as follows: In the next section, we review previous studies in the field of technology adoption and specifically those related to TAM and its application to mobile Internet usage. Based on the theoretical background, a research model is proposed along with research hypotheses. We then describe the research procedures employed to test the proposed hypotheses. In the next section, we do a detail data analysis on the data we gathered through our survey study. We conclude the paper by acknowledging number limitations of our study and discussing the implications of our findings for mobile Internet service providers, and suggestions for future researches.

THEORETICAL BACKGROUND
Culture was defined by Hofstede (1980) as “the collective programming of the mind that distinguishes the members of one group or category of people from another”. Therefore, the cultural characteristics of individuals include a constellation of psychological traits, attributes, and characteristics (Matsumoto et al. 1999). Most information systems' research on cultural issues treated culture at the country level. For example, Kralisch et al. (2005), argues that users’ cultural backgrounds influence their Web site navigation patterns. However, sometimes within-country heterogeneity is greater than between-country heterogeneity and as the result using country as a surrogate for the individual is likely to be misleading. Ford et al. (2005) have proposed identifying users’ individual-level cultural characteristics. Conceptualization of culture at the individual level reflects the multilayered cultural values accumulated in the self (Erez and Gati 2004). Technologies like the mobile Internet, designed for individual users who have different needs and expectations, and are based on voluntarily used, in accordance with the individual preferences of the users (Hong and Tam 2006). Models based on national or other group cultures may be essential for understanding behaviors within organizational contexts (Karahanna et al. 2005), however, as we are interested in how cultural characteristics influence an individual’s voluntary Internet usage, a model based on individual cultural characteristics is more appropriate (McCoy et. al. 2005). There is little knowledge about how consumers react to mobile Internet and this gap becomes even wider when this issue is addressed on an international basis. Despite the importance of cultural and market specific factors, not much research has been conducted on comparing adoption of mobile Internet in different markets. Previous research on the mobile Internet mostly focused on technological developments, usability issues, and
mobile telecommunication policies (Kristoffersen and Ljungberg 1999, Gruber 2001, Gruber and Verboven 2001). Rarely has research been done to investigate the usage differences of mobile Internet from a cross-cultural perspective.

Many empirical studies have tested the TAM model and confirmed that these factors do correlate with the usage. Technology Acceptance Model (Davis et al. 1989) was initially designed to predict a user’s acceptance of information technology and usage on the job. TAM has become a well-established, robust, powerful, and parsimonious model for predicting user acceptance (Venkatesh and Davis 2000) and become the most broadly applied model of user acceptance and usage (Ma and Liu 2004). TAM is grounded in the Theory of Reasoned Action (Fishbein and Ajzen 1975) and Theory of Planned Behavior (Ajzen 1991) and compares favorably with TRA and TPB (Venkatesh and Davis 2000). Chang et al. (2000) and Cheung and Chang (2001) studied factors affecting the acceptance of Internet in workplace settings. Their analyses revealed that perceived ease of use, and usefulness (increase the job performance) influence their acceptance and usage behaviors. Lederer et al. (2000) report the results that support TAM in general in which increases the probability of returning user to use mobile Internet. Morris and Turner (2001) explored the role of experience in changing relationships among TAM variables in the Internet usage context. Kim & Kwahk, (2007) have investigated the influences of different factors such as perceived usefulness and ease of use on the consumers’ usage of mobile phone internet. Lee et al (2002) have also studied the value structure of mobile phone internet usage between Japan and Korea. Some other conducted research have surveyed the impact of performance expectancy, effort expectancy, social influences, and facilitating conditions on the attitude and intentions of the consumers towards using mobile technologies (Park et al. 2007).

External variables, both individual and organizational, are important considerations with respect to the process of adopting new information technologies. Both the indirect and the direct effects of these external variables on user behavior must be considered. Seyal and Rahman (2003) have confirmed that external variables such as; demographics, task characteristics, computer exposure, and institutional support, do contribute towards both perceived ease of use and perceived usefulness that further affects the attitude of the students in predicting the Internet usage in an educational institution. Seyal and Rahman (2007) tested and built argument based on TAM to study the usage internet by the business executives with three external variables of computer attitude, computer self-efficacy, and personality. Their study has shown that computer attitude has a significant effect on perceived ease of use. Whereas, computer self-efficacy has a significant but negative effect on perceived usefulness and has a positive and significant effect on perceived ease of use. Seyal and Rahman (2007) have found that the ‘perceived ease-of-use’ and ‘perceived usefulness’ constructs fully mediate the influence of external variables on usage behaviors. Their study shows that external variables could have direct effects on usage behavior apart from their indirect effects. Seyal et al. (2007) confirmed in their study that prior experience with the Internet has a strong impact with the utilization of the Internet. Kim and Lee (2001) attempted to explain the mobile Internet acceptance in Korea using the TAM. In their use of TAM, they specifically considered user characteristics (age, education, use frequency, and experience of cellular phones, income, etc) and social pressure representing subjective norms. Their findings show that the acceptance and usage behavior are affected by some of the user characteristics such as age, education, and use frequency of cellular phones as well as social pressure. Due to limitations in their statistical analysis, Kim and Lee (2001) suggest that their results should be interpreted with caution. A study of the pattern of mobile Internet spread worldwide and within given countries from the viewpoint of innovation diffusion and adoption literature could provide valuable insights (Takacs and Freiden 1998).

**RESEARCH MODEL AND HYPOTHESES**

The rapid growth of the mobile Internet has significant implications but cannot be simply accepting the rules of the stationary Internet. The mobile Internet differs significantly in various aspects from the stationary Internet. We need to analyze the characteristics of the mobile Internet from three different perspectives: user, system, and culture (Chang and Cheung 2001). First, from the user’s perspective, mobile Internet devices are usually more personal and individual than stationary Internet devices (Igbaria et al. 1997). As a result, the mobile device always carries its user identity, and it will be affected by individual characteristics. From the system’s perspective, most mobile Internet systems, especially cellular phones, have a lower level of available resources in comparison to those provided by the stationary Internet. Nevertheless, previous experience and tenure of consumer’s on mobile device and Internet access in stationary devices may play a role in attitude toward mobile Internet. From the cultural perspective, cultural differences among the
countries may be one of the main causes for the different usage and adoption patterns of the mobile Internet due to different values and needs. As mobile communication can only be operated locally while stationary Internet can be accessed anywhere in the world, it could be concluded that mobile communication is fundamentally characterized for a local market, whereas the stationary Internet is for a global market. In comparison to the stationary Internet, the mobile Internet is more dependent on the characteristics of local culture. A cross-cultural investigation, therefore, is more in need for mobile Internet research. Cultural issues and in relation consumer’s characteristics plays an important role on consumer’s access to Internet. Two individuals may have different cultural characteristics even though they live in the same country (Ford et al. 2005, McCoy et al. 2005, and Straub et al. 2002). There is, then, a growing agreement that culture is important as an individual-level variable (Matsumoto et al. 1999). The main objective of the present study was to examine how the cultural characteristics of individual users affected their intention to use and actual usage of mobile Internet. The study investigates the different usage patterns of mobile Internet users in three countries in three continents. These three countries were selected to have two countries from emerging markets, China, and Russia and one western country, USA. The Technology Acceptance Model (TAM), which has been widely used in technology and service adoption studies, is modified and employed to provide the theoretical foundation for this study (Figure 1).

Figure 1

TAM assigns a considerable weight to two key determinants of perceived usefulness: “the degree to which a person believes that using a particular system would enhance his or her job performance” and perceived ease-of-use “the degree to which a person believes that using a particular system would be free of effort” (Davis 1989). These two concepts are fundamental to understanding the core workings of TAM. Perceived usefulness and ease of use from user’s attitude towards technology that leads into intention to use a technology. Four hypotheses, H1 to H4 in Figure 1 originated from the TAM to explain computer usage behavior. TAM proposes that perceived usefulness and perceived ease of use largely determine whether a technological innovation will be used. In addition, the improved technology acceptance model (Davis, 1993) proposes that perceived usefulness is influenced by perceived ease of use, but not vice versa. This relationship has been confirmed in a number of other studies (see for examples, Davis et al., 1989; Davis, 1993; Taylor and Todd, 1995; Chau, 1996). Therefore, we hypothesized that if consumers found mobile Internet easy to use, then they would also find it useful. The TAM further postulates that behavioral intention to use a particular technology is determined by attitude and perceived usefulness. Past studies invariably show that the latter factor has a large impact on intention, either directly or indirectly via attitude. The level of behavioral intention, in turn, determines the likelihood that actual usage will occur (Ajzen and Fishbein, 1975; Davis et al., 1989). These relationships were examined in the context of mobile Internet using the following hypotheses:

**Hypothesis 1:** There will be a positive relationship between Intention to use and service usage.

**Hypothesis 2:** There will be a positive relationship between Perceived Usefulness and Intention to use.

**Hypothesis 3:** There will be a positive relationship between Perceived Ease of Use and Intention to use.

**Hypothesis 4:** There will be a positive relationship between Perceived Ease of Use and Perceived Usefulness.

External factors such as gender, age, education, income, and prior experience have been proven to play a role in intention to use and usage of Internet (Seyal and Rahman 2007, Seyal et al. 2007). The selected external factors reflect individual differences. User’s gender affects usefulness and ease of use expectancy, where it is expected that males to be more likely to rely on perceived usefulness when determining to accept a technology with his highly task oriented nature (Park et al. 2007). On the other hand, female’s technology acceptance may be determined mainly by perceived ease of use rather than usefulness under cognitions related to gender roles. The effect
of gender has been studied in the area of technology acceptance research in a variety of technologies like web-based shopping (Slyke et al. 2002), e-mail (Gefen and Straub 1997), Internet (Seyal and Rahman 2007, Seyal et al. 2007), Internet banking (Lichtenstein and Williamson 2006), mobile technologies (Park et al. 2007) and so on. Significant invariance between relationships in the technology acceptance process can be expected through gender differences (Lu et al. 2003). Gender differences and gaps in IT acceptance and usage are diminishing, as the technologies are more widely diffused (Zhou et al. 2007). Vigne et al. (2005) found that men and women did not show significantly different behaviors in mobile shopping in Spain with 86% of penetration rate. Possible moderating effects due to gender still exist in countries such as China where the infiltration rate of the mobile technologies is about 20%. Previous researches show that men have a more positive attitude toward accepting and using new technologies (Songan & Noor, 1999; Gefen & Straub, 1997; Igbaria et al. 1995; Pijpers et al. 2001) In regard to mobile phones, gender has shown to be relevant in forming overall attitudes, where men and women perceive mobile phones and their usage differently (Ozhan Dedeoglu, 2004). Ling (2001) reported that the role of the mobile phone differs between genders.

**Hypothesis 5: There will be different Perceived Usefulness values between men and women.**

Zmud (1979) documented that the demographic variables such as age influence the successful use of computer applications. Czara et al. (1989) found that younger people learn computer skills more easily than by older people. Older people have more difficulty generating syntactically complex commands (Egan and Gomez 1985) and make more errors in information search. In general, young people are heavy users of mobile services (Dickinger, et al., 2004a and 2004b), as for them mobile devices are as much as a fashion accessory as they are a communication device (Robins, 2003). Considering these facts, we conclude that younger consumers value accessing Internet via mobile devices to a higher extent than older consumers’ value and show a more positive attitude toward them. Pijpers et al. (2001) illustrated in their study that age had a negative relation to technology acceptance.

**Hypothesis 6: There will be a negative relationship between Age and Perceived Usefulness.**

Enhanced abilities and more favorable attitude towards information systems have been associated with higher levels of educations (Hubona and Kennick 1996). Davis and Davis (1990) reported that end users that are more educated significantly outperformed those with less educations in a training environment. Several studies have reported that higher levels of education are positively related to favorable computer attitudes and negatively related to computer anxiety (Howard 1988, Igbaria and Parasuraman 1989, Raub 1981). Lucas (1978) reported that individuals that are more educated, have more positive attitudes towards information systems than those who are less educated individuals. Harrison and Rainier (1992) maintained that education and training are effective techniques to overcome negative attitudes towards computers to enhance individual computer skill. Based on results from previous researchers, people with lower education levels are anticipated to be more sensitive to the efforts required to adopt new technologies in an early stage, as the technology presents a sort of barrier to them (Szajna 1996; Venkatesh and Morris 2000). Agarwal and Prasad (1999) identified that several individual differences including level of education have significant effects on TAM’s beliefs. Ozhan (2004) reports that as educational level increases, the level of negative attitude toward mobile phone increases also. In china, mobile technology users are mainly predominated by the educated young generation (Tan and Ouyang 2004).

**Hypothesis 7: There will be a positive relationship between Education and Perceived Usefulness.**

Financial barriers emerge as most important determinants of an individual’s decision to use mobile services. The cost considerations shift attention from the value creating capabilities and reflect consumers’ desires for reasonably priced services over anything else. Sarker and Wells (2003) consider economic conditions as an influencing factor on adoption and usage of mobile phones. Consumers in every country divide into high and low income based on where their household’s income falls on their county’s income distribution curve. The technology attitude and income variables are both split into two groups. Even though some income-based differences in access to and use of the mobile telephone had been seen, but Rich Ling in his book *The Mobile Connection* (Elsevier, 2004) concludes that the “digital divide” issues associated with the personal computer and the Internet do not appear to apply to the world of mobile telephony.

**Hypothesis 8: There will be a positive relationship between Income and Perceived Usefulness.**

Numerous studies have related the impact of experience to computer usage behaviors. Levin and Gordon (1989) reported that those who owned computers were more motivated to become familiar with computers, and had more favorable attitudes towards computers, than those did not own
experience and mobile phone experience as elements affecting prior experience that facilitates usage of mobile Internet. All of these antecedents are adopted from previous studies that are listed in table 1.

### Table 1 - Empirical studies testing TAM

<table>
<thead>
<tr>
<th>Studied Technology</th>
<th>Researcher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voice mail</td>
<td>Adams et al. 1992, Straub et al. 1995</td>
</tr>
</tbody>
</table>

### RESEARCH METHODOLOGY

Large-scale on-line surveys were conducted in US, Russia and China, using a questionnaire with battery of 35 questions at around the same time in order to increase the external validity of the results. The back-translation method was used to maintain the linguistic integrity of the questionnaire across the three countries. Respondents were solicited via banner advertisements on the Web sites of several popular portals. Survey data were collected as follows. Before going to the main questionnaire was presented, it was asked if the participant owns a mobile phone and had used mobile Internet services at least once. If the respond was yes, then the participant was allowed to continue to answer the main questionnaire. In other hands, respondents were asked to provide their mobile phone numbers, which telecommunication companies could use to verify prior. The research has been exploratory, asking more than 3000 consumers in three countries in a period of 3 months in the last quarter of year 2007. The questions were broad enough to include different aspects of mobile technologies, especially mobile internet. All data were collected via online survey and respondents were drawn from demographically diverse groups of mobile phone users, who have agreed to participate in the online survey. The questionnaire was distributed among the responders via email. The study aims at delivering high-level metrics to clarify issues.
regarding mobile Internet usage. Quota sampling was used to select a demographically representative sample in each country, based on nested age and gender groupings as determined by each country’s most recently available census population proportions. The portion of each country’s population covered in Table 2.

### Table 2 - Research participants’ age statistics

<table>
<thead>
<tr>
<th>Country</th>
<th>N</th>
<th>Min user</th>
<th>Max Age</th>
<th>Mean Age</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>US</td>
<td>107</td>
<td>94</td>
<td>13</td>
<td>85</td>
<td>43.66</td>
</tr>
<tr>
<td>Russia</td>
<td>151</td>
<td>76</td>
<td>13</td>
<td>85</td>
<td>35.04</td>
</tr>
<tr>
<td>China</td>
<td>110</td>
<td>92</td>
<td>15</td>
<td>85</td>
<td>36.65</td>
</tr>
</tbody>
</table>

The countries selected for the survey are from different cultural contexts to investigate whether the impacts of these factors on the intentions of the consumers to use the mobile internet in different countries are the same or not. As it has been discussed in the introduction, United States of America is one of the frontiers in the usage of mobile internet. In addition, China and Russia had been considered due to big opportunities in their market of mobile technologies. For the present study, in the context of mobile internet, we define a task as an objective or a function that is performed using Internet service, such as email, download & upload files, instant messaging, online search and purchase orders, online services and online game and gambling. In order to measure the real sense of the consumers in each of the constructs in the model, we used the 5-point scale Likert. It should be noted that some of the scales were reverse-coded where required. Based on the research model, the endogenous variables compromise of perceived usefulness and perceived ease of use and the exogenous variables include gender, age, education, income, stationary Internet experience, mobile experience. Table 3 summarizes the descriptive mean values for the constructs of the model for the consumers in these three countries.

### Table 3 - Descriptive summary of responds

<table>
<thead>
<tr>
<th></th>
<th>USA</th>
<th>ST D</th>
<th>Russia</th>
<th>China</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived Usefulness</td>
<td>3.3</td>
<td>3.2</td>
<td>3.3</td>
<td>3.2</td>
</tr>
<tr>
<td>Perceived Ease of Use</td>
<td>1.9</td>
<td>2.2</td>
<td>1.9</td>
<td>2.2</td>
</tr>
<tr>
<td>Behavioral Intention to Use</td>
<td>2.1</td>
<td>2.5</td>
<td>1.9</td>
<td>2.2</td>
</tr>
<tr>
<td>Actual Usage</td>
<td>1.5</td>
<td>4.7</td>
<td>3.6</td>
<td>4.7</td>
</tr>
<tr>
<td>Income Level</td>
<td>2.6</td>
<td>3.2</td>
<td>2.5</td>
<td>3.2</td>
</tr>
<tr>
<td>Education Level</td>
<td>4.3</td>
<td>1.3</td>
<td>2.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Stationary Internet Usage</td>
<td>2.8</td>
<td>0.7</td>
<td>2.5</td>
<td>0.6</td>
</tr>
<tr>
<td>Mobile Usage</td>
<td>3.2</td>
<td>1.2</td>
<td>3.1</td>
<td>1.1</td>
</tr>
</tbody>
</table>

The minimum is 1 and the maximum is 5 for all of the constructs.

In order to validate the fitness of the model the AMOS software has been utilized for measuring the fitness. The posterior predictive p value that has been described by Lee & Song (2003) was measured for the model in each of the cultural contexts to assure that the model is fitting for the study in all the three countries. Based on Gelman et al. (2004) a posterior predictive p-value should be near 0.5 for a correct model, and the values toward the extremes of 0 or 1 indicate that a model is not plausible.

In analyzing the relationship between the factors and the actual usage and/or the intentions of the consumers, we computed the coefficient of correlation to find out how much and in what way the effects are. The coefficient of correlation is a statistical measure of how well a regression between two variables is fit. The coefficient of correlation lies in a range of minus one to one and the nearer the absolute of the coefficient is to unity, the higher is the correlation. The sign of the coefficient also determines whether the correlation is in the inverse direction or not. For example, if the coefficient of correlation between the two variables is negative, it means that as one of the variables increases the other one will decrease. In our analysis, the coefficients more than 0.2, were assumed to be considerable.

For analyzing the gender differences, a t-test was conducted and the p-value was calculated to see if there exists a significant difference between different genders on the intention to use the mobile...
internet or not. The p-level reported by a t-test represents the probability of error involved in accepting our research hypothesis about the existence of a difference. Technically speaking, this is the probability of error associated with rejecting the hypothesis of no difference between the two categories of observations. Null Hypothesis is typically statements of no difference or effect. A p-value close to zero signals that your null hypothesis is false and typically that a difference is very likely to exist. Large p-values closer to one imply that there is no detectable difference for the sample size used.

**STUDY RESULTS**

The fitness measurement of the model was done using the AMOS software in which the posterior predictive p values were extracted for the data of each country. Table 4 shows that the posterior predictive values for each country are around 0.5, which implies that the model is plausible, based on Gelman et al (2004).

| Table 4 - Fit measures for the model in different countries |
|----------------|--------|--------|--------|
|                | USA    | RU     | CH     |
| Posterior P value | 0.51   | 0.51   | 0.50   |

Questionnaire data was analyzed by using SPSS with which we computed the coefficients of correlations to investigate the hypothesis that we had defined for the research. In addition to that, we also applied the T-test to determine the gender influences. Actually, we calculated the correspondent p value, which shows whether there exists evidence against the null hypothesis, which is “no difference between men and women in their perceived usefulness of mobile internet technology”. Table 5 summarizes the results of the analyses for all the target countries.

| Table 5 - Summary results of the analyses |
|----------------|--------|--------|--------|
|                | USA    | RU     | CH     |
| H1             | 0.460**| 0.417**| 0.507**|
| H2             | 0.038  | 0.296**| 0.251**|
| H3             | 0.413**| 0.296**| 0.405**|
| H4             | 0.164**| 0.418**| 0.111**|
| H5 (p values for the t-test) | 0.0373 | 0.067693 | 0.046261 |
| H6             | 0.081* | -0.015 | -0.043 |
| H7             | -0.049 | -0.027 | 0.026  |
| H8             | -0.009 | 0.132**| 0.117**|
| H9             | 0.128**| 0.149**| 0.129**|
| H10            | 0.085**| 0.140**| 0.117**|

*Correlation is significant at the 0.05 level (2-tailed).
**Correlation is significant at the 0.01 level (2-tailed).

The result of correlation analysis revealed that positive correlation between behavioral intention and actual usage is supported in all the countries. The correlations show that the behavioral intention is one of the anticipants of usage behavior of the customers in all the cultural contexts. The results of previous research (Venkatesh, Morris, Davis, 2003) have also proven that behavioral intention (attitude) has a direct effect on the actual behavior (usage). The role of intention as a predictor of behavior (e.g. usage) is critical and has been well established in IT services (Ajzen 1991; Sheppard et al. 1988; Taylor and Todd 1995b). Christer Carlsson et al (2006) have also found out that the behavioral intention does have a positive effect on the actual usage of mobile services. In addition, the studies of Nysveen et al (2005a) confirmed that attitude toward the use is a direct determinant of mobile services’ usage.

Referring to the analysis results shown in table 5, clearly the positive correlation between perceived usefulness and behavioral intention is not supported in USA. The coefficients of the correlation show that the hypothesis is supported in Russia and China. In contradiction to our results which reveal how the impact of perceived usefulness on behavioral intention is different in different countries, some other studies had proven perceived usefulness as one of the dominant anticipants of usage behavioral intention regardless of the cultural context. The studies of Venkatesh et al (2003) showed that perceived usefulness has been considered the most powerful tool for explaining the intention to use the system. In addition, Bhattacherjee (2001) suggests more satisfaction is gained through on-line services that are found more useful than the services that are not perceived useful. This implies that perceived usefulness is likely to be a key factor in the post-adoption behavior of mobile Internet users. Studies of Lee et al (2007) also proved that perceived usefulness is a significant determinant of users’ satisfaction in Korea, Hong Kong, and Taiwan, although they have also proven that the results are different through different cultural lenses. On the other hand, in some other studies the relationship between the perceived usefulness and behavioral intention has not been supported (Jackson et al 1997; Lucas and Spitler 1999; Bhatti 2007). In addition, the studies of Kim and Kwahk (2007) showed that usefulness and emotion are indirect anticipants of both usage and intention through perceived value, and overall they do not directly influence usage and intention. Studies of Kim, H. Chan, and Y. Chan (2007) also support these findings suggesting that for the services to be useful, service providers should focus on satisfying the users’ needs and desires in ways that are...
impossible in other typical similar services. Our findings explain why these surveys differ from each other as we have found both results in different cultural contexts. In other words, the reason why the results of the survey are different lies in the fact that the effect of perceived usefulness is dependent to the society in which the survey is conducted. For example, the results of studies of Lee et al (2007) in Korea, which has probably more similarity with China, are near to our findings in China. An explanation to why in some countries the effect of perceived usefulness on intention to use is more dominant might be related to the extent of joblessness and social welfare in each country. Thus in countries with less joblessness and greater social welfare, the usefulness of the technology for consumers’ jobs may be less important than the countries with more competition for acquiring a job. The gross domestic product (GDP) of each country is very often positively correlated with standard of living (Sheffrin 1996) and based on a study conducted by International Monetary Fund (2009) we can see that US has higher GDP comparing to Russia and China. In another study by Global Career News (2006), the same ranking is determined for unemployment rates of the countries. These are consistent with our findings, as our study has revealed that in US the relationship between perceived usefulness, behavioral intention cannot be proven while in China, and Russia the hypothesis is supported. The positive correlation between perceived ease of use and behavioral intention is supported in all the countries. Therefore, it can be concluded that perceived ease of use is one of the participants of the behavioral intention in these cultural contexts. Previous studies (Straub et. al 1999; Bhattacherjee 2001; Wu & Wang; 2005; Bhatti 2007; Wu, Tao & Yang 2007) have also revealed that perceived usefulness is a significant determinant of users’ behavioral intention. Lee et al. also studied perceived usefulness as a post adoption perception of users and proved that it is a strong determinant of satisfaction of users in three different Asian countries. In addition, the correlation between perceived ease of use and perceived usefulness is only supported in Russia. Even the result in US is in the contrary direction of what has been expected by the hypothesis H4. Making the service easier to use is even more important in Russia in order to increase the adoption rate in customers, perceived usefulness will increase the behavioral intention. The studies of Taylor and Todd (1995) also suggest that easiness of using technologies have influence on users’ future attitude and intention towards using the technology. Nysveen et al (2005) also found out that perceived ease of use influence perceived usefulness of the consumers. Although perceived ease of use has been proven to have strong effect on intention to use, some studies have revealed that perceived ease of use is important in the early stages of the adoption (Venkatesh 2000). In other words, through the passage of time, the effect of perceived usefulness will be lessen and in the early stages of a technology adoption usefulness will be more important. A survey conducted by ComScore in 2008 showed that the internet audience has grown 27 percent, which is the highest growth in the world. This conveys that Russia is in its early stages of technology adoption and that might be a good reason why perceived ease of use has an impact on perceived usefulness in Russia. While perceived ease of use is an important factor in different countries, only in Russia it also has a positive correlation with perceived usefulness that indeed increases the importance of ease of use in Russia. The results of t-test revealed that there is a difference between men and women in their perceived usefulness. Research on gender differences indicates that men tend to be highly task-oriented (Minton and Schneider 1980). Therefore, performance expectancies, which focus on task accomplishment, are likely to be especially salient to men. Gender schema theory suggests that such differences stem from gender roles reinforced from birth rather than biological gender per se (Bem and Allen 1974). This suggests that in different cultural contexts with different gender roles the effect of the gender on the adoption of the technology is different. The surveys conducted to investigate the effect of gender on adoption of an IT services has revealed different results. For example, studies of Westlund and Bohlin (2008) revealed that there is a gendered dimension in the use of internet services as men use the internet more frequently especially the search engines, news sites and sports. The studies of Ozhan Dedeoglu (2004) have also revealed that men and women perceive mobile phones’ usage differently. On the other hand, Slyke et al (2002) showed that gender does not have a significant impact on the adoption of web based services. Bigne et al (2007) also proved that gender does not have a significant impact on intention towards M-Commerce. Bigne et al explained that the differences between genders tend to disappear due to changes in social habits and in the greater level of introduction and development of the new technologies. Their study has confirmed the results of other researches’ findings (Modahl 2000, Siegel 2003) which had concluded that women are becoming more engaged in virtual environments and that mobile use is becoming more and more widespread and thus the effect of gender is decreasing. Therefore, just like...
Haghirian et al (2005 & 2006) also could not find Russia and China. Similar to our findings, reveal weak evidence of such a relationship in perceived usefulness in US. However, the results In addition, there is no evidence of existence of perceived usefulness of the service in the customers. Also, the studies of Park et al (2007) showed that education has a significant moderating effect on the main antecedents of attitude of the Chinese consumers towards using mobile technologies. Moreover, some other studies indicate that early-adopters of internet related services for mobile devices are people with a high income and educational level (Matsuda 2005, Versakalo 2006, Ohlsson 2007, OPA 2006, and Kivi 2007). Pederson et al (2003) also found out that there exist differences in perceived expressiveness, enjoyment, attitudes, interpersonal influence and use of different educational levels. Users that were more educated found the services less expressive and enjoying, and had a less positive attitude towards the use. They also used less and felt a less interpersonal influence in using. Park et al (2003) also found that there were income differences in external influence, self-efficacy and intention to use. High-income users felt a less external influence and more self-efficacy but also reported higher intentions to use the service. Regarding the issue of education it should be noted that through the passage of time internet activities categories are broadened and the cover a vaster range of activities. The pew internet and American life project tracking surveys (2008) has resulted in a list of 72 activities, which are popular tasks people do using internet. This decreases the effect of education on perceived usefulness as people with less educations also find internet useful in their daily activities. On the other hand, the mobile internet costs have been lessened and therefore, people with lower incomes can afford to use the technology. However, the World Bank categorization of the countries based on the income level shows that China and Russia are among lower and upper middle-income countries while United States is a high-income country. These statistics are in consistency with our results as we have revealed the weak impact of income in Russia and China as well. Eventually, the experience of working with stationary internet on PC and experience of working with mobile phone could not be proven to have a strong impact on ease of use in different cultural contexts. A study of Park et al (2007) also supports our findings as they found that the moderating effect of past internet experience is insignificant. Therefore, it is concluded that the mobile internet service providers do not need to focus on more educated and high-income customers, and they can present the service to a wider range of customers. The same conclusion is true for the previous background of working with stationary internet and mobile phones, which highlighted that the service
providers can include consumers with little or no previous background of working with stationary internet and mobile phones in their target market.

CONCLUSIONS AND DISCUSSIONS
Throughout this study, we fulfilled the objectives of the survey. We tried to provide an answer to whether the service providers are to customize the service based on the effect of endogenous variables, or they should focus on specific segments of the market (effect of exogenous variables). In other words, we tried to see if the relationships between the constructs of the TAM model are different for the consumers in different cultural contexts or not. We utilized the AMOS software for testing the validation of the model and the results of model validation analysis showed that the model is plausible for the analysis in all the target countries. As a whole the results of this survey revealed that exogenous variables (except for gender) have little or no impact in almost all the cultural contexts and thus the service providers do not need to focus on a specific segment of market in different cultural contexts. On the other hand, the endogenous variables have different impacts in different countries emphasizing on the fact that the service has to be customized for each cultural context to have the highest adoption in each country.

In some aspects, our findings are supported by other previous studies. However, we have revealed new findings. We have not only worked out the correlations between the constructs of the model, but also we have compared the results between three countries with different cultural contexts. We tried to investigate how these factors affect intentions towards mobile internet usage and how these impacts differ in different countries. Although we have revealed the existence of such difference, the underlying reasons of these differences between different cultural contexts are not known. This understanding may help the providers even more in developing their future services and products before entering each specific market.

RESEARCH LIMITATIONS/IMPLICATIONS
The study has its own limitations. Therefore, we suggest that our results should be interpreted with caution. The mobile services are now presented globally in different cultural contexts and understanding whether cultural differences affect adoption behavior of consumers is of high value. The study has practical significance for the mobile internet service providers as it provides them an understanding of how to customize their service and tells them whether they have to focus on specific segments of markets or not. This decreases the chance of encountering low adoption of service in each specific market. The authors suggest that studying latent reasons for different responses in different cultures towards mobile internet is of high importance. Other external variables may also be explored and investigated to determine whether they have different impacts in different cultural contexts.

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The Impact of IS Employees’ Perceived Fairness on Organizational Commitment in Post-Merger Information Systems Integration

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Abstract
Despite the proliferation of mergers and acquisitions (M&As) for last few decades, lots of M&As have failed to fulfil planned objectives and to create synergy. Many researchers pointed out the failure of post-merger information systems (IS) integration as one of critical causes for M&A failure. This study, based on organizational justice theory (OJT), proposes a research model to identify the impact of IS employees’ perceived fairness on their organizational commitment during post-merger integration stage. In addition, the relationship between those variables and organizational trust and job insecurity is also examined. We expect the results of this study can contribute to provide some guidelines for the firms that is now integrating IS systems after M&A or considering M&A in the future.

Keywords: Merger and Acquisition (M&A), Post-Merger Integration, Information Systems Integration, Organizational Justice Theory, Organizational Commitment, Trust, Job Insecurity

Introduction
For the decades after the 1980’s M&A wave, many companies have utilized M&As as an effective means to strengthen their competitiveness in rapidly changing market conditions. Although the global financial crisis triggered by the US subprime mortgage defaults has shrunk the M&A markets throughout the world, the volume of worldwide M&As still recorded about US$2.9 trillion in 2008 [1].

Despite growing demand for M&As among companies, recent studies on the M&As failed to prove that M&As have a significant impact on overall corporate value-creation [2]. It is found that more than two thirds of M&As fail to create any synergistic benefits such as anticipated cost savings, revenue growth, and shareholders’ value maximization [3].

Therefore, many researchers have focused on identifying causes of success and failure of M&A. Among them, majority of studies pointed out that success of M&A is determined at the post-merger integration stage [3] [4] [5] [6] [7] [8]. In particular, successful integration of information systems determines success of M&A as information system has an utmost importance in the large-scale business [9] [10] [11] [12] [13]. Still, the number of prior research on post-merger IS integration were absolutely insufficient [10] [12] [13] [14] and studies from human resources management (HRM) perspectives cannot even be found almost at all [15].

Most of prior studies on M&As put their emphasis on strategic or financial aspects, but research with focus on successful information systems integration and human side of M&As to identify how M&A affects employees psychology and behaviors, recently began to draw attention amid growing failure of M&As [15].

This paper, based on comprehensive review of previous research in many disciplines such as management, psychology, and information systems, proposes a research model to identify the impact of IS employees’ perceived fairness of treatment on their organizational commitment during post-merger integration. For this, we adopted organizational justice theory as a theoretical framework. In particular, we divide those factors into sub-domains and also try to identify the relationship between those sub-domains. In addition, the relationship between those variables and organizational trust and job insecurity is also examined.

We expect the results of this paper can contribute to provide a theoretical framework for systematic research on post-merger IS integration and also give some implications about human resource management for the firms that is now integrating IS systems after M&A or considering M&A in the future.

Theoretical Framework:
Organizational Justice Theory
Organizational justice theory originated from Equity Theory of Adams [16] [17] is a result of efforts to explain the impact of justice on organizational function [18] [19] [20]. The term, organizational justice was coined to describe role of justice at workplace, with emphasis on decision as to how fairly an employee should be treated and how much this decision affects the employee’s attitudes and behaviors [21].
As the theory derived from of perceived fairness of outcome distribution in the early 1960s, or Adams’s Equity Theory [16] [17] which stressed distributive fairness, failed to explain or predict people’s reaction to unfairness recognized in distributive justice models and outcome distribution was not necessarily important as much as the processes assigned is to them [22], significance of procedural justice with its focus on procedures of outcome distribution began to draw attention [23] [24] [25]. The organizational justice theory received consistent support from many researchers as it introduced procedural justice and emphasized distributive justice and procedural justice [26].

However, the organizational justice model with two traditional factors of distributive justice and procedural justice created discrepancy among researchers over introduction of interactional justice, which focuses on interpersonal treatment that occurs in execution of each procedure. The interactional justice introduced by Bies and Moag [27] puts emphasis on how fairly decision-makers respect and treat their subordinates, while communicating with them. In response, some researchers [21] [28] argued that the procedural justice should be put over the interactional justice, and others considered the interactional justice as new form of justice [25] [26] [29] [30] [31].

In this study, the organizational justice theory was adopted as a theoretical framework to discuss this study, as the theory suggested an important theoretical insight into impact of major decisions made in post-merger integration on attitude and behavior of employees [3] [15].

Research Model and Hypothesis

Post-merger integration requires not only strategic, cultural and organizational fitness between pre-merger companies, but also integration of information systems, such as defining requirements of new information system infrastructures, and integration of pre-merger information systems and technologies, is considered the biggest challenge [14]. However, organizational integration can’t be effectuated without successful integration of information systems [32].

This study focuses on IS employees who participated or are participating in post-merger IS integration, in contrast to other studies which focus on the integration of IS infrastructures. Based on organizational justice theory, this study examines the impact of IS employees’ perceived fairness on organizational commitment with its emphasis on organizational justice issues that occur in the process of post-merger IS integration. For this, our research model is depicted in <Figure 1>.

The research model shown in <Figure 1> considers each construct as a second-order factor, which consists of some sub-factors. In other words, organizational justice includes distributive justice, procedural justice, and interactional justice, while job insecurity covers perceived threat of valued job characteristics and perceived threat of job loss felt by IS employees. Organizational trust is classified again into trust in organization and trust in supervisor, while organizational commitment is put into affective commitment, continuance commitment, and normative commitment.

M&As bring with concerns over justice in distribution, procedure, and interaction in the post-merger integration, so does in the post-merger IS integration.

First, post-merger IS integration project can cause distributive injustice in the process-handling. The integration requires long-time efforts and it itself is a large-scale project with high risks embedded. Employees participating in the integration even have to devote their much time and effort for success of the project. In this process, they expect their efforts made would be justified and compensated with a reasonable reward in return. Less compensation distribution than expected chips away at their commitment to organization.

Second, post-merger IS integration includes major decision-making processes, in which a variety of problems for procedural justice can arise. In the process of putting pre-merger IS all together, discrepancies in degrees to compatibility, standardization, complexity, and maturity of the ISs, hardware distribution, data sharing, project management capacity, and capabilities of the IS departments [11] [12] can cause divergence in the decision-making. When such decision-making process isn’t transparent, and favors towards one particular organization, excluding opinions of IS employees from other organization, they might felt left out, which in turn could cause organizational conflicts.

Third, companies usually set up a special task...
force team to perform their post-merger IS integration project. In this process, most of IS employees have to work along with supervisors from other pre-merger companies. They tend to be sensitive to a variety of unfairness or disadvantages which might occur during communication and suffer from much stress, particularly when those from other companies become head of the department or team.

As shown in the prior studies, IS employees also tend to be actively immersed in their new organization, when they are guaranteed with organizational justice. Based on these findings, following hypothesis can be drawn in terms of organizational justice (distributive justice, procedural justice and interactional justice) and organizational commitment.

**Hypothesis 1: Organizational justice will have a positive impact on organization commitment.**

Job insecurity has become one of common features in most of domestic and foreign companies [33] [34] [35]. Therefore, people are under much anxiety and stress negatively affecting their attitude and behavior towards M&A activities and post-merger integration [36]. Many studies focused on what impact perceived fairness has on reaction of those who survived lay-off as researchers recognized that their perceived fairness is one of key determinants of their behavior [37].

Brockner [37] proved, in his studies on the relationship between job insecurity arising from lay-off and work effort, that procedural fairness has an inverse relation to their worries about lay-off.

Just like unfairness affects their job insecurity (perceived threat of job loss and valued job features) in post-merger integration [37] [38] [39] [40] [41] [42], unfairness affects IS employees’ perceived job insecurity also in post-merger IS integration. This leads to the following hypothesis.

**Hypothesis 2: Organizational justice will have a negative impact on job insecurity.**

M&As are usually accompanied by corporate restructuring, including lay-offs and re-disposition. The previous studies showed that job insecurity impairs organizational commitment. Ashford et al. [38] proved that job insecurity that came from downsizing, restructuring and merger, lowers job satisfaction and trust, triggers intention to quit, and furthermore undermines organizational commitment as well. Davy et al., [43] also came with the same findings. Similarly, [34] and Ito and Brotheridge [35] identified that job insecurity and job loss strain weaken affective commitment. Although some employees at IS department inevitably face lay-offs right after M&A, many are still kept in to take on their IS integration. After the IS integration is completed and new IS is stabilized, however, some of them are still put under the strain of job insecurity. Examples used in the previous studies assumed that job insecurity that occurs both during and after IS integration, undermines an overall organizational commitment, including participation in the process. Therefore, following hypothesis can be drawn.

**Hypothesis 3: Job insecurity will have a negative impact on organizational commitment.**

Amid organizational change such as M&As, downsizing, and restructuring for the causes of increased efficiency, productivity, and survival and growth, many studies recognized importance of organizational trust and began to have great interest in it [44].

During M&As, organizational trust can be divided into trust in organization and trust in supervisor. Luhmann [45] found that attitude to trust can change according to structural relationship. He argued that degrees of trust towards supervisor and the entire organization are not necessarily the same [46].

Post-merger IS integration project is a daunting challenge that takes several months, in some cases, even years. As such, the project requires voluntary and active participation by IS employees, which is not possible without trust in organization. During IS integration, people at IS department tend to have less trust in organization when they are not guaranteed with justice in decision-making process and compensation distribution. If so, their attitude and behavior in organization are also undermined [47]. Moreover, trust among colleagues and towards supervisors determines success or failure of the project as the IS integration takes long time [46] [47]. Therefore, perceived fairness of treatment affects trust in supervisor as it does to trust in organization during post-merger IS integration. Therefore, following hypothesis can be drawn.

**Hypothesis 4: Organizational justice will have a positive impact on organizational trust.**

Organizational trust including trust in organization and supervisor affects employees’ attitude, behavior, and accomplishment [48]. The prior studies showed that organizational justice plays an important role in shaping trust towards organization and supervisor, and the trust formed that way has a positive impact on organizational commitment, job satisfaction, organizational citizenship behavior [44] [46] [48] [49] [50] [51].

Amid organizational change and downturn, well-established trust keeps employees’
organizational commitment firmly. Liou [52] found that trust in organization and supervisor affects organizational commitment [51]. Similarly, employees at IS department tend to have more organizational commitment when they have stronger trust in organization and supervisor during post-merger IS integration, leading to their higher participation in the project and in turn, higher possibility of success. Therefore, following hypothesis can be drawn.

Hypothesis 5: Organizational trust will have a positive impact on organizational commitment.

Research Methods

Sample Data
The study used survey method to identify relation of variables suggested in the research model and prove research hypotheses. Data analyzed came from IS departments in securities-related organizations and securities companies doing business in Korea which experienced M&As recently. And survey was conducted on the employees at IS department who participated in their post-merger IS integration.

A total of 280 copies of questionnaires were distributed through door-to-door or face-to face visit, and e-mail. 130 of them were returned in, showing 46% of respond rate. Out of the 130 responses, 12 responses with incomplete data were eliminated from further analysis. As a result, 118 responses from 5 organizations in Korean securities industry were used in the data analysis.

Operationalization of Research Variables
Measurement items in the questionnaire are developed by adapting measures that have been validated by other researchers or by converting the definitions of constructs into a questionnaire format. The research variables used in this study include reflective second-order factors, which are composed of several first-order factors. Sources of measurement items are summarized in <Table 1>.

Table 1. Source of Measurement Items

<table>
<thead>
<tr>
<th>Second-Order Factor</th>
<th>First-Order Factor</th>
<th>Source of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organizational Justice (OJ)</td>
<td>Procedural Justice (PJ)</td>
<td>[26]</td>
</tr>
<tr>
<td></td>
<td>Distributive Justice (Dj)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Interactional Justice (IJ)</td>
<td></td>
</tr>
<tr>
<td>Job Insecurity (JI)</td>
<td>Threat of Job Loss (JS)</td>
<td>[53]</td>
</tr>
<tr>
<td></td>
<td>Threat of Job Features (JC)</td>
<td>[54]</td>
</tr>
<tr>
<td>Organizational Trust (OT)</td>
<td>Trust in Organization (TO)</td>
<td>[55]</td>
</tr>
<tr>
<td></td>
<td>Trust in Supervisor (TS)</td>
<td></td>
</tr>
<tr>
<td>Organizational Commitment (OC)</td>
<td>Affective Commitment (AC)</td>
<td>[56]</td>
</tr>
<tr>
<td></td>
<td>Continuance Commitment (CC)</td>
<td>[57]</td>
</tr>
<tr>
<td></td>
<td>Normative Commitment (NC)</td>
<td>[58]</td>
</tr>
</tbody>
</table>

Results

Partial Least Square (PLS) Graph Version 3.0 [59], a structural equation modeling (SEM) tool that utilizes a component-based approach to estimation, was used to prove validity of measurement items and test research model in this study. While covariance-based SEM tool such as LISREL, EQS, and AMOS uses maximum likelihood function for parameter estimation, PLS utilizes least square estimation, providing flexibility in expressing formative and reflective latent constructs, and relatively less restriction in measurement scales, sample size, and distributional assumptions [60] [61] [62]. As variables in the proposed model are composed of second-order factors, two-phase approach methodology was used for analysis.

First, psychometric properties of each measurement item were estimated through confirmatory factor analysis. Second, structural relationship among second-order factors was analyzed based on latent variable (LV) values of first-order factors, which were provided by PLS Graph 3.0 [63] [64].

Measurement Model

PLS was used to test psychometric properties of each measurement item that includes internal consistency reliability (also known as composite reliability), convergent validity, and discriminant validity.

First, <Table 2> shows composite reliability (CR) value, average value extracted (AVE), and correlation of first-order factors. As shown in <Table 2>, composite reliability value of first-order factor is 0.913 to 0.973, exceeding 0.7 of a recommended value for a reliable construct [54]. For the average variance extracted by a measure, a score of 0.5 indicates acceptability. <Table 2> shows a) AVE of our measures is 0.606 to 0.878, exceeding acceptability value, b) the square root of the AVE for each construct is greater than the correlation between that construct and other constructs (without exception). In addition, Appendix A shows the weights and loadings of the measures in our research model and Appendix B exhibits the results of confirmatory factor analysis.
As shown in Appendix A and B, loadings of all items is high for intended construct (> 0.707), and each t-value is significant at significance level of 1%, proving that convergent validity and discriminant validity of measurement items were verified.

We compared internal consistency, convergent validity and discriminant validity of second-order factors as it did for analysis for first-order factor. Latent variable (LV) values were used to identify reliability and validity of each second-order factor as PLS does not support direct analysis for the second-order factor model.

Table 3. Analysis Results of Second-Order Factors

<table>
<thead>
<tr>
<th>CR</th>
<th>AVE</th>
<th>OJ</th>
<th>JI</th>
<th>OT</th>
<th>OC</th>
</tr>
</thead>
<tbody>
<tr>
<td>OJ</td>
<td>0.930</td>
<td>0.817</td>
<td>0.904</td>
<td></td>
<td></td>
</tr>
<tr>
<td>JI</td>
<td>0.518</td>
<td>0.499</td>
<td>-0.695</td>
<td>0.706</td>
<td></td>
</tr>
<tr>
<td>OT</td>
<td>0.921</td>
<td>0.854</td>
<td>0.654</td>
<td>-0.605</td>
<td>0.924</td>
</tr>
<tr>
<td>OC</td>
<td>0.740</td>
<td>0.518</td>
<td>0.718</td>
<td>-0.525</td>
<td>0.669</td>
</tr>
</tbody>
</table>

As shown in Table 3, composite reliability to show internal consistency reached over 0.7 of acceptability value. AVEs of measurement items all exceeded acceptability value of 0.5. The square root of the AVE for each construct was higher than correlation between each construct. However two constructs, ‘Threat of Job Loss’ and ‘Continuance Commitment’ were dropped because of low level of factor loading value. As a result, these constructs are excluded from further analysis of structural model.

Structural Model
Path coefficient was investigated to prove validity of structural model and hypotheses as reliability and validity of measurement model was verified. Analysis results are as follows in Figure 2 and Table 4.

As shown in Figure 2, organizational justice has a positive impact on organizational commitment ($\beta = .553, p < .001$), confirming Hypothesis 1. As for correlation between organizational justice and job insecurity, organizational justice was proved to affect job insecurity ($\beta = -.691, p < .001$), supporting Hypothesis 2. But, Hypothesis 3 was not supported as job insecurity does not significantly affect organizational commitment. The model explained substantial variance in both organizational commitment ($R^2 = .58$) and job insecurity ($R^2 = .48$).

In Hypothesis 4, organizational justice was verified to have an impact on organizational trust ($\beta = .653, p < .001$), supporting Hypothesis 4, and the Hypothesis 5 was also supported ($\beta = .319, p < .001$) and the model explained substantial variance in organizational trust ($R^2 = .42$).

Table 4. Results of Hypothesis Testing

<table>
<thead>
<tr>
<th>No</th>
<th>Hypothesis</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td>Organizational Justice $\rightarrow$ Organizational Commitment</td>
<td>Supported</td>
</tr>
<tr>
<td>H2</td>
<td>Organizational Justice $\rightarrow$ Job Insecurity</td>
<td>Supported</td>
</tr>
<tr>
<td>H3</td>
<td>Job Insecurity $\rightarrow$ Organizational Commitment</td>
<td>Not Supported</td>
</tr>
<tr>
<td>H4</td>
<td>Organizational Justice $\rightarrow$ Organizational Trust</td>
<td>Supported</td>
</tr>
<tr>
<td>H5</td>
<td>Organizational Trust $\rightarrow$ Organizational Commitment</td>
<td>Supported</td>
</tr>
</tbody>
</table>

Discussion
The objective of this study is to analyze the impact of IS employees’ perceived fairness of treatment during post-merger IS integration stage on organizational commitment, job insecurity, and trust. The analysis results show that all hypotheses excluding Hypothesis 3 were supported.

As argued in organizational justice theory, we could identify that organizational justice plays an important role in shaping IS employees’ attitude and behavior when they are involved in large-scale and significant projects, such as post-merger IS integration amid organizational changes including M&As.

First, IS employees’ perceived threat of job security can be lower when they feel that their organization and supervisor treat them fairly during the post-merger IS integration. That is, they tend to be certain that they would not be laid-off or put at disadvantage of role assignment, promotion, and career path after IS integration, and have less worry and anxiety when they feel they are treated fairly.

Second, organizational justice has a positive impact on organizational commitment. As shown in prior studies in other fields such as organizational
behavior and psychology, IS employees also tend to have more willingness to devote themselves to their organization, subsequently contributing to success of IS integration project, when they are fairly treated.

Third, organizational justice helps IS employees trust in organization and supervisor to increase. As proven in many previous studies, we could find that trust contributes to drawing voluntary participation from employees by playing a positive role in relations between individual and organization, and among individuals. Therefore, increase in perceived fairness of treatment felt by IS employees towards their organization and supervisor contributes to increased voluntary participation in their IS integration by shaping mutual trust. As shown in the analysis result, trust shaped in IS integration project does have a positive impact on organizational commitment.

However, the study shows that job insecurity does not significantly undermine organizational commitment, which can be interpreted in the same line with studies of Greenhalgh and Rosenblatt [53] and Jordan et al. [34], in which the impact of job insecurity on attitude creates conflicting results among employees. In some studies, researchers assumed and came up with hypotheses that job insecurity would have a negative impact on organizational commitment because it triggers propensity to leave and resistance to change, but the significant result between two variables were not found. That can be explained that job insecurity appropriately controlled, as argued by other researchers, has rather a positive impact on work effort. IS employees witnessed other colleagues in business departments being laid off upon announcement of M&A and they might also be cut out of their organization after completion of post-merger IS integration. Such high tension creates willingness for them to work harder [34].

Conclusion

The purpose of this study is to identify what impact the perceived fairness of treatment felt by employees has on their individual attitude when they are faced with rapid organizational change such as M&As. To do this, this study tested the impact of organizational justice on organizational commitment, job insecurity, and organizational trust of IS employees during post-merger IS integration.

We can identify their perceived fairness does have a significant impact on their attitude towards IS integration, as argued in organizational justice theory. That is, organizational justice affects organizational commitment, job insecurity and organizational commitment, and organizational trust also has a positive impact on organizational commitment. However, unlike the result of previous studies, we couldn’t find the significant relationship between job insecurity and organizational commitment.

This study is expected to provide some implications from the academic perspectives. First, this study is expected to contribute to facilitation of the related studies about post-merger IS integration by empirically verifying the impact of fairness empirically based on organizational justice theory. Second, most of previous studies on IS integration were usually about IS itself (in terms of infrastructure), and studies on integration of employees at IS department themselves, a key player of IS integration are barely found. However, this study focused on human resource management perspective of IS employees and examined the attitude of IS employees during post-merger IS integration stage. Thus, we expect this study can provide a guideline for a successful integration of IS human resources. Lastly, from the comprehensive review of related studies in other disciplines, we divided each construct into sub-domains and could enhance nomological validity of phenomenon related to IS integration.

From the practitioners’ perspective, this study is expected to provide following implications. First, most of post-merger IS integration underestimated integration of human resource, and they were usually conducted with their focus only on the integration of technology itself. However, we expect this study will provide companies that are integrating their ISs or plan M&As with some guidelines by showing the importance of human resource management. Second, the results of this study can give some implications to IS managers who is in charge of IS integration. That is, If they want to successfully complete IS integration project, they should give more attention to IS employees’ perceived fairness of treatment during post-merger IS integration.

In the meantime, this study has some limitations together. First, for the analysis we used the survey data from IS employees who already completed post-merger IS integration and survived from layoff. This can cause some bias because they already survived and could be less threatened about job insecurity. Second, generalization of the result of this study has limitation as the study came up with conclusion using data extracted from IS employees only in the field of securities industry in Korea. Third, we performed cross-sectional study to test our research model, but variables used in this study and their impacts can be changed according to M&A stage.

Therefore, for future research, companies currently involved in IS integration need to be included, and variables and degree of their impact need to be analyzed as well for each M&A stage ranging from pre-merger to post-merger. Furthermore, research model and hypotheses suggested in this study need to be tested for IS.
employees in other industries and countries for generalization of the research findings.

References


**Appendix A:**

**Weights and Loadings of the Measures**

<table>
<thead>
<tr>
<th>Construct</th>
<th>Items</th>
<th>Weight</th>
<th>Loading</th>
<th>Standard Error</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distributive Justice</td>
<td>DJ1</td>
<td>0.209</td>
<td>0.917</td>
<td>0.019</td>
<td>49.674</td>
</tr>
<tr>
<td></td>
<td>DJ2</td>
<td>0.209</td>
<td>0.919</td>
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<td>42.827</td>
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<tr>
<td></td>
<td>DJ3</td>
<td>0.219</td>
<td>0.960</td>
<td>0.008</td>
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</tr>
<tr>
<td></td>
<td>DJ4</td>
<td>0.218</td>
<td>0.958</td>
<td>0.010</td>
<td>92.953</td>
</tr>
<tr>
<td></td>
<td>DJ5</td>
<td>0.212</td>
<td>0.932</td>
<td>0.014</td>
<td>64.845</td>
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<tr>
<td>Procedural Justice</td>
<td>PJ1</td>
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<td>0.882</td>
<td>0.035</td>
<td>25.355</td>
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<tr>
<td></td>
<td>PJ2</td>
<td>0.162</td>
<td>0.932</td>
<td>0.015</td>
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<tr>
<td></td>
<td>PJ3</td>
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<td>0.904</td>
<td>0.020</td>
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<td>PJ4</td>
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<td>0.891</td>
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<tr>
<td></td>
<td>PJ5</td>
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<td></td>
<td>PJ6</td>
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<td>0.912</td>
<td>0.030</td>
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<tr>
<td></td>
<td>PJ7</td>
<td>0.160</td>
<td>0.921</td>
<td>0.026</td>
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<tr>
<td>Interactional Justice</td>
<td>L1</td>
<td>0.187</td>
<td>0.898</td>
<td>0.023</td>
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<tr>
<td></td>
<td>L2</td>
<td>0.175</td>
<td>0.840</td>
<td>0.037</td>
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<tr>
<td></td>
<td>L3</td>
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<tr>
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<td>L6</td>
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<tr>
<td>Perceived Threat of Job Loss</td>
<td>JS1</td>
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### Appendix B: Results of Confirmatory Factor Analysis

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<tr>
<th>DJ</th>
<th>PJ</th>
<th>LJ</th>
<th>JS</th>
<th>JC</th>
<th>TO</th>
<th>TS</th>
<th>AC</th>
<th>CC</th>
<th>NC</th>
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<tr>
<td>DJ1</td>
<td>.917</td>
<td>.710</td>
<td>.574</td>
<td>.029</td>
<td>-.580</td>
<td>.466</td>
<td>.352</td>
<td>.652</td>
<td>-.025</td>
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<tr>
<td>DJ2</td>
<td>.919</td>
<td>.693</td>
<td>.600</td>
<td>.084</td>
<td>-.557</td>
<td>.406</td>
<td>.360</td>
<td>.637</td>
<td>-.059</td>
</tr>
<tr>
<td>DJ3</td>
<td>.960</td>
<td>.704</td>
<td>.618</td>
<td>.077</td>
<td>-.611</td>
<td>.415</td>
<td>.381</td>
<td>.658</td>
<td>.027</td>
</tr>
<tr>
<td>DJ4</td>
<td>.958</td>
<td>.743</td>
<td>.638</td>
<td>.019</td>
<td>-.641</td>
<td>.485</td>
<td>.489</td>
<td>.667</td>
<td>-.020</td>
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<tr>
<td>DJ5</td>
<td>.932</td>
<td>.729</td>
<td>.639</td>
<td>-.044</td>
<td>-.619</td>
<td>.470</td>
<td>.440</td>
<td>.672</td>
<td>.013</td>
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<tr>
<td>PJ1</td>
<td>.648</td>
<td>.882</td>
<td>.642</td>
<td>.024</td>
<td>-.499</td>
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<td>.466</td>
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<td>-.067</td>
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<tr>
<td>PJ2</td>
<td>.743</td>
<td>.932</td>
<td>.729</td>
<td>.116</td>
<td>-.586</td>
<td>.506</td>
<td>.460</td>
<td>.711</td>
<td>-.018</td>
</tr>
</tbody>
</table>

**Constructs**

- **Trust in Supervisor**
  - TS1
  - TS2
  - TS3
  - TS4
  - TS5
  - TS6
  - TS7

- **Affective Commitment**
  - AC1
  - AC2
  - AC3
  - AC4
  - AC5

- **Continuance Commitment**
  - CC1
  - CC2
  - CC3
  - CC4
  - CC5

- **Normative Commitment**
  - NC1
  - NC2
  - NC3
  - NC4
  - NC5
The Impact of Employees’ Perceived Fairness on Organizational Commitment

| PJ3 | 669 | .984 | .664 | .155 | .473 | .425 | .489 | .667 | -.085 | .249 |
| PJ4 | .693 | .891 | .701 | .097 | .586 | .539 | .508 | .702 | -.083 | .222 |
| PJ5 | .687 | .914 | .681 | .065 | .554 | .488 | .478 | .616 | -.040 | .228 |
| PJ6 | .683 | .912 | .684 | .137 | .593 | .477 | .497 | .660 | -.056 | .231 |
| PJ7 | .730 | .921 | .704 | .147 | .566 | .471 | .480 | .636 | .002 | .166 |
| J1  | .615 | .736 | .898 | .060 | .608 | .593 | .559 | .721 | -.125 | .333 |
| J2  | .494 | .584 | .840 | .100 | .545 | .531 | .575 | .542 | -.089 | .318 |
| J3  | .583 | .728 | .918 | .046 | .576 | .572 | .555 | .701 | -.138 | .322 |
| J4  | .549 | .622 | .895 | .132 | .480 | .528 | .596 | .597 | -.093 | .363 |
| J5  | .651 | .672 | .898 | .005 | .640 | .599 | .566 | .653 | -.033 | .321 |
| J6  | .614 | .707 | .910 | -.014 | .504 | .572 | .603 | .663 | -.180 | .373 |
| JS1 | .062 | .145 | .083 | .098 | .035 | .187 | .002 | .059 | .307 | .017 |
| JS2 | .052 | .110 | .080 | .098 | .035 | .187 | .002 | .059 | .307 | .017 |
| JS3 | -.016 | .072 | .005 | .098 | .035 | .187 | .002 | .059 | .307 | .017 |
| JS4 | -.016 | .072 | .005 | .098 | .035 | .187 | .002 | .059 | .307 | .017 |
| JS5 | -.016 | .072 | .005 | .098 | .035 | .187 | .002 | .059 | .307 | .017 |
| JS6 | -.016 | .072 | .005 | .098 | .035 | .187 | .002 | .059 | .307 | .017 |
| JS7 | -.016 | .072 | .005 | .098 | .035 | .187 | .002 | .059 | .307 | .017 |
| TO1 | .355 | .387 | .459 | -.312 | .398 | .782 | .433 | .448 | -.157 | .215 |
| TO2 | .429 | .387 | .534 | -.101 | .575 | .826 | .611 | .528 | -.128 | .386 |
| TO3 | .507 | .538 | .572 | -.044 | .576 | .832 | .642 | .595 | -.162 | .352 |
| TO4 | .411 | .462 | .593 | -.114 | .585 | .841 | .598 | .479 | -.146 | .276 |
| TO5 | .206 | .308 | .353 | -.207 | .297 | .721 | .486 | .346 | -.086 | .253 |
| TO6 | .348 | .346 | .335 | -.180 | .385 | .711 | .506 | .479 | -.037 | .274 |
| TO7 | .351 | .485 | .605 | -.152 | .515 | .777 | .600 | .473 | -.247 | .255 |
| TS1 | .286 | .344 | .450 | -.075 | .286 | .504 | .765 | .440 | -.282 | .334 |
| TS2 | .394 | .407 | .524 | -.064 | .407 | .564 | .823 | .538 | -.207 | .395 |
| TS3 | .406 | .417 | .579 | -.087 | .405 | .483 | .804 | .481 | -.278 | .436 |
| TS4 | .405 | .455 | .563 | -.032 | .530 | .642 | .809 | .507 | -.125 | .356 |
| TS5 | .133 | .326 | .322 | -.141 | .256 | .540 | .722 | .310 | -.128 | .237 |
| TS6 | .335 | .465 | .490 | -.170 | .377 | .578 | .790 | .497 | -.302 | .352 |
| TS7 | .377 | .478 | .569 | -.042 | .564 | .613 | .729 | .444 | -.195 | .277 |
| AC1 | .653 | .714 | .664 | -.001 | .557 | .554 | .461 | .896 | -.056 | .373 |
| AC2 | .672 | .656 | .639 | -.041 | .581 | .548 | .538 | .940 | -.093 | .450 |
| AC3 | .633 | .664 | .656 | -.010 | .552 | .582 | .591 | .956 | -.193 | .516 |
| AC4 | .631 | .640 | .689 | -.008 | .524 | .594 | .619 | .916 | -.193 | .463 |
| AC5 | .614 | .691 | .687 | -.134 | .509 | .530 | .515 | .887 | .030 | .428 |
| CC1 | -.052 | -.112 | -.139 | -.292 | .065 | -.087 | -.178 | -.096 | .849 | -.210 |
| CC2 | .060 | -.002 | -.033 | -.410 | -.004 | -.133 | -.186 | -.050 | .896 | -.261 |
| CC3 | -.014 | -.078 | -.145 | -.332 | -.065 | -.229 | -.360 | -.160 | .854 | -.321 |
| CC4 | -.032 | -.024 | -.102 | -.271 | -.036 | -.133 | -.276 | -.103 | .827 | -.177 |
| CC5 | -.024 | -.021 | -.117 | -.404 | -.025 | -.183 | -.268 | -.077 | .894 | -.301 |
| NC1 | .274 | .224 | .330 | -.029 | .227 | .378 | .463 | .428 | -.344 | .833 |
| NC2 | .184 | .168 | .305 | -.032 | .148 | .239 | .322 | .350 | -.182 | .819 |
| NC3 | .294 | .222 | .267 | -.070 | .269 | .291 | .287 | .406 | -.161 | .811 |
| NC4 | .286 | .223 | .275 | -.012 | .194 | .318 | .340 | .393 | -.310 | .813 |
| NC5 | .347 | .255 | .383 | -.012 | .222 | .285 | .399 | .423 | -.215 | .840 |
THE RESEARCH OF EFFECTIVE FACTORS ON IS PLANNING CAPABILITY OF IT ORGANIZATION

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Abstract

In fast-paced business environments, most businesses rely on IT. Business units continuously require planning, development and management of IS aligning with their business strategies. In this continuous process, an IS organization performs business analyses as well as planning and application functions for IS environments in a position of mediator between both business and IT units. In recent years, monitoring and evaluation of developed information systems has become an important tasks, which is inevitable and essential for making IT investment decision. This organization is generally referred to as an 'IS strategic planning team', 'IT planning team', 'information strategic team', and 'IT strategy planning team', etc., and is collectively referred to as an 'information strategic organization'.

This paper aims to identify ‘IS Planning Capability’ as the most important critical factor for information strategic organizations and examined how different factors that can affect planning capability, and further impacts on IS planning satisfaction in business units.

Keywords: Strategic IS unit, IS Planning Capability,

1. Introduction

Use of Information Technology (IT) in business and organizations has shifted to knowledge society and sped the change to a networked society. In general, business unit is operated based on their business processes while IS unit or organization, providing and operating information systems according to business requirements. Planning, developing and operating information systems corresponding to business requirements through effective communication and efficient coordination have emerged as critical aspects to sustain organization’s competitive advantage. In other words, a reciprocal dependency between business and IT functions is an important factor in providing business IT users with the optimal IT service, assuring service continuity and quality of IS organization.

To provide the best IT service corresponding to diverse business requirements, components and types, a mediating unit known as an ‘information strategic team’ or ‘IS strategic planning team’ is recognized to be essential for aligning between business and IS units and performing functions of IT planning and coordination.

However, there may be communication problems between two parties, i.e. IS organization and different business units. These problems may cause IT service quality deterioration, failures in development of satisfactory service actively reflecting business requirements, and service failures through absence of timely, precise services and processes, late delivery for development, operation, maintenance, etc.

In so far, there have been no previous studies on planning capability, the most important task among characteristic tasks of an organization mediating business and IT units, determinant factors affecting planning capability, and influences of mediating organizations' planning capability may impacts on user satisfaction of IS, etc.

The study designates an organization that mediates between business and IS units as described above an ‘IS strategic planning units’ and examines aspects that these organizations can retain for planning capability, and that affect service satisfaction of IS users. This research study provides a guide to factors that improve planning capability of IS strategic planning unit. By establishing a causal relationship between mediating planning capability and IS user satisfaction. In short, the study will contribute to development of IT planning team where business users can be satisfied. Hence following research questions are proposed:

RQ 1: What are internal/external antecedent factors that determine IS planning capability of 'IS strategic planning unit'?

RQ 2: How different levels of IS planning capability is co-related with IS users’ satisfaction?

2. Theoretical Background and Research Hypothesis Development
2.1 Research Model

To answer the research questions proposed in the study, a research model comprising seven hypotheses in Figure 2-1 is presented.

2.2 Definition and Literature Review of IS Planning Capability

2.2.1 Literature on IS Strategic Planning Team

Management strategies to resolve communication problems occurring in process of establishing business strategies and achieving goals of the business are defined as ‘Relationship Management’ (RM) [15]. In the case of conflict within a business, it is assumed that communication between both units will be smooth if there exists a system or organization to mediate and make a decision, and ultimately be of great help in achieving strategic goals of the business. Lee (2005) defines IS strategic planning unit as a team having a coordination role of determining how to develop information resources to achieve strategic goals of the business. Through his study, ‘A study on Development of IT Strategic Planning Function (2005)’, he broadly defines functional aspects of IS strategic planning unit under three different activities: Plan, Do, and See. They are summarized as follows:

Table 2-1 Functional Aspects of IS Strategic Planning Unit

<table>
<thead>
<tr>
<th>Plan</th>
<th>Development Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Establish a systematic and well organized plan with the least amount of resources within a short time to maximize implementation effect of strategies</td>
<td></td>
</tr>
<tr>
<td>• Establish a practical plan to efficiently and effectively implement information and communication infrastructure</td>
<td></td>
</tr>
<tr>
<td>• Take a role of problem identifier related to construction and operation of information and communication infrastructure in cases where problems occur in information systems</td>
<td></td>
</tr>
<tr>
<td>• Smooth reciprocal communication as a project owner with responsibilities shared between business and IT divisions</td>
<td></td>
</tr>
<tr>
<td>• Take a role of mediator and intermediary to maintain agreement without friction and conflict</td>
<td></td>
</tr>
</tbody>
</table>

2.2.2 Literature Study on IS Planning Capability

This paper proposed 'IS Planning Capability' as a measurement variable to evaluate Operational Effectiveness and tasks of IS strategic planning units by defining using Lee (2005)'s functional aspects of IS planning units as defined above. The study focused on planning capability based on a previous study finding [3] that IS planning is the most critical tasks undertaken by an IS strategic planning organization.

According to studies by McFarlan (1983), King (1983), and Lederer and Sethi (1998), commonly proposed characteristics used to
evaluate planning capability are ‘Analysis Capability’, ‘Lead Capability’, ‘Coordination Capability’, etc. Firstly, ‘Analysis Capability’ means a capability to systematically analyze, evaluate, and propose possible solutions to problems using all internal and external quantitative and qualitative information, and include capability to predict a possible exceptional situation during task performance and distinguish a main problem area [3]. In other words, understanding organizational factors using information input into information system planning and fulfilling needs depend on Analysis Capability. This Analysis Capability is the capability to understand organizational strategies, and internal and external characteristics, and fulfill fundamental needs to ultimately achieve goals of the organization. Thus, Analysis Capability is an important factor for success in information system planning.

Secondly, ‘Lead Capability’ means the capability to form and lead in an external competitive environment as organizations introduce new products, technology, or management skills, etc. It is defined as the capability of organizations to lead in competitive environments ahead of competing organizations with creative products or management skills, etc.[3]. For IS planning, this Lead Capability helps plan information systems needed for the organization more creatively, and may be used as a competitive weapon which other organizations cannot imitate.

Lastly, ‘Coordination Capability’ means a capability for 'Coordination' which has lexical meanings of 'mediation', and 'equivalence' for two or more groups. ‘Coordination Capability’ is defined as the capability to more efficiently manage construction and operation tasks for information systems through mediation and control of organizations, and to mediate between IT and business units to help them coordinate effectively, which allows IT units to develop systems meeting business requirements. Johnston and Vitale (1988) explain the importance of coordination between organizations in their study findings, showing that frequent and prompt information exchanges by a mediator/intermediary between organizations bring several competitive advantages such as prompt decision-making and responses, close mediation and control of business operations, and accompanying cost reduction. Jane Coughlan et al. (2005), Venkatraman and Ramamujam (1987), McGinnis (1984) etc., as previously mentioned, also conclude in their studies that communication capability between business and IT units, and mediation capability are important factors affecting performance of information systems.

In conclusion, it is shown that organizations may operate efficiently if IS planning capability, described as ‘Analysis Capability’, ‘Lead Capability’, and ‘Coordination Capability’, are efficiently demonstrated. In effect, it is assumed that IS planning capability has an important impact on IS performance and business user satisfaction.

2.3 Antecedent Factors on IS Planning Capability

The study proposed independent variables affecting IS Planning Capability into two aspects: internal and external. The former defines as the IS strategic planning team itself, in other words, the internal characteristics of within the unit while the latter aspect focused on 'external factors of organization.'

2.3.1 Internal Factors of Affecting IS Planning Capability
1) Business Knowledge (BK)

Coughlan and Lycett (2005) suggested that the greater the interest in and higher the level of IT knowledge business organization members have, the more comprehensive and in-depth discussion IT sector members can have [29]. In other words, the members of higher the level of business knowledge the higher the possibility they propose effective use of IT corresponding to business strategies. In the end, it is predicted that members of the business sector can have even more in-depth discussion [13].

In other words, if a member who has experience and knowledge of both IT and business is a member of an IT unit, it is predicted that more analytical and innovative ideas can be proposed when planning IT strategic tasks based on in-depth understandings of both sides of IT and business, and that communication problems between both business and IT units can be more smoothly coordinated.

There are several study findings suggesting persons who have expert and technical knowledge related to information and communication infrastructures, and many experiences of development and management of information and communication, are generally suitable as members of an IS strategic planning team (The Ministry of Information and Communication, 2004). Thus, it is perceived that members of IS strategic planning team have a higher level of IT understanding. Therefore, the study establishes knowledge and understanding of business as factors exclusive of IT understanding of organization members and the first hypothesis is as follows:

Hypothesis 1: If members of an IS strategic planning team have a higher understanding of business, then planning capability may be better.
2) Procedure Standardization (PS)
Among studies on variables to operate organizations effectively, the most widely recognized ones are 'Complexity', 'Decentralization', 'Formalization' by Robbins (1985), etc., as described in previous section.

Among these, Formalization means the extent tasks in an organization are performed by official regulation and procedure. It is explained as the degree to which procedure, regulation, and communication, regulating actions of organization members, are documented and tasks in an organization are standardized. If specific procedures are formalized and documented during decision-making, it is recognized that task implementing procedures are standardized and assumed that planning tasks of IS strategic planning team can be more effectively implemented. By applying standardized characteristics of an organization as described above, the following hypothesis is established:

Hypothesis 2: If the extent of standardization of task implementation procedures of an IS strategic planning is higher, then planning capability may be better.

3) Leader’s Leadership (LL)
All organizations in business have a system established to achieve strategic goals of the organization, and the system has an 'organizational leader' taking the role of chief manager fully in charge of decision-making and issue discussion [25].

Quinn and McGrath (1985) categorized culture of organizations into four different elements, 'Group Culture', 'Developmental Culture', 'Hierarchy Culture', 'Rational Culture', and divide leadership of an organizational leader into four types, namely rational achievement, realistic team design, empirical professional, and idealistic innovation pursuit type, and studied types of ideal leadership to effectively run organizations in connection with each leadership and cultural type [8].

Through previous studies, leadership of organizational leaders is representatively categorized under four different types, 'considerate', 'innovative', 'organizational leading', and 'transactional' [1]. This study represents the four types under the single word 'Leadership' by implication. If an organizational leader of an IS strategic planning has capability to lead and coordinate members, it is assumed that planning capability of an IS strategic planning team is well established. A hypothesis is proposed as follows:

Hypothesis 3: If the leadership capability of an organizational leader, a chief manager in charge of an IS strategic planning team, is higher, then planning capability of an IS strategic planning team may be better.

2.3.2 External Factors of Affecting IS Planning Capability

1) Estimate for Organization (EO)
Karimi (1988) suggested that if the size of a business is generally larger, then human and financial resources are greater, and structures and functions of an organization in business are well developed. In addition, there are previous studies showing that the extent of budget investment for hardware and software of IS has an indirect effect on business performance using IS [25]. King and Prekumar (1994) present that the extent of invested IT budget is an important factor for planning IS. Thus, by applying the study results on invested budget for organizations as described above to an IS strategic planning, the following hypothesis are proposed:

Hypothesis 4: If the extent of invested budget in an IS strategic planning team in business is greater, then planning capability of IS planning team may be better.

2) Director’s Commitment & Support (DCS)
Sethi and Lederer (1988) recognized the extent of commitment and continuous support by a CEO and organizational management as success factors. Pyburn (1983) suggested that the leadership capability of a CEO is an important factor in operating an organization efficiently. Thus, by applying the study results on commitment and support of management as described above, the fifth hypothesis is established as follows:

Hypothesis 5: If management has greater commitment and continuous support for an IS strategic planning team, then planning capability of an IS strategic planning team may be better.

3) Business User’s Commitment & Support (BCS)
Franz and Robey (1986) suggest in their study that there is a meaningful causal relationship between participation of business users and success of IS. Commitment and support of business users occur when they are participated a role or certain tasks in an IS project. When they hope to address their own needs, and to take on an important role in successfully realizing the system, and when system requirements are unclear, these user involvement consideres as an important factor [31]. Therefore, by applying study results on commitment and
support of business users, the sixth hypothesis can be suggested as follows:

Hypothesis 6: If commitment and support of business users for an IS strategic planning team are higher, then planning capability of an IS strategic planning team may be better.

2.4 Studies on User Satisfaction for IS Strategic Planning

2.4.1 IS User Satisfaction

Many studies on IS among previous studies propose user satisfaction as an evaluation measure for IS performance [12]. Jarvenpaa (1985), etc. also propose user satisfaction as a variable to evaluate IS, and livari (1994) emphasize that user satisfaction for information provided by an IS is a proper variable to measure successful implementation of an IS. This study also selected user satisfaction as an independent variable ultimately affected by effective operation of an IS strategic planning team. Information system users here are limited to those of business organizations in charge of business not within IS planning team or IT unit. For this reason, the study ultimately aims to identify influences affecting business user satisfaction of an IS through planning capability.

2.4.2 Components of Information Systems Quality

Considering many previous studies, IS quality is generally used as a measurement variable to gauge user satisfaction of IS [24]. Previous studies like Pitt (1988), etc. generally divide information System Quality into three factors, System Quality, Service Quality and Information Quality.

1) System Quality

System Quality is the first factor among IS qualities, and there are a number of studies on quality of systems themselves. Previous studies on measurement of System Quality recognize that technical factors such as stability, reliability, availability, responsiveness, and timeliness of a system are important factors in deciding System Quality [4, 12].

2) Service Quality

Previous studies establish that reliability of services provided by planning divisions and professionalism of the IS developers in charge, accuracy and availability of maintenance and repair, responsiveness of members of a computing division, support and training for users, problem solving ability, etc. are important factors in evaluating Service Quality [7, 11, 23, 24].

3) Information Quality

Information Quality means quality of the output of information systems provided to users [5]. In here, information characteristics provided by IS are divided into timeliness, reliability, understandability, newness, accuracy, convenience, applicability, conciseness, validity, usefulness, sufficiency, etc. [5, 14, 30].

2.4.3 User Satisfaction on IS Strategic Planning

Several quality measurement variables for IS are derived from three factors, namely System Quality, Service Quality, and Information Quality. Among them, five representative measurement variables are abstracted and summarized as follows:

First is ease of use of IS. Second is usefulness of information provided by IS. Third is timeliness of IT service provided by IS. Fourth is accuracy of IT service provided by IS. Fifth is reliability of IT service provided by IS. Among the above five factors, 'ease of use' and 'usefulness of information' are quality measurement factors determined by technical and functional characteristics of the implemented system itself, and the variable, ‘timeliness’ of services generally contains comprehensive meaning of providing 'accurate' and 'reliable' services at the 'proper' time. Thus, accuracy and reliability are regarded as prior conditions of timeliness. For this reason, by controlling and arranging other variables, the study uses the ‘Timeliness (TL)’ variable as a measure of user satisfaction for IT planning service provided by IS strategic planning team.

In this research other factors are excluded and only 'timeliness' is adopted as a measurement variable. This is because the study recognizes not technical quality of the system itself for evaluation, but how well an IS strategic planning took on a role of mediator between business and IT organizations, and if the IT organization provided business users with IT planning service in a timely manner as 'satisfaction', and aims at measuring a causal relationship between organization planning capability and user satisfaction.

If planning capability of an IS strategic planning team is performed well then it is assumed that timely accurate IT services will affect user satisfaction of business users. Hence following hypothesis can be proposed.

Hypothesis 7: IS Planning Capability (PC) of an IS strategic planning team is performed well, IS user satisfaction may be higher.

3. Research Design

3.1 Design of Variables

In line with the research model proposed previously, variables consist of a total of six independent variables which relate to internal and external factors, and dependent variables which are Mediating Effect for ‘IS Planning Capability’ and
For internal factors, five measurement items are established in accordance with three independent variables. For external factors, six measurement items are established in accordance with three independent variables. Three measurement items are established for Mediating Effect. Lastly, one measurement item, 'IT planning output or timeliness' of service, provided to users' is established as a dependent variable. Detailed items and components are presented in Appendix 1.

4. Data Collection and Analysis

4.1 Data Collection Method
As a data collection method, a 'questionnaire survey' was conducted by a professional research organization consigned a sample of 200 firms having IS strategic planning team in charge of IT related planning, coordination support, evaluation, etc. in a position of mediator between business and IT units among KOSPI-listed companies in each industry cluster of banks, securities, insurance, electricity, electronics, IT, communication service, steel, etc. The survey sample included managerial employees working within IS strategic planning teams, whose positions rank from department level managers to executives.

The survey was performed from June 1 to 6 of 2009, and contained a total of 41 questions, consisting of 34 questions in four parts and 7 questions on demographic.

Prior to distribute the questionnaire, content analysis for measurement items in the questionnaire was reviewed and completed through interviews with academic and industry staff in charge for pre-tests.

4.2 Demographics of Samples
Response rate of the survey was 76% with respondents from 152 businesses among the sample of 200 firms. A distribution chart of the industries of businesses that responded shows that the Petroleum and Chemical industry comprised the most of the total at 21.1%. The distribution of the rest of the industries, exclusive of 'other', consisted of Construction, Distribution, Electronics, and Securities, in that order. The demographic results in relation to the size of IS strategic planning team are as follows: 150 among a total of 152 businesses responded 'less than 10', and this is an absolute value having a distribution of 98.7%.

4.3 Reliability and Validity of Measurement Variables
To verify the reliability of measurement variables, this study used Cronbach’s $\alpha$, a coefficient representing internal consistency of measurement items. According to Nunnally (1978), there is no absolute standard to evaluate reliability of measurement variables. However, it is suggested that a factor value of Cronbach’ $\alpha$ of more than 0.6, shown in a general Exploratory Study, is an appropriate level. In the case of using measurement items of preceding researchers without alteration, the factor value of Cronbach’ $\alpha$ should be greater than 0.7 to assure reliability of measurement items.

Analysis results for reliability of measurement variables using collected data through survey measurement factors are found in Table
A2-1 of Appendix 2. Reliability of independent variables, a mediating variable, and dependent variables was greater than 0.7 in all. This shows that the reliability level for application of this study model is very high.

Next, this study confirmed Construct Validity showing how measurement method accurately measures the construct. According to study results by Comrey (1973), Factor Loading of aspects are generally numeric values showing which variables are related to specific aspects. If values are greater than 0.45 and less than 0.54, they are ‘Fair’, greater than 0.55 and less than 0.62, they are Good, and greater than 0.71, they are Excellent. Three measured items among Factor Loading for all variables fell in the range greater than 0.63 and less than 0.70, and they were evaluated as Very Good. All of the remaining measured items were greater than 0.71. Thus, Construct Validity of this study was evaluated as Excellent.

4.4 Verification of Research Hypothesis

Results of the proposed research model are summarized in Figure 4-2 as follows.

To test hypotheses 1 through 6, multiple regression analysis was executed.

As shown in Table A2-2, it was found that among internal antecedents, only one variable, Business Knowledge has a statistically significant effect on IT Planning Capability (0.25, p < 0.01) and the other variables were rejected (thus H1 is supported).

When it comes to external antecedents, Director’s Concern & Support (0.16, p < 0.10) and Business Worker’s Concern & Support (0.18, p < 0.10) were found to have a statistically significant effect on IT Planning Capability and the other variable was rejected, (thus H5 and H6 are supported). Adjusted $R^2$ was 0.33 which means an explanatory power of antecedents on IT Planning Capability. Put another way, antecedents are explaining IT Planning Capability of information strategic organization by about 33%.

On the other hand, we tested the causal relationship between IT Planning Capability (PC) and Timeliness (TL), the reflector of Satisfaction of Business Users. As shown in Table A2-3 in Appendix 3, there was a statistically significant causal relationship on them (0.30, p < 0.01). It means that Hypothesis 7 is supported. Adjusted $R^2$ was 0.28 which means that IS Planning Capability explains Timeliness by about 28%.

To test the mediation effect of IS Planning Capability between independent variables and a dependent variable, we used the methodology proposed by Baron & Kenny (1986). This technique assesses mediating effects through a 3-step regression analysis.

![Figure 4-2 Result of Research Model](그림 수정 Concern=>Commitment)

Table 4.1 Measurement Results of Mediating Effect of IS Planning Capability Variables (Independent Variables: Business Knowledge; BK)

<table>
<thead>
<tr>
<th>Step</th>
<th>Dependent Variables</th>
<th>Independent Variables</th>
<th>β</th>
<th>Result</th>
<th>F-value</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>PC</td>
<td>BK</td>
<td>0.402</td>
<td>***</td>
<td>30.376</td>
<td>0.161</td>
</tr>
<tr>
<td>1.2</td>
<td>TL</td>
<td>BK</td>
<td>0.517</td>
<td>***</td>
<td>87.312</td>
<td>0.373</td>
</tr>
<tr>
<td>1.3</td>
<td>TL</td>
<td>BK</td>
<td>0.163</td>
<td>Rejected</td>
<td>106.524</td>
<td>0.416</td>
</tr>
<tr>
<td></td>
<td>PC</td>
<td></td>
<td>0.327</td>
<td>***</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The first step is regressing the mediator variable on the independent variable; the second step is regressing the dependent variable on the mediator; the third step is regressing the dependent variable on both the independent variable and the mediator [6].

If the results of these three regression analyses satisfy the following four conditions, mediating effects are confirmed:

First, the first regression analysis must indicate that the independent variable has significant influence on the mediating variable. Second, the second regression analysis must indicate that the independent variable has significant influence on the dependent variable. Third, the mediating variable must have significant influence on the dependent variable. If these conditions all hold in the predicted direction, then the effect of the independent variable on the dependent variable must be greater in the second equation than in the third. Perfect mediation holds if the independent variable has no effect when the mediator is controlled [6].

By definition, the perfect mediation effect means the situation in which causal relationship between antecedents (e.g., Business Knowledge) and a dependent variable (e.g., Timeliness) can be explained only through a mediating variable (e.g., IT Planning Capability). On the other hand, partial mediation effect means the situation where causal relationship between antecedents and a dependent variable can be explained not only through their direct relationship but also through a mediating variable.

According to results summarized in Table 4-1, it was found that the IS Planning Capability (PC) variable has a 'Perfect Mediation Effect' between independent variable, Business Knowledge (BK) of IS strategic planning team and dependant variable, Timeliness (TL).

In addition, according to results summarized in Table 4-2, it was found the IS Planning Capability (PC) variable has a 'Perfect Mediation Effect' between Director's Commitment & Support (DCS) and Timeliness (TL).

Lastly, according to results summarized in Table 4-3, the IS Planning Capability (PC) variable has a 'Perfect Mediation Effect' between Business worker's Commitment & Support (BCS) and Timeliness (TL).

It means that the impacts of Business Knowledge (BK), Director's Commitment & Support (DCS) and Business worker's Commitment & Support (BCS) on Timeliness can be explained only by the level of IT Planning Capability (PC).

### Table 4-2 Measurement Results of Mediating Effect of IS Planning Capability Variables (Independent Variables: Director's Commitment & Support; DCS)

<table>
<thead>
<tr>
<th>Step</th>
<th>Dependent Variables</th>
<th>Independent Variables</th>
<th>β</th>
<th>Result</th>
<th>F-value</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>PC</td>
<td>DCS</td>
<td>0.417*</td>
<td>Accepted</td>
<td>36.667**</td>
<td>0.211</td>
</tr>
<tr>
<td>2.2</td>
<td>TL</td>
<td>DCS</td>
<td>0.288*</td>
<td>Accepted</td>
<td>17.577**</td>
<td>0.128</td>
</tr>
<tr>
<td>2.3</td>
<td>TL</td>
<td>DCS</td>
<td>0.119</td>
<td>Rejected</td>
<td>75.390**</td>
<td>0.379</td>
</tr>
<tr>
<td></td>
<td>PC</td>
<td></td>
<td>0.281***</td>
<td>Accepted</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

DCS: Director’s Concern & Support
PC: IS Planning Capability
TL: Timeliness

### Table 4-3 Measurement Results of Mediating Effect of IS Planning Capability Variables (Independent Variables: Business worker’s Concern & Support; BCS)

<table>
<thead>
<tr>
<th>Step</th>
<th>Dependent Variables</th>
<th>Independent Variables</th>
<th>β</th>
<th>Result</th>
<th>F-value</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td>PC</td>
<td>BCS</td>
<td>0.346***</td>
<td>Accepted</td>
<td>37.648**</td>
<td>0.191</td>
</tr>
<tr>
<td>3.2</td>
<td>TL</td>
<td>BCS</td>
<td>0.299***</td>
<td>Accepted</td>
<td>15.489**</td>
<td>0.089</td>
</tr>
<tr>
<td>3.3</td>
<td>TL</td>
<td>BCS</td>
<td>0.042</td>
<td>Rejected</td>
<td>44.212**</td>
<td>0.362</td>
</tr>
<tr>
<td></td>
<td>PC</td>
<td></td>
<td>0.579***</td>
<td>Accepted</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

BCS: Business worker’s Concern & Support
PC: IS Planning Capability
TL: Timeliness

As a matter of course, three independent variables (Procedure Standardization, Leader’s...
Leadership and Estimate for Organization), already rejected during verification process of hypothesis 1 - 6, were excluded when the mediation effect was tested.

5. Conclusion

5.1 Summary

The study selected ‘IS Planning Capability’ as the most important business task among tasks implemented in IS strategic planning teams, and established internal influencing factors and external influencing factors in information strategic organizations which can affect this planning capability as independent variables. In addition, the study selected ‘timeliness’ as an index to measure business user satisfaction, and established research hypotheses for a causal relationship among variables to explore how the relation between independent variables and IS Planning Capability can affect ‘timeliness’ representing business user satisfaction.

Through a survey results of hypothesis testing after establishing a proposed research model, it was found that independent variables established have a positive effect on IS planning capability, and furthermore, on business users of an information system. Through study results, it was suggested that ‘business understanding of IS strategic planning members’, among internal influencing factors, has a positive effect on planning capability of an IS strategic planning team. This shows information strategic organization members implementing planning and supervising operation tasks in a position of mediator between business and computing organizations should clearly understand the industry cluster within which the business falls, and greater understand the business strategy and whole business tasks of the business.

In addition, the study shows that to plan an information system with which business can be satisfied, IS strategic planning teams should take the role of experts, representing business situations and opinions based on a wide and concise understanding of the business environment, business description, and characteristics of business tasks in discussion with a computing organization during the planning process of an information system on behalf of business.

The study also shows that Director’s Commitment & Support (DCS), and Business worker’s Commitment & Support (BCS), among external influencing factors, have a positive effect on IS Planning Capability of IS strategic planning team. This shows that to smoothly implement specific planning tasks, an IS strategic planning team in a position of mediator between business and IT units should implement a whole business strategy and be supported by management, including the CEO managing the business on the whole and business organizations performing business practices. In other words, commitment and support of business and management organization surrounding an IS strategic planning team can be expressed as a requirement and expectation for constructing an IS in the end. If an IS strategic planning team plans a system within which these requirements and expectations are well reflected, it is concluded that business users of this system ultimately can be satisfied.

Unfortunately, a total of three variables, including two internal influencing factors (The extent of standardization for implementation procedure of organizational tasks, leadership of information strategic organizational leader) and one external influencing factor (the extent of budget support for the organization) among a total of 6 variables were rejected. It is assumed that these three variables, unlike the other variables selected in results, were not selected because these are factors greatly affected by organization type, components, task characteristics, etc. of many businesses participating in the survey, thus resultant values in the survey were varied.

This study summarizes two managerial implications as follows: First of all, this initial research study is attempted to identify a causal relationship by establishing internal and external influencing factors on planning capability of an IS strategic planning team. Secondly, this study empirically supports the need for a mediating organization. This allows academia and industry to recognize a required role of an IS strategic planning team.

5.2 Limitations

There are two limitations summarized in this study. First, this study focused only on 'planning tasks of IS' as an index to measure effectiveness of operational tasks of an IS strategic planning team. Like reasons given in the conclusion for why three variables among independent variables were rejected, it is seen that only a specific task, 'planning tasks', was focused on and generalized under the assumption that each business can have different operational methods and types of organization. Thus, there exists a limitation in the study that Contingency Variables were not considered. Secondly, user satisfaction was only evaluated by a measurement index, 'timeliness.' Needless to say, it was decided to focus on 'timeliness' while establishing the study model and hypothesis, and found that timeliness can represent user satisfaction, a dependent variable, through factor analysis. However, characteristics other than timeliness could be seen as measurement factors to
measure user satisfaction of those provided with IT planning related output and services from an IS strategic planning team.

References


Appendix 1. Design of Study Variables

1. Internal Factors of Organization

Three measurement variables, Business Knowledge (BK), Procedure Standardization (PS), and Leader’s Leadership (LL) and a total of five subdivided measurements were established.

<table>
<thead>
<tr>
<th>Measurement Variable</th>
<th>Operational Definition</th>
<th>Measurement Item</th>
<th>Explanation</th>
<th>Related Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business Knowledge</td>
<td>The extent of knowledge of information strategic organization members</td>
<td>The extent of knowledge of organization members for business tasks</td>
<td>The extent of understanding of information strategic organization members of business strategy and industry characteristics of related business</td>
<td>Henderson (1990); Lederer &amp; Sethi (1988)</td>
</tr>
<tr>
<td>Procedure Standardization</td>
<td>The extent of implementing organizational tasks according to official regulation and procedure</td>
<td>The extent of tasks officially documented within information strategic organization</td>
<td>The extent of tasks officially documented within information strategic organization</td>
<td>John R. Schermerhorn et al. (1985)</td>
</tr>
<tr>
<td>Leader’s Leadership</td>
<td>The extent of leadership capability of leaders on organization culture and members</td>
<td>Power influencing organization culture by leadership of organizational leader within information strategic organization</td>
<td>The extent of influence by leadership of an information strategic organizational leader for culture formation</td>
<td>Quinn &amp; McGrath (1985); Cameron &amp; Freeman (1999); Kim, Ho-jeong (2003);</td>
</tr>
</tbody>
</table>
2. Organization External Factors

Three measurement variables, Estimate for Organization (EO), Director’s Concern & Support (DCS), and Business Worker’s Concern & Support (BCS) were established along with two measurement items for each variable.

<table>
<thead>
<tr>
<th>Measurement Variable</th>
<th>Operational Definition</th>
<th>Measurement Item</th>
<th>Explanation</th>
<th>Related Study</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Estimate for</strong> U0 <strong>Organization</strong></td>
<td>The extent of budget invested to specific organization within business for developing structure and function of organization (Karimi, 1988)</td>
<td>The extent of budget invested for hardware and software of information system</td>
<td>The extent of budget invested in an organization for construction, design, and operational tasks for hardware and software of information system</td>
<td>Raymond (1985)</td>
</tr>
<tr>
<td><strong>Director’s Concern &amp; Support</strong></td>
<td>The extent of concern and support by management including CEO in all situations of planning, constructing, operating, maintaining information systems</td>
<td>The extent of concern and support of CEO and management for information strategic organization</td>
<td>The extent of leadership capability of CEO among management for effective operation of whole organization in business including information strategic organization</td>
<td>Sethi &amp; Lederer (1988)</td>
</tr>
<tr>
<td><strong>Business Worker’s Concern &amp; Support</strong></td>
<td>The extent of concern and support for information strategic organization by business organization</td>
<td>The extent of concern by business organization members for projects, conferences, tasks organized by information strategic organization</td>
<td>The extent of support by business organization</td>
<td>Franz and Robey (1986); Wixom B. H. and H. J. Watson (2001);</td>
</tr>
</tbody>
</table>

3. IS Planning Capability (PC) of an Information Strategic Organization

IS Planning Capability (PC) of information strategic organization was established as a measurement item to measure Operational
Effectiveness (OE) of an information strategic organization. IS Planning Capability (PC) means the extent of Analysis Capability to propose alterations through analysis and evaluation of an organization's problems (Analysis Capability), the extent of leadership in an external competitive environment (Lead Capability), and the extent of coordination capability, mediating smooth communication between computing and business organizations (Coordination Capability).

### Table A1-3. Operational Definition and Measurement Item of 'IS Planning capability of Information Strategic Organization' Variable

<table>
<thead>
<tr>
<th>Measurement Variable</th>
<th>Operational Definition</th>
<th>Measurement Item</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>IS planning Capability of information strategic organization</td>
<td>The extent of capability to propose alterations by analyzing and evaluating organizational problems (Analysis Capability), the extent of capability to lead in an external competitive environment (Lead Capability), the extent of capability to mediate communication between computing organization and business organization (Coordination capability)</td>
<td>Analysis Capability among IS Planning capability of information strategic organization</td>
<td>The extent of flexibility for change, the extent of capability to find problems, understand, and propose proper alterations for the problems</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lead Capability among IS Planning capability of information strategic organization</td>
<td>The extent of capability to find new technologies and services for information systems, the extent of capability to lead in industry cluster</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Coordination Capability among IS Planning capability of information strategic organization</td>
<td>The extent of smooth mediating capability to deliver requirements of business organization users to developer in charge of computing organization and smoothly deliver development related opinions of developer in charge of computing organization to business organization users</td>
</tr>
</tbody>
</table>

### 4. User Satisfaction for IT Planning Service Provided by Information Strategic Organization

User Satisfaction (US) for IT planning service provided by an information strategic organization means the extent of business user satisfaction for IT planning services, reflecting timeliness and accuracy, provided through effective operation of an information strategic organization.

As a measurement item, Timeliness (TL) (Bailey and Pearson, 1983, Rainer and Watson, 1995, Iivari and Koskela, 1987) of IT planning output or services provided to users was established.

### Table A1-4 Operational Definition and Measurement Items of 'User Satisfaction of IT Service Provided by Information Strategic Organization' Variable

<table>
<thead>
<tr>
<th>Measurement Variable</th>
<th>Operational Definition</th>
<th>Measurement Item</th>
<th>Explanation</th>
<th>Related Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>User Satisfaction of IT planning</td>
<td>The extent of reflecting timeliness of IT planning services provided through effective operation of an information strategic organization</td>
<td>Timeliness of IT planning output or services provided to information strategic organization</td>
<td>The extent of timeliness and accuracy of output and services provided by information strategic organization</td>
<td>Bailey and Pearson, 1983; Rainer and Watson, 1995, Iivari and Koskela, 1987</td>
</tr>
<tr>
<td>service</td>
<td>information strategic organization</td>
<td>users</td>
<td>meeting requirements of business users</td>
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<td></td>
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<td></td>
<td>Watson (1995); Iivari and Koskela (1987)</td>
<td></td>
</tr>
</tbody>
</table>
### Appendix 2 Analysis of Reliability and Validity of Measurement Variables

#### Table A2-1 Analyzed Results of Factors and Reliability

<table>
<thead>
<tr>
<th>Construct</th>
<th>Item</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>Cronbach’s alpha</th>
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</thead>
<tbody>
<tr>
<td><strong>Business Knowledge</strong></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>BK1</td>
<td></td>
<td>0.811</td>
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<td></td>
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<td>0.808</td>
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<tr>
<td>BK2</td>
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<td>0.852</td>
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<tr>
<td><strong>Procedure Standardization</strong></td>
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<td>PS4</td>
<td></td>
<td>0.774</td>
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<td>PS2</td>
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<tr>
<td><strong>Leader’s Leadership</strong></td>
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<td>LL3</td>
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<td>0.753</td>
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<td>0.782</td>
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<tr>
<td>LL4</td>
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#### Table A2-2 Regression Analysis of Independent Variables for IS Planning Capability

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<th>VIF</th>
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Table A2-3 Regression Analysis of Independent Variables for Timeliness

<table>
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<th>Level of Significance</th>
<th>Result</th>
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Dependant Variables(Timeliness)
AN EMPIRICAL STUDY OF CIVIL SERVANTS’ LIFELONG E-LEARNING CONTINUANCE INTENTION

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Abstract
E-learning is an effective way for job-training and continuous education. In recognizing the need for civil servants to embrace the lifelong learning to sustain competitiveness, many countries around the world have created policies to develop e-learning. This study is focus on civil servants’ e-learning continuance intention and through e-learning experience to achieve lifelong learning. Based on Information system (IS) success model proposed by Seddon (1997) and adding organizational factors (Incentive, Supervisor Support, and Technical Support) to survey civil servants’ e-learning behaviour. The sample for the study was taken from the civil servants in Taiwan who have the experience of using the lifelong e-learning websites. The results also support Seddon’s IS success model. Finally, the implications and limitations of the study are discussed.

Keywords: E-learning, Lifelong learning, Lifelong e-learning, continuance intention, information system (IS) success model.

1. Introduction
The 21st century is the new century of knowledge economy and also the e-century of network. With the development of the Internet and information technology in the era of knowledge-driven economy, e-learning is experiencing rapid growth and many companies and governments utilize it for training and education. E-learning has received considerable attention as a means of providing alternatives to traditional face-to-face, instructor-led education [1]. Today, governments are making great effort to adjust to the changing environment and to enhance their competitiveness. Most government agencies have made large investment in information technology to comply with the trend of e-government worldwide, such as Intranet, knowledge tank, knowledge platform, performance evaluation management system and so on. The goal is to build a good, sound environment for knowledge management.

E-learning is the convenient and effective way of learning as it overcomes the limits of time and space and contributes to knowledge expansion. It achieves borderless of global learning, and it’s also the best way to achieve lifelong learning. Many countries implement e-learning system to train their civil servants and enhance national competitiveness. For example, the Korean government has saved 10 million US dollars since it invested in e-leaning system from 2001. In Singapore, the Civil Service College is the training institute for civil servants. There are about 120,000 personnel in the civil services in Singapore. As a policy, the civil service has stipulated that every civil service staff should attain about 100 hours of training every year. In order to implement the idea of lifelong learning and enhance the civil servants’ competence, the government of Taiwan established the Civil Servants’ Life-long Learning Passport System which was enforced from July, 2001. In 2007 every civil servants in Taiwan had to carry out at least 5 hours of e-learning courses. These learning records would be used as a reference of the year’s performance appraisal and promotion by the human resource department. There are about 52 websites (belonging to 22 different government agencies) provide variety of e-Learning training courses for civil servants in Taiwan [2].

While numerous studies have focused on the e-learning but little topic is about civil servants’ e-learning. Therefore, this research wants to understand the civil servants e-learning behavior after using the learning website, users’ satisfaction, continuance intention, and other related factors to achieve lifelong learning. This study is based on Seddon (1997) [3] IS Success Model and adding
Organizational Factors (Incentive, Supervisor Support, and Technical Support) that influence the correlation of satisfaction and continuance intention. This study aimed to provide a theoretical basis and empirical evidence for predicting and explaining antecedents of civil servants’ lifelong e-learning and to provide important guidelines for government when designing and implementing civil servants’ lifelong e-learning.

2. Theoretical background

2.1 Lifelong learning and e-learning

E-learning has been defined as the use of information and communication technology to support and enhance learning and teaching [4]. E-learning is also a tool of lifelong learning and continuous education. In recent years, factors such as the knowledge-based economy, learning society and the rise of information technology have given rise to a consensus that lifelong learning is not only a norm, but also a culture and attitude [5]. Learning is not restricted to classrooms and formal learning in any learning institutions; it is an activity which happens throughout life, at work, play and at home. Nowadays, in the knowledge-intensive era, life-long competence development has become more important. People need to upgrade their skills not just at work but also in their daily lives.

There is an increasing demand for new approaches towards fostering life-long learning perspectives. Emergent Web 2.0 concepts and technologies are opening new doors for more effective learning and constituting an important strategy for enhancing public-sector efficiency. E-learning tools can be applied more effectively to human resources cultivation within the area of public sectors so as to help strengthen national competitiveness.

2.2 IS Success Model

The concept of IS success is widely accepted throughout IS research as the principle criterion for evaluating information systems [6]. Because IS success is a multi-dimensional concept that can be assessed at various levels, the measure for IS success has neither been totally clear nor exactly defined. However, DeLone and McLean in 1992 made a major breakthrough [7]. They comprehensively reviewed IS success measures proposed taxonomy and an interactive model as frameworks for conceptualizing and operational IS success. That included six dimensions of success factors: system quality, information quality, use, user satisfaction, individual impact, and organizational impact. The original model did not empirically test. DeLone and McLean [8] also encourage further development and validity was needed for their taxonomy. Since 1992, a number of studies have explicitly tested the associations among the measures identified in the model [9][10][11][12][13, p.9]. Based on the DeLone and McLean [8] model, Seddon [3] proposed a respecification and extension of the DeLone and McLean of IS success model. Seddon's IS success model includes three columns of variables: (1) measures of information and system quality, (2) general perceptual measures of net benefits of IS use (including perceived usefulness and user satisfaction), and (3) other measures of net benefits of IS use (See Fig1). Seddon’s IS success model focuses on the causal (variance) aspects of the interrelationships among the taxonomic categories, and separates the variance model of IS success from the variance model of behavior that occurs as a result of IS success. Seddon [3] also claimed that IS use is a behavior rather than a success measure, and incorporated the additional construct of perceived usefulness adapted from TAM. It replaced DeLone and McLean's IS "use" with "perceived usefulness" which serves as a general perceptual measure of net benefits of IS use [14]. Rai et al. [6] empirically and theoretically assessed the DeLone and McLean [8] and Seddon [3] models of IS success in a quasi-voluntary IS use context, and found that both the models exhibited reasonable fit with the collected data.

DeLone and McLean ten years after the publication of their original model and based on the empirical and theoretical contributions, they proposed an updated IS success model [15]. This model according the original model by combining the individual and organizational impacts as one dimension called “Net Benefits” and also adding another quality dimension called “Service Quality” to reflect the important of service and support in successful IS system. They suggested that intention to use may be employed as an alternative to use as a success dimension.

This study evaluates the current situation of civil servants’ lifelong e-learning in Taiwan and focus on e-learning behavior research. We examine several IS success model and assume that the Seddon’s IS success model can be better adapted to the civil servants’ lifelong e-learning context.
3. The proposed model and research hypotheses

According to the literature background and based on IS Success Model and organizational factors. The relationships among these constructs are integrated in a conceptual model depicted in Fig. 2.

3.1. Measures of Information and System Quality and General Perceptual Measures of Net Benefits of IS Use

Seddon [3] IS success model arranged the variance in three columns. First column was “measures of information and system quality” which was based on DeLone and McLean [8] 1992 original model. The second column was “general perceptual measures of net benefits of IS use” which including two perceptual measures “perceived usefulness and satisfaction”. Perceived usefulness was based on David [16]. “The degree to which a person believes that using a particular system would enhance his or her job performance”. User Satisfaction is the most general perceptual measure of information systems success. The third column was “other measures of net benefits of IS use” which was a volitional-use setting, continued IS use (by individuals, organizations or society) is an indicator of net benefit [3]. This study mainly measures the variance of the Seddon’s model first two columns (information quality, system quality, perceived usefulness, satisfaction) and then affect expectations about the net benefit of future IS USE. In this study the expectations about the net benefits of future IS Use was replaced with continuance intention.

Information quality refers to quality of the output, such as timeliness, scope, accuracy, format, completeness and relevance of information generated by and information [17][8][18]. Seddon [3] considers system quality to be concerned with “bug” in the system (system reliability), user interface consistency, ease of use, documentation quality, and quality and maintainability of the program code.

Chiu et al. [19] found perceived system quality has a positive effect on the behavioral intention to use the e-learning service. In the information system perspective, end user’s satisfaction is a user’s attitude toward the specific computer application system they utilized [20].

Several studies have found system quality and information quality have a direct effect on users’ satisfaction [8] [9] [21]. Negash et al. [22] found that information and system quality determine satisfaction while service quality has no impact. Lederer et al. [23] found information quality to be a major influence on the perceived usefulness of websites. According to Seddon [3] the system quality is concerned mainly with the consistency of the interface and the ease of use. In the TAM, perceived ease of use has been found to influence perceived usefulness to use a new system [16]. Rai et al. [6] empirically and theoretically assess DeLone and McLean’s [8] and Seddon’s [3] models of information systems (IS) success in a quasi-voluntary IS use context and found that both model were supported and the testing of the Seddon’s IS success model found that Information Quality and System Quality both influence users’ satisfaction and perceived usefulness. Therefore, the following hypotheses are proposed:

H1: Information quality has a positive effect on civil servants’ satisfaction of the lifelong e-learning system.

H2: Information quality has a positive effect on perceived usefulness while civil servants use of the lifelong e-learning system.
H3: System quality has a positive effect on civil servants’ satisfaction of the lifelong e-learning system.

H4: System quality has a positive effect on perceived usefulness while civil servants use of the lifelong e-learning system.

3.2 Perceived Usefulness and Satisfaction
Bhattacherjee [24][25] his studies suggested that perceived usefulness was a significant antecedent of users’ satisfaction. Devaraj et al. [26] found that perceived usefulness were significant determinant of consumer satisfaction in the e-commerce environment. Roca et al., [27] based on the expectancy disconfirmation theory, found user satisfaction as impacted by perceived usefulness and. Therefore, the following hypotheses are proposed:

H5: Perceived usefulness has a positive effect on satisfaction while civil servants use the lifelong e-learning system.

3.3 Incentives
Incentive described equivalently as rewards, can be structured to reward individual performance, team performance, or both, especially group-based incentives [28]. In the knowledge management success model which proposed by Kulkarni Ravindran and Freeze [29], incentive refer to formal appraisal and recognition of efforts by knowledge workers for furthering knowledge sharing and reuse and also a part of organizational support. People may expect that if they accomplish certain tasks, they will receive certain rewards. Naidoo & Leonard [30] indicate that there is a positive association between users’ beliefs about the loyalty incentives of an e-service and their continuance intentions. Lai [31] found rewards will have a positive effect on perceived usefulness and intention to use knowledge management system. Martins and Kellermanns [32] in a study of business school students’ acceptance of a web-based course management system found perceived incentive to use has a positive effect on perceived usefulness of the system. In this study, the civil servants’ e-learning study hours have been a part of reference of organizational appraisal. Therefore, the following hypotheses are proposed:

H6: Incentive has a positive effect on perceived usefulness while civil servants use of the lifelong e-learning system.

3.4 Supervisor support
Igbaria et al. [33] found that internal management support and external support were significant predicatars of perceived usefulness of systems in small firm’s personal computing acceptance. Igbaria et al. [34] indicated organizational support positively related to perceived usefulness of microcomputer usage. Lin and Wu [35] found that management support has a direct effect on perceived usefulness in small and medium enterprises computing acceptance. Karahanna and Straub [36] proposed and explanation for the psychological origins of usefulness and ease of use. The results indicated that system usage is affected through perceived usefulness and perceived ease of use by the degree of social influence exerted by supervisors. Therefore, the following hypotheses are proposed:

H7: Supervisor support has a positive effect on perceived usefulness while civil servants use of the lifelong e-learning system.

3.5 Technical Support
Technical support refers to availability of specialized personnel (e.g. help desk, information center) to answer user questions regarding IT usage, and provide instructional and/or hand on support to users before and during usage [37]. Prior studies have also highlighted the importance of computing support. Ndubisi and Jantan [38] found technical backing has a positive effect on perceived usefulness in Malaysian small and media size firms IS usage. Martins and Kellermanns [32] indicated that availability of technical support has a positive effect on perceived usefulness in the Web-based course management system. Therefore, the following hypotheses are proposed:

H8: Technical support has a positive effect on perceived usefulness while civil servants use of the lifelong e-learning system.

3.6 Satisfaction and continuance intention
Satisfaction is an individual’s feelings of pleasure or disappointment resulting from comparing a product’s perceived performance (or outcome) in relation to his or her expectations. Past research has also indicated that satisfaction is positively related with future intention [39][40][41]. Bhatacherjee [25] found that consumers’ continuance intention is determined by their satisfaction when using B2C e-commerce service. Chiu et al. [19] found that learners’ satisfaction with e-learning was significantly associated with their continuance intention. Roca et al. [27] found that users’ continuance intention is determined by satisfaction. Therefore, the following hypothesis is proposed:

H9: User’s satisfaction has a positive effect on civil servants’ e-learning continuance intention while use of the lifelong e-learning system.
4. Research Methodology

4.1. Sample and procedures
The sample for the study is taken from the civil servants in Taiwan who have the experience of using the lifelong e-learning websites. A total of 300 surveys were distributed to the civil servants from Taipei to Kaohsiung including district office, district health center, university, Tax administration and the county government since March 2009. A total of 228 surveys were returned in April 2009 and deleted 7 surveys because uncompleted or unusable, the effective questionnaires are 221 surveys with an effective response rate of 74 percent.

4.2 Instruments
The survey instruments consisted of 30 items to assess constructs of the proposed model. These items were adapted from previous studied and were refined to make them specifically relevant to the present study. System quality, Information quality and were using a scale adapted from DeLone & McLean [15] and C-M Chiu et al. [42], the items used to construct the perceived usefulness was based on the scale from Davis et al.[16] with some modifications. Incentive was measured using a scale adapted from Lai [31] and Martins & Kellermanns [32] with some modifications. Supervisor support was measured by five items adapted from Igbaria et al [33]. Technical Support adapted from Martins & Kellermanns [32]. Items related to satisfaction were adapted from C-M Chiu et al. [42]. E-learning continuance intention was adapted from prior work by C-M Chiu et al. [42]. These eight constructs were measured on a five-point Likert scale ranging from (1) “strongly disagree” to (5) “strongly agree”. Investigate the civil servants’ lifelong e-learning continuance intention.

5. Data Analysis and Results

5.1 Demographics and descriptive statistics
The returned sample characteristics are illustrated in Table 1. In this study a total of 300 questionnaires were distributed, of which 221 were effective and shows that the majority of the respondents of civil servants in terms of gender, age, position, education, working experience, online learning methods, online learning reasons, total of online learning hours over Last year (2008) and Estimating total of online learning hours this year (2009) of the respondents, the learning hours has slightly increased.

Table 1 Demographic Profiles of the Respondents

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<th>Table 1 Demographic Categories</th>
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<td>Gender Female</td>
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<td>Age 41-50 years old</td>
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<td>Age 51 years or older</td>
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<td>Position Supervisor</td>
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<td>Online learning reasons To learn</td>
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<td>Online learning reasons Curious</td>
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<tr>
<td>Estimating total of online learning hours 2009 More than 60</td>
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5.2 Data Analysis
This research has adopted structural equation modeling (SEM) for its data analysis to study the causalities among all parameters constructed in each model. The estimation of the parameters uses the maximum likelihood estimation (MLE), and the
sample size cannot be too small when utilizing this. In order to be suitable for MLE, it is generally acknowledged that the sample size should lie at least somewhere from 100 to 400 [43]. The sample size was 221, meeting the requirement. The statistical analysis software used for the research was LISREL 8.50 and SPSS 17.0. When carrying out analysis with SEM, a two-phased approach was used, based on Anderson & Gerbing [44]. The first step involves the analysis of the measurement model, while the second step tests the structural relationships among latent constructs.

5.3 Analysis of validity and reliability

The reliability and validity of the measurement instrument was evaluated using reliability and convergent validity criteria. Reliability and validity of the survey instruments were established by calculating composite reliability (CR) to measure internal consistency. Additionally, the convergent validity of the scales was verified using two criteria suggested by Fornell & Larcker [45]: (1) all indicator loadings should be significant and exceed 0.7; and (2) average variance extracted (AVE) for each construct should exceed the variance because of measurement error for that construct (i.e. AVE should exceed 0.50). As shown in Table 2, composite readability values were above the recommended level of 0.7 and AVE ranged from 0.64 to 0.77 (See Table3), exceeding the minimum value of 0.50. All of the factor loadings of the items in the research model were greater than 0.70. Thus, all factors in the measurement model had adequate reliability and convergent validity.

<table>
<thead>
<tr>
<th>Constructs/factors</th>
<th>Indicator(s)</th>
<th>Composite reliability</th>
<th>Mean (S.D.)</th>
<th>Loading</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information Quality(IQ)</td>
<td>IQ1</td>
<td>0.91</td>
<td>3.46 (0.70)</td>
<td>0.80</td>
<td>DeLone &amp; McLean (2003)</td>
</tr>
<tr>
<td></td>
<td>IQ2</td>
<td></td>
<td>3.44 (0.73)</td>
<td>0.76</td>
<td></td>
</tr>
<tr>
<td></td>
<td>IQ3</td>
<td></td>
<td>3.48 (0.68)</td>
<td>0.82</td>
<td>C-M Chiu et al. (2007)</td>
</tr>
<tr>
<td></td>
<td>IQ4</td>
<td></td>
<td>3.47 (0.66)</td>
<td>0.81</td>
<td></td>
</tr>
<tr>
<td></td>
<td>IQ5</td>
<td></td>
<td>3.35 (0.71)</td>
<td>0.91</td>
<td></td>
</tr>
<tr>
<td>System Quality (SQ)</td>
<td>SQ1</td>
<td>0.90</td>
<td>3.48 (0.71)</td>
<td>0.85</td>
<td>DeLone &amp; McLean (2003)</td>
</tr>
<tr>
<td></td>
<td>SQ2</td>
<td></td>
<td>3.48 (0.63)</td>
<td>0.85</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SQ3</td>
<td></td>
<td>3.70 (0.63)</td>
<td>0.70</td>
<td>Wu &amp; Wang (2006)</td>
</tr>
<tr>
<td></td>
<td>SQ4</td>
<td></td>
<td>3.50 (0.70)</td>
<td>0.81</td>
<td>C-M Chiu et al. (2007)</td>
</tr>
<tr>
<td></td>
<td>SQ5</td>
<td></td>
<td>3.48 (0.66)</td>
<td>0.78</td>
<td></td>
</tr>
<tr>
<td>Perceived Usefulness(PU)</td>
<td>PU1</td>
<td>0.931</td>
<td>3.19 (0.72)</td>
<td>0.83</td>
<td>Davis et al. (1989)</td>
</tr>
<tr>
<td></td>
<td>PU2</td>
<td></td>
<td>3.19 (0.71)</td>
<td>0.80</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PU3</td>
<td></td>
<td>3.34 (0.71)</td>
<td>0.89</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PU4</td>
<td></td>
<td>3.39 (0.70)</td>
<td>0.88</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PU5</td>
<td></td>
<td>3.52 (0.66)</td>
<td>0.84</td>
<td></td>
</tr>
<tr>
<td>Satisfaction(SA)</td>
<td>SA1</td>
<td>0.88</td>
<td>3.61 (0.72)</td>
<td>0.83</td>
<td>C-M Chiu et al. (2007)</td>
</tr>
<tr>
<td></td>
<td>SA2</td>
<td></td>
<td>3.52 (0.70)</td>
<td>0.85</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SA3</td>
<td></td>
<td>3.41 (0.76)</td>
<td>0.85</td>
<td></td>
</tr>
<tr>
<td>Incentive</td>
<td>IN1</td>
<td>0.87</td>
<td>3.38 (0.93)</td>
<td>0.76</td>
<td>Martins &amp; Kellermanns (2004)</td>
</tr>
<tr>
<td></td>
<td>IN2</td>
<td></td>
<td>3.14 (0.86)</td>
<td>0.95</td>
<td>Lai (2009)</td>
</tr>
<tr>
<td>Supervisor Support</td>
<td>SS1</td>
<td>0.88</td>
<td>3.28 (0.80)</td>
<td>0.75</td>
<td>Igbaria et al. (1997)</td>
</tr>
<tr>
<td></td>
<td>SS2</td>
<td></td>
<td>3.40 (0.78)</td>
<td>0.75</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SS3</td>
<td></td>
<td>3.32 (0.81)</td>
<td>0.85</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SS4</td>
<td></td>
<td>3.32 (0.77)</td>
<td>0.85</td>
<td></td>
</tr>
<tr>
<td>Technical Support</td>
<td>TS1</td>
<td>0.85</td>
<td>3.34 (0.81)</td>
<td>0.87</td>
<td>Martins &amp; Kellermanns (2004)</td>
</tr>
<tr>
<td></td>
<td>TS2</td>
<td></td>
<td>3.30 (0.83)</td>
<td>0.81</td>
<td>Lee &amp; Kim (2009)</td>
</tr>
<tr>
<td></td>
<td>TS3</td>
<td></td>
<td>3.45 (0.75)</td>
<td>0.75</td>
<td></td>
</tr>
<tr>
<td>Continuance</td>
<td>CI1</td>
<td>0.91</td>
<td>3.72 (0.62)</td>
<td>0.81</td>
<td>C-M Chiu et al. (2007)</td>
</tr>
<tr>
<td></td>
<td>CI2</td>
<td></td>
<td>3.53 (0.65)</td>
<td>0.90</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CI3</td>
<td></td>
<td>3.50 (0.67)</td>
<td>0.91</td>
<td></td>
</tr>
</tbody>
</table>

Table 3 Correlations and AVE
According to Fornell and Larcker (1981), discriminant validity can also be tested among all constructs by comparing the average variance extracted (AVE) of each construct with the squared correlation of that construct and all the other constructs. As shown in Table 3, the square root of average variance extracted for each construct is greater than the correlations between the constructs and all other constructs. The results suggested an adequate discriminant validity of the measurements.

### 5.4 Measurement Model Fit Analysis

The first step in model estimation involved examining the model fit. To validate the measurement model, this study used LISREL 8.50 to assess the analysis. For a good model fit, the Chi-square value normalized by degrees of freedom ($\chi^2$/d.f.) should not exceed 3, goodness of fit index (GFI) should exceed 0.8, adjusted goodness of fit index (AGFI) should exceed 0.8, normed fit index (NFI), Incremental index of fit (IFI) and comparative fit index (CFI) should exceed 0.9, and root mean square error of approximation (RMSEA) should not exceed 0.08. For our CFA model, $\chi^2$/d.f. was 1.46 ($\chi^2 = 459.30$; d.f. =314), GFI was 0.88, AGFI was 0.82, NFI was 0.97, IFI was 0.99, CFI was 0.99, and RMSEA was 0.046. As shown in Table 4, the goodness-of-fit indices are all within accepted thresholds. Therefore, the summary of the overall goodness-of-fit indices indicate an adequate fit of the model and data.

### 5.5 Structural Model Analysis

The second step in model estimations was to examine the significance of each hypothesized path in the research model, as well as the variance explained ($R^2$) by each path. The results of testing the structural model are presented in Table 5 and a graphical presentation of the results is shown in Fig.3. The explanatory power of the research model is also shown in Fig.3. The $R^2$ value showed that civil servants’ lifelong e-learning continuance intention explained by the model is 75 percent. Furthermore, users’ satisfaction accounting for 55 percent and perceived usefulness accounting for 53 percent are all significant determinants of civil servants’ lifelong e-learning continuance intention.

### Table 4 Fit Indices for the Structural Model

<table>
<thead>
<tr>
<th>Structural Model Statistic</th>
<th>Fit Indices</th>
<th>Recommended Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\chi^2$/d.f.</td>
<td>1.46</td>
<td>$\leq$3.0</td>
</tr>
<tr>
<td>Goodness-of-fit index (GFI)</td>
<td>0.88</td>
<td>$\geq$0.8</td>
</tr>
<tr>
<td>Adjusted GFI (AGFI)</td>
<td>0.82</td>
<td>$\geq$0.8</td>
</tr>
<tr>
<td>Normed fit index (NFI)</td>
<td>0.97</td>
<td>$\geq$0.9</td>
</tr>
<tr>
<td>Incremental index of fit (IFI)</td>
<td>0.99</td>
<td>$\geq$0.9</td>
</tr>
<tr>
<td>Comparative fit index (CFI)</td>
<td>0.99</td>
<td>$\geq$0.9</td>
</tr>
<tr>
<td>Root mean square error of approximation (RMSEA)</td>
<td>0.046</td>
<td>$\leq$0.08</td>
</tr>
</tbody>
</table>

Significant path (**P<0.01***P<0.001) - Non-significant path

---

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<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Standardized Path</th>
<th>t-value</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1 IQ →</td>
<td>0.16*</td>
<td>2.33</td>
<td>Supported</td>
</tr>
<tr>
<td>H2 IQ →</td>
<td>0.16*</td>
<td>2.27</td>
<td>Supported</td>
</tr>
<tr>
<td>H3 SQ →</td>
<td>0.27***</td>
<td>3.39</td>
<td>Supported</td>
</tr>
<tr>
<td>H4 SQ →</td>
<td>0.41***</td>
<td>5.02</td>
<td>Supported</td>
</tr>
<tr>
<td>H5 PU →</td>
<td>0.41***</td>
<td>4.86</td>
<td>Supported</td>
</tr>
<tr>
<td>H6 IN →</td>
<td>0.12</td>
<td>1.98</td>
<td>Supported</td>
</tr>
<tr>
<td>H7 SS →</td>
<td>-0.22</td>
<td>-1.20</td>
<td>Not supported</td>
</tr>
<tr>
<td>H8 TS →</td>
<td>0.40*</td>
<td>2.03</td>
<td>Supported</td>
</tr>
<tr>
<td>H9 SA →</td>
<td>0.87***</td>
<td>13.81</td>
<td>Supported</td>
</tr>
</tbody>
</table>

6. Discussion

This study showed that the Seddon’s IS success model was well suited to survey civil servants’ lifelong e-learning continuance intention. Using Structural Equation Modeling (SEM), the hypotheses are proposed to validate the fit of empirical data and model. Several key findings emerge from the study. First, General Perceptual Measures of Net Benefits of IS Use two key factors “users’ satisfaction and perceived usefulness” which are two important predictors of civil servants’ lifelong e-learning continuance intention. This study provides a good explanation of Users’ Satisfaction and Perceived Usefulness. Satisfaction was explained (55%) and Perceived accounted for 53%. Also, Information and System Quality are two most significant determinants toward Satisfaction and Perceived Usefulness.

Second, Supervisor Support does not have positive effect on perceived usefulness. The possible explanation that may account for the civil servants’ lifelong e-learning is just on the early stage in Taiwan. Although the organization plays an important role in supporting e-learning, most of the public sectors’ supervisors focus more on employees’ hard working and efficiency and sometimes it could be a pressure that hinders e-learning implementation.

Third, Technical Support is the important antecedent of e-learning continuance Intention; the government authorities can increase users’ usage intention by improving technical support and employ training and promotion approaches which in turn influence the civil servants’ behavior intention to consist using lifelong e-learning systems.

Fourth, the results also illustrate that Incentives was critical factors in affecting Perceived Usefulness. In this study about 85% civil servants’ e-learning reasons are to acquire learning certificates. This indicates currently most of the civil servants e-learning reasons are not self-direct learning but due to their organizational regulations or they concerned more about that learning certificates are a part of year appraisal. In order to promote civil servants’ lifelong e-learning, the incentives strategy needs to be continued. The e-learning hours should be a part of consideration of civil servants’ year apparel and continue promoting to motivate more civil servants autonomous learning.

7. Limitations and future research

There are several limitations in this study. First, the investigation of civil servants lifelong e-learning is relatively new and the government is on the early stage of promoting lifelong e-learning in Taiwan. Second, In Taiwan, the civil servants’ lifelong e-learning portal did not totally integrate. There are about 52 of the websites and the quality of the websites is not equal. Therefore, different e-learning websites have different system quality and information quality. Third, there are only 221 valid responses to the survey. If more valid questionnaires were received, the result may be more representative. Beside, future research can increase the sample size and a higher response rate for a more complete research. In addition, some of the civil servants think that civil servants lifelong e-learning is a compulsive learning. They want to learn it because the organizational regulation.

The future studies can consider more variables in the research instruments, such as extrinsic and intrinsic motivation, self-direct learning, computer literacy; organization culture, subjective norm or social pressure and performance etc. It also can conduct observation approach, in-depth interviewing and qualitative approach for more understanding the learning behaviors and attitude. Finally, longitudinal studies are also required to observe the civil servants continuous or discontinuous use the lifelong e-learning systems.

8. Implications and Conclusions

This study presents significant progress toward explaining the factors affecting civil servants’ lifelong e-learning continuance intention. This study has investigated the underlying relationship between system quality, information quality, incentive, supervisor support, technical support, perceived usefulness, satisfaction and e-learning continuance intention for civil servants’ lifelong e-learning behavior. The empirical examination was using a structural model based on Seddon’s IS success model has been tested and validated. Most of the causal relationships between the constructs postulated by the structural model are well supported.

An empirical study was conducted to identify determinants of civil servants’ e-learning continuance intention. The findings of the present study have various implications. First, perceived usefulness and satisfaction are critical to the success of civil servants lifelong e-learning system.
Second, technical support was a significant mediator of the effects of perceived usefulness. Third, incentive has positive effects on perceived usefulness. Finally, based on the research findings, hoping the government can continue implement civil savants’ lifelong e-learning and future research can conduct a deeper research on civil servants’ lifelong e-learning behavior and related factors.

The academic value of this study is fourfold. First, this study proposed a comprehensive theoretical framework to identify determinants of civil servants’ lifelong e-learning continuance intention. Second, the sample was real civil servants. Thus, the validity of the findings is not limited. Third, lifelong e-learning not only can apply to civil servants’ training and education but also in adult learning and organization learning. Finally, based on Seddon’s IS success model and organizational factors, this study confirmed that the proposed model has a high explanatory power for continuance intention.

In the 21st century which is full of unknowns, challenges, and infinite possibilities, knowledge and learning are the cores for sustainable development and continuous progress of the society. With the desire to enhance government’s performance and to remain competitive in this global village, the need for incorporating ICT and effective ways of training among civil servants has become inevitable.

References
[19] Chi, C., Hsu, M., Sun, S., Lin, T., Sun, P., Usability, quality, value and e-learning


ELECTRONIC WORD-OF-MOUTH: IMPACT ON MUSIC SALES IN THE AMERICAN MARKET

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Abstract
Internet, today, is a popular communication and feedback sharing platform. Digital content is also readily available over the internet. These two phenomena have propelled the electronic interaction among music consumers to new heights. Our study investigates the contribution of electronic word-of-mouth (eWOM) to the sales of music albums. We studied the American music market for 13 consecutive weeks. The Sales data for these weeks was correlated to the eWOM data for the period mentioned before.

Keywords: eWOM, Word Of Mouth, music sales, albums, power law, ranks.

Introduction
Word-of-mouth communication (WOM) has long been a topic of considerable importance to many business researchers and practitioners for various reasons. Previous studies about WOM show that WOM has considerable impact on the consumers choice [1] [2] [3] [4], and it also helps to provide a good post product perception [5] on the consumer's choice.

The new communication structure, with internet as the facilitator, is an amorphous web of connections [6]. Internet has also awarded WOM a unique significance [7].

We consider eWOM as a relevant remark made by potential, actual, or former customers, about a product or service. This remark is readily available to potential customers and institutions through the Internet [8].

Unlike WOM, eWOM involves print-based, recorded, traceable, organized, and reusable one-to-many consumer interactions among strangers in cyberspace. Several studies have been done to examine online consumer created information from the perspective of information credibility. Dellarocas [7] in his paper explained the relationship between online consumer feedback and an unknown seller’s reputation. Mayzlin’s [9] studied the credibility of the promotional messages in online chat rooms and the implication of those new information channels on sales. These studies help us to understand the basics of consumer created information, and its possible impact on revenues.

However, Internet-based peer-to-peer communication differs from the face-to-face inter-personal communication, common in traditional WOM, in several ways. First, the Internet allows people to reach many other people in a one-to-many process- similar to that of the mass media [8], while email messages are like inter-personal communication, in that they can be personalized for the recipient [10]. Second, electronic referrals are usually unsolicited (i.e. they are also sent to recipients who are not looking for information) [11].

A Model to quantify the WOM effects has been developed earlier by Hogan, Leman, and Libai [12]. However a predictive model is out of scope due to the following limitations:

a) The music industry is producing new content everyday. The life cycle of the consumable good in our study is very short when compared to physical goods.
b) eWOM is a dynamic phenomenon where the content changes more rapidly than the WOM content.
c) There are many untraceable channels of eWOM such as e-mail.
d) The eWOM phenomenon is a product focussed phenomenon rather than a brand focussed one. Hence the consideration of Customer Long Term Value (CLV), [12] is minimal.

eWOM occurs through different channels: e-mails, discussion forums, instant messaging, short messaging services, news groups, and social networking sites. It has been associated with Viral Marketing by some researchers. In our study, we have focussed only on sharing of opinions, evaluations, and experiences as eWOM. Hence Viral Marketing [13] [14], is excluded from the current scope.

After the advent of internet, online user reviews have played a vital role in consumers’ purchase decisions [15]. There is a major difference between the owner or the seller created information, and the consumer created information. The owner-created information focuses more on
the technical details. It does not describe a product’s actual performance or user perspective. eWOM has been described as empowering consumers, and adding value to Sales [15]. There are clear findings of the consumer-created information being more credible than seller-created information [16].

Consumers usually comment online on various products such as apparel, books, electronics, games, videos, music, beverages, and wine [16]. Various studies have been done on the effect of eWOM on books, movies [15], beverages, electronic products, and other items [8] [17] [18]. In this paper we analysed the effect of eWOM on the music industry in America. Music industry has not yet been fully explored for eWOM effects in the past.

eWOM can be considered as a value-adding component of advertising in the marketing systems. Many marketing, communication, and new product literature theories have stated that the effect of word-of-mouth in general increases over time and the effect of advertising decreases over time. However, it needs to be empirically demonstrated that consumer word-of-mouth is more sustainable over the long term than advertising. This research work draws on the two streams of WOM. They are 1) WOM as a driver of buyer behaviour, and 2) The importance of social behaviour in the flow of WOM [11].

**Objective**

According to Godes [17], the two dimensions of eWOM are Volume and Dispersion. In our research we considered the volume only. It is measured as the number of views at a particular time. More number of views implies that more people are aware of the music album. One of the Web 2.0 tools, YouTube, records the number of views and allows anyone to post their comments for free. The comments and the number of views are useful in determining the popularity, and probable sales of the albums.

Our research is particularly useful in understanding consumer behaviour on the internet. It can also be used to evaluate web 2.0 tools such as MySpace, YouTube and others as effective, revenue enhancing word-of-mouth channels for music albums. Hence eWOM should not be viewed as an alternative to advertising, but as an important complementary aspect.

**Research Methodology**

Traditional attempts to measure consumer word-of-mouth (WOM) are based on inference, surveys, and controlled experiments [18]. In our methodology, we have focussed on inferences from available data. Five elements of eWOM [8] and their values as applicable in our study are:

1. **Statement-** comments on blogs, posts on sites, etc.
2. **Communicator-** blogger, or site visitor who views, uploads, or comments on the content.
3. **Object-** albums.
4. **Receiver-** blog followers, social media members, site visitors.
5. **Environment-** internet.

**Data Collection**

In our study, we gathered the data from the Internet and Billboard magazine.

The data was classified into two categories:

**eWOM data**

We are interested to analyse the eWOM impact on sales. eWOM data is in the form of (a) number of views/listenings of an album (b) number of posts on a blog or site (c) number of comments on an uploaded singles/video belonging to the album.

We collected data from the internet with the help of Google search engine. Google facilitates data searching for specific time periods, and in specific geographical area – United States, and most importantly in a specific site or domain.

Google Blog Search was used for collecting the number of blog posts for the music entities. MySpace was used to gather the number of times the entity has been played, and the posts. YouTube facilitated the number of uploads, views, and comments for the entities. Searches were conducted based on keywords such as album title and artist name, the country, and period of observation. We are collecting the eWOM data for a period of 13 weeks for 30 albums. The results included in this paper represent 45 percent of that information.

Not all the search results retrieved were relevant to our study. For example, searching for an artist, “Pink”, and an album, “Funhouse”, by Pink, gave us some irrelevant results. These results were irrelevant because of the absence of any views and or comments, and posts on the music entity. Hence we arrived at a criterion that we used in filtering the relevant results from the irrelevant ones:

(a) The data must be from US. This is due to the sales ranking data also being for US territory.

(b) The eWOM data must be in English.

(c) The data must be relevant to our research objective. This means that there must be some manifestation of eWOM in the search results.
The social media and video streaming domains did not allow week-wise searching of data. Hence, to retrieve weekly data from them we are using Google search. Given the amount of eWOM data from YouTube, we sampled 20% of the relevant results.

I. **Sales Data**

Sales Rankings and figures were collected from Billboard magazine, online resources and from some music content providers. These rankings and sales were then mapped to the music entities consumption in U.S.

Data collection activities were performed for over 3 months.

**Research Design**

Our study investigated the impact of eWOM on music sales. However, publicly accessible data is in the form of sales ranks and not the actual sales quantities. Hence a model for representing sales was needed.

Earlier studies on power law were done by Hoogeboom [19] and Clauset [20]. They show that power law distributions occur at many situations of scientific interest. It has also been applied for ran-to-sales estimation of books and movies [21][22][23].

In our study we estimated sales probabilities from the billboard magazine ranks using a Power Law distribution. Then we tested our model with the real-data as tabulated in Table 1.

\[
P(x) = x^{-\alpha}
\]

The validity of such models has been studied earlier by Clauset[20].The scaling parameter, \( \alpha \), was found to vary from 2.37 to 3.21. With this model, the goodness of fit with the actual sales values was found with significance greater than 95 percent.

We calculated the exponents in the power law using Equation 2, which considers the maximum likelihood estimators (MLEs).

\[
\hat{\alpha} = 1 + n \left[ \sum_{i=1}^{n} \ln x_i \right]^{-1}
\]

Using (1) and (2), we calculated values of \( \alpha \) for each week and then a general value from all the available data for the 13 weeks. Linear Regression between the Log values was performed using SPSS to determine the R square and significance of each model.

<table>
<thead>
<tr>
<th>Week #</th>
<th>Constant</th>
<th>Alpha</th>
<th>R Square</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.05689</td>
<td>2.62</td>
<td>0.781</td>
<td>0.00100</td>
</tr>
<tr>
<td>2</td>
<td>0.031661</td>
<td>2.23</td>
<td>0.961</td>
<td>0.00000</td>
</tr>
<tr>
<td>3</td>
<td>0.0121</td>
<td>2.52</td>
<td>0.882</td>
<td>0.00000</td>
</tr>
<tr>
<td>4</td>
<td>0.01778</td>
<td>3.04</td>
<td>0.902</td>
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<tr>
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<td>0.959</td>
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<td>0.02976</td>
<td>2.66</td>
<td>0.927</td>
<td>0.00000</td>
</tr>
</tbody>
</table>

The collected data shows an acceptable fit with our weekly and general model, shown in Table 1.

**Hypotheses**

We hypothesize that different channels used to spread electronic word-of-mouth have different impact on sales. This impact can be represented by the following null hypothesis, also shown in Figure 1.

\[ H_{10} - eWOM \text{ represented by the blog postings does not impact album sales.} \]

\[ H_{20} - eWOM \text{ represented by the comments in video-sharing sites does not impact album sales.} \]
H3o-eWOM represented by the views in video-sharing sites does not impact album sales.
H4o-eWOM represented by the total number of videos uploaded on video-sharing sites does not impact album sales.
H5o-eWOM represented by the postings on social networking sites does not impact album sales.
H6o-eWOM represented by the listenings on social networking sites does not impact album sales.
H7o-the combination of eWOM represented by blog postings, social networking site postings, and number of video uploads, does not impact album sales.

The eWOM value in the above hypotheses is the total eWOM count for 13 weeks for each album.

Dependent variables

A single dependent variables is used: total album sales for the 13 weeks defined as below:

\[ \text{Total \ Album \ Sales} = \text{Total Albums sold during the 13 week period for each of the 14 album titles.} \]  
(3)

Independent variables

a) \( eWOM_{B \_A} \): total number of posts on blogs about the album.

b) \( eWOM_{YT \_Comm \_A} \): total number of comments posted by users on YouTube about the album.

c) \( eWOM_{YT \_View \_A} \): total number of times the album related video has been played on YouTube.

d) \( eWOM_{YT \_Video \_S} \): number of album related videos uploaded by users on YouTube.

e) \( eWOM_{MySp \_Msg \_A} \): total number of posts by users about the album in MySpace.

f) \( eWOM_{MySp \_Play \_A} \): total number of times the album’s song or video has been played on MySpace.

Results and Discussion

Data was analysed using the SPSS (version 14.0). Descriptive statistics were computed for dependent and independent variables. Bivariate analyses were undertaken to explore the associations between independent, dependent, and potentially confounding variables. Linear regression analysis was then conducted to determine the variables with which sales were most strongly associated.

<table>
<thead>
<tr>
<th></th>
<th>H1o</th>
<th>H4o</th>
<th>H5o</th>
<th>H7o</th>
</tr>
</thead>
<tbody>
<tr>
<td>R Sq.</td>
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<td>0.379</td>
<td>0.359</td>
<td>0.607</td>
</tr>
<tr>
<td>Sig.</td>
<td>0.001</td>
<td>0.019</td>
<td>0.024</td>
<td>0.001</td>
</tr>
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<td>( B_0 )</td>
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<td>2.343</td>
<td>2.25</td>
<td>2.28</td>
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<tr>
<td>( B_1 )</td>
<td>0.00013</td>
<td>0.00017</td>
<td>0.00015</td>
<td>0.00013</td>
</tr>
<tr>
<td>( t )</td>
<td>4.3</td>
<td>7.5</td>
<td>6.5</td>
<td>4.3</td>
</tr>
</tbody>
</table>

Table 2

The hypotheses H2o, H3o, and H6o were not rejected. H1o, H4o, and H5o were rejected as shown in Table 2.

On performing the stepwise regression, \( eWOM_{B \_A} \) was found to be the only predictor in the model. Hence we conclude that the blog posts impact the album sales most strongly.

The blogs are posted by news media and music lovers. It is one of the best mediums to be updated on music and music related news. Probably the data is more representative of the views of the music connoisseurs. Moreover, the structure and popularity of blogs among consumers in general could be the reasons for people to keep themselves updated on music entities and related news.

Despite the large number of views and listenings on Youtube and Myspace respectively, which exceeded the blog posts by a large amount, the dependence of sales on views and listenings was not significant. In fact the more significant factor was the number of video uploads on Youtube. If these results are correct, the media industry may re-think their strategy in order to allow more video uploads.

Limitations and future research

The study involved data posted by users, and official sales data/rankings as released by Content Providers or magazines. Hence, there were many instances when exhaustive data was not available during the period of research. Data collection for more samples is ongoing and will strengthen the robustness of our findings in the current investigation.

The dynamic nature of the eWOM and the presence of some untraceable channels, such as instant messaging services, and e-mails, pose a major challenge in estimating the collective impact of all eWOM sources on digital music sales. Hence the current study focuses on the impact, if any, on the sales of music entities. In the near future, we
intend to collect more data and further substantiate the findings and investigate them across different levels (singles, ring tones, videos, other formats), platforms (mobile, web), and tools (MySpace, Content Providers, Music producer’s websites).

Conclusions
Our study helps in understanding the transition from physical goods market to the e-business market for music. The findings may be used to complement the existing advertising, and promotion to increase revenues. It can be used as a tool by stakeholders to create strategies for better positioning and segmentation of digital music market

The study is also suggestive of the most effective eWOM channels. It could be used by content providers to replicate the environment present at these effective eWOM tools, for marketing and increasing album sales. This insight also opens doors for similar research on other content such as music singles across platforms.

Acknowledgement
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References


TRANSFORMING EXPERIENCE GOOD INTO SEARCH GOOD: HOW VIRTUAL EXPERIENCE MAY CHANGE THE INTERNET ADVERTISING MARKET?

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Abstract
Prior research indicates that goods contain either search or experience attributes and those that are categorized as search goods may induce more product information search efforts prior to purchase. Considering the low search cost online, search goods could easily prompt even more search efforts. However the experiment results of this study indicate an interesting finding that seem to go against this projection by showing more search efforts (including online advertisements click-throughs and searching time) for experience goods than for search goods. Explanations to the finding which in part echoing Klein’s (1998) proposition of virtual experience are provided and implications for online advertising are drawn.

Keywords: Online advertising, search goods, experience goods

Introduction
Since the inception of online advertising in 1994, internet advertisement has become the major growth source in advertising (Robinson, Wysocka, & Hand, 2007). In light of a unique feature -- interactivity -- with which this new advertising vehicle carries, pay-for-clicks on online advertisements is currently a widely adopted pricing mechanism for internet advertising. Therefore, factors that could trigger click-through on advertisements receive research attention (C. H. Cho, 2003; Robinson, et al., 2007). While research attention is drawn to evaluate and optimize this new advertising vehicle, the declining click-through rate of advertisements (Chatterjee, Hoffman, & Novak, 2003) casts shadows on this new vehicle. Klein (1998) indicates that the online advertising may not be analogous to traditional media, such as, TV, radio, newspapers and magazines. By reviewing prior research, she contends that consumers’ pre-purchases and ongoing information acquisition processes in this new medium could be vastly different from traditional ones in several dimensions, including the amount of total search, the number and types of sources consulted, and the distribution and weighting of information gathered from these sources.

To explore this new medium, Klein adopts the information economics’ approach (Nelson, 1974; Stigler, 1961) -- consumer information search behavior -- and draw an important implication in consumer information search process. Klein contends that the low cost of online information search could transform the experience good into search good with the prevalent virtual experience online; as a result, advertising could play a role which serves better value than simply being a signal (Klein, 1998, p. 201).

Klein’s assertion may turn the advertising market into a new feature with regards to consumer information search behavior as follows. First of all, the product information economics theory that is drawn by Nelson and Stigler defines that the search goods are products dominated by product information attributes which can be acquired by perspective consumers prior to purchase whereas the experience goods are products dominated by information attributes that can only be appreciated after purchase and use. Without “virtual experience,” it implies: Since the cost of product information browsing on web is low, the value of search goods, such as dresses and magazines, can be estimated by buyers prior to purchase; therefore, buyers may exert more information searching efforts prior to purchase – more click-throughs on web pages – for instance. On the other hand, experience goods that can only be appreciated after purchase and use, such as canned tuna fish and computers, may induce few browsing efforts. Furthermore, if virtual experience is provided, experience goods could be transformed into search goods (as Klein has contended). This transformation may result in a huge advertising market since there will be a huge amount of goods holding “search” attributes that demand advertisements. And the demands are fueled with low search cost in internet.

In sum, if without the sharing of virtual experience online, according to Nelson’s theory the internet may induce more online information searching efforts for search goods because of the low cost associating searching efforts. An important implication for advertising is that the search goods may combine the experience goods to generate more advertising demands as well as supplies than in the traditional media.
However, our experiments reveal a surprising result that goods’ experience attributes affect click-throughs as well as search time positively at a significant level; whereas goods’ search attributes affect negatively at a marginal significant level. After inspecting the web pages browsed by the participants of experiments, this “anomaly” at the first glance can be understood as analogous to Klein’s assertion of “virtual experience,” in which experience goods are transformed into search goods which call for a certain amount of search efforts, particularly on electronic forums and blogs in internet. Nevertheless, the virtual experience transformation cannot account for the reduction of search efforts for search goods observed in this experiment. And this is likely attributed to the information qualities of search goods that their information is easily obtained in a chart of comprehensive side-by-side comparison; buyers rarely need to take further actions to search for information.

In the following, we will go over prior research on internet advertising and consumer’s product information search behavior. The research method and data analysis models are laid out in Section 3. Section 4 shows the experiment results, while conclusions and implications are delineated in Section 5.

**Literature review**

Internet advertising in recent years has become an important alternative (C.-H. Cho, 1999; C.-H. Cho, Lee, & Tharp, 2001; Hofacker & Murphy, 2000; Leckenby & Jongpil, 1998) to traditional media, such as newspapers, magazines and television. As more visitors viewing the internet, internet advertising becomes the major vehicle to reach consumers who used to acquire product information from conventional media yet switched to the internet nowadays (Hofacker & Murphy, 2000). A subsequent question will be “How is this new advertising medium different from its traditional counterparts?”

For instance, how may the performance of internet advertising be measured (Briggs & Hollis, 1997; Lisa R. Klein, 1998; Leong, Huang, & Stanners, 1998; Shamdasani, Stanaland, & Tan, 2001)? Several studies (Hoffman & Novak, 1996; Leckenby & Jongpil, 1998; Leong, et al., 1998; Novak, Hoffman, & Yung, 2000) are set to align this new advertising medium along with its conventional counterparts. This alignment may endow an important implication where one could, directly or with minor adjustments, apply traditional measurements to this new medium.

**Product information qualities**

While attention are drawn to the linkage between the newbie and the existing ones, Klein (1998) raises a concern of overlooking the potentials of interactive media, such as the internet environment. Klein begins her assertion with Philip Nelson’s renowned theory on product information search (Nelson 1970; Nelson 1974).

When Nelson (1970) proposes the product information concept of search versus experience product qualities, the key is whether or not buyers can inspect products and collect information with respect to the resulted consumption utilities prior to purchase. Dress for one is a product that Nelson uses as an example to illustrate the search good since buyers oftentimes can only taste it after it has been purchased. Thus, an important distinction between the two is whether or not a product’s consumption utilities could be well perceived by objective product statements. If yes, then during purchasing products, buyer may focus solely on the comparison of product statements; as a result, information collecting would be essentially prior to purchase. If product’s objective statements explain little about the resulted consumption utilities, such as the canned tuna fish, buyers may just buy the product and experience it by themselves to evaluate product values. And this is where brand building weights in.

The distinction of product information attributes in terms of “search” quality and “experience” quality poses important implications in advertising as Nelson (1974) concludes: Since search efforts come with cost, Nelson contends that in regard to different brands, buyers may reduce the sampling size when search cost rises. Moreover, firms that produce search goods may try to use advertisements to persuade perspective buyers. In sum, search goods oftentimes are the drivers in advertisements.

**Information search effort measurement**

An important implication of Nelson’s (as well as Stigler’s) theory on consumer’s information search behavior is: consumer may keep searching product information until the costs accumulated during the search efforts are grater than the benefits acquired by the search efforts (Kuliviwat, Guo, & Engchanil, 2004). While this cost-benefit projection is appropriate within traditional media (Guo, 2001), would it be the same situation for the new media – the internet? As stated above, the internet provides a user-friendly environment in exceptionally low cost either posting or searching for product information. Since product information of search goods is beneficial, that is, the more the better, the information search campaign may keep running and this momentum remains high in internet because the...

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search costs are much lower than those in other media. However, the low search costs in internet may not affect consumer’s demand for product information of experience goods which can only be appreciated after being experienced.

**Click-through**

To verify the assertion above, it requires effective measures that are associated with information search efforts in internet. For traditional media, Klein and Ford (2003) summarize the measures associated with consumer information search efforts adopted in prior studies. And the time spent in searching is proposed as the measure for total search efforts.

Besides, within the internet environment, another measure – the click-throughs – may well serve as a good measurement. To the internet users, the most convenient and widely used function is the “click”; it acts as a magic wand; by clicking (mostly through the mouse) on certain icons, the intended functions attached to the icons would start performing. Accordingly, advertisers insert enormous amount of advertisements in different features on web pages, trying to catch web visitors’ attention. Web visitors can point their mice, click on any of the advertisement icons, and be re-directed to the intended web sites or pages. This process is coined as the “click-through.” Technically, the process is achieved with the help of IP (Internet Protocol) address abiding with each web page. By monitoring the click-through behavior, advertisers are able to investigate whether or not web visitors are interested in the advertisements on web pages. In other words, the click-through could be an appropriate tool in determining whether or not a web visitor is aware of and attracted to the presence of the advertisements on web pages (Briggs & Hollis, 1997; Hofacker & Murphy, 2000).

**Hypotheses**

Applying Nelson’s theory to the internet advertising case, one may expect more click-throughs when searching for the search goods than for the experience goods for two reasons. Firstly, according to the theory, search goods would generate more search efforts before purchase because information regarding product utilities is sufficient for making purchase decisions; As a result, we expect more search efforts, including time-spent and click-throughs, for search-good product information search than for experience-good. Secondly, searching on internet is less costly than traveling to different shops, going over different magazines, or viewing over several TV advertisements, consequently, more online searching efforts could be induced for search goods. In sum, we draw two hypotheses to be tested as follows:

**H1:** Search goods induce more information searching time than experience goods do.

**H2:** Search goods induce more click-through on advertising banners than experience goods do.

**Method**

To test our hypothesis, we use quasi-laboratory experiments to record experiment participants’ online searching paths for further analyses. In the following we will describe the design of the experiments and the modeling for data analyses.

**Experimental design**

The data was collected in two stages. Firstly, we asked 60 students (will be referred to as the subjects hereafter) to present their attitudes toward search and experience qualities using a 7-point scale (from -3 to 3) with respect to twenty-four popular products taken from a government sponsored information providing web site. According to Nelson’s theory, experience goods are the products with utilities that cannot be justified by customers before purchase and use, whereas search goods can be compared solely based on product specifications. Then we chose six products for the next stage experiments. Of the six products, two (a computer magazine and a Taipei-Kaohsiung fly ticket) are in the search goods domain with the highest average search attitude, another two (a mobile phone and a color ink-jet printer) are in the mid of the two qualities, and the other two (a notebook computer and a computer game) are in the experience goods domain with the highest average experience attitude.

In the second stage, we asked other 33 subjects to participate in a shopping experiment. These subjects were asked to assume that they were perspective buyers of the six chosen products and needed to collect the product information on the web. The subjects browsed through the internet to search for the product information. All of the web pages that subjects went through were recorded in the log files in dedicated computers. In particular, the IP addresses with respect to each web page that the subjects visited were recorded. The log files were our raw data for further analyses. The subjects were requested to finish the search within 90 minutes and were paid 300 NT dollars. For readers’ reference, the regular pay for the odd-jobs students do on campus is around NTS 80 dollars/hour. After the search for the product information was finished, subjects were asked to fill out a questionnaire about product involvement, subjective impressions of the adequacy of information on the web, satisfaction regarding the information they collected through their search and demographic information.

The experiment was conducted with real web pages, that is, we did not set any limitation to the web pages the subjects can access. Consequently, the collected raw data and the log files contained
web pages that did not carry any advertisement. Thus, the collected web pages were firstly divided into two categories depending on the presence of any advertisement. For testing purposes we only analyzed those web pages where advertisement appeared. We investigated whether or not subjects chose to click the advertisements icons/banners.

Variable measurement
In addition to the dependent variable (searching time-spent and the number of click-throughs), our independent variables included the “search quality” and the “experience quality.” The two variables were measured in a 7-point scale. The subjects were asked whether or not that the goods’ qualities could be verified with search efforts before procurement.

Eight additional variables were also measured for control purposes. “Price” was measured in a 5-point scale; the subjects were asked to indicate whether or not the goods were expensive given his/her disposable incomes. “Product involvement” was measured with Zaichkowsky’s Scale for Personal Involvement Inventory (Zaichkowsky, 1994). This factor is due on Torres and Briggs’s (2007) finding where it indicates that advertisements could induce favorable consumer attitudes for low-involvement products without affecting the high-involvement ones. “Advertisement types” were coded “1” for banner-type advertisement and “0” for others. “Experience with the internet” measured the degree to which the subjects were acquainted with the internet in terms of years. “Average hours on the web per day” measured the average time that the subjects spent on the web in terms of hours. “Purchase style” asked the subjects to report their habits of shopping. Finally, gender and students’ seniority at the university were also recorded.

Data analyses
Since one of the dependent variable, the number of clicking through internet advertising, is a countable number, we could either use the Poisson regression or the negative binomial regression to analyze (Cameron & Johansson, 1997; Le, 1998; Long, 1997; Long & Freese, 2006). The two models are briefly described as follows.

Let \( Y_i \) be the dependent variable, then the typical Poisson regression is:

\[
p(Y_i|\beta) = \frac{(\lambda_i)^{Y_i}}{Y_i!} \exp(-\lambda_i)
\]

where \( E(Y_i) = \lambda_i \) depicts the mean of \( Y_i \), which in Poisson regression is assumed to be equal to its variance, noted \( Var(Y_i) \). For the studied cases, there might be several independent variables that trigger clicking through the internet advertisements. As a result, the relationship between \( \lambda_i \) and those independent variables is:

\[
E(Y_i) = \lambda_i = \exp(x_i'\beta).
\]

To estimate the regression coefficients, one can use the Maximum Likelihood Estimation (MLE) as follows,

\[
L(\beta) = \prod Y_i^{\lambda_i} \exp(-\lambda_i)
\]

If the assumption \( E(Y_i) = Var(Y_i) = \lambda_i \) is not supported, then one can assume that the \( \lambda_i \) follows a random distribution, for example the Gamma distribution, and solve the problem with the negative binomial regression. In this model, the dependent variable is parameterized with \( \alpha \) and \( \theta \) as follows,

\[
P(Y_i|\alpha, \theta) = \sum \int p(Y_i|\lambda_i) p(\lambda_i|\alpha, \theta) d\lambda_i,
\]

Where

\[
p(Y_i|\lambda_i) = (\lambda_i)^{Y_i} \exp(-\lambda_i),
\]

\[
\exp(\alpha, \theta) - \frac{Y_i!}{\theta Y_i!} \left( \frac{\theta}{\theta+1} \right)^\theta \exp \left( \frac{-\lambda_i}{\theta+1} \right)
\]

and \( \lambda_i \sim \text{Gamma}(\alpha, \theta) \). Consequently, the mean is

\[
E(Y_i|\alpha, \theta) = \frac{\theta}{\theta+1} \left( \frac{1}{\theta+1} \right)^\theta = \alpha \theta - 1
\]

and the variance is

\[
Var(Y_i|\alpha, \theta) = \frac{\theta}{\theta+1} \left( \frac{1}{\theta+1} \right)^2 = \alpha \theta (\theta + 1)
\]

After incorporating those independent variables into the previous equation, we arrive

\[
E(Y_i|\alpha, \theta) = \alpha \theta = \exp(x_i'\beta).
\]

By applying MLE on

\[
L(\beta) = \prod \exp(-\lambda_i) \exp(\alpha, \theta) - \frac{Y_i!}{\theta Y_i!} \left( \frac{\theta}{\theta+1} \right)^\theta \exp \left( \frac{-\lambda_i}{\theta+1} \right)
\]

\[
\alpha \theta = \exp(x_i'\beta)
\]

is obtained.

An immediate question is then raised: which model is appropriate for the present analysis? In most empirical cases, the variances are significantly greater than the means, which is called “overdispersion (Cameron 1986).” To investigate whether or it is a case of overdispersion, it is essential to test the following hypotheses:

\[
H_0 : \gamma = 0 \\
H_1 : \gamma > 0
\]

Two testing procedures can be applied: either the Likelihood ratio test (LRtest):

\[
T_{LR} = -2 \left[ \log(L(\hat{\theta}_{\gamma=0}) - \log(L(\hat{\theta}_{\gamma})) \right].
\]

If \( T_{LR} > \chi^2(\gamma) \), then the hypothesis \( H_0 : \gamma = 0 \) is rejected. That is to say, the negative binomial is more appropriate.

or the Wald test:

\[
T_{W} = \hat{\gamma} \left( \frac{\partial \log(L)}{\partial \gamma} \right)^2 \left( \frac{\partial \log(L)}{\partial \gamma} \right)
\]
If $T_z > Z_{a}$, then the hypothesis $H_{a}: \gamma(0) = 0$ is rejected.

**Results**

**Manipulation check**

First of all, subjects’ attitudes toward both “search quality” and “experience quality” are presented in Table 1, where the student *t*-values with respect to the search quality and experience quality are listed in the second and the third columns. Student *t*-tests are performed to test whether or not the two qualities are greater than zero.

Table 1- Paired Student-t-tests on attitudes to search vs. experience

<table>
<thead>
<tr>
<th></th>
<th>Search</th>
<th>Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer game</td>
<td>-0.80</td>
<td>3.59**</td>
</tr>
<tr>
<td>Notebook computer</td>
<td>-0.24</td>
<td>3.93**</td>
</tr>
<tr>
<td>Color inkjet printer</td>
<td>0.53</td>
<td>2.79**</td>
</tr>
<tr>
<td>Mobil phone</td>
<td>-0.24</td>
<td>2.27**</td>
</tr>
<tr>
<td>Computer magazine</td>
<td>1.94*</td>
<td>-0.15</td>
</tr>
<tr>
<td>Taipei-Kaohsiung fly ticket</td>
<td>3.71**</td>
<td>-1.49</td>
</tr>
</tbody>
</table>

Note: * for *p*-value is less than 0.05 and ** for *p*-value is less than 0.01.

This result indicates that computer game and notebook computer represent experience goods whereas computer magazine and Taipei-Kaohsiung fly ticket fall into the category of search goods. In terms of the color inkjet printer and mobile phone, according to the first stage result, they are supposed to be classified in the mid of the experience goods and the search goods. The subjects hired for the second stage experiments seem tend to recognize them as experience goods. Nevertheless, this does not affect our hypothesis testing.

**Descriptive statistics and the correlation check**

Before the regressions, we conduct a correlation analyses on the independent and the control variables. Table 2 shows the correlations. Given the minor correlations for some variables, co-linearity may not be of concern to our regression analyses.

Table 2- Correlations between each independent variable

<table>
<thead>
<tr>
<th>(1)Search good index</th>
<th>(2)Experience good index</th>
<th>(3)Price</th>
<th>(4)Product involvement</th>
<th>(5)Advertisement types (1:banner)</th>
<th>(6)Gender</th>
<th>(7)School years</th>
<th>(8)Experience with internet</th>
<th>(9)Average hours on web per day</th>
<th>(10)Purchase style (1: internet shopper)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td>0.05</td>
<td>0.00</td>
<td>-0.10*</td>
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<td>0.05</td>
<td>0.03</td>
<td>-0.08</td>
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</tbody>
</table>

Furthermore, validity and reliability regarding the product involvement derived with factor analysis on Zaichkowsky’s scale for Personal Involvement Inventory are also checked. The Scree plot shows that the first factor is dominant for the rest and is the only factor whose Eigenvalue value is greater than 1, which renders a cumulative percentage of variance of 71.2%. In terms of the validity, the value of the KMO (Kaiser-Meyer-Olkin) is 0.946 (greater than 0.5); i.e., the measuring is appropriate for the factor analysis. The Bartlett’s testing is also significant with $\chi^2 = 1795.9$, while Cronbach $\alpha$ is 0.95 which also satisfies reliability concern.

In addition, the mean and variance for the dependent variable – click-through – were 1.34 and 9.70, respectively. That is to say, overdispersion may be of concern to our further analysis of regression. Since the variance for the negative binomial regression is $\text{mean} + k \times \text{mean}^2$, where $k \geq 0$, the hypothesis testing regarding

$$H_0: \gamma(0) = 0$$

$$H_1: \gamma(0) \neq 0$$

can be transformed as
If $k = 0$ is rejected, it concludes with the negative binominal case. By Poisson regression, we derive the value of log likelihood as -584.506, and -529.619 with negative binominal regression. We firstly test the overdispersion problem with the Likelihood Ratio test. The estimate is $T_{LR} = 2 \times \left( 584.506 - 529.619 \right) = 109.774 > \chi^2_{(1)} = 5.41$.

Hence, the null hypothesis is rejected. Secondly, we performed the Wald test and the estimate is $T_w = 56.66 > Z_{0.99} = 2.33$.

Again, the null hypothesis $H_0 : k = 0$ is rejected. Hence, we choose negative binominal regression for our further analyses.

**Negative binominal regressions**

Consequently, the negative binominal regressions are applied and the results are shown in Table 3.

**Table 3 - Negative binominal regression on counts of click-through advertisements**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Search goods model</th>
<th>Experience goods model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Search index</td>
<td>-0.05 0.04 -1.24</td>
<td>- - -</td>
</tr>
<tr>
<td>Experience index</td>
<td>- - -</td>
<td>0.11 0.05 2.25*</td>
</tr>
<tr>
<td>Price</td>
<td>0.21 0.09 2.42*</td>
<td>0.20 0.08 2.37*</td>
</tr>
<tr>
<td>Product involvement</td>
<td>0.08 0.08 0.99</td>
<td>0.08 0.08 0.92</td>
</tr>
<tr>
<td>Advertisement types (1:banner)</td>
<td>-0.73 0.17 -4.29**</td>
<td>-0.74 0.17 -4.31**</td>
</tr>
<tr>
<td>Gender</td>
<td>-0.19 0.20 -0.95</td>
<td>-0.13 0.21 -0.65</td>
</tr>
<tr>
<td>School years</td>
<td>0.05 0.08 0.63</td>
<td>0.08 0.08 0.97</td>
</tr>
<tr>
<td>Experience with internet</td>
<td>-0.12 0.11 -1.12</td>
<td>-0.17 0.11 -1.50</td>
</tr>
<tr>
<td>Average hours on web per day</td>
<td>-0.00 0.07 -0.04</td>
<td>0.00 0.07 0.04</td>
</tr>
<tr>
<td>Purchase style (1: internet shopper)</td>
<td>0.18 0.36 0.50</td>
<td>0.20 0.36 0.55</td>
</tr>
<tr>
<td>Constant</td>
<td>-1.53 0.66 -2.34</td>
<td>-1.54 0.65 -2.38</td>
</tr>
<tr>
<td>log likelihood</td>
<td>-542.002</td>
<td>-540.173</td>
</tr>
</tbody>
</table>

Note: * indicates that p-value is less than 0.05 significance level; ** is less than 0.01

**Ordinary least squares regression on time-spent**

Another dependent variable representing the information search efforts is the time spent for the information searches. Table 4 shows the OLS regressions results.

**Table 4 – OLS Regressions on search time (seconds) spent on each product (random-effects)**

<table>
<thead>
<tr>
<th>Models</th>
<th>Search goods model</th>
<th>Experience goods model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variables</td>
<td>Coef. Std. Z-value</td>
<td>Coef. Std. Z-value</td>
</tr>
<tr>
<td>Search good index</td>
<td>-22.42 12.79 -1.75</td>
<td>- - -</td>
</tr>
<tr>
<td>Experience good index</td>
<td>- - -</td>
<td>29.69 13.69 2.17*</td>
</tr>
<tr>
<td>Price</td>
<td>-29.99 25.64 -1.17</td>
<td>-30.09 25.56 -1.18</td>
</tr>
<tr>
<td>Product involvement</td>
<td>-32.42 18.23 -1.78</td>
<td>-34.44 18.19 -1.89</td>
</tr>
<tr>
<td>Advertisement types (1:banner)</td>
<td>0.00 46.61 0.00</td>
<td>0.00 46.46 -0.00</td>
</tr>
<tr>
<td>Gender</td>
<td>9.87 97.03 0.10</td>
<td>16.79 98.39 0.17</td>
</tr>
<tr>
<td>School years</td>
<td>-1.96 38.29 -0.05</td>
<td>5.98 38.76 0.15</td>
</tr>
<tr>
<td>Experience with internet</td>
<td>3.31 51.31 0.06</td>
<td>-6.16 52.06 -0.12</td>
</tr>
<tr>
<td>Average hours on web per day</td>
<td>-6.83 32.21 -0.21</td>
<td>-6.22 32.63 -0.19</td>
</tr>
<tr>
<td>Purchase style (1: internet shopper)</td>
<td>203.97 186.97 1.09</td>
<td>206.81 189.18 1.09</td>
</tr>
<tr>
<td>Constant</td>
<td>662.34 296.55 2.23</td>
<td>658.48 299.71 2.20</td>
</tr>
<tr>
<td>Sample size (groups)</td>
<td>396(33)</td>
<td>396(33)</td>
</tr>
<tr>
<td>$R^2$ (overall)</td>
<td>0.026</td>
<td>0.030</td>
</tr>
</tbody>
</table>

Note: * indicates that p-value is less than 0.05 significance level; ** is less than 0.01

The results in Table 4 show that the correlation directions and statistical significances are the same as those in Table 3 where the count of click-throughs served as the instrumental variable representing the information search efforts.

**Discussion**

The results in Table 3 and 4 are surprising which clearly indicate that subjects made more click-throughs and spent more time on the experience goods than search goods. According to Nelson’s theory, consumers shall endeavor more to search for information regarding search goods. This is because consumers can fully identify search goods utility based on product specifications. Further investigation on the seemingly contradictory result was then conducted. We went through those web pages that subjects had clicked through.

The investigation arrives two major findings: firstly, it is easy for web-page information providers to offer complete information about search goods. For instance, “EZtravel” is the web site of a local travel agency that provides fly tickets information. Web visitors can obtain a list of comprehensive side-by-side comparison regarding the flights within any designated period; the flight information collectors do not need to take any further search
action. On the other hand, for experience goods, it is difficult for web-page information providers to construct a web site with thorough information regarding the goods of different brands or alternatives.

Secondly, we found that internet is also a wonderful place for experience goods users to exchange their usage experience. Internet blogs particularly are the places that users would like to share their personal experiences. Although experience goods by Nelson’s definition could not be appreciated prior to purchase, a perspective consumer may borrow other users’ experiences virtually. At the same time, borrowing through the forums and blogs is literally costless. For instance, “Mobile01” is an extremely popular web site for 3C (consumer, computer, communication) products users as well as other hobbies. The forums of the web site provide thousands of users’ experiences and comments regarding all sorts of electronic equipments and their related “big toys” such as bicycles. Our investigation shows that experiment participants spent most of their time surfing around to gather the information they needed on experience goods. As a result, the amount of click-throughs for experience goods is greater than the clicks for search goods, which does not agree to our hypotheses derived from the product information search theory.

The experiment results show that the search good quality did not contribute more search efforts than the experience good quality do, which is contrary to our hypotheses based on information search theory (Nelson, 1974). To resolve this puzzling result, further investigation efforts were set by screening the web pages that experiment participants had gone through. The findings were twofold: firstly, for the web-page information providers, it is easy to offer product information of search goods than that of experience goods. Consumers can obtain a complete list of side-by-side comparison regarding the search goods but not for the experience goods. Secondly, although experience goods could not be appreciated prior to purchase, with the help of forums and blogs, perspective consumers may virtually experience other users’ experiences without any cost prior to purchase. In our experiment, when collecting information, participants exerted more search efforts (the amount of time spent and the number of click-throughs) on experience goods than on search goods.

Instead of showing Nelson’s theory whether is outdated or not for the new media, the present study wishes to shed some lights on the uniqueness of the internet and the significance for advertising. The uniqueness is that the internet does not simply provide a costless vehicle for product information search, but also offer a robust tool for information providers – such as the consumer report – as well as advertisement agents to present product qualities to the consumers. And this is particularly favorable for search goods (by Nelson’s definition) because the product specifications of search goods can be easily reduced to item-by-item or side-by-side charts to deliver product information desired by consumers.

On the other hand, it is more difficult to communicate the products with merely specifications of experience goods in conventional media. Accordingly, consumers may seek to consult other users’ consumption experiences – the virtual experience, as Klein (1998) would coin. These efforts are not easily accessible before the internet era. However, due to the low cost of sharing information on the web, gratification after making their experiences known, and the immediacy of going public, consumers are more willing to document and post their experiences on web sites, e.g. electronic forums and blogs, as supposed to the traditional medium, such as magazines. As a result, perspective consumers can acquire needed information online in a timely fashion. Consequently, experience goods induce more search efforts than search goods. And it leads to an important implication for advertising, that is, the need for advertisements of experience goods may surpass that of search goods. An evidence for the implication is the omni-present ads on electronic forums and blogs on the social networking sites nowadays.

Although our hypotheses drawn from Nelson’s theory are rejected in light of the new medium, Nelson’ eminent work pertains to show the significance of the distinction of product information attributes – search versus experience, even with the new medium. And the reverse of advertising implications indeed indicates the strengths of internet compared to traditional media, which echoes Klein (1998)’s demand for new assessment of the new medium.

For practices, our study underlines an emerging market for advertising wherein demands for sharing the experience of experience goods are rising. In conventional advertising media, making personal experiences sharing is not only time consuming, but also unlikely to be achieved inexpensively. The internet, however, is a perfect medium to this end. Consumers are enticed to surf the web with minuscule cost of searching for product information and of sharing their use experiences on the web. Although, practitioners have far reckoned the potential for advertising since the inception of the internet (Verity, Hof, Baig, & Carey, 1994), the present study helps to enrich our understanding of the internet by highlighting its ubiquitous characteristic not to be found in any other advertising media.
Future studies

While our research objective is to investigate product information search online, one of the instrumental variable for search efforts that we adopt is click-trough, and the finding shows that click-through rate is positively affected by the attributes of goods’ experience qualities. This finding may complement another research thread about click-through behavior. This thread of research is motivated by that click-through rate on internet ads is a widely adopted pricing mechanism nowadays, thus factors that could induce click-through are highly thought-after and carefully designed by advertisements. Shamdasani et al.(2001), for instance, address web advertising placement by examining two variables: website reputation and the relevance between website content and banner ad product category. Cho et al.(2001) explore the effects of different levels of forced exposure of web visitors to banner ads on advertising responses (e.g., banner click-through). Hofacker and Murphy (2000) study the effectiveness of the design of advertisement banners on click-through rates. Robinson, et al.(2007) examine the banner design elements affecting the effectiveness of banner ads in gaming industry and show that banners that are larger in size, longer in content, absent in promotional incentives and the presence of casino gaming information induce higher click-through rates.

Beyond those design elements described above, Cho (2003) indicates that the level of product involvement, congruency between the content of a vehicle and the product category of an advertising banner, attitude toward the vehicle, and the overall attitude toward web advertising are four important factors affecting the click through rates. Moreover, although not directly on advertising responses of click-through, Novak et al.(2000) propose a construct wherein the web consumers’ cognitive state experienced during navigation is investigated with a structural modeling on online data.

To conclude, it would be beneficial to include product information attributes in the click-through study framework. Further, along with Kulviwat, et al. (2004)’s framework, we can expect an extensive descriptive model of information search behavior in internet.

References


DO MALE AND FEMALE FAVOR ONLINE PRODUCT REVIEW THE SAME?

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Abstract
Online consumer product review is becoming increasingly important in consumers’ purchase decisions. Online product review is a sort of product information created by users based on their personal usage experience. It basically serves as a passive “sales assistant” for information seeker, the customer, to check if the product matches her idiosyncratic usages. And in the consumer behavior literature, gender has been an issue because it affects consumers’ approaches to decision making. Thus, in the context of product information seeking online, this paper investigates the effects on online consumer behavior from the TAM perspective. A structural equation model (SEM) on empirical data confirms that there exist some differences between the genders in the underlying mechanism on online product review.

Keywords - TAM; gender; information search; product involvement; online consumer review

Introduction
On choosing which products to buy or how to spend money is an art. Subjective evaluations by others are always valuable. People read magazines devoted to product evaluation before purchasing cars; they ask friends and read reviews by professional critics when selecting movies and restaurants. Consumers rely on advertisement, expert reviews, consumer magazine, to facilitate their purchasing decisions. Nevertheless, they may be unreliable in a way that most of them seek profits one way or the other.

Recent developments in computer networks have driven down the cost of distributing information virtually drastically, creating extraordinary opportunities for sharing product evaluations. It provides a new opportunity for consumers to share their product evaluations online [2]. In turn, it drastically reduces the costs of collecting information. With the information propagation power, a breadth of information via online user reviews is available for assisting purchasing decision. For some marketers, it is the ultimate consumer solution. It offers consumers unprecedented product information, facilitating their decision making with minimal effort and cost [15]. In this sense, it induces a new issue about information search with online reviews.

Information search is an important part of the decision process for most consumers considering the purchase of an item. Comprehensive theories of consumer decision processes [3] recognize the importance of this component and incorporate it as a construct in the models of the decision process. During the information seeking process online, the consumer is also an Internet user. The information seeker is interacting with a website. However, ideas in the IS are quite different fundamentally from those in the consumer behavior. Information system researchers believe that technology relieves the stress of communication and breaks down the interpersonal barriers such as race and gender. Researches on TAM are generally indifferent about gender [1], and for example [16]. However, gender makes a big difference from the consumer behavior perspective [8], for example [10]. Yet, little is known about the gender differences on the issue. And two aspects of the user should be considered: An online reviewer basically performs the functions of 1) a typical consumer; s/he should exhibit some characteristics of a traditional consumer and 2) a technology user which can basically modeled by a TAM.

Studies about the issue should incorporate characteristics from the consumer behavior perspective. Factors like product involvement from consumer research [31] [32] are included in this study. Our objective is thus to investigate the determinants of the use of bulletin board / chat rooms, or alike, as an information source. The inclusions of consumer behavior factors are believed to have predicting power to the behavioral intentions to websites, either direct or indirect. Of particular interest in this paper is the difference contributed by gender to the core TAM members. To assess the difference, estimates from a structural equation model (SEM) will be used.

The structure of the paper is as follows. The next section presents a brief review of the issue together with a theoretical framework. It leads to the research methodology. Data analysis starts with validation of the measurement model. Then, by studying the structural relationship, the effects of information quality and product involvement are assessed. With discussions on the results, it leads us to the ending section on the conclusions.

THEORETICAL FOUNDATIONS AND HYPOTHESES
A majority of previous research on consumer reviews centered around seller reputation, especially on the eBay platform [19][20][21]. In terms of information seeking, the reputation system provides
transparency on seller history and minimizes the risk on uncertainty about fraud. Seller reputation would be important for direct transaction; however, reviews on the product itself are equally important for prospective buyers. Such information are mostly available in third-party websites such as bulletin board and chat rooms [22][23].

Information quality is always a focus on mainstream information system research [12]. It is all the more true in the context of this paper when a website can become a customer/partnering systems [13]. It is a common belief that better information quality can lead to a better overall attitude towards a site. Previous researches also show that sales are significantly influenced by the volume of online posting, suggesting the importance of the awareness effect [18]. Some suggest that the intensity of underlying word-of-mouth plays a dominant role in driving revenues [24][25]. The persuasive impact of the reviews actually depends on both their quality and their quantity [26]. However, their researches are either theoretical or not subjected to empirical test in the individual level. And they do not examine how consumer characteristics affect the uses of websites as a form of information source for product review. Thus, this paper adopts ideas from both the TAM and consumer behaviors to solve the puzzle.

**Technology Acceptance Model**

Early efforts of IS research concentrated on the identification of factors that facilitated IS use. And for practical reasons, the factors are grouped into a model in a way that would facilitate analysis of IS use. The most discussed tool is the technology acceptance model (TAM). Many variations and modifications according to the applications are available in the literature [11]. But the core members remain quite similar. This research involves three core members [14] and they serve as the backbone. The TAM here starts with perceived usefulness, which leads to the attitude to the site, which leads to the intention to use. These form the two basic hypotheses from the generic TAM. The study here is simply a case on third-party websites for product review. And that these sites do not involve in the transaction of the products under reviewed. Examples are bulletin board, chat room and personal blog.

An augmented member to TAM is of particular interests here. It is the information quality of the site. It is commonly believed that better information quality can lead to a better overall attitude towards a site as well as to positive behavioral intentions. Furthermore, in the context of product review, people have expectation on the site about its ability in providing useful information, and hence the usefulness perception and the attitude towards the site [23][25]. Thus, information quality is hypothesized to positively affect all the three core members in the generic TAM. These hypotheses are shown graphically in Fig. 1 at the end of the paper.

**Individual Differences**

For the sake of simplicity and focus, researcher on the Flow Theory incorporated with TAM does not hypothesize on any possible differences in online consumer due to gender or age [16]. However, in the definition of consumer behavior, consumer actions are dependent on the thinking process, in the direction to satisfying their needs. From this standpoint, male and female have different ways of thinking as well as behavior. Researchers confirm that gender affects consumers’ approaches to decision making [10]. The case in this paper is about the use of the tool – the use of third-party website for assisting purchasing decision. From the consumer behavior literature, we know that male exhibit a weaker sensitivity to the opinions of their friends [1] and have fewer interpersonal relationships [6]. Nonetheless, male show a greater interest in communications technology products [7]. Researchers also confirm factors like satisfying, time and economy seeking are concerns for men [10]. Thus, male and female should also behave differently in using a bulletin board as the information source for product review. More precisely, we are interested in testing if male is more capable of using online product review information than female (H6). On the contrary, because of their interpersonal communication ability, female is more capable of reviewing product information with her interpersonal relationships (H7). However, the difference in online product review ability of the two sexes with bulletin board remains unsure due to disagreeing forces working on him.

Besides gender, the study should also consider and be controlled for more individual differences as defined under consumer behavior. Two such items are taken into account. They are product involvement and time cost of an individual.

Product involvement reflects the perceived relevance of the product category to the individual. It has a strong effect on the positive shopping experience and the intention to return to the website [16]. However, according to the TAM, such intention may arise from its two antecedents: the perceived usefulness and attitude of the website.

Should product involvement affect perceived usefulness only - treating it as an external variable in the original TAM (interested reader may refer to Fig. 2 in [11] for detail); or, should it be treated as a factor affecting attitude? To study this, we have to understand the background of the TAM. It is basically a belief-attitude-intention-behavior relationship, which predicts user acceptance of IT. In the well-accepted TAM, belief is the belief of perceived usefulness of the site to the user. But user satisfaction is typically viewed as the attitude [1]. One antecedent
of such satisfaction is the product involvement [4]. Thus, two hypotheses are proposed: Product involvement induces perceived usefulness and positive attitude towards the website. And since attitude is involved, intention to use is more of a result of the attitude rather than the product involvement.

Time cost is the perception of costs in undertaking the review, including the psychological costs of processing information. A major component is the value of time for the online user. By assessing time availability, we estimate such perceived value of time [27]. In researches related to information seeking, it is always an important variable to determine the use of information sources. In time scarcity of an average Internet user and the availability of the website as a convenient information source [15], it is reasonable to consider it as a control variable, and thus, we have these two hypothetical relationships for controlled testing: time cost will positively affect the perceived usefulness and attitude towards the website.

Methodology

Research Design

It is an empirical study using a questionnaire to measure individual consumer perceptions of the research constructs using multiple-item scales. The measurement instruments are adopted from previous studies that are well-accepted and reported with satisfactory statistical reliability and validity, although we test it again for our newly collected data. The questionnaire asks for a specific product that a user may have experience in reviewing online. The products are shortlisted items developed from a pilot test involving open-ended discussions with 80 undergraduate students. The list includes low-end product like sport shoes to high-end electronic product like mobile phone. This design helps identify subjects with potentially different level of product involvement due to individual difference in needs.

The questionnaire also contains instructions asking the respondent to identify a Web site that he or she has used for product review. The subject should recall the name of website and then answer the questions pertaining to that recalled website. Moreover, the subject should also identify if it is a “bulletin board/chat sources or alike”.

Measurement Scale

TAM is the basic model. Unlike some researches [16], the original construct “attitude towards the website” is not ignored and intentionally kept as it directly contribution to “intention to use the system” in the original TAM. The three dimensions are “Usefulness” (4 items), “Attitude towards the website” (4 items) and “Intention to use the system” (3 items). All items used the original seven-point Likert scale.

An augmented site characteristic is information quality. It is modified from [30] and measured by 8 items based on the user assessment of the information on eight aspects, including accuracy, timeliness, relevance, right level of detail, trustworthiness, sufficiency of hints to reflect the trustworthiness and lastly the ability to reflect fairness of the information. It is measured in the original designed seven-point Likert scale.

To primarily test the hypotheses on the difference between male and female, measures are developed based on key findings from online use of information sources [17]. The respondent is asked to report the time, in hour, he or she used to review the product. There are altogether six sources of information: three for online. They are the 1) manufacturer/dealer sources, 2) the buying services and other third parties, and 3) the bulletin board/chat sources. Each of them has an offline counterpart. They are 1) the dealer visits/Advertisements, 2) the consumer reports and other print information and 3) the interpersonal contact with friends/relatives. The subject is to indicate his or her total time spent on them. With a transformation procedure, as proved mathematically and validated empirically by Ratchford et la [17], the corresponding ability in using the source can be detected.

For the individual characteristics, product involvement and its measurement have been the source of considerable research and debate since Personal Involvement Inventory was first proposed and analyzed by [31]. While there have been many variations on the definition of involvement, the Revised Personal Involvement Inventory [32] is adopted for this research. It encompasses the most important and academically accepted elements for motivational state activated by the product [33]. It is a 6-item scale and the original seven-point Likert scale was used.

The last measure is on time cost. It reflects the search effort by measuring the respondent’s own perception of how much effort is put into the search of information. It was a 3-item scale developed by [34] and the original seven-point Likert scale was used. This instrument is as shown in TABLE I.

Sample

Chinese Internet users were our research subjects. They were randomly selected in this study. A brief introduction about the survey was provided to each invited user. If a user had experience in online review that product, he or she was invited to complete the questionnaire anonymously. The final sample size is 766. Within them, 396 are males, 370 are females. Within them 232 have age below 20 (30.3%), 457 age between 20 and 25 (59.7%) and 77 of the sample age above 25 (10.1%). 69% of them are studying either fulltime or part-time and 85.1% have a job. The total time spent on product review has a mean of 5.2 hours, with a standard deviation of 4.7 hours.
TABLE I. THE SURVEY INSTRUMENT MEASUREMENT MODEL

<table>
<thead>
<tr>
<th>Construct</th>
<th>Item</th>
<th>CFA Loading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived usefulness</td>
<td>Using the site . . .</td>
<td>0.74</td>
</tr>
<tr>
<td></td>
<td>. . . improve my shopping performance.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>. . . increase my shopping productivity.</td>
<td>0.86</td>
</tr>
<tr>
<td></td>
<td>. . . increase my shopping effectiveness.</td>
<td>0.86</td>
</tr>
<tr>
<td></td>
<td>. . . is useful.</td>
<td>0.69</td>
</tr>
<tr>
<td>Information quality</td>
<td>The site provides --- information.</td>
<td>0.78</td>
</tr>
<tr>
<td></td>
<td>. . . accurate.</td>
<td>0.76</td>
</tr>
<tr>
<td></td>
<td>. . . timely.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>. . . relevant.</td>
<td>0.82</td>
</tr>
<tr>
<td></td>
<td>. . . at the right level of detail.</td>
<td>0.82</td>
</tr>
<tr>
<td></td>
<td>. . . believable.</td>
<td>0.78</td>
</tr>
<tr>
<td></td>
<td>. . . hints to reflect the trustworthiness of . . .</td>
<td>0.73</td>
</tr>
<tr>
<td></td>
<td>. . . notes to reflect fairness of . . .</td>
<td>0.73</td>
</tr>
<tr>
<td>Internet to use</td>
<td>To use it . . .</td>
<td>0.89</td>
</tr>
<tr>
<td></td>
<td>Assuming I had access to the site, I intend to use it.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Given that I had access to the site, I expect that I would use it.</td>
<td>0.89</td>
</tr>
<tr>
<td></td>
<td>I intend to visit it in the near future.</td>
<td>0.87</td>
</tr>
<tr>
<td>Attitude</td>
<td>Reviewing a product on this website . . .</td>
<td></td>
</tr>
<tr>
<td></td>
<td>. . . makes me feel ______ (good)</td>
<td>0.82</td>
</tr>
<tr>
<td></td>
<td>. . . would be ______ (pleasant)</td>
<td>0.84</td>
</tr>
<tr>
<td></td>
<td>. . . is a _____ idea (good)</td>
<td>0.86</td>
</tr>
<tr>
<td></td>
<td>. . . is a _____ idea (wise)</td>
<td>0.76</td>
</tr>
<tr>
<td>Product involvement</td>
<td>To you, the commodity is:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unimportant . . .</td>
<td>0.72</td>
</tr>
<tr>
<td></td>
<td>Important . . .</td>
<td>0.72</td>
</tr>
<tr>
<td></td>
<td>Relevant . . .</td>
<td>0.72</td>
</tr>
<tr>
<td></td>
<td>Unattracting . . .</td>
<td>0.79</td>
</tr>
<tr>
<td></td>
<td>Attracting . . .</td>
<td>0.79</td>
</tr>
<tr>
<td></td>
<td>Boring . . .</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Interesting . .</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Not fun . . .</td>
<td>0.77</td>
</tr>
<tr>
<td></td>
<td>Unappealing . .</td>
<td>0.79</td>
</tr>
<tr>
<td>Time Cost</td>
<td>How about your feeling of the followings.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I seem to be busier than most people I know</td>
<td>0.69</td>
</tr>
<tr>
<td></td>
<td>Usually there is so much to do that I wish I had more time</td>
<td>0.88</td>
</tr>
<tr>
<td></td>
<td>I usually find myself pressed for time</td>
<td>0.81</td>
</tr>
</tbody>
</table>

TABLE II. T-TEST OF ONLINE REVIEW ABILITY

<table>
<thead>
<tr>
<th>General Online resources</th>
<th>Mean Share</th>
<th>Std. Deviation</th>
<th>Levene’s Test for Equality of Variances</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>0.583</td>
<td>0.164</td>
<td>0.103</td>
<td>2.966 *</td>
<td>0.001</td>
</tr>
<tr>
<td>Female</td>
<td>0.566</td>
<td>0.152</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bulletin Board</td>
<td>Male</td>
<td>0.255</td>
<td>0.169</td>
<td>0.001</td>
<td>1.874</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>0.230</td>
<td>0.137</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interpersonal Contact</td>
<td>Male</td>
<td>0.184</td>
<td>0.103</td>
<td>-2.09</td>
<td>0.035</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>0.180</td>
<td>0.098</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Do Male and Female Favor Online Product Review the Same

**Measurement Model**

Most variables of interests cannot be measured directly as they are not observable. They are called latent variables, but the measurement should be validated before the analysis for casual relationship. To validate the measurement model, this paper uses a conformational factor analysis (CFA). In it, the latent variables are hypothesized and are approximated by the observable variables [37]. It is a proven technique and has been extensively used in econometrics, marketing, sociology, and education [35] [36].

LISREL 8 was used to test the measurement model and to ensure convergent and discriminant validity [42]. The analysis results on CFA report Degrees of Freedom 309 and a χ2 value of 1177.9. Although the P value is 0.0, the Root Mean Square Error of Approximation (RMSEA) is 0.058 (<0.10) [38]. Goodness of Fit Index (GFI) is 0.902; the Normed Fit Index (NFI) is 0.968; Non-Normed Fit Index (NNFI) is 0.973; Comparative Fit Index (CFI) is 0.977. All these results indicate acceptable fit [40]. Moreover, all indicators load significantly to their corresponding factors; satisfying the test for convergent validity [41]. Table I shows the CFA loadings. Reliability test also shows that all the latent variables have Cron-Alpha values greater than the threshold of 0.7.

Since all six latent variables were measured by items in a questionnaire completed by a single respondent, we also check for common method variance [45]. All the measuring items were entered into a principal components factor analysis. It produced six factors, with the first factor explaining only 35 percent of the variance. Moreover, no general factor was apparent in the unrotated factor solution. Thus, common method variance should not be a problem in the study [46]. With these evidences, we confirm the measurement model and can process to the structural analysis.

**Structural Model**

The result for the structural equation models are shown in TABLE III. All these indicate a acceptable fits with the empirical data. The standardized estimated structural equations coefficients are presented in TABLE IV. The analysis confirms most of our hypotheses. Ironically, the TAM for male differs from the female’s, under the study in bulletin board for product review purpose.

Analysis

Presence of gender difference

From the theoretical perspective of the consumer's choice of information sources [17], the shares of use of each source identify the differences across individuals in their ability to use different sources. The transformation involves a recoding procedure. The total time in information seeking for each individual was used as the base for the share; and the shares of the total online time, bulletin time and interpersonal contact time were calculated. Results show that there is a significant difference between male and female in general online review ability (H6) and review ability particularly with interpersonal contact (H7), TABLE II. It confirms our hypotheses. However, they do not show difference in the ability to use bulletin board as an information source. It concludes that, the ability on online product review with bulletin board is more or less the same between male and female. It may be due to the fact that disagreeing forces are acting at more or less the same magnitude.
TABLE III. FITTING STATISTICS ON THE STRUCTURAL MODELS

<table>
<thead>
<tr>
<th>Description</th>
<th>Overall</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample size</td>
<td>766.00</td>
<td>396.00</td>
<td>370.00</td>
</tr>
<tr>
<td>Degrees of Freedom</td>
<td>312.00</td>
<td>312.00</td>
<td>312.00</td>
</tr>
<tr>
<td>Minimum Fit Function (Chi-Square)</td>
<td>1124.49</td>
<td>768.70</td>
<td>848.46</td>
</tr>
<tr>
<td>Normed Fit Index (NFI)</td>
<td>0.97</td>
<td>0.96</td>
<td>0.95</td>
</tr>
<tr>
<td>Non-Normed Fit Index (NNFI)</td>
<td>0.97</td>
<td>0.97</td>
<td>0.96</td>
</tr>
<tr>
<td>Parsimony Normed Fit Index (PNFI)</td>
<td>0.86</td>
<td>0.85</td>
<td>0.84</td>
</tr>
<tr>
<td>Comparative Fit Index (CFI)</td>
<td>0.98</td>
<td>0.98</td>
<td>0.97</td>
</tr>
<tr>
<td>Goodness of Fit Index (GFI)</td>
<td>0.90</td>
<td>0.87</td>
<td>0.86</td>
</tr>
</tbody>
</table>

TABLE IV. STANDARDIZED ESTIMATED IN THE MODELS

For male, the product involvement is of much greater influence to the perceived usefulness of the bulletin website (H8). The standard errors are 0.053 and 0.052 for male and female, respectively. And for female, the information quality is of much greater influence to the perceived usefulness of the bulletin website (H3). The standard errors are 0.055 and 0.062 for male and female, respectively. These two differences are significant to the 0.05 level. Moreover, the long-held gender-indifferent TAM is challenged together with these differences. Perceived usefulness may not lead to positive attitude towards a bulletin board when it is used for product reviews (H1). (The standard errors are ignored here due to the insignificance of the path in female group."

Male (generally more technology affinity but exhibit a weaker sensitivity to the opinions of their friends [1]) actually does not care as much as female does in the review information. Thus, information quality exhibits less influence to the perceived usefulness in the male group. Nevertheless, male shows a greater interest in communications technology related matters [7], satisfying this need of him is more essential [10]. A proper bulletin board serves this purpose in a timely and economic manner [10]. These fulfill the requirement of male. The more his product involvement is, the more is such need for a website. Thus, his product involvement plays a more dominating role in the perceived usefulness of the bulletin board.

The insignificant path of H1 in the female group can be explained by the fact that information quality actually dominates the influence to attitude towards the bulletin board. The general information quality is very important to female, as that is the cue for her evaluation of her satisfaction due to the service quality of the information source [47] - the alternative way to the attitude towards the bulletin board [1]. At the same time, in the correlation relationship among the three latent variables – perceive usefulness, information quality and attitude towards the bulletin board, information quality actually partials out the correlation between perceive usefulness and the attitude towards the bulletin board. All these make happened the very low correlation between the two TAM members.

It might be that the above gender-related differences are due to the difference in internet information search skill1 between the genders. Thus, here presents a post-hoc analysis to address the suspicion. However, the internet information search skill is a formative measure [43]. It is too complicated to handle with the structural model as shown in Fig. 1 [44]. Instead, we use multiple regressions on the summative measures to reveal the effect of the search skill on the two involved hypotheses, H1 and H8 in TABLE V.

Just as Koufaris predicts [16], gender does make a difference in the TAM model under specific context. The test of the models provides the evidence. In the context of product review, information quality and product involvement play important roles in the TAM. These can be explained by the literature in consumer research, which identifies that gender makes some differences.

Conclusions

This paper has presented a casual model from the consumer behavior perspective on top of the technology user model. The SEM analyses provide a holistic view of the latent variables under investigation. Empirical evidence shows that the mechanism behind TAM may differ according to gender. As a result of the considerable differences in the context of product review between males and females, it may be necessary to devise a more gender-specific strategy for building a bulletin board for the purpose. Although female is less sensitive to technology and use online resources for product review less, our result suggests that female demands more information quality on bulletin board. This piece of information would be valuable for online companies when they like to differentiate themselves from their competitors with a gender focus. The implication is that, for site or blog owner interested in product review, they should work on promoting information quality, as it is more important for female.

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For the moderator, if any, domain expertise on the product is thus more important than social skills or technological skills in site development. Development skills are however important, when such skills are directed to develop interface to encourage other participant to review a product. Practitioners may seek advice from such experts, e.g. [48][49]. This could also be accomplished and enhanced by highlighting provisions to specific gender. For instance, fashionable and attractive styling is very important to females [10]. And, this issue is highly related to the information quality of timeliness.

Care should be taken when generalizing the results of our study. Consumer behavior itself is a multifaceted concept, and although our study focused on a major component of product involvement, which is related to the consumer’s need and information search motivation, other components like demographics, psychographics, personality, motivation, knowledge, attitudes, beliefs, and feelings could yield different results. Our study also had some limitations due to the use of young subjects in our experiments; however, they had similar profiles to those of typical web shoppers but did not include novice or older potential online customers.

Acknowledgment

The study was partially supported by the Socio-cultural Development Research Association, Macau. Without their assistance, this paper should never be accomplished.

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California, Berkeley, 102 South Hall, Berkeley, CA 94720


Figure 1. The structural model
IOS–ENABLED CONTROL IN MOBILE SERVICE PARTNERSHIP-A CASE STUDY

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Abstract
In mobile service partnership (MSP for short), partners’ opportunism has become a serious question which obsessed mobile network operators (MNO for short) and impedes healthy growth of mobile services chain. For loose-coupled inter-organizational cooperation partnership, the implementation of formal control is often faced with many challenges. Meanwhile, mobile communication service industry is one of highest-level IT/IS equipped sector, how IT/IS affects control mechanism in MSP is the main objective of this study.

Drawing from a typical case study, we identify what characteristics of MSP are more vulnerable to inclination of opportunism. On the other hand, we report the significant role that interorganizational system (IOS)-enabled process control played in curbing opportunism in MSP from this case. Lastly, we conclude some managerial implication of our study.

Keywords: IOS, mobile service platform, control, partnership

Introduction
Telecommunications is one of the most turbulent industries in today's economy. Among this industry, the fast growth of mobile value-added service has acquired high attention and was predicted as the most potential business in incoming “3G” era.

In the mobile service sector, MNOs and service providers/content providers (hereafter we all use SPs to refer to both two unless otherwise specified) formed a unique cooperative relationship. [1] identified relationship between MNO and its partners as a virtual and global one which enacted through an inter-organizational information system (IIS). [2] called this relationship “strategic community”; specifically, partnership between mobile operator and SPs as “Portal community”. As the former focus on communication medium and the latter emphasized strategic attribute of this partnering, this relationship is supposed to be learned from different angles.

In line with prior literatures which studied telecom partnership, we think, MNO and SPs have established a cooperative strategic alliance partnership but with its distinguishing feature. Both of two parties focused on their own specialty, therefore joint surplus can be created only through melting by complementary skills, routines and capabilities of specialized partners [3]. Using Das’s analogue that opportunistic behaviors by partners are like “thorns on the stems of roses” [4], alliance solely pursuing fast growth was easily exposed to the hidden “thorns”. Opportunistic behavior of one or more partners to an alliance is often suggested as a primary cause for the failure of an alliance to achieve the goals and purposes of the partners [5].

Control in alliances is generally viewed as a process of regulation and monitoring for the achievement of desired alliance goal [6]. In MSP, control is implemented by controller (operator) to influence controllee (service providing partners) through a variety of governing actions. The main purpose of control is reduction of goal incongruence and interest divergence among organizational members. Although control can be costly and challenging, it is often presumed necessary to curb opportunism [7].

We focus on formal control in alliance. There are two main modes of formal control: 1) Outcome control, which refers to the prespecification by the controller of desired controllee outputs and the associated evaluation criteria; 2) process (or behavior) control, which refers to prescribing the methods and procedures that the controllee should follow [8]. The two forms of control play different part in curbing opportunism. Outcome control, similar to market mechanism, can effectively avoid “free-ride” behavior of alliance partners; comparatively, process control by regulating the conduct of partners to prevent major surprise may effectively reduce opportunism in a more direct way.

Process control increases the ability to detect opportunism, and accordingly make rewards and sanctions to the partner's behavior more appropriately [9]. Moreover, from a behavioral perspective, the monitoring process itself may place uncomfortable social pressure on a party and thereby increase compliance [10].

As the new form of internet-based fraud emerging, some academic interest has transferred to more advanced IOS controls, such as EDI controls [11]. However, existing literatures on IOS and organizational control are limited, most of them
focus on EDI [12][13], and Organizational context, technology factors, task characteristics and relational factors are suggested to influence EDI control. Although the purpose of IOS is to enhance cooperation and control, some practical works claim IOS often merely play a part in monitoring [14].

As there are few studies concerning how IOS is used to control over partners’ opportunistic behaviors, and IOS served in mobile service sector usually has surpass the scope of “information links” or “electronic market”[15]. So the study in this filed still needs more specific evidence and understanding.

In this study, we want to explore these questions: How does focal firm govern partners’ opportunistic behavior effectively? As a typical virtual partnering relationship, we also want to know what role that IOS played in alliance control, and further more in curbing opportunism in MSP.

For seeking evidence to answer the questions we interested, a specific case is leveraged to find answers. Firstly, we extensively collect documentation and report material about China Mobile and its value-added service chain. An interview to several experts, including three managers in China Mobile and two managers in main SP to verify data we used, meanwhile, their insights on the above research questions have been organized to develop our proposition.

The Rest sections outline our analyses and results; and discuss the implications of the study. Lastly, we conclude some managerial implication of our study, and index the limitations of our study, suggest directions for further research.

**Case study**

China Mobile Communications Corporation (“China Mobile” for short) is the world’s largest mobile telecom operator in terms of network scale and subscriber base. By 2008, the number of subscribers has reached 400 million.

China Mobile and SPs cooperated in the open and mutual beneficial basis mainly through “Monternet” business model which launched by China Mobile in 2000. From initial mainly focusing on SMS-based value added services, the “Monternet” business has become synthesized mobile services including various types of wireless data services and voice value-added business.

In China Mobile and value-added service providers partnering development process, there has several distinctive key stages:

Prior to August 2004, the value-added business was in its infancy. China Mobile attracted partner to its “open value chain” without serious selection just running for high speed. The qualification of SPs is uneven. Some SPs adopted deceitful behaviors to pursue high profit. Since lack of corresponding regulations and sanctions, their misconduct didn’t accept enough punishments. Meantime, although high profit stimulate fast growth of value-added services, the misconducts of SPs also affect interests of subscribers seriously and lower their confidence to mobile value-added services. The whole services chain was affected consequently.

Facing this case, both the MNOs and government regulator step up efforts on the regulating and managing of SPs from 2004. At the same time, China Mobile also strengthened the supervision of SPs and issued some regulations.

In the end of 2004, China Mobile constructed a data service management platform (DSMP) system named MISC (mobile information system center, more detailed introduction and process reengineering see Appendix). The management of contracted SPs was transferred in this powerful platform in succession.

Meantime, China Mobile prescribed a series of new methods to implement control. In the starting of cooperation, the outcome control implemented by China Mobile only focuses on partners’ business performance. When recognized that opportunism has damaged the whole alliance’ interests and reputation, China Mobile began to evaluated partners’ performances based on both business performance and credit.

From October 2005, China Mobile introduced credit score approach to manage SPs in Monternet, which is based on credit assessment of SPs negatively to their irregularity. The credit score approach mainly measures SPs’ trustworthiness, business and service quality, not including operating income. The indicators of credit score management have three dimensions including: SPs’ violation, customer complaints, and the fulfillment of contract. The low-level credit SPs will subject to punishment from business suspension until the termination of operation. The high-level credit SPs have qualification to participate China Mobile’s “leveled management” in which SPs will obtain different resource support from China Mobile according to their business performances.

Since there methods were adopted, the opportunistic behaviors of partners were held up effectively. For instance, according to the public financial reports of listed SPs like Linktone (NASDAQ: LTON), Kongzhong (NASDAQ: KONG), they all attribute d revenues decline during 2004 and 2005 to application of MISC platform as the main affecting factor coincidentally. This also proved MISC platform played a role in rectifying misconducts of SPs.

**Analysis and discussion**
This case reveals some beneficial implications, and we discuss our finding as follows.

**IOS-enabled process control**
The case studies revealed that one of the most important enablers of efficient process control is that an appropriate deployment and implementation of interorganizational information system (IOS) which can effectively reduce partners’ misconducts and thereby decrease the threat of opportunism.

Some key value-added service processes was transformed after adoption of MISC, and the transformation effectively curb SPs’ opportunistic behaviors including modify business logic, enforcing subscription, hostile mass message sending et al.

The IOS-enable process control plays a role in curbing opportunism from following aspects:

1) Facilitate automatic monitoring. Employing IOS, the content delivered by SPs towards end users can be monitored automatically, non-compliance and ill messages will be blocked accordingly, thereby reduce SPs’ fraudulent behaviors.

   Automation by IOS helps to reduce process variance, thereby effectively reduce human intervention. e.g. IT always acts as an automatic tool of process implementing, which makes controllees’ act in accordance with prespecification.

2) Automate key business process. The IOS replaces human to achieve certain key processes, facilitates information and data flow between MNO, service providers and end users without human intervention.

3) Synchronize business process. IOS helps to increase process synchronicity which can effectively reduce human intervention. Employing IOS, many processes of previous independent business units can be synchronized with other business process to assure data reliability and reduce the possibility that partners will change business process logic privately. What’s more, synchronization makes sure that master data is harmonized and homogenized.

4) Standardize business processes and increase business transparency. Through adding authentication of subscription and request, the IOS can effectively prevent SPs from leveraging entry traps to mislead end users.

**IOS-facilitated outcome control**
The influence taken by IOS on outcome control may not as obvious as on process control. However, Deployment and implementation of advanced IOS also benefit to outcome control by facilitating accurate measuring partners’ business performances.

As [16] stated “without precise specification of the expected outcomes, outcome controls are subjective and ineffective”. The extensive use of IT/IS facilitates the efficient gathering of vast amounts of data, thereby forming more accurate measurement of partners’ output. Moreover, IOS is likely to create a relatively advantage for institutional over contractual governance mechanism [17], and controller can render more contingent incentive and outcome control over controllees.

In effect, for purpose of curbing opportunism or strengthening partner relationship management (PRM), more comprehensive and restrictive partner evaluation is needed and depends on more information gathered.

Employed by IOS, focal firm is facilitated to measure partners’ output from many more appropriate aspects, thereby adopt corresponding incentives and sanctions based on more contingent situation. For example, China Mobile can implement “Leveled management” towards SPs based on more comprehensive evaluation from both business performances and credit scores.

**Prerequisites for IOS-enabled control**
This case also highlight that only higher levels of external integration that go beyond simple procurement or communication systems allow focal firms to enhance formal control efficiency. That means some important conditions are supposed to be fulfilled to implement this IOS-enabled control.

Firstly, IOS-enabled control demand focal firm have mature IT-capacity (e.g. China Mobile held majority stake in platform provider — ASPire Technologies to strengthen this capacity). Most of the businesses are carried on based on IT-infrastructure, and thereby business intelligence (BI) can be widely supported. From the above analysis, whatever process control or PRM can’t be achieved without BI derived from mature IT-capacity.

Secondly, a reciprocal interdependent cooperation is demanded between focal firm and its partners. In effect, the resource complementarity of MNO and SPs means that they need to share mutual resources, exchange reciprocity, which are also essential enablers in implementing IOS.

Thirdly, IT strategy should be integrated with partnering strategy with complementary incentive and sanction institution rather than a tool facilitating business process automatically or communication. In this case, whether a series of management approaches issued by China Mobile go behind or beyond IT construction, they can’t work effectively. IT provides MNO with flexible ability to deal with contingency, further, the better use this ability is another art.

**Conclusion**
In this study, we raise the question of partners’ opportunism and its curbing mechanism in emerging MSP. From perspectives of organizational control
and IOS, we propose our central argument that an IOS-enabled process control can effectively curb opportunism, which is illustrated by using a typical case study. In our context, we implied that the IOS-enabled process control is linked with focal firm’s mature IT capacity. In addition, the focal firm incorporated technology strategy and partnering strategy also contribute to the success of IOS-enabled process control.

We also discussed the prerequisites for efficient implementation of IOS-enabled control, not merely related to task characteristic, industrial context, the complementarity between institutional arrangement and IOS practices is highlighted as well.

Several limitations still exist in this work. Firstly, our evidence rest on qualitative analysis of a typical case, we still need more quantitative data to support our results. Secondly, we focus our interest on IOS’s impact on formal control, but how IOS use affect informal control, like some relational governance mechanism, is still needed to be inspected in MSP further.

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**Appendix**

**Table 1** key processes reengineered before and after adoption of MISC

<table>
<thead>
<tr>
<th>Item</th>
<th>After Upgrade</th>
<th>Before upgrade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subscription records storage</td>
<td>Subscription records are only stored by SP.</td>
<td>Subscription records are stored in MISC and SP’s system simultaneously, and validation should based on MISC</td>
</tr>
<tr>
<td>Subscription status delivery</td>
<td>Notification of subscription is delivered by SP own</td>
<td>Notification of subscription as well as canceling are delivered by MISC</td>
</tr>
<tr>
<td>Subscription canceling</td>
<td>Services canceling process is charged by SP own</td>
<td>Services canceling process is automated by MISC</td>
</tr>
<tr>
<td>Monthly charges</td>
<td>SP launched monthly charges request independently</td>
<td>MISC launches monthly charges request based on valid subscribers instead of SP</td>
</tr>
<tr>
<td>Authentication of Subscription and request</td>
<td>No authentication of Subscription and request, all the messages were delivered to SP by gateway</td>
<td>All the MO/MT messages must be authenticated by MISC</td>
</tr>
<tr>
<td>Synchronization of subscription records</td>
<td>Subscription records were only stored by SP, no synchronization exist</td>
<td>Subscription records were synchronized in MISC and SP’ system through Provision interface.</td>
</tr>
</tbody>
</table>

**Reference**


THE EFFECT OF IT, GEOGRAPHICAL COVERAGE, SERVICES, AND MANAGERIAL COMPETENCE ON 3PL SERVICE PROVIDERS’ PERFORMANCE IN CHINA

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Abstract

The resource-based view (RBV) indicates that firm performance is determined by the availability of rare and heterogeneous resources. It is important for third party logistics (3PL) firms to identify the core resources that will enable them to develop and maintain core competencies. In this study based on RBV theory, our objective is to test the effects of information technology (IT) infrastructure, IT capability, geographical coverage, range of services, and managerial competence on logistics service quality and financial performance among Chinese 3PL firms. Exploratory and confirmatory factor analysis and other tests were used to demonstrate the reliability and validity of our model constructs. Furthermore, the LISREL structural equation model estimation results illustrated that geographical coverage, range of services, and managerial competence have positive effects on financial performance; that information technology capability and managerial competence have positive effects on logistics service quality, and that geographical coverage and range of services have negative effects on logistics service quality.

Introduction

The importance of effective supply chain management (SCM) has become increasingly apparent in recent years. Businesses continue to recognize the role of SCM in creating and maintaining a strategic competitive advantage through increased customer value and satisfaction and the attendant business profitability (Mentzer, 2001; Stank et al., 1996). While a number of studies focus on supply chain performance, most of the extant literature centers on participants on the upstream side of supply chains such as manufacturers (Lieb and Miller, 2002; Lieb and Bentz, 2004). Logistics plays an increasingly important strategic role for organizations that strive to keep pace with market changes and supply chain integration (Laura and Joseph, 1998). Realizing that an essential aspect of SCM is consistent, high-quality logistics services, a great number of firms outsource their logistics activities to focus on developing competitive advantages (Muller, 1991). However, little interest has been shown in the performance of logistics service providers. Bowersox et al. (1995) identified four paradigm shifts or changes in strategic practices resulting from the use of information technology in logistics practices. Lieb et al. (2002; 2003; 2004) considered the current status and future prospects of the third-party logistics industry in the United States. However, to the best of our knowledge, no previous study has focused on the operation and performance of 3PL firms. Little is known about what enables some logistics firms to perform better than others (Ellingera et al., 2007). It is essential for LSPs (logistics service providers) to consider ways in which they can improve the quality of logistics services and organizational performance as a means of competing in an intensely competitive market (Photis and Meko, 2005).

The resource-based view (RBV) indicates that firm performance is determined by the availability of rare and heterogeneous resources. It is important for third-party logistics (3PL) firms to identify the core resources which can be used to develop and maintain core competencies. In this study based on RBV theory, our objective is to test the effects of information technology infrastructure, information technology capability, geographical coverage, range of services, and managerial competence on the logistics service quality and financial performance of 3PL firms in China.

The remainder of the paper is structured as follows. The next section reviews the literature and develops our hypotheses. The third section explains our research methodology, including construct measurement, data collection, and hypothesis testing, and reports our results. We conclude the paper by presenting our conclusion and discussing the managerial implications.

Literature review and hypotheses

Africk and Calkins (1994) referred to a 3PL relationship as “a relationship between a shipper and a third party which, compared with basic services, has more customized offerings, encompasses a broader number of service functions and is
characterized by a longer-term, more mutually beneficial relationship.” Stank and Maltz (1996) regarded a 3PL provider as “any firm providing a good or service that is not owned by the purchaser of the good or service.” Lieb and Randall (1996) defined 3PL as “outsourcing activities that have traditionally been performed within an organization. The functions performed by the third party can encompass the entire logistics process, or more commonly, selected activities within that process.” Given that this study focuses on the relationships between internal resources and performance and because 3PL firms in mainland China are still in the developmental stage, we prefer Lieb and Randall’s (1996) definition in this context.

Several prior studies have examined 3PL performance. Germain et al. (1996) studied the relationship between the just-in-time (JIT) inventory strategy and logistics management and performance. Their findings indicated that the greater the JIT orientation of the firm, the greater the level of performance measurement information available to logistics managers, the more specialized the logistics function and decentralized logistics become, and the more integrated logistics strategic decision-making becomes with other functions. The financial and market performance of the firm also improve with JIT implementation. Ellingera et al. (2007) proposed that market orientation and certain employee development practices (service-related training, coaching, and empowerment) influence both employee and organizational performance. Panayides and So (2007) examined the influences of relationship orientation in 3PL and its impact on logistics service quality and performance. Their findings suggested that relational exchanges have a positive effect on 3PL logistics service quality and performance.

The RBV, which was proposed by Wernerfelt in 1984, has attracted considerable attention and enjoyed widespread support in the strategy literature. Barney (1991) pointed out that firms compete on the basis of “unique” corporate resources: resources that are valuable, rare, difficult to imitate, and non-substitutable. This view of the firm is based on the assumption that resources are both heterogeneous across firms and imperfectly mobile (Hunt and Morgan, 1995). In the LSP context, these resources can be tangible (e.g. equipment, plants, fleets, hardware) or intangible (e.g. organizational processes, skills, know-how, reputation), and enable LSPs to attain superior performance (Daugherty et al., 1996; Murphy and Poist, 2000) and foster strategic partnerships with customer firms (Skjoett-Larsen, 1999). Based on a study examining the competitive resources of 3PL providers in mainland China, we found that information technology infrastructure (IT inf), information technology capability (ITC), manager competence (MC), and service network (SN) can affect logistics service effectiveness (LSE) and financial performance.

Hypotheses

Geographical coverage, the range of the service network, and performance

Shippers tend to favor 3PL service providers that cover a wide geographical area and offer an enhanced range of services networks. Bottani and Rizzi (2006) showed that shippers prefer 3PL service providers that offer a broad range of services rather than using those that provide traditional arm’s length outsourcing for a single activity. Shippers’ objective of using a one-stop shop is also fulfilled if a 3PL service provider expands its geographical coverage and range of services. Thus, 3PL service providers with wide-ranging service networks will attract more customers and increase their market share. At the same time, 3PL services providers that are willing to respond quickly to new shipping requirements through their service networks are likely to improve customer satisfaction, resulting in greater market share and better financial performance.

Hence, we propose the following hypotheses:

Hypothesis 1a: Increasing geographical coverage and service network range has a positive effect on logistics service effectiveness (LSE);

Hypothesis 1b: Increasing geographical coverage and service network range has a positive effect on financial performance.

IT infrastructure and performance

Due to the relatively low barriers to imitation and acquisition by other firms, IT-based advantage tends to diminish fairly quickly (Clemons & Row, 1991). Therefore, IT, as part of a firm’s resource portfolio, probably does not meet the resource-based view criteria when acting alone. How IT as a resource can provide a sustained competitive advantage for a firm has become one of the key research topics in recent years.

The related literature supports the idea of IT as an enabler of logistics activities and documents its role in supply chain strategy, and several studies have directly associated higher IT usage with better performance. For example, Sum and Teo (1999) observed heavy usage of IT in the most profitable logistics service providers and identified the importance of technology as a key impact agent for the future. IT is one of the essential components of logistics systems and supports daily operations in many ways. The use of IT leads to an improvement in service level and increases the competitive posture of the company (Bowersox and Daugherty, 1995; Sum and Teo, 1999).

Hence, we hypothesize as follows:

Hypothesis 2a: Heavy usage of IT infrastructure
can positively affect financial performance;

Hypothesis 2b: Heavy usage of IT infrastructure can positively affect logistics service effectiveness (LSQ).

IT capability and performance
Given the types of IT infrastructure that have been applied to logistics activities, the successful implementation of IT, which we refer to as IT capability, is expected to bring a number of benefits to the logistics field. Closs et al. (1997) showed that IT capabilities significantly affect the overall competence of logistics providers. Furthermore, IT not only improves the effectiveness and efficiency of logistics processes, but the successful implementation of IT can have a significant impact on the practical execution of logistics strategies and on organizational structure choices. In general, enhancing a firm’s IT capability can yield a wide range of potential benefits, such as improving service effectiveness, reducing data entry errors, and increasing customer service satisfaction (Piplani et al. 2004). In addition, advances in IT capabilities have significantly improved the extent of internal and external organizational information sharing. IT capability has been positively linked to firm performance (Bharadwaj, 2000; Kearns and Lederer, 2003). We thus make the following predictions:

Hypothesis 3a: Enhancing a firm’s IT capability can positively affect its financial performance;

Hypothesis 3b: Enhancing a firm’s IT capability can positively affect its logistics service effectiveness (LSQ).

Managerial competence and performance
RBV theory proposes that resources that are rare, valuable, and difficult to imitate enable firms to attain superior performance (Daugherty et al., 1996; Murphy and Poist, 2000). Managerial competence is one such resource. According to Gatewood and Field (1994), knowledge, skills, and abilities are predictors of success on the job. For instance, social skills, problem-solving skills, decision-making skills, and work experience have a positive effect on job performance (Matthew et al. 2004). On the one hand, decision-making skills enable managers to deal more effectively with ambiguous situations, leading to more confident and timely decisions and an ability to make difficult decisions in dynamic or volatile markets (Matthew et al. 2004). On the other hand, problem-solving skills enable managers to solve customers’ problems and improve customer satisfaction. In addition, work experience and social skills have both been proven to have a positive effect on job performance (Waldman et al. 2001). Because managers’ job performance is related to firm performance, we hypothesize as follows:

Hypothesis 4a: The better the managerial competence of a firm, the better will be its financial performance;

Hypothesis 4b: The better the managerial competence of a firm, the better will be its logistics service effectiveness (LSQ).

Logistics service effectiveness and firm performance
3PL organizations that deliver effective logistics services will benefit from enhanced organizational performance for several reasons. First, LSPs that keep their clients satisfied through their ability to solve problems, keep accurate records, deliver services on time, and communicate effectively can increase customer satisfaction (Leuthesser & Kohli, 1995) and loyalty, which has been viewed as a proxy for market share (Innis & La Londe, 1994). Second, a high level of customer satisfaction has been linked to improvements in a firm’s economic returns, including market share and profitability (Anderson, Fornell, & Lehmann, 1994; Crosby, Evans, & Cowles, 1990). Daugherty, Stank, and Ellinger (1998) and Stank, Goldsby, Vickery, and Savitskie (2003) have also reported empirical investigations indicating that logistics service performance (availability, reliability, and speed) ultimately has an impact on market share. Furthermore, Photis (2005) concluded that logistics service effectiveness has a positive relationship with firm performance as measured by market share, profitability, sales growth, return on investment, and overall performance. On this basis, we hypothesize that:

Hypothesis 5: Increased logistics service effectiveness has a positive effect on the financial performance of firms.

Research methodology
Measurement Development
We measured geographical coverage and service network range by the number of service branches in capital cities and prefecture-level cities and the total number of service branches. To the best of our knowledge, no prior study has proposed measures for these items. To determine the number of service networks available in each option, we statistically analyzed the number of service networks available based on 3PL firms’ Web sites in a frequency study. Our measurements of IT infrastructure and IT capability were drawn from the studies conducted by Bowersox and Daugherty (1995), Shaukat and Hua (2006), and Sum and Teo (1999). We revised the IT infrastructure items due to technological obsolescence and innovation. The respondents to our study were required to indicate the degree to which specific types of IT infrastructure were used on a Likert scale in which the responses ranged from 1-5. We also increased the number of IT capability items after holding discussions with logistics and supply chain management experts and scholars on issues such as seamless links between 3PL firms’ IT systems and customers’ IT systems and good
connections among 3PL firms’ internal IT systems. All these measures were scored on a Likert scale in which the responses ranged from 1-5.

Our managerial competence items were taken from several studies on issues including experience in the logistics field, communication skills, decision-making ability, and problem-solving skills (Matthew et al. 2004; La Londe and Pohlen 2000; Sandberg 2000). Respondents were asked to indicate the degree to which they agreed with a statement on a Likert scale in which the responses ranged from 1-5.

Logistics service quality was measured using items that capture essential aspects of the logistics domain, as defined by Mentzer et al. (2001). These items were tested and refined through interviews held with logistics managers and after being subjected to configurational frequency analysis (CFA). Given the objectives of this study, logistics service quality was also conceptualized as an operational measure that encompasses the factors leading to competitive success in logistics, including reliability, timeliness, responsiveness, problem-solving ability, information accuracy, variety of services, and flexibility (Mentzer et al., 2001; Beamon, 1999; Gunasekaran et al., 2001). LSPs were asked to indicate the extent to which they were effective in the delivery of logistics services (as measured by the aforementioned items) in comparison with their competitors. All these measures were anchored on a Likert scale in which the responses ranged from 1-5.

Financial performance was measured by items such as sales growth, market share, profitability, and investment return, which were drawn from studies carried out by Morgan and Piercy (1998) and Kotabe and Murray (1990). The measurement we used for business performance was based primarily on two general approaches that involve the use of either objective or subjective measures of performance. In the context of this study, subjective measures of performance were deemed to be more appropriate than objective measures. Although it has been recognized that subjective measures of financial performance carry a degree of risk because managers are more likely to over-evaluate their own performance than others (Weber, 2001), we chose to use subjective measures because only a small proportion of Chinese 3PL companies are publicly traded and secondary data on such companies are less readily available. In addition, financial performance data are difficult to obtain through surveys of managers typically carried out in mainland China.

Sampling

The samples used for this study comprised all members of the China Federation of Logistics and Purchasing. The China Federation of Logistics and Purchasing is the biggest, most authoritative logistics association in mainland China. We used two methods to collect our samples. The first was an E-mail survey in which we obtained the E-mail addresses of 3PL firms from their Web sites or from contact lists from logistics forums. We distributed a total of 350 questionnaires and received 31 responses. Due to the low number of respondents, we supplemented our sample by using a second method consisting of face-to-face questionnaire-based interviews with managers of 3PL firms in Shenzhen, Guangdong. This second method naturally resulted in a 100% response rate and yielded 160 questionnaires, 114 of which were usable. This left us with a total of 191 questionnaires, 145 of which were usable, resulting in a 37.45% response rate.

Results

Profile of Respondents

Among the 145 mainland Chinese 3PL firms in our final sample, 40.69% were privately owned by Chinese proprietors, 10.34% were state-owned companies, 16.55% were joint ventures, and 24.83% were foreign-owned. The number of employees of 3PL firms, indicating that about half of the respondents were at least medium-sized. Part C shows that more than 90 percent of the 3PL firms in our sample had been operating in China for more than three years. Part D indicates that more than 60 percent of the sampled 3PL firms had sales revenue of less than 5,000 million RMB in the previous year. Of the 145 3PL firms, 12.41% outsourced their entire IT function, 21.38% outsourced most of their IT function, and 31.03% outsourced a smaller part of their IT function. 10.9% of the 3PL firms in our sample provided services to the food, furniture and wood industry, while 2.96% provided such services to the construction industry. Part H shows that more than 20% of the 3PL firms in our sample provided transportation and freight forwarding services, whereas only 6.54% provided value-added services. These results imply that most 3PL firms provide traditional types of logistics services and that few have extended their operations to value-added or customized services.

Reliability and validity of measurements

We used SPSS 13.0 and Lisrel 8.70 to test both the reliability and the convergent and discriminant validity of our measurements. First, the content validity of an instrument represents the extent to which it provides adequate coverage for the construct domain or the essence of the domain being measured (Churchill, 1979). Content validity is not determined numerically, but on a subjective and judgmental basis (Emory, 1980). Prior to collecting our data, the content validity of the instrument was established by grounding it in existing literature. Pre-testing of the measurement instrument before additional data were collected further established its validity. The scales were tested for normality and outliers using the Kaiser-Meyer-Olkin (KMO) measure of
sampling adequacy and the Bartlett test of sphericity in EFA (exploratory factor analysis). Using SPSS 13.0 to analyze the scales, we found that they all exhibited normality. The KMO values ranged from 0.76 to 0.92, comfortably in excess of the 0.50 value Kaiser (1974) suggested. All the results of the Bartlett tests of sphericity were significant at the p=0.00 level. Taken together, the results indicated that the measurements had a good level of fit for factor analysis. In addition, the principal component procedure from SPSS 13.0 was used to test the latent variables. The eigen values for their factors were above the 1.0 cutoff point, while the percentage of variation was around 60 percent. All the latent constructs exhibited a good level of reliability. The constructs were accepted if the Cronbach’s alpha value was greater than 0.7 (Cronbach, 1951; Flynn et al., 1994) The Cronbach’s alpha values ranged from 0.83 to 0.93, exceeding the cutoff point of 0.70 suggested by Nunnally (1978).

Convergent validity indicates the degree to which different measures of the same construct are highly correlated and hence yield the same result (Hensley, 1999). Generally, a construct with a reliability value of at least 0.30 and a significant t-value for loadings (e.g., t > 2.0) is considered to be convergent valid (Hair et al., 1995). All the factor loadings ranged from 0.47 to 0.89 and that the T-values for the factor loadings were greater than 5.0. These results strongly suggest that all indicators measure the same construct (Anderson and Gerbing, 1988). We also calculated composite reliability to assess the reliability of the individual indicators based on confirmatory factor analysis (Bagozzi et al., 1991). Composite reliability represents the shared variance among a set of observed variables measuring an underlying construct (Fornell and Larcker, 1981) and a value of at least 0.6 is considered desirable (Bagozzi and Yi, 1988: 82). The values of composite reliability were all greater than 0.90. The average variance extracted is a direct measure of the amount of variance captured by the construct in relation to the amount of variance due to measurement error. Values of 0.50 and above are desirable (Hair, Anderson, Tatham and Black, 1998).

One of methods used to test discriminant validity is to fix the correlation between various constructs to 1.0 and then re-estimate the fixed model. A significant difference in $\chi^2$ between the fixed and unconstrained models indicates high discriminant validity (Lytle, Hom, and Mokwa, 1998). By fixing the correlation between any pair of constructs to the perfect correlation of 1, we found that the $\chi^2$ values increased by at least 16.57. With changes in one degree of freedom, these values were significant at the p = 0.01 level ($\chi^2 > 6.64$). shows the correlation matrix and descriptive statistics for the research variables examined in CFA. The variable means ranged from 2.10 to 4.08. The standard deviations for the variables ranged from 0.84 to 1.6, indicating a considerable degree of variation in the responses. The correlations ranged from 0.04 to 0.76. The hypotheses were later tested more stringently using a structural equation model (SEM).

The confirmatory factor analysis (CFA) model fit indices calculated included the $\chi^2$ to degrees of freedom statistic of 1.87 (below the recommended value of 3.0 suggested by Bollen (1989)). The LISREL 8.70 output showed adequate model fit, as follows: (1) CFI was 0.95, NNFI was 0.95, PNFI was 0.82, and PGFI was 0.62; and (2) RMSEA was 0.10, indicating a close model fit (Steiger, 1990).

### Hypothesis testing

The fit statistics indicated that the hypothesized model achieved acceptable fit ($\chi^2$=881.82; df=480; p=0.00; CFI=0.96; NNFI=0.95; PNFI=0.82; PGFI=0.63; RMSEA=0.07; SRMR=0.08). Given the satisfactory fit of the model, the hypotheses were evaluated by examining the estimated structural coefficients.

Specifically, we show the paths linking: (1) geographical coverage, service network range, and logistics service quality (B=0.14; T=2.03); (2) geographical coverage, service network range, and financial performance (B=0.38, T=3.85); (3) IT capability and logistics service quality (B=0.43, T=3.90); (4) managerial competence and financial performance (B=0.38, T=2.98); and (5) managerial competence and logistics service quality (B=0.42, T=3.1). To avoid the mediated effect in the full structural equation model, we separated the latent variables, logistics service quality (LSE) and financial performance. The statistics for model fit were as follows: $\chi^2=1031.77; DF=488; p=0.00; CFI=0.94; NNFI=0.93; PNFI=0.82; PGFI=0.61; RMSEA=0.08; SRMR=0.08$. The path value was 0.30 and the T value was 3.10. The empirical result was significant.

### Discussion and implications

This study contributes to empirical research on the performance of third-party logistics firms by specifically investigating the effects of information technology infrastructure, information technology capability, geographical coverage, range of services, and managerial competence on logistics service quality and financial performance. In general, the results provide empirical evidence on the areas in which 3PL firms can take initiatives to enhance their operations and improve performance.

First, this study used the number of service branches in capital and prefecture-level cities and the total number of service branches to measure geographical coverage and service network range. The reliability and validity of our model constructs showed that the measurements we adopted are feasible. Our results indicated that increasing

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geographical coverage and service network range can have positive effects on financial performance, but may have negative impacts on logistics service quality.

Second, IT infrastructure does not appear to have a significant effect on either logistics service quality or financial performance. Our results suggest that IT infrastructure does not meet the resource-based view criteria because of low barriers to imitation and acquisition by other firms (Clemons & Row, 1991). There is another possible explanation for this result. Our descriptive statistics show that less than 20% of the 3PL firms in our sample were established more than 15 years ago, making it possible that our sample firms may have begun to invest in IT infrastructure only recently. It may take some time for the benefits of such investment to be reflected in firm performance. In addition, IT capability has a significant positive effect on logistics service quality. This result is in line with that of Piplani et al. (2004). However, IT capability has an insignificant influence on financial performance. The correlations among our measurement items show that the relationship between enhanced IT capability and financial performance is positive. This insignificant result may be due to the hysteretic quality of IT capability. In general, it is better for 3PL firms to focus on developing their IT capabilities rather than making excessive IT infrastructural investments.

Third, managerial competence has positive effects on both logistics service quality and financial performance. To some extent, managerial competence can be measured by relevant experience, communication skills, problem-solving ability, and decision-making ability. Our empirical results show that managerial competence could represent a unique resource (Matthew et al. 2004). 3PL firms should pay more attention to developing managerial competence in an effort to improve both operational and financial performance.

Finally, this study has shown that logistics service quality has an impact on the composite measure of firm financial performance adopted in this study. It has also shown a direct causal link between logistics service quality and financial performance. Our empirical result shows that 3PL firms may secure better financial returns, greater market share, and higher investment returns if they devote their efforts to improving logistics service quality.

**Limitations and future research**

Our empirical analysis was undertaken using data collected from 3PL firms in mainland China. Although our results carry with them some managerial implications, we would interpret them with caution due to several limitations. First, it is likely that more accurate results would have been achieved if we had employed more comprehensive measurements for information technology infrastructure, information technology capability, geographical coverage, range of services, and managerial competence. Second, a larger sample would allow for more definitive managerial implications to be derived.

Future studies would be well-directed if more attention is paid to examining the relationship between business orientation and 3PL firm performance. A comparison of 3PL firms in terms of their business orientation would be a line of research worth pursuing.

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SHARING COMPETITIVE INTELLIGENCE, SECURING COMPANY KNOWLEDGE – A FRAMEWORK

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Abstract
This paper discusses the recognition of critical knowledge residing in companies. Company employees are important sources of competitive knowledge. At the same time the employees have a key role in securing critical knowledge in the company. A framework for recognizing critical knowledge is presented to work for both competitive intelligence and knowledge security perspectives. Employee awareness is essential to both of these perspectives, and the framework is intended to be used in building this awareness.

Keywords: Competitive Intelligence, Competitive Knowledge, Knowledge Security, Knowledge Sharing

Introduction
Competitive intelligence is a process that provides decision-makers with actionable information about what is happening in a company’s business environment. Understanding and anticipating competitors’ actions, possible changes in legislation or launch of a new competing product is essential for the company to maintain and improve its competitive position. A recent trend in competitive intelligence is shifting from analyst-centered competitive intelligence unit serving only the top management into involving all employees and in some cases even external partners, such as suppliers or customers, to participate in competitive intelligence activities (see e.g. [1], [2]).

Employees are seen not only as valuable sources of competitive information but also having an important role in refining that information. When information regarding competitive environment is processed in employees’ head to have a concrete meaning in the company’s context it is simultaneously refined into more valuable and usable form; competitive knowledge [3].

Companies aim to the best possible use of competitive knowledge. There are many mechanisms that aim to efficient knowledge sharing within a company. Competitive intelligence is an area where the smallest bits of knowledge about the operations and plans of competitors should be gathered together in order to construct a good overall picture of the competitive environment of a company. Knowing what kind of knowledge is worth sharing within the company is essential for the competitive intelligence process to work efficiently.

When a company tries to protect the competitive position it has, it is essential to keep important knowledge inside the company. Information security processes are built to prevent information from leaking outside. What these processes do not protect as easily is knowledge that resides in the heads of employees. Empowering employees to participate in competitive intelligence efforts may provide the company with better understanding about competitive issues, but it also causes more risks for the company’s information security. How people behave, what they discuss and with whom should be planned and controlled, at least to some extent, so that even the smallest bits of knowledge that might be useful for competitors are kept safe.

Sharing competitive intelligence and keeping company knowledge secure are the two sides of the same medal: important knowledge. The key for success of both activities is the awareness of employees about what knowledge is valuable to the operations of a company. This paper draws on this common factor to build a framework on how to recognize important knowledge, and how to build awareness of it.

Competitive intelligence
A company’s strategy and operations are based on its view on the surrounding world. The view is constructed on the understanding the company has of its surroundings, what is going on and why. Companies apply different kinds of intelligence activities to provide decision makers information to help them build a solid understanding of the prevailing situation and what might be lying ahead. Competitive intelligence is one approach for doing this. Competitive intelligence is continuous scanning of the environment, gathering and linking bits and pieces of information and analyzing them to provide insights to back up decisions that further the company’s business goals [4], [5], [6]. Such external issues as future economic situation, competitors’ actions, customer needs and consumer
trends, changes in legislation etc. are in the focus of competitive intelligence.

Competitive intelligence can be described as a process which, according to several authors (see e.g. [7], [8], [9], [10], [11], [12]), typically consists of the following phases:

- identifying what information is needed in the organization,
- gathering information from multiple sources according to the needs,
- processing and analyzing information by combining it with existing knowledge and applying suitable analysis methods,
- disseminating and sharing information in form of analyses, presentations, reports etc. and storing it in databases or other suitable places, and
- using the information to form decisions that steer the organization towards its goals.

The textbook example of how to do competitive intelligence most efficiently, that has been promoted for last decade, is a centralized, professional and organized competitive intelligence unit (see e.g. [13], [14], [2]). The unit usually consists of a competitive intelligence manager and analysts, whose responsibility it is to provide the needed information to decision makers at the right time in a suitable form. In other words, carrying out the competitive intelligence process and serving the needs of information users. Regardless of the advantages of such an efficiently organized unit, it does not suit every company and all situations. Alternative approaches, such as competitive intelligence networks, have started to gain more attention in recent years. Some companies do very well even without any organized competitive intelligence gathering.

During the last few decades competitive intelligence has evolved from informal and tactically oriented data-gathering into formal competitive intelligence units serving strategic decision making as described above [14]. The next evolutional step of competitive intelligence is that it is no longer the prerogative of the top management practiced by competitive intelligence experts. Instead, competitive intelligence is demystifying, decentralizing and shifting “from serving the few to empowering the many” [2]. The new stage of competitive intelligence emphasizes the value and significance of human input in the competitive intelligence process over information systems and engages employees in the process.

Employees as competitive knowledge assets
The sources of competitive intelligence are various: from personal human contacts to the internet and data bases. The most used sources are often the explicit ones, such as reports from a database, news service feeds or consultant analyses, because due to their definite form they are easier to reach and utilize. Nevertheless the sources more difficult to reach are often more advantageous and human sources are especially valued (see e.g. [15], [8], [16], [17]). For example, using a search engine to find information from the Internet is cheap, quick and brings abundant amount of answers related to the used search terms. However, the search results, though numerous, may not be very accurate or useful in any way. In addition, information obtained from a source available for everyone, such as a public database, does not bring much of an advantage to a company, because the competitors can as easily get the same information from the same source just as easily and fast. Therefore unique sources that possess critical knowledge are of great value.

A company’s own employees are important competitive knowledge assets, and Collins [8] even names them as the biggest intelligence asset of a company. They may have interesting information about competitors, customers and the market situation and they can provide in depth explanations and interpretations to information [16], [18], [19]. This refines information into knowledge that has more value to its holder and receiver. Vitt et al. [12] note, that human input is the key ingredient in creating knowledge, because knowledge cannot be generated through mere technology. Employees can therefore have a valuable role in piecing together a puzzle that reveals a clearer picture of what is going on in a company’s business environment: they create and possess competitive knowledge.

The best source of potential competitive advantage is in knowledge that makes a difference, and is obtained and acted upon before competitors get their hands on it. A company has the best and possibly exclusive access to its employees’ competitive knowledge. The employees can be made aware of the company’s information needs and thus harnessed to be active information gatherers, interpreters and sharers.

Engaging employees in the competitive intelligence process is recognized to be worthwhile, even though not always an easy task. Fuld, Bernhardt and Herring state that the potential of employees as information sources has been underutilized due to a lack of communication and coordination [20]. Employees do not know that the knowledge they possess might be of value to the
company or there is no coordination or medium to share knowledge to others in the company.

However, it must also be pointed out, that not all knowledge employees have is relevant for competitive intelligence purposes, and therefore it is important to identify and communicate what kind of knowledge is interesting and indispensable for the company and should therefore be shared. On the other hand, employees possessing so much important knowledge to their own company can also cause risks.

Knowledge security

Security as a state is often defined as a lack of threat toward an object [21]. When an object is physical in nature, the threats can be more easily identified. A house can be threatened by a flood, or trees falling down. Money transported from a supermarket to the bank is threatened by robbers. The threats that an immaterial object faces are more difficult to recognize. Knowledge is highly immaterial in nature, and thus it is difficult to name all the threats toward it. Despite this difficulty, knowledge, as an important asset to a company, needs to be secured.

When planning the securing of an object it is important to recognize all the threats that face it. At this point discussion on what is a threat is essential. A threat is the consequences of an unwanted event. An example of a threat to knowledge is the unveiling of a plan to publish a new product. This threat can realize itself for example through casual conversation in the wrong place or by an email sent to the wrong recipient. One way to analyze and compare threats is to assign a value to them. The most informative way to do this is to estimate a monetary value to the threat. In the case of physical objects this is fairly straightforward: if a building is damaged, the costs of repair can be estimated quite accurately. In the case of immaterial objects such as knowledge the task is not as easy. How much will the company lose money, if a competitor can react to a product launch early? What is the value of product development knowledge? Even though the task seems impossible, even crude monetary estimates give something to work with (see e.g. [22]).

The estimate of the size of the threat does not usually provide enough information about the threats in order to make decisions on what threats to address and how. As all actions of a company, also security needs to be reasoned and prioritized. Therefore the concept of risk is more familiar to many decision makers. Risk can be defined in a simple formula:

\[ \text{Risk} = \text{threat} \times \text{probability} \]

Although the usefulness and reasonability of the whole concept of risk can be challenged [23], it is a useful tool when security investment decisions are done and security measures planned. One way to use the concept of risk is to calculate a monetary risk value to every identified threat. In the case of knowledge this leads to a crude estimate of monetary consequence being multiplied by a crude estimate of probability. As such, the risk figures are not very trustworthy and provide little value to the decision maker. A simpler way is to assess both the probability and the monetary consequences in a three-step scale as illustrated in Table 1.

<table>
<thead>
<tr>
<th>Consequences of Threat</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strong</td>
<td>Moderate risk, actions need to be considered</td>
<td>High risk, needs to be addressed</td>
<td>Critical risk, must be addressed</td>
</tr>
<tr>
<td>Moderate</td>
<td>Moderate risk, actions need to be considered</td>
<td>High risk, needs to be addressed</td>
<td>High risk, needs to be addressed</td>
</tr>
<tr>
<td>Weak</td>
<td>Small risk, no actions are urgent</td>
<td>Moderate risk, actions need to be considered</td>
<td>High risk, needs to be addressed</td>
</tr>
</tbody>
</table>

The risk matrix gives the security planner a tool to assess different threats and to select which ones to address first [24]. There are basically two ways to lower a risk: by reducing the consequences or by lowering the probability. In the case of critical or high risks, both aspects need to be done. How this is done depends on the threat and the asset that needs to be protected.

As risk assessment tools can be helpful in reasoning the security measures, they don’t provide with the actual solutions to how to protect important assets. When it comes to knowledge, securing it can be as difficult as it is to assess the risk facing it. Knowledge is immaterial, and mostly bound to people. Thus securing knowledge requires affecting the way people behave.

It is said that 80% of information security risks are caused by people [25]. As knowledge can here be seen as a sub-section of information, it is fairly safe to state that nearly every threat to knowledge is caused by people. Human error has a remarkably big role in these threats. From the risk management perspective the consequences of human error is hard to lower. Some technical limitations for example to the kind and size of documents allowed to be attached to emails can be set. However, there is no technical way to limit the
subjects an employee chooses to discuss for example in a fair or seminar, nor to limit the places he/she decides to take an important business call. Awareness of threats by every employee is the only way to affect both the consequences and the probability of a threat.

Knowledge security as a concept refers to the ability of a company to protect its intellectual assets [26]. Key ways to protect knowledge are to promote awareness of threats to knowledge, and to limit the amount of people that have access to critical knowledge. Not only need the employees be aware of threats that face critical knowledge, they need to be able to decide what knowledge is critical, and what they are to do with it in different situations.

**Critical knowledge**

**Classifying critical knowledge**

When the previous two sections of this paper are examined, some similar characteristics can be seen. Both competitive intelligence and knowledge security efforts rely on the ability of employees to recognize important knowledge, and act accordingly. In knowledge security the necessary action with critical knowledge is to keep it safe. In competitive intelligence the necessary action is to share this knowledge with the right people.

These similarities lead to a conclusion, that both the fields of competitive intelligence and security are to be considered when business critical knowledge is handled in an organization. The big challenge from both viewpoints is how to recognize what knowledge is critical to the company.

The information a company considers critical for its success varies depending on the company, situation and context. The company’s game plan – its strategy – also has an impact on the information needs. If the aim is to be the market leader, the company making the bold decisions and growing by buying out competing companies, the need of information concerning the production capability and profitability of a competitor’s different manufacturing sites is far greater than for a company which lives by the rules of merely keeping the status quo [27], [28]. In addition, in the case of a highly competitive strategy the value of getting critical information to use before others increases. Therefore it is important to have access to information assets that competitors do not have.

Hannula and Pirttimäki’s [29] categorization of business information a company’s information needs can be conceptualized to better understand them. By defining where in the cube the most critical knowledge for the company is located it can be more easily targeted, communicated and obtained. Set in the cube of business information the employees are internal sources of information, and in the context of competitive intelligence, the subject of information is external. The type of information can be both qualitative and quantitative.

Classifying information and knowledge in the context of security refers to defining who has access to it. This classification needs to be done to all information assets. Desouza and Vanapalli emphasize that private organizations could learn from the defense and intelligence organizations on how to secure critical knowledge. However, they begin from the phase when critical knowledge documents have already been tagged with a classification of top secret or classified. They pay little attention to classification or identification of knowledge that has not been documented. [30] From the viewpoint of this paper the non-documented knowledge is what is interesting. How to classify it remains still an open question.

Data or information classification frameworks such as the one introduced by Appleyard [31] can be of help when critical knowledge is assessed. It is often suggested that such classification schemes are kept simple, and following this simplicity rule Appleyard suggests a classification of important information into three classes: public, internal use only, and company confidential. [31] The rule being that the more critical to business the information is, the higher the classification class. When dealing with knowledge, the challenge is to implement this classification scheme into the minds of every employee, because there is no-one else to tag the knowledge they possess. Employee judgement needs to be influenced in order to enforce correct classification of critical knowledge.

**Framework for recognizing critical knowledge**

When combining the information classification schemes and the risk matrix approach to find the information assets that most need protection, the following framework can be built. When employees realize they have knowledge that they feel could be of value to the company they can assess the knowledge in the dimensions of importance and awareness. The framework is illustrated in Figure 1.
The framework is constructed from two dimensions: the importance that certain competitive knowledge has to a company and how well this knowledge is known. The more critical the knowledge and the less people aware of it, the greater the potential of the competitive advantage it may bring to a company.

The competitive knowledge in the upper right corner is the best source of competitive advantage to a company. Its implications are crucial but at the moment only few people are aware of it. This information should be shared to the decision makers that can act upon it and simultaneously it has to be protected from spreading, so that competitors will not get their hands on it.

Respectively the competitive knowledge positioned in the lower left corner is not worth to invest protective actions in. Knowledge that has got no significant affect and is widely known is not likely to be a source of competitive advantage. It is good to note that the amount of people here is in proportion to the number of employees working in the company. If 10 people have the knowledge, in a company of 1000 employees they are a few, but in a company of 20 employees they are many.

A third dimension could be added to the framework: the sources aware of information, and whether they are internal or external. If the sources are internal, i.e. employees, the competitive knowledge they possess is not as easily obtained by competitors. The value of knowledge increases when the knowledge is critical, known by few and those few are company’s own employees. This also increases the need to protect that knowledge from leaking outside the company. In the context of this paper we focus on knowledge that is possessed by the employees of a company. The security perspective of this paper is not relevant to knowledge that is outside the company, although that source may be relevant from the competitive intelligence perspective.

As such this framework works mainly to spot critical bits of knowledge. The challenge in the assessment is how to decide how important a bit of information or knowledge is to the company. The framework can be used both in the company level and in the level of individual employees.

At the company level the framework can be complemented with a set of questions to help determine the importance of knowledge. The questions can be for example:

- Is the knowledge important to top management?
- Does it impact product or service development and planning?
- Does it concern customer relationships?

If the answer to such questions is yes, the importance to the company is high. The question sets need to be made company specific, as it heavily depends on the type of business what kind of knowledge is of most value.

The dimension of amount of people aware of the knowledge has meaning when considering actions on whether a piece of knowledge should be protected or not. If it is widely known inside a company, chances are that it is widely known also outside the company, and there is no need to protect. Some knowledge however might be widely known inside a company but still be of high importance.

The difficulty of positioning knowledge that is known by few in the company is the judging of importance. A rumor that a customer is planning a new way of operations might not be of high importance to a maintenance worker, but this same bit of knowledge might be critical when combined with other bits of knowledge about that customer of the industry. So the worker who hears the rumor needs to a) realize that the managers might need that bit of knowledge, b) share it with the appropriate persons, and c) not tell it to anyone else. In the employee level the framework can thus be utilized as a tool for awareness training.

**How to act with critical competitive knowledge**

Critical competitive knowledge can be secured in the company when it has been recognized as critical. The above described framework can be used to structure the training and awareness programs inside companies. Once employees recognize that what they know can be characterized as critical competitive knowledge they can act accordingly.
What to do with critical knowledge depends on the type of knowledge in question. If the knowledge is known by many, the key is to emphasize the meaning of that knowledge to the company so that employees are aware of its importance. The knowledge about a major customer’s products may not create competitive advantage, but it still is critical in the sense that it cannot leak outside the company, or the company will lose the customer and possibly suffer other consequences too.

When a bit of knowledge is known only by a few employees, and is of high importance to the company the awareness of who to share that knowledge with becomes essential. The training offered in the company needs to emphasize the kinds of knowledge that the executives use to make decisions, so that employees recognize it. The question sets described in the previous section can be useful in awareness training.

An ideal situation for a company would be that a company has most of its knowledge in the top right and bottom left corners of the framework. That would mean that business critical knowledge would be known only by a limited amount of people and that all other knowledge would be widely spread in the company. Since such a situation is very difficult to reach, the security and intelligence functions aim to build awareness into the company so that critical knowledge, even if widely known is kept safe. Also knowledge that is not widely known should be reasonably shared so that potentially critical knowledge is spotted and useful knowledge is put into wider use.

**Conclusions and implications for further work**

This paper has discussed the importance of employee awareness of critical knowledge and the perspectives of both security and intelligence to that knowledge. Knowledge security works toward securing important knowledge assets, where as competitive intelligence aims to the efficient sharing of them. At first glance these two seem opposite approaches to the same issue. However, a lot of similarity can be seen in these approaches.

Sharing knowledge or even articulating the need for a certain kind of knowledge does not have mere positive effects but poses also risks. Sometimes revealing a need can also reveal strategic information that might do the company a lot of harm if ended up in public. Sharing knowledge has risks, and some knowledge should not be shared even inside the company other than on a need-to-know basis. Employees need to be aware of executive knowledge needs so that when they come across a bit of knowledge that they feel is of importance, they know what to do. Sometimes it may be only after the decision has already been made that employees can be told what the meaning of the knowledge was, but to the benefit of future situations it should be done.

The process of securing knowledge can create risks also from the employee satisfaction perspective. If employees are not allowed to openly discuss company issues, and are not told how executives use the knowledge they are provided with, it can cause dissatisfaction. The framework introduced in this paper works as a means of communicating both the competitive knowledge and knowledge security perspectives of knowledge to employees.

Further analysis of this framework could be done by testing it in actual companies and refining the question sets complementing the framework. The perspective of competitive intelligence would also suggest the dimension of persons outside the company being added to the framework.

An interesting question to be discussed further is how companies can choose a method of efficient knowledge sharing that is both secure and adequately supports the competitive knowledge needs in the company. This brings also the perspective of knowledge management to this already interdisciplinary framework.

**References**


BLOG ADVERTISING EFFECTIVENESS—AN AD ENDORSER PERSPECTIVE

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Abstract
Many consumers routinely gather product information and appraisals via the Internet before making purchase decisions. For them, blogs are an important information source. Therefore, enterprises have begun using blogs as a new and effective instrument of product marketing. However, selecting the blog type that optimizes advertising effectiveness is now an important issue in corporate advertising.

This study classifies blogs into three types (celebrity blog, expert blog, and typical consumer blog) and defines product type (experience product and search product) and brand awareness (high and low) as two product constructs. The aim is to help enterprises evaluate the type and brand awareness of a product to be promoted and to select the blog type that maximizes advertising effectiveness (perceived risk, ad attitude, brand attitude, and purchase intention) in diffusing product information. A quasi-experiment design was adopted, and twelve experimental contexts were designed. A valid sample of over 2,000 responses was collected to study between-group differences in advertising effectiveness. The analytical results showed between-group differences in advertising effectiveness, which indicated that blog advertising effectiveness varies with different combinations of product constructs and blog types.

Keywords: Blog, product type, brand awareness, advertising effectiveness.

Introduction
Instead of simply browsing and collecting web data, Web 2.0 allows users to also become content creators by composing, editing, modifying, and exchanging data. An early 2007 market survey by Jupiter Research showed that 75% of Internet users are 18-25 years old. These users read and write Internet content. However, content creation is not dominated by young users. One third of users above 55 years of age report having experience in content creation as well [36]. Because most blogs provide a very user-friendly interface, personal blogging is a fad throughout the world, and blog use has grown rapidly. A report released by Sifry [34] indicated that the number of blogs around the globe has exceeded 70 million, and 120 thousand new blogs and 1.5 million new posts are added daily. Pollster Online Survey also reported that 93.8% of Internet users have browsed blogs, and 66.6% have a personal blog [11]. These statistics reveal the prevalence of blogs. Because they embed rich digital content, blogs are expected to be an important digital information source in the Web 2.0 era.

As the prevalence of Internet applications increases, users are beginning to rely heavily on information available on the Internet. “Information search” has thus become an important Internet use behavior. A study of consumer intention and behavior showed that 87% of the 8000 consumers sampled search for product information and appraisals posted by other consumers before making purchasing decisions [11].

As blogs have become an important information communication medium, selecting blog types that are appropriate and effective for the products they are to promote is now an important issue in corporate advertising. However, the impact of different blog types on consumers and their advertising effectiveness are issues seldom addressed in the existing literature.

This study views product information that consumers post on blogs as advertisements and compares advertising effectiveness between different blog types to help enterprises properly employ blogs in their marketing campaigns. According to product type and brand awareness, they can select a suitable blog type and use it as a medium to diffuse their product information. In sum, this paper compares (1) advertising effectiveness between different blog types; (2) advertising effect of interaction between blog type and product type; and (3) changes in advertising effectiveness caused by the interaction effect between blog type and brand awareness.

Theoretical Background
Blog Type
The term blog is derived from weblog, which is a technical record on web servers. Blogs are a new information exchange method that emerged became widely used after email, electronic bulletin board, and instant messaging. In fact, blogs have existed for several years but were not widely known until
Jorn Barger first coined the term “Weblog” in 1997, which defined it as a way to present personal logs on web pages [38]. In recent years, browsing blogs has become a major Internet activity. Some blogs have millions of regular visitors. By frequently reading and exchanging information on blogs, visitors develop strong bonds and close interpersonal relations. Thus, they are likely to trust and apply the information published on blogs [3].

The numbers of blogs and their content have grown rapidly in recent years. Consumers have more channels for publishing and searching for information about products and experience using certain products. Frequently visited theme blogs and other popular blogs are a particularly important information source that consumers browse, adopt, and trust. These blogs often have great influence on purchasing behavior. As blogs are becoming a powerful advertising medium, blog marketing considered a promising advertising model and marketing approach.

Studies of endorsement advertising usually focus on two aspects: “endorser reliability” and “endorser type”. Senecal and Nantel [31] proposed that recommendation sources be classified as human experts, recommender system, and other consumers. Human experts refer to salespersons and experts. Recommender system refers to individualized commodity recommendation mechanisms provided by online stores. Other consumers include relatives, friends, and acquaintances. Their study suggests that recommender systems are more influential to consumers than other consumers and human experts. Freiden [13] explored the effect of endorsers, endorser gender, and viewer age on advertising effectiveness and classified endorsers into four types: celebrity, high-ranking executive, expert, and typical consumer. Based on the views of Senecal and Nantel [31] and Freiden [13], this study similarly classifies blog types as celebrity blog, expert blog, and typical consumer blog.

**Product Type**

Nelson [26] classified products as experience products, search products, and credence products. Information about search products is readily available and their attributes, such as size and price, can be evaluated before purchase. Experience products have attributes, such as taste and fitness that are difficult to evaluate [2] until they are actually used [9]. Online information search techniques are more advantageous for search products because the perceived cost of providing and evaluating the goods is low.

Many products have attributes of both product types. For instance, apparel products have attributes of search products, such as producing nation and model, and their fitness is an attribute of experience products [2]. The boundary between the two product types is not fixed since, through demonstration and provision of a sample, an experience product can be converted into a search product. Advancing Internet technologies now allow consumers to “virtually experience” goods online before buying them, and experience products are often converted into search products [21]. Because the quality of experience products is unknown before purchase, consumers value recommendations made on the Internet [31].

Some important attributes of experience products cannot be known before the products are actually purchased and used. The costs of these products, such as movies, restaurants, tour packages, perfume, and sunglasses, are usually high [9] [39]. However, they can obtain attributes of search products, such as furniture, computer desktop, camera, and mobile phone, through information search before buying or using them [20] [31] [39].

Although consumers can certainly obtain product information, they may not have the practical experience of an experience product without buying or using it. Therefore, we propose that classifying products as search products or experience products to compare the advertising effectiveness of blogs between different product types is highly appropriate in the digital era. We define experience products as “products characterized by certain important attributes that cannot be known through information search but only through purchase and actual use and search products are those characterized by attributes that can be known through information search before actual purchase or use.

**Brand Awareness**

A brand consists of a name and a label that distinguishes a product or a firm from its competitors. The literature refers to brand value as brand equity, which is determined not by the product provider but judged from the perspective of customers. Brand awareness is how readily consumers can think of certain attributes of a familiar product. These attributes simplify product information and purchase decisions. When consumers choose from among several products in the same category, the products with high brand awareness are likely to be in their consideration sets [19]. Band awareness plays a crucial role in consumer decisions. Consumers tend to choose familiar brands with high brand awareness when making purchase decisions. Brand awareness is a tool that simplifies purchase decisions. They infer...
the quality of a product based on its brand awareness and have higher intention to purchase familiar brands of products than to purchase those of unfamiliar brands. The above studies suggest that brand awareness significantly influences consumer purchase decisions. Creating brand awareness is the first step to ensuring that a product is included in the consideration set of a potential consumer because brand awareness can further affect their decisions. This study defines brand awareness as the ability of a customer to recognize or recall a brand and includes brand awareness as a research variable.

**Advertising Effectiveness**

Wright et al. [37] contended that advertising can be defined from either a marketing perspective or from a communication perspective. From the marketing perspective, advertising is any paid form of non-personal presentation and promotion of ideas, goods or services by an identified sponsor. From the perspective of communication, advertising convey persuasive information through mass communication media. The main effects of advertising are the sales effect and the communication effect [22]. Studies of the communication effect focus mainly on a series of responses in cognitive, affective, and conative dimensions of consumers after stimulation by an ad message. The cognitive dimension includes recognition and understanding; the affective dimension includes liking and preference; the conative dimension includes determination and buying.

From the communication perspective, the purpose of advertising is to convey persuasive information via mass communication media [37]. This study views product recommendation information on blogs as advertising from the communication perspective to explore the advertising effectiveness of blogs. The advertising effectiveness of blogs is measured by four variables: perceived risk, ad attitude, brand attitude, and purchase intention.

This analysis views perceived risk as the subjective perception of expected losses. Consumers may perceive uncertainties and adverse outcomes when purchasing a product or service [32]. Ad attitude is defined as the propensity of the consumer to continuously like or dislike a certain ad after repeated exposure to the ad [23]. Brand attitude is the propensity to continuously like or dislike a specific brand [12]. Purchase intention refers to the willingness of the consumer to purchase products of an advertised brand [23].

**Model and Hypotheses**

This study explores the effects of blog type on advertising effectiveness as well as the interaction effects of product types, blog types, and brand awareness on advertising effectiveness. Figure 1 presents the research framework.

Based on the Frieiden [13] classification of advertisement endorsers, blogs can be classified as celebrity blogs, expert blogs, and typical consumer blogs. When information seekers search for product information on the web, they consider the professionalism [25], content relevance, and integrity [8] of the information source. Experts and typical consumers have better communication effects. Expert opinions are more reliable to consumers and can deepen their impression about the product [35]. The more professional the information source, the more influential its word-of-mouth recommendation [29]. The professional competence and experience of the information provider that is perceived by the information receiver has an important effect on the purchase decision made by the information receiver [3]. Consumers are likely to consider the professionalism, credibility, and attractiveness of each information source when searching for information related to a product. Therefore, the following hypothesis is proposed:

**H1:** The attributes of advertising effectiveness (a. perceived risk; b. ad attitude; c. brand attitude; d. purchase intention) vary according to blog type.

Product type affects the use and choice of information by consumers [20]. Consumers are unlikely to perceive certain important attributes of experience products through information search. Instead, they are more likely to trust product recommendations and appraisals from other consumers [35]. Descriptions of user experience and feedback on blogs are important references for
consumers, so credibility of information sources is crucial [18]. Because different products have different experience and search attributes, the information sources chosen by consumers varies, and advertising effectiveness of the information varies as well. Therefore, we hypothesize the following:

**H2:** Attributes of advertising effectiveness (a. perceived risk; b. ad attitude; c. brand attitude; d. purchase intention) are affected by the interaction effect of blog type and product type.

Richardson et al. [30] proposed that a brand represents an aggregate of information about a product and is an extrinsic cue for inferring product quality. Consumers usually perceive high quality in products of well-known brands. However, they cannot infer the quality of lesser-known brands from the product information, so they refer to extrinsic cues. Meanwhile, professional information sources and abundance user experiences provided by these sources become an important reference for purchase decisions. Therefore, we argue that advertising effectiveness is affected by the interaction effect between brand awareness and blog type and propose the following hypothesis.

**H3:** The attributes of advertising effectiveness (a. perceived risk; b. ad attitude; c. brand attitude; d. purchase intention) are affected by the interaction effect between blog type and brand awareness.

**Methodology**

**Experimental Design**

The experiment was designed to evaluate three factors, including blog type, product type, and brand awareness. The analysis included three blog types (celebrity blog, expert blog, and typical consumer blog), two product types (experience product and search product), and two levels of brand awareness (high and low).

Through a pretest, this study first selected representatives of celebrity blogs, experience products, search products, products of high brand awareness and products of low brand awareness. Twelve experimental contexts were created. In each context, the blog contained feedback and appraisals regarding a product. Based on the between-subject design, the subjects were randomly assigned to the experimental groups for testing in different contexts. This design prevented the subjects from knowing how the experiment was manipulated and to avoid disturbing the experimental results. Individual differences between subjects were also widely distributed, so between-group differences caused by individual differences were avoided. The questionnaires were randomly distributed to the subjects. Each subject was assigned to only one experimental context and was required to complete the questionnaire after viewing the assigned blog.

The first section of the questionnaire contained items measuring advertising effectiveness. By manipulating the experimental contexts, each subject was asked to evaluate the perceived risk of the product, ad attitude of the blog article, their brand attitude and purchase intention after viewing the content of given blogs, including the author, recommended product, brand, product appraisal, and user feedbacks. The second section measured the propensity of the subjects to trust. The last section surveyed personal data.

**Pretest**

The purpose of conducting a pretest was to confirm the representatives of each product type, each blog type, and high and low brand awareness products.

First, twenty products were selected through expert discussion and reviews of the literature on experience products. Thirty-one undergraduate and graduate students participated in the pretest. The method adopted by Chiang and Dholakia [9] was employed. Based on mean scores, hair salon services, skin care products, financial consultancy, and tour products were selected as experience products; mobile phones, computers, magazines, and cameras were selected as search products. With product involvement [28] and product knowledge [6] considered, “tourist products” and “mobile phones” were selected as representative experience products and search products, respectively.

Celebrity endorsers were selected according to the results of “The Best Ad Endorsers of Summer 2006”, a survey conducted by Taylor Nelson Sofres (TNS) was employed [11]. Twenty celebrities were selected based on discussions with ten consumers. A representative celebrity endorser, Lin Chi-ling, was selected according to measures of ad endorsers [13] and the fitness between product and celebrity endorsement. Based on the method developed by Aaker [1] in his study of brand equity, brand awareness was measured in terms of “recognition” and “recall”. Among the cell phone brands, NOKIA had high brand awareness, and UTEC had low brand awareness. Among the brands of tour products, ezTravel was selected as a high awareness brand, and Mastery Travel was selected as a low awareness brand.
Manipulation of Contexts

This study classified blogs as celebrity blogs, expert blogs, or typical consumer blogs. Product photos and descriptions were displayed for each blog type. The experience and expertise of the bloggers were described as “cell phone master” or “tour master” in the introduction section of the expert blogs to indicate that they were experts in cell phones or tour products. In typical consumer blogs, the introduction section explicitly indicated that the purposes of the blog were to keep a journal of life and to express personal feelings.

According to the Tourism Bureau, Ministry of Transportation and Communication, Hong Kong was the most popular overseas destination of Taiwan tourists in 2008, and the average tourist visit was 2–3 days. Therefore, the tour product called “3 Day Backpacking Tour to Hong Kong” was designed. As to the search product, the specifications and functions of the latest mobile phones were surveyed, and a virtual cell phone model called “W88” was designed. Its main features including a large touch screen, MP4 audio/video playback, and a GPS navigation system.

Among the brands of tour products, ezTravel had high brand awareness, and Mastery Travel had low brand awareness. Of the mobile phones, NOKIA had high brand awareness, and UTEC had low brand awareness. These brands were directly described in blog articles.

The questionnaire items for perceived risk and purchase intention were measured on a 7-point Likert scale from 1 (strongly disagree) to 7 (strongly agree).] Items for ad attitude and brand attitude were designed to be measured on a 7-point semantic Likert scale. Items for perceived risk were as follows: (1) This product may be defective; (2) This product is a waste of money because it will not work or it will cost more than it should to maintain it; (3) This product is extremely risky/not risky in terms of how it will perform [33]. Items for ad attitude were: (1) My overall impression of this blog article is bad/good; (2) I think the content of this blog article is detestable/likable; (3) I feel displeased/pleased when reading this blog article [10]. Items for brand attitude were: (1) I think this brand is reliable/unreliable good; (3) I dislike/like the products or services of this brand; (3) I am satisfied/disappointed with this brand [7]. Items for purchase intention included: (1) I would consider buying this product; (2) I expect to purchase this product; (3) I am very likely to buy this product; (4) I would recommend this product to my friends [33].

Data Sampling

The research subjects were general Internet users. Because the population size and range were fuzzy, random sampling method was difficult to perform. Therefore, convenience sampling was adopted.

The questionnaire was conducted online. Survey information was published on PTT BBS, the largest online Bulletin Board System in Taiwan. Since it was established in 1995, PTT has become not only the largest BBS in Taiwan, but also the largest Chinese BBS in the world. The blog had more than 1.5 million members as of the end of 2008. To attract more respondents, all participants were given a chance to win NTS2,000. Each subject was then randomly assigned to one of twelve contexts. By convenience sampling of general Internet users in Taiwan, a valid sample of 2,134 responses was obtained; 47% (1,002 persons) of the respondents were male, and 53% (1,132 persons) were female. In terms of age, the largest age group was 21–25 years old (61.3%, 1,390 persons), and the second largest age group was 26–30 years old (22.1%, 471 persons). In terms of occupation, the largest group was students (62.9%, 1,342 persons) followed by those with stable jobs (29.6%, 631 persons). Table 1 presents the distribution of the sample across the contexts.

Results

As Table 2 shows, the Cronbach’s α values for all the constructs were higher than 0.7, which confirmed the good internal consistency of items in each construct. Validity was assessed by EFA. The Bartlett test of sphericity and KMO measure were applied to detect co-variation among the values of the research variables. The KMO measure was 0.87, and Bartlett test results reached significance, indicating that there were common factors and that the data were acceptable for factor analysis. Through principal component analysis, five factors were extracted. Items for perceived risk, ad attitude, brand attitude, and purchase intention were convergent and compliant with the expected constructs with total variance explained 70.77%. Because the questionnaire items were developed according to previous research, the developed scale was deemed to have theoretical validity.
Table 2 Principal component analysis result, mean, standard deviation, and Cronbach’s α

<table>
<thead>
<tr>
<th>Expected construct</th>
<th>Items</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Mean</th>
<th>S.D.</th>
<th>Cronbach’s α</th>
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<tbody>
<tr>
<td>Purchase intention</td>
<td>PI2</td>
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<tr>
<td></td>
<td>PI3</td>
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<td>PI1</td>
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<td>Ad attitude</td>
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<td>Brand attitude</td>
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<td>0.78</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PR1</td>
<td>0.76</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Hypotheses H1a-d were tested using MANOVA to examine the main effects of blog types on advertising effectiveness. The homogeneity of the sample of each group was tested by Levene test. If the Levene test result was significant, the Welch method was applied to estimate the F-value. Finally, all groups passed the homogeneity test.

Table 3 summarizes the results for the main effects test. The data indicated that perceived risk, ad attitude, and purchase intention of consumers significantly varied according to blog type.

Table 3 ANOVA of blog type

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Dependent Variables</th>
<th>F value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived risk</td>
<td></td>
<td>7.14</td>
<td>0.001**</td>
</tr>
<tr>
<td>Blog type</td>
<td></td>
<td>6.42</td>
<td>0.002**</td>
</tr>
<tr>
<td>Ad attitude</td>
<td></td>
<td>2.34</td>
<td>0.097</td>
</tr>
<tr>
<td>Brand attitude</td>
<td></td>
<td>12.76</td>
<td>&lt;0.001***</td>
</tr>
</tbody>
</table>

Means and standard deviations of advertising effectiveness were further compared for variables with significantly differences. Scheffe post-hoc comparison method was adopted. If the variances were not homogeneous, the Dunnett T3 comparison method was adopted. Table 4 shows that the perceived risk of celebrity blogs was higher than that of other blogs and also significantly higher than that of expert blogs. The consumer survey results indicated that the highest brand attitude and purchase intention were for products recommended on expert blogs. Consumer ad attitude about expert blogs was significantly better than attitude about celebrity blogs and typical consumer blogs; consumer intention to purchase products mentioned in expert blogs and typical consumer blogs was significantly higher than that for products mentioned in celebrity blogs. The main effects test result supported H1a, H1b, and H1d.

Table 4 Analysis of differences in main effects

<table>
<thead>
<tr>
<th>Dependent Variables</th>
<th>Independent variable (Blog type)</th>
<th>Mean</th>
<th>S.D.</th>
<th>Post-hoc comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived risk</td>
<td>Celebrity blog (ET1)</td>
<td>4.80</td>
<td>1.08</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Expert blog (ET2)</td>
<td>4.58</td>
<td>1.02</td>
<td>ET1 &gt; ET2*</td>
</tr>
<tr>
<td></td>
<td>Typical consumer blog (ET3)</td>
<td>4.67</td>
<td>1.07</td>
<td></td>
</tr>
<tr>
<td>Ad attitude</td>
<td>Celebrity blog (ET1)</td>
<td>4.42</td>
<td>1.05</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Expert blog (ET2)</td>
<td>4.60</td>
<td>0.97</td>
<td>ET2 &gt; ET3*</td>
</tr>
<tr>
<td></td>
<td>Typical consumer blog (ET3)</td>
<td>4.46</td>
<td>1.03</td>
<td>ET2 &gt; ET1*</td>
</tr>
<tr>
<td>Purchase intention</td>
<td>Celebrity blog (ET1)</td>
<td>3.65</td>
<td>1.21</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Expert blog (ET2)</td>
<td>3.95</td>
<td>1.13</td>
<td>ET2 &gt; ET3*</td>
</tr>
<tr>
<td></td>
<td>Typical consumer blog (ET3)</td>
<td>3.88</td>
<td>1.18</td>
<td>ET2 &gt; ET1*</td>
</tr>
</tbody>
</table>

*p<0.05, **p<0.01, ***p<0.001.

The H2 and H3 were verified by 2-way MANOVA. The interaction effects were tested using the simple main effect test. Table 5 shows the interaction effects between blog type and product type on advertising effectiveness. Clearly, the interaction between blog type and product type was significantly related to ad attitude. Thus, H2b was supported.
Table 5 Two-way MANOVA of blog type and product type

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Dependent Variables</th>
<th>DF</th>
<th>MS</th>
<th>F value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived risk</td>
<td></td>
<td>1</td>
<td>1.07</td>
<td>0.96</td>
<td>0.326</td>
</tr>
<tr>
<td>Ad attitude</td>
<td></td>
<td>1</td>
<td>2.91</td>
<td>2.81</td>
<td>0.094</td>
</tr>
<tr>
<td>Brand attitude</td>
<td></td>
<td>1</td>
<td>27.26</td>
<td>26.11</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>Purchase intention</td>
<td></td>
<td>1</td>
<td>1.68</td>
<td>1.22</td>
<td>0.269</td>
</tr>
<tr>
<td>Perceived risk</td>
<td></td>
<td>2</td>
<td>7.64</td>
<td>6.86</td>
<td>0.001**</td>
</tr>
<tr>
<td>Blog type (A)</td>
<td></td>
<td>2</td>
<td>6.79</td>
<td>6.57</td>
<td>0.001**</td>
</tr>
<tr>
<td>Ad attitude</td>
<td></td>
<td>2</td>
<td>2.72</td>
<td>2.60</td>
<td>0.074</td>
</tr>
<tr>
<td>Brand attitude</td>
<td></td>
<td>2</td>
<td>16.79</td>
<td>15.56</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>Purchase intention</td>
<td></td>
<td>2</td>
<td>0.08</td>
<td>0.08</td>
<td>0.927</td>
</tr>
<tr>
<td>Perceived risk</td>
<td></td>
<td>2</td>
<td>3.12</td>
<td>3.02</td>
<td>0.049*</td>
</tr>
<tr>
<td>Ad attitude</td>
<td></td>
<td>2</td>
<td>1.39</td>
<td>1.33</td>
<td>0.265</td>
</tr>
<tr>
<td>Brand attitude</td>
<td></td>
<td>2</td>
<td>1.49</td>
<td>1.08</td>
<td>0.340</td>
</tr>
<tr>
<td>(A) × (B)</td>
<td></td>
<td>2</td>
<td>4.42</td>
<td>4.42</td>
<td>0.110</td>
</tr>
</tbody>
</table>

*p<0.05, **p<0.01, ***p<0.001.

The simple effect test was conducted to examine variables with a significant interaction effect. Table 6 presents the means and standard deviations of the effects of product type and blog type on ad attitude for specified conditions. On typical consumer blogs, search products had a stronger effect than experience products (F=8.68, p<.05); for experience products, expert blogs were more effective than typical consumer products were (F=6.10, p<.05); for search products, expert blogs were also more effective than celebrity blogs were (F=3.77, p<.05). Figure 2 shows the comparison results.

Table 6 Effects of variables (product type × blog type) on ad attitude in limited conditions

<table>
<thead>
<tr>
<th>Dependent Variables</th>
<th>Source of variance</th>
<th>Product type</th>
<th>Mean</th>
<th>S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ad attitude</td>
<td></td>
<td>Celebrity</td>
<td>4.42</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Experience</td>
<td>4.60</td>
<td>0.92</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Typical</td>
<td>4.35</td>
<td>1.04</td>
</tr>
<tr>
<td>Purchase intention</td>
<td></td>
<td>Celebrity</td>
<td>4.41</td>
<td>1.10</td>
</tr>
</tbody>
</table>

Figure 2 Interaction effects of blog type and product type on ad attitude

According to Table 7, the interaction effect of blog type and brand awareness on brand attitude was significant. Thus, H3c was supported.

Table 7 Two-way MANOVA of blog type and brand awareness

<table>
<thead>
<tr>
<th>Source of variance</th>
<th>Dependent Variables</th>
<th>Degree of freedom (DF)</th>
<th>Mean sum of squares (MS)</th>
<th>F value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived risk</td>
<td></td>
<td>2</td>
<td>8.49</td>
<td>7.63</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Ad attitude</td>
<td></td>
<td>2</td>
<td>6.78</td>
<td>6.56</td>
<td>0.001**</td>
</tr>
<tr>
<td>Brand attitude</td>
<td></td>
<td>2</td>
<td>3.13</td>
<td>3.01</td>
<td>0.049*</td>
</tr>
<tr>
<td>Purchase intention</td>
<td></td>
<td>2</td>
<td>19.10</td>
<td>13.92</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>Perceived risk</td>
<td></td>
<td>1</td>
<td>3.91</td>
<td>3.52</td>
<td>0.061</td>
</tr>
<tr>
<td>Ad attitude</td>
<td></td>
<td>1</td>
<td>2.81</td>
<td>2.72</td>
<td>0.099</td>
</tr>
<tr>
<td>Brand attitude</td>
<td></td>
<td>1</td>
<td>35.24</td>
<td>33.94</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>Purchase intention</td>
<td></td>
<td>1</td>
<td>10.34</td>
<td>7.53</td>
<td>0.006**</td>
</tr>
<tr>
<td>Perceived risk</td>
<td></td>
<td>2</td>
<td>0.63</td>
<td>0.57</td>
<td>0.567</td>
</tr>
<tr>
<td>Ad attitude</td>
<td></td>
<td>2</td>
<td>2.51</td>
<td>2.43</td>
<td>0.088</td>
</tr>
<tr>
<td>Brand attitude</td>
<td></td>
<td>2</td>
<td>3.23</td>
<td>3.11</td>
<td>0.045*</td>
</tr>
<tr>
<td>Purchase intention</td>
<td></td>
<td>2</td>
<td>0.87</td>
<td>0.63</td>
<td>0.532</td>
</tr>
</tbody>
</table>

*p<0.05, **p<0.01, ***p<0.001.

Variables with a significant interaction effect were examined by simple effect test. Table 8 shows the means and standard deviations of the effects of
blog type and brand awareness on brand attitude in limited conditions. On expert blogs, products with high brand awareness had a stronger effect than those with low brand awareness (F=22.95, p<.001); for products with low brand awareness, typical consumer blogs were more effective than celebrity blogs were (F=4.14, p<.05). Figure 3 shows the comparison results.

Table 8 Effects of variables (blog type × brand awareness) on brand attitude in limited conditions

<table>
<thead>
<tr>
<th>Source of variance</th>
<th>Advertisment effectiveness</th>
<th>Blog type</th>
<th>Brand awareness</th>
<th>Mean</th>
<th>S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Celebrity</td>
<td>Low</td>
<td>4.22</td>
<td>1.02</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Expert</td>
<td>High</td>
<td>4.68</td>
<td>1.03</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Low</td>
<td>4.34</td>
<td>0.90</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Typical consumer</td>
<td>High</td>
<td>4.54</td>
<td>1.13</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Low</td>
<td>4.44</td>
<td>0.96</td>
</tr>
</tbody>
</table>

Figure 3 Interaction effect of blog type and brand awareness on brand attitude

**Conclusions**

**Findings**

This study demonstrates that perceived risk and purchase intention vary with blog type. Compared with celebrity blogs, expert blogs were characterized by lower perceived risk and higher purchase intention. Purchase intention for products mentioned in celebrity blogs was significantly lower than that for products mentioned in expert blogs and typical consumer blogs. Previous studies of ad endorsers similarly revealed that experts and typical consumers have better communication effects; expert opinions are considered more reliable by consumers and can deepen their impressions about the product [35]. In this study, celebrity blogs revealed no advertising effectiveness, probably because most of the articles on celebrity blogs are not composed by celebrities but by product providers. As a result, the non-commercial characteristics of blog articles are limited, which increases perceived risk. Consumers tend to discount the credibility of a blog if they perceive it as commercialized. Consumers are persuaded partly by the perceived expertise of the blogger in a certain area and partly by the description of user experience, particularly if the blog is not commercialized and is intended for sharing of personal experiences.

Additionally, blog type and product type had interaction effects on ad attitude. Among the products recommended by typical consumer blogs, consumers had a better ad attitude about search products than about experience products. This implies that consumers have more confidence in information about search products when viewing typical consumer blogs. For search products, expert blogs can form a better brand attitude than celebrity blogs can; for experience products, expert blogs can exhibit better advertising effectiveness than typical consumer blogs can. Wang [35] mentioned that recommendations and appraisals by experts and typical consumers are considered more reliable by consumers and can form a better product attitude. In terms of experience products, consumers have more purchase intention if the products are endorsed by other consumers. The evidence in this study suggests that, for experience products, expert endorsement can lead to the highest ad attitude, and consumer endorsement often confers the lowest ad attitude. Therefore, in terms of advertising effectiveness, consumer recommendations on blogs are most effective for search products and for experience products. This finding is inconsistent with previous research.

Finally, among products recommended in articles composed by experts, high brand awareness products can form a better brand attitude than low brand awareness products. For low brand awareness products, typical consumer blogs can form a better brand attitude than celebrity blogs can. Therefore, for lesser-known brands of products, consumer recommendations have a greater effect on brand attitude than expert or celebrity recommendations do. The inference is that when consumers are unable to infer the quality of a product by its brand and need to make the judgment by extrinsic cues, they pay attention to the characteristics of typical consumer blogs that share extrinsic cues, such as user experience, feedback or reliability of the product.

**Management Implications**

The research findings can help enterprises to select appropriate blog types according to the type and brand awareness of their products and to use the blog as a medium for diffusing product information. Suggestions for planning blog marketing campaigns are as follows:

1. Select a blog type appropriate for the product
To promote experience products on blogs, enterprises must first consider expert blogs because typical consumer blogs are less persuasive to consumers. For search products such as cell phones, cameras, computers, and furniture, expert endorsements on blogs are more effective than celebrity endorsements are. Therefore, enterprises should search for experts on the Internet, provide trial programs, and give rewards to attract well-known experts to write about their products and enhance the advertising effectiveness of the blog.

(2) Select an appropriate blog type according to brand awareness:
For products with low brand awareness, typical consumer blogs are the best endorsers because they can form the highest brand attitude. Enterprises can provide frequent product trial programs, rewards to writers of promotion articles, or other mechanisms such as lotteries, gift giveaways, and essay contests. They can also use the power of the Internet to promote related activities, enhance the number and quality of typical consumer posts of opinions about their products, and increase opportunities for Internet users to access these posts. Such measures can effectively enhance the advertising effectiveness of their blogs.

(3) Select blogs without considering product attribute and brand awareness
Of the three blog types, expert blogs have the strongest word-of-mouth effect followed by typical consumer blogs. Because expert blogs are effective for advertising, enterprises can provide incentives such as free trials and rewards for writers of product-related essays to attract experts in related fields to write articles about their products. Bloggers can also be encouraged to make objective comments about their products to maintain consumer trust.

Modern consumers are better informed than ever. Diffusing information via conventional advertising is insufficient for differentiating a product from its competitors. Modern consumers are not susceptible to one-way advertising. Besides, consumers have more autonomy and product options, so the advertising effectiveness of most ads is unsatisfactory. Although many enterprises often hire well-known celebrities to endorse their products at tremendous cost, celebrity endorsements on blogs are apparently unpersuasive to consumers. Enterprises are suggested to attract experts or typical consumers who have personally tried or used their products to write vivid and persuasive articles and to attach related photos to elaborate on their practical experiences. These articles may then become the best source of product information on the Internet and exhibit the highest effect of endorsement.

Besides, enterprises can also collect URLs to articles published on other blogs and integrate them into their official sites or blogs. These articles are the best testimonies of product users. Recommending a product from a third-party perspective not only ensures advertising effectiveness, it also shortens the distance between enterprises and consumers and enables closer interactions between consumers and the product.

Limitations and Future Research
In this analysis, the price factor was not incorporated into the experimental model, and shopping channels were not limited.

There might be a gap between the prices of the experimental products and the average expense of online shoppers. Experimental products, including cell phones and tour products, are high-involvement products. Future researchers are suggested to investigate the advertising effectiveness of blogs for other industries. Because consumers may access blog information via different channels, future researchers can also compare advertising effectiveness between blogs accessed via different channels. The Bickart and Schindler study [4] suggests that commercial and non-commercial information available on the Internet have similar effects on the knowledge, ideas, and purchase intentions of consumers. Therefore, we did not discuss the effect of endorsement by high-ranking executives or the effect of commercial uses of blogs. However, if the time, space or Internet user behaviors are different, further study is warranted.

References


FACTORS OF EMPLOYEE’S E-LEARNING EFFECTIVENESS: A MULTI-LEVEL STUDY BASED ON SOCIO-TECHNICAL SYSTEMS THEORY

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Abstract
Application of e-learning in enterprises provides the advantages of lower training cost, richer learning content, higher information consistency, and easier update of content. Despite the fact that enterprises have the intention to introduce e-learning, there is not a complete framework to which they can refer to ensure the benefits of e-learning for employee training or learning and understand which important factors affect employee’s e-learning effectiveness. Relative to the difficulties of introducing e-learning in management practice, the academic achievements in this aspect also seem very limited. Most the existing papers are focused on discussion and survey of e-learning in school, and very few of them are dedicated to empirical research of e-learning in corporate environment. Besides, these studies discuss e-learning only at the technical or the individual level without a comprehensive investigation into the factors affecting e-learning effectiveness with multi-level theoretic framework.

This paper applies the socio-technical systems theory to review and integrate theories about employee e-learning from a macro view. To make up the insufficiency of related research, literature review and case research are conducted first. Based on the interview results, an analysis model is constructed to thoroughly explore factors affecting employee’s e-learning effectiveness. Later, through a questionnaire survey on employees’ adoption of e-learning and subsequent multi-level data analysis, hypotheses on the relationship of the influencing factors and the research model are verified.

Results show that e-learning effectiveness (usefulness of e-learning, continuance intention to use, and e-learning performance) is simultaneously or alternately affected by direct or moderating factors of the technical system and the social system at the work environment level and the individual level. Compared with the existing research, this paper uses a more comprehensive system view to construct the theoretical model and empirically verify it. The results can be a reference for future researchers and managers of e-learning in enterprises.

Keywords: e-learning, socio-technical system, multi-level analysis

Introduction
For enterprises, e-learning is not simply a training tool but also a performance enhancement tool. The Comparative Advantage Theory of Competition [1] proposes that an enterprise has more competitive advantage when the relative resource costs are lower and the relative resource-produced value is superior. Application of e-learning in a corporate environment can enhance employees’ skills and knowledge and also motivate self-directed learning in organizational learning. On one hand, e-learning is not confined to geographical barriers. Employees can engage in self-directed learning, and learning resources can be repeatedly used. As the training cost is reduced, creation and accumulation of organizational knowledge can be achieved at a lower cost (lower relative resource cost). On the other hand, e-learning provides flexible learning materials and consistent information. The learning content is easy to update, and the enterprise’s latest strategic goals can be instantly reflected. By embedding e-learning in knowledge management, enterprises can reshape the learning culture within the organization, facilitate externalization of tacit organizational knowledge, and accelerate knowledge acquisition, storage, and reuse. They can even share a portion of established learning content with suppliers or customers, utilizing e-learning as a strategic instrument to diffuse information of new products (superior relative resource-produced value).

However, in application of e-learning, domestic enterprises are less proactively than foreign enterprises. The main barriers include lack of professionals in e-learning, low e-business level, inability to estimate learning performance, lack of a long-term introduction plan, and lack of budgets for introduction. Even if they have the intention to introduce e-learning, but there is not a complete framework to which they can refer to ensure the benefits of e-learning for employee training or learning and understand which important factors affect employee’s e-learning effectiveness. Relative to the difficulties of introducing e-learning in management practice, the academic achievements
in this aspect also seem very limited. Since e-learning was proposed, a considerable number of papers on related issues have been published. However, most of them are focused on discussion and survey of e-learning in school, and very few are dedicated to empirical research of e-learning in corporate environment. A corporate organization is a complicated system and differs significantly from schools in terms of environment and management. Employee training or learning is also extremely different from student learning at school. Therefore, there is really a need to conduct a deeper and more comprehensive research on employee e-learning to make up the insufficiency of research in this area.

DeRouin,ritzschte, and Salas [2] conclude a review of studies on e-learning in organizations with some suggestions for future researchers: (1) For design, training, and implementation of e-learning in organizations, further theorization is necessary; (2) future research should be more centered on learners rather than technologies; (3) research on e-learning effectiveness should be more focused on e-learning in workplace. Most of the existing studies discuss e-learning with a sole focus on training effectiveness or at only the technical or individual level without a comprehensive investigation into the theoretic framework and factors affecting e-learning. A corporate organization comprises of multiple interactive subsystems, including individual, task, technical environment, and social environment subsystems. Without a multi-level analysis, i.e., analysis of the technical level, individual level, organizational level, and etc., it is not possible to grasp a comprehensive view of applications of e-learning in corporate organizations from the system perspective. After reviewing literature associated with training transfer, Burke and Hutchins [3] proposed that systematic and multi-level consideration of corporate training is necessary and the socio-technical systems approach adopted in Kontogiorgoues [4] should be employed.

Therefore, the objective of this paper is to answer and explain which work environment factors and individual factors affect employee’s e-learning effectiveness.

To answer the above-mentioned issue, we will follow the research procedure to answer the following questions: How to define employee’s e-learning effectiveness? What are the main factors that affect employee’s e-learning effectiveness? Of these factors, which are the factors at the work environment level? Which are the factors at the individual level? How do these factors affect employee e-learning?

To sum up, this paper aims to: (1) apply the Socio-technical Systems Theory to review and integrate theories about employee e-learning from a macro view and construct the research framework of this paper; (2) construct a multi-level analysis model and propose hypotheses, through literature review and case analysis; (3) verify the theoretic model and relationship between research variables through multi-source and multi-stage questionnaire survey and multi-level analysis of the data; and (4) propose conclusions based on empirical evidence and explain factors affecting individual employee’s e-learning effectiveness and how to design and manage e-learning.

**Literature Review**

**Employee e-learning and evaluation of its effectiveness**

According to Cisco Systems, employee e-learning is to transfer various kinds of information and knowledge needed by individuals via the Internet in real-time; e-learning encompasses formal training, courses, information delivery, and interaction on the web, and also involves knowledge management and performance management. This definition explains the types and various forms of learning in enterprises, which are more applicable to enterprises (Institute for Information Industry, 2003). Based on the results of previous research [5] [6] [7] [8], we will focus on e-learning in a corporate context. Because most of the existing e-learning methods in corporate environment have relied on application of the Internet, we define “employee e-learning” as “an approach to transfer digital materials to employees via the Internet to help them continuously and autonomously engage in self-directed learning, receive training-related information, and participate in training activities”.

Based on Newstrom’s [9] procedural view as well as the summative and formative indexes of training effectiveness and the classical diffusion theory, we propose a three-level framework of employee’s e-learning effectiveness, as shown in Figure 1. This framework reflects the performance evaluation levels of the above-mentioned views: the “reaction” and “learning” levels of Kirkpatrick’s four levels of evaluation; the “training output” level of training transfer mentioned in Baldwin and Ford’s research [10]; the “attitude” and “use” stages of the classical diffusion theory.

![Figure 1 The three-level framework of employee’s e-learning effectiveness](image)
Socio-technical systems and a multi-level theoretic framework

Falconer [11] points out that organizational learning involves multiple levels of an organization. In an integrative review of literature associated with training transfer, Burke and Hutchins [3] propose that a systematic and multi-level consideration of corporate training is necessary and the socio-technical systems approach adopted by Kontoghiorghes [4] should be employed. In this paper, we apply the socio-technical systems approach to review and integrate factors affecting employee’s e-learning effectiveness from a macro view and construct a multi-level analysis model. The socio-technical systems theory was proposed by Trist, Emery, and et al. during 1950–60 [12] [13]. Because conventional organizational design methods were focused on the optimization of the technical aspect with little consideration of the social aspect, they were unable to explain why enterprises could not obtain expected results after introducing new technologies and facilities at a huge cost. The socio-technical systems concept was developed as a result [14] [15].

The socio-technical system consists of two interdependent subsystems, namely the social system and the technical system. The social system encompasses organizational culture, interpersonal relations, values, beliefs, motivations, interactive patterns, learning, and adaptability to changes. The technical system encompasses mechanical facilities, technical methods, and professional knowledge. The Socio-technical Systems Theory proposes that joint optimization of the social system and the technical system can lead to higher productivity, quality, and employee satisfaction [16] [17] [18].

In as early as the 1950s, psychologist Kurt Lewin proposed that individual behaviors are affected by two main factors, namely personal characteristics and the environment [19]. This view has inspired the management community to develop the view of individual-environment interaction and also explained that organization is essentially a multi-level phenomenon. All activities of an organization are affected by the organizational environment; creation of organizational knowledge is also affected by organizational contexts, such as interactive contexts, information contexts, and application contexts. Geels [20] applies the Socio-technical Systems Theory to conduct a series of innovative studies and proposed that socio-technical systems and the individual belong to different levels, and socio-technical systems can be called a socio-technical regime which consists of management activities and norms that affects individual activities.

However, in a multi-level framework, how do the technical system and the social system influence employee’s e-learning effectiveness? Salmon [21] discusses e-learning in a book titled e-Moderating, emphasizing that digital technology is an important “moderator” in learning activities, as it is a condition and an environment that can assist learners in learning activities. Besides, individual applications of technology are also influenced by effects of social relations that exist between people, such as the reward system and power structure [22]. DeRouin et al. [2] point out that the extent empirical research on employee’s e-learning effectiveness does not fully support a positive relationship between e-learning and learning effectiveness. They argue that there may be moderators between e-learning and learning effectiveness, so further exploration of the moderators is necessary. Therefore, we employ the socio-technical systems view to construct a multi-level analysis framework, with a focus on the effects of each subsystem at the individual level—employee’s e-learning effectiveness.

Case Study

According to Gable [23], case research method and survey research method have their respective strengths and weaknesses, so they can be complementary to each other. Attewell and Rule [24] suggest that case research should be conducted before survey research, because case research allows researchers to access the phenomena in the research environment and collect important perspectives to find causal relations or causes of a certain event. In this paper, 9 enterprises in Taiwan which have used e-learning for more than 6 months were selected. From each enterprise, one management executive and one user of e-learning were selected and given an open-ended interview. The interview records were organized according to previous literature to induce main factors in each level of the research framework and find the subsystem and analysis level that each factor belongs to. Finally, the relationship of these variables was investigated using the analyst triangulation method proposed by Patton [25]—using multiple analysts to review case findings. The result would be the basis for subsequent multi-level questionnaire survey.

Conceptual Framework, Hypotheses, and Research Design

According to literature review and case study, employee’s e-learning effectiveness can be divided into three levels, which are respectively dominated by three variables, including e-learning usefulness, continuance intention to use, and e-learning performance. As shown in Figure 2, the preceding
variables have direct effects on the succeeding ones. Hypotheses are inferred and proposed in the following paragraphs.

E-learning usefulness

It has been empirically validated that the perceived quality of an information system is an important factor that affects user satisfaction of the system [8] [26]. Lee [27] proposes that the information quality reflected on the needs of e-learning is focused on content quality, which includes content richness and update regularity. The case research result also shows that employees consider content richness and constant update of the learning materials as the determinants of the perceived usefulness of e-learning. The empirical evidence in Lee [27] also suggests that content quality is an important factor influencing perceived usefulness of e-learning. Therefore, we propose:

Hypothesis 1: Content quality of e-learning positively influences usefulness of e-learning.

According to the Media Richness Theory [28], media richness refers to using multiple and most appropriate digital media, including images, audios, and graphics to present learning content. Many studies of e-learning have revealed that application of a plurality of media [29] and interactive media [30] can draw learners’ attention and effectively enhance their learning effectiveness. Studies of the Internet also point out that the rich information media embedded in websites can enhance satisfaction of website users (e.g., [31]). Therefore, we propose:

Hypothesis 2: Media richness of e-learning positively influences usefulness of e-learning.

Continuance intention to use

In a training context, “motivation” refers to the incentive that propels learners to be devoted to learning activities [32]. Intrinsic motivation is a key success factor of e-learning. Career attitude is a form of intrinsic motivation [33]. Employees with a high career attitude have a better understanding of the needs to improve their work competence as well as the importance of acquiring job-required skills through training [34]. Managers interviewed in the case research also mentioned that employees who pay much attention to their career and job care about learning tasks given by their company and will accomplish them in time autonomously. Empirical evidence in Williams, Thayer, and Pond [35] suggests that career attitude and pre-training motivation are positively correlated. Therefore, we propose:

Hypothesis 3: Job/career attitude positively influences employee’s e-learning continuance intention to use.

The Freedom to Learn Theory points out that learning content should be conformed to learning goals [36]. The Adult Learning Theory stresses that intention to learn is affected by the necessity of solving practical problems in life. The perceived effectiveness/value of training is derived from trainees’ belief that application of the acquired skills can enhance their job performance. Higher job utility can lead to higher intention to receive training, and conformance of training content to job requirement is one of the most important values of training for trainees [3]. Wang [37] also mentions that learners’ e-learning adoption intention is affected by appropriateness of e-learning content and tasks. Therefore, we propose:

Hypothesis 4: Content/task relevance positively influences employee’s e-learning continuance intention to use.

Many empirical studies conducted on the basis of the classical Diffusion Theory have pointed out that users’ positive attitude to a technical system (perceived as satisfactory and useful) can help increase their intention to continue using the system. In an empirical study of usage of services of a portal site, van Riel, Liljander, and Jurriens [38] found a strong and positive effect of overall satisfaction on users’ intention to continue using the portal site. According to Keller [29], satisfaction of e-learning is one of the incentives for e-learning. Roca et al. [26] also discovered through a research of employee e-learning that increase of user satisfaction will positively influence employee’s intention to continue using the e-learning system. In this paper, the construct of usefulness encompasses satisfaction, effectiveness, and efficiency, so we propose:

Hypothesis 5: Usefulness of e-learning
positively influences employee’s e-learning continuance intention to use.

Technical systems play the role of an “e-moderator” [21]. Information systems can help increase learning efficiency and facilitate organizational learning [39] [40]. A useful e-learning system can provide a better system environment for learning, allowing employees with intrinsic motivations of content/task relevance to learn in a good environment and meet the demand for higher work efficiency. Learning content with a good job match can more effectively enhance employee’s intention to learn when transferred by a better e-learning system. Hence, satisfaction of an e-learning system can reinforce the “motivation to use” induced by content/task relevance, propelling employees to have more intention to continue using e-learning. Based on the above discussion, the following hypothesis is proposed.

Hypothesis 6: Usefulness of e-learning reinforces the positive influence of content/task relevance on employee’s e-learning continuance intention to use.

Pre-training motivation has considerable effects on training outcomes. In an employee training and learning context, requirements of the management system are a form of extrinsic motivation [3]. Extrinsic motivation includes reward, promotion, pay raise, and higher scores in performance evaluation [34]. While content/task relevance provides a better job utility, extrinsic motivations provide a better career utility [4]. In the design of training, sufficient definition of the goals of the training can help learners understand what levels of learning achievement or job achievement are expected and has significant effects on the training outcomes (e.g., [41]). Many studies have pointed out that a stronger extrinsic motivation (such as when performance is incorporated) can increase employee’s intention and opportunities to engage in learning activities. Therefore, we propose:

Hypothesis 7: Extrinsic motivations for e-learning positively influence employee’s e-learning continuance intention to use.

Workplace factors also play an important role in employee training. Organizational culture influences employee behaviors inconspicuously. The culture of continuous learning serves as an extrinsic motivation to employees and can enhance their learning intention [42]. The evidences in some studies on training (e.g., [42]) or e-learning (e.g., [43]) all suggest that the continuous learning culture has positive influence on employee training or learning effectiveness. The case research result also indicates that many enterprises have already put a strong emphasis on learning and employee training or development before introduction of e-learning. In such organizational culture, most employees will more be more active in participating in various learning activities. Therefore, we propose:

Hypothesis 8: The continuous learning culture within an organization positively influences employee’s e-learning continuance intention to use.

E-learning performance

The main difference between e-learning and conventional training models lies in application of digital technologies. Researchers of employee e-learning adopt the view of technology use and consider the uniqueness of technology use in employee e-learning, suggesting that “use” should be encompassed in the e-learning framework [44] [45]. Transfer of training via e-learning requires employees to use e-learning in a self-directed manner; otherwise, the learning effectiveness cannot be achieved. From the Freedom to Learn Theory, effective learning relies on spontaneous and full engagement of learners in learning activities. When learners attempt to discover new concepts, their intelligence can be enlightened, ability to acquire knowledge improved, and effectiveness of learning boosted [36]. Likewise, when employees have a higher intention to continue using e-learning and a stronger learning motivation, their learning performance can be positively influenced. This relationship has been empirically validated as significant by many researchers. Therefore, we propose:

Hypothesis 9: Employee’s e-learning continuance intention to use positively influences e-learning performance.

In all training activities, training content is an important factor of learning effectiveness. Ford and Wroten [46] thus suggest that training effectiveness should be evaluated by the relevance of training program content to the job. From a learner perspective, whether a learning material is meaningful is determined by learners rather than the material itself. Meaningful learning emerges when the learning content complies with the learning goals [36]. According to Pintrich and Schrauben [47], a higher perceived task value (i.e. the belief in the expected value of a learning task) can result in a higher performance. Studies of training transfer also show that whether the training
content is readily usefulness affects the training outcome (e.g., [48]). Alliger, Tannenbaum, Bennett, Traver and Shortland [49] point out that trainees apply skills acquired from the training in their job only when they perceive the training content as practical. Therefore, we propose:

**Hypothesis 10:** Content/task relevance positively influences employee’s e-learning performance.

The research of training transfer indicates that trainee’s “reaction” to training, i.e. satisfaction, affects training outcomes (e.g., [10]). Studies based on the Theory of Reasoned Action (TRA) and Technology Acceptance Model (TAM) also have a similar argument—user’s reaction to technology use affects user performance [44]. Besides, studies of the learning theories propose that learner control (i.e. learners control learning processes and methods according to individual needs and pace) is an important factor of learning effectiveness [50]. A better e-learning system can provide a better digital environment, allowing learners to exercise learner control (through functions such as providing learning history, note-taking, and connections to web resources) and increase their learning effectiveness. The empirical evidence in Johnson, Hornik, and Salas [51] suggests that technology usefulness has positive effects on e-learning outcomes. Therefore, we propose:

**Hypothesis 11:** Usefulness of e-learning positively influences employee’s e-learning performance.

Hierarchy is normal in any organization, and many individual activities may be subject to the influence of the organizational system and the organizational environment. In a review of literature associated with e-learning in organizations, DeRouin et al. [2] point out that previous studies have not fully supported the positive relationship between e-learning and learning effectiveness. Besides, there may be important moderators between e-learning and learning effectiveness, so further exploration is required. We argue that the social supports from the organization, including “extrinsic motivation” and “continuous learning culture” are influential.

The Expectancy Theory of Motivation [52] proposes that motivation = expectancy × instrumentality × valence. In addition to intention to use e-learning, connecting goal settings and reward plans to e-learning performance can increase the instrumentality of e-learning and thus enhance the motivation for e-learners. Besides, while content/task relevance provides job utility, extrinsic motivations provide career utility [4] and can elevate the value of e-learning behavior. Researchers of the Cognitive Evaluation Theory argue that extrinsic motivation and intrinsic motivation have interaction effects on behavior [53]. Therefore, we propose:

**Hypothesis 12:** Extrinsic motivation for employees reinforces the positive relationship between e-learning continuance intention to use and e-learning performance.

Many studies on organizations have found that organizational culture plays the role of a situational enhancer for employee behaviors [54]. This is a strategic focus, which means that behavioral signals will be formed under the atmosphere of the organizational culture, revealing which tasks are “important” in the organization [55]. It has been pointed out in many studies that the continuous learning culture in the work environment is an important variable affecting trainee’s learning. Continuous learning culture provides employees with specific goals, allowing them to realize that “learning is important” in the work environment. Thus, the strategic focus that stresses learning performance improvement through e-learning will make employees more dedicated to e-learning activities. Besides, according to the Social Learning Theory and subjective norms, learning in an organization with a continuous learning culture and with co-learning companions or with subjects to learn or imitate from can increase employees’ learning motivation. Employees’ increased attention to learning achievement will ultimately result in better learning performance. Therefore, we propose:

**Hypothesis 13:** The continuous learning culture within an organization reinforces the positive relationship between e-learning continuance intention to use and e-learning performance.

**Participants, Procedures, and Measures**

The research scale was developed according to previous empirical studies and modified on the basis of related theories. To verify the proposed hypotheses and the overall model, we invited 258 enterprises from related reports and data provided by industrial associations which have introduced an e-learning system and are using it to provide technical knowledge to a considerable number of employees.

The questionnaire was collected in three stages, starting from Dec 2008 and spanning for about four and half months. In the first stage, responses of managerial questionnaire in which items of media richness and extrinsic motivation
were asked from e-learning managers of 58 enterprises.

The second stage: Three months later, 766 responses of users’ questionnaire in which most items of research variables were asked from e-learning users were collected from the mentioned 58 enterprises. The third stage: One more month later, all responses were further asked with questionnaire of items for “e-learning performance”.

Among the 58 enterprises, however, 28 enterprises did not have insufficient sample scale of users’ questionnaires. Responses from employees in these 28 enterprises, 136 in total, were all excluded. Besides, there were 28 incomplete responses, 5 responses with missing or incomplete answers, and 10 responses from employees who did not use e-learning in the past three months. After these responses were excluded, a total of 587 valid employee responses from 29 enterprises were obtained.

All measures (with 3-6 items) of constructs were modified from measures of former empirical studies and findings from case studies in this research. The results of validity and reliability analysis are presented in Table 1. For the e-learning user questionnaire, confirmatory factor analysis (CFA) was performed to verify the convergent validity of the measurement tool. For the e-learning managerial questionnaire, the sample sizes of “media richness” and “extrinsic motivation” were too small, so CFA was not suitable. Therefore, principal component analysis of exploratory factor analysis (EFA) was conducted to verify the construct validity of the questionnaire. Besides, according to the factor analysis results, all the constructs were tested for reliability.

Data Analysis and Results

Aggregation Statistics and Hypotheses Testing Results

This research was designed to conduct a multi-level analysis. Because many variables were induced from data of many individuals, theoretically, there should be a certain degree of consistency or consensus between individuals. Therefore, consistency between individuals in the perception of a specific phenomenon is a key criterion that determines whether a group variable can be generated. Besides, variance of the variable should be tested by explaining the group variable and measuring the mean reliability at the group level. We conducted the test by measuring $r_{wg}$ (within group agreement), intra-class correlation coefficient ($ICC_{(i)}$), and reliability at the group level ($ICC_{(ii)}$). The results show that all the $r_{wg}$ values are greater than the 0.6 threshold suggested by James [56]. The mean $r_{wg}$ values are as follows:

content quality (0.727), usefulness of e-learning (0.737), and continuous learning culture (0.768).

### Table 1 Factor analysis and reliability analysis results

<table>
<thead>
<tr>
<th>Construct &amp; Item</th>
<th>Factor Loading</th>
<th>t-value</th>
<th>CR (AVE)</th>
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<tbody>
<tr>
<td>E-Learning Users’ Questionnaire</td>
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<td>Environmental Quality</td>
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<td>Job/Career Attitude</td>
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<td>Usefulness of E-learning</td>
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<tr>
<td>Continuous Intention to Use</td>
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<tr>
<td>E-Learning Performance</td>
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<tr>
<td>Computer Self-Efficacy</td>
<td>0.945</td>
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</table>

<table>
<thead>
<tr>
<th>Construct &amp; Item</th>
<th>Factor Loading</th>
<th>t-value</th>
<th>CR (AVE)</th>
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<td>E-Learning Performance</td>
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<tr>
<td>Computer Self-Efficacy</td>
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</tbody>
</table>

The 9th International Conference on Electronic Business, Macau, November 30 - December 4, 2009
Table 2 Hypotheses testing result

(1) The effects on usefulness of e-learning

<table>
<thead>
<tr>
<th>Dependent: Usefulness of E-learning</th>
<th>Independent</th>
<th>Model A1</th>
<th>Model A2</th>
</tr>
</thead>
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<tr>
<td>Content Quality</td>
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<td>0.467 *</td>
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<tr>
<td>Media Richness</td>
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<tr>
<td>R²</td>
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<tr>
<td>ΔR²</td>
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<tr>
<td>F</td>
<td>16.901 ***</td>
<td>13.936 ***</td>
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</table>

*p<0.05; **p<0.01; ***p<0.001

(2) The effects on continuance intention to use

<table>
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<th>Dependent: Continuance Intention to Use</th>
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<th>Model B1</th>
<th>Model C1</th>
<th>Model B2</th>
<th>Model C2</th>
<th>Model B3</th>
<th>Model C3</th>
<th>Model B4</th>
<th>Model C4</th>
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<tr>
<td>Content /Task Relevance</td>
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<td>0.582 ***</td>
<td>0.586 ***</td>
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<tr>
<td>Continuous Learning Culture</td>
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<td>0.435 ***</td>
<td>0.435 ***</td>
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<tr>
<td>Usefulness of E-learning × Content /Task Relevance</td>
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<td>R²</td>
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<td>F</td>
<td>13.936 ***</td>
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</table>

*p<0.05; **p<0.01; ***p<0.001

(3) The effects on e-learning performance

<table>
<thead>
<tr>
<th>Dependent: E-Learning Performance</th>
<th>Independent</th>
<th>Model A1</th>
<th>Model A2</th>
<th>Model B1</th>
<th>Model B2</th>
<th>Model C1</th>
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<td>4.617 ***</td>
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<tr>
<td>Continuous Learning Culture</td>
<td>0.326 **</td>
<td>0.326 **</td>
<td>0.326 **</td>
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<td>Cross-Level</td>
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<td>Residual Variance</td>
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*p<0.05; **p<0.01; ***p<0.001

Conclusions and Suggestions

Usefulness of an e-learning system is an important determinant of employee's intention to use e-learning and learning effectiveness: e-learning encompasses management of transfer of knowledge and is also a part of the learning environment. A well-designed e-learning system can not only enhance employees’ intention to use the system but also help them obtain learning effectiveness. This finding is consistent with conclusions of many studies on technology use and e-learning. However, through a multi-level research framework, we explore the moderating role of technology at the work environment level. The finding indicates that employees’ continuance intention to use induced by the job value incentive (content/task relevance) can amplify the effects of a good e-learning system. Our empirical evidence also supports Salmon’s [21] argument about the moderator of e-learning in e-Moderating.

The quality and media richness of e-learning content are key indicators in user evaluation of the usefulness of an e-learning system: What kind of e-learning system is a satisfactory learning system is a focal issue in many existing studies. Through literature review, we induced the development process of this research domain. In early years, the research of e-learning technologies was focused on system quality and service quality of the supporting systems. Later, researchers began to shift their...
focus onto information quality, i.e. quality of e-learning materials. In recent years, compared with the system aspect, researchers paid more attention to the content aspect, i.e. sufficiency, richness, and presentation of the learning content. Therefore, many recent researchers have employed the Media Richness Theory proposed by Daft and Lengel [28] to propose the importance of content richness and use of multimedia in e-learning.

Content/task relevance is imperative for the design of e-learning content: In addition to the quantity (content) and quality (media richness) of e-learning materials, "content/task relevance" based on the perceived job value can induce employees’ e-learning continuance intention to use. Many enterprises may purchase more generalized learning materials when introducing e-learning due to consideration of material development time and cost. Because some of these learning materials may have no direct relevance to employees’ regular tasks, employees may not consider e-learning as an immediately necessary activity. Whether in previous studies of training transfer or this study, the empirical evidence suggests that relevance of learning content to tasks can induce motivation for continuous learning and more substantial learning outcomes.

The continuous learning culture reinforces motivation: Many studies of organization theories have pointed out that “culture” affects employee behaviors inconspicuously. From the learning perspective, the Social Learning Theory provides a foundation for this argument. Learning from others in the group to change individual behaviors is a foundation for this argument. The empirical finding in this paper supports that the continuous learning culture reinforces learners’ motivation to learn.

Extrinsic motivations reinforce learning: Previous studies have shown that compared with intrinsic motivations, extrinsic motivations are less influential to learning motivation. This finding is also supported in this paper. However, while scholars contemplate on whether there are important situational factors that may reduce the effects e-learning on learning performance, our research results have provided some clues. Employees’ performance in e-learning is certainly influenced by their intention to learn. However, extrinsic motivations serve as an effective “situational” factor that enhances employees’ learning motivation and learning performance.

An answer to the Self-Determination Theory: a continuum of e-learning motivation is formed according to self-determination levels. Continuance intention to use is affected by factors including job/career attitude, content/task relevance, usefulness of e-learning, extrinsic motivation, and continuous learning culture. Among these factors, extrinsic motivation does not exhibit a significant influence on continuance intention to use in this paper. Ryan, Connell, and Deci [58] first developed the Self-determination Theory and proposed in the subsequent research that motivation is a continuum of self-determination levels which reflect the perceived locus of causality. Motivations in the highest level are intrinsic motivations (enjoy doing it) and extrinsic motivations including autonomous motivation (worth doing) and controlled motivation (supposed to do it; must do it). The controlled motivation comes from reward and threat and may thus reduce autonomy and motivational needs. In our investigation into the factors affecting continuance intention to use, we found several types of motivations as follows: usefulness of e-learning—enhance intrinsic motivation (enjoy doing it); job/career attitude and content/task relevance—enhance autonomous motivation (worth doing); continuous learning culture—enhance controlled motivation (supposed to do it); extrinsic motivations—enhance controlled motivation (must do it). Among these motivations, the must-do-it controlled motivation comes from extrinsic motivations rather than voluntary motivations, so it can hardly induce employees’ enduring intention to engage in e-learning.

Transfer tools for e-learning materials, employee learning motivation, and e-learning content are equally important for learning performance. Although the mediating role of intention to use between use responses and use benefits has been pointed out in many existing studies, its mediating effect is not significant in this study. To obtain substantial learning effectiveness, usefulness of e-learning (i.e. material transfer tool), continuance intention to use (i.e. employee learning motivation), and content/task relevance (i.e. material content) are equally important. Extrinsic motivations are important social supports. In addition to the above-mentioned three factors, social supports for “enhancing” learning can be provided. Extrinsic motivations such as rewards and performance appraisals are important “catalyzers”. The evidence of the moderating role of extrinsic motivations explains why extrinsic motivations are important but not significantly influential in empirical tests.

The factors of the technical system and the social system simultaneously or alternately influence individual responses, motivations, and behaviors: E-learning is a series of activities, in which employees go through reactions, motivations,
Management implications

A “useful” e-learning system defined by users: There is no denying that constructing a good “digital environment” for learning is necessary. Employees may feel very frustrated whether they are required or self-directed to use a not very useful e-learning system. Besides, the usefulness of an e-learning system is defined by users. Therefore, e-learning managers must realize and even investigate employees’ needs for the learning content, responses to the system quality, and suggestions on system improvement.

Learning activities that can enhance work efficiency and integrate career development: Learning activities must be connected to the goals of learning. In workplaces, the most direct goal of learning is to enhance work efficiency. Hence, e-learning content should be “customized” as much as possible to provide content needed by each individual user. For instance, new employees need to acquire knowledge of the work processes and methods in a short time, managers need to learn effective leadership and communication skills, and technicians need to know latest innovations and industrial information. Employees can be attracted to continue using an e-learning platform only when they can acquire appropriate learning content from it. Besides, employees who are more concerned about self-development and career plans will have a stronger intention for autonomous learning.

Therefore, reinforcing the linkage between learning activities and career development is a must. The amount of learning content for each level of employees should be effectively planned. Besides, what learning content that employees need to acquire at each career stage should also be made clear. Therefore, when employees make future plans, they will also take into account the requirement of learning activities into their plan of work life.

Develop a culture that promotes learning: A far-sighted strategic leader will convey and form common values by shaping their organizational culture. Certainly, organizational culture cannot be shaped overnight. In the long-run, it can be an intangible power that influences employees’ thinking and behavior in inconspicuous ways. The learning culture involves the value that “learning is necessary” and “learning is a part of work life”. This value is shared by employees, who will provide support to one another to accomplish the “task” of learning. Effective construction of a learning culture should start from top to bottom in an organization. If executives emphasize learning, lower ranking employees will realize that learning is important.

Provide rich, constantly updated, and “planned” learning content: For users of e-learning systems, constant update of e-learning content is more important than content richness. In the development of e-learning content, managers should plan materials like school curricula. They should plan progressive learning content from the perspective of learners and provide suggestions on learning pace. In our case research, most of the interviewed managers mentioned that they should gradually transform their role as a content provider into a content or course planner. In nowadays, the information technologies advance in a fast speed. Application of multimedia is no longer costly, and software and hardware environments for e-learning are very mature. Effective use of presentation methods for each type of course content can help increase learners’ learning intention and effectiveness.

Limitations and suggestions for future researchers

Due to the constraint of research needs, a non-random sampling method—purposive sampling was adopted. As a result, there was limitation on generalization of the theories. Besides, to avoid common methods variance, extrinsic motivations were assessed by executives. This design prevented us from verifying whether the extrinsic motivations were motivations perceived by employees. With consideration of the survey difficulty and large differences in e-learning
content between enterprises, employees’ e-learning performance was assessed by subjective measures rather than objective test measures. There are still numerous issues of e-learning in organizations that should be empirically investigated. Subject to the constraints of research time and cost, we could only select factors affecting learning effectiveness at the individual level from previous literature and verify the effects of these factors. Thus, future researchers should be empirically investigated. Subject to the numerous issues of e-learning in organizations that rather than objective test measures. There are still performance was assessed by subjective measures between enterprises, employees’ e-learning content.

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A CASE STUDY OF REMOTE MONITORING OF HEALTH STATUS OF THE ELDERLY AT HOME IN TAIWAN

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Abstract
This case is a B2B2C model (service provider vs. community vs. the elderly) of innovative tele-care service provision. The service provider under study is the Chu-Shan Show-Chw an Hospital, a district hospital. The community consists of the social welfare institutions such as temples, community care centers, and nursing homes. The elderly are either residents of the community or the nursing homes. The community, as a service promoter, contributes to the increased acceptance compared to the traditional B2C model. Many communities under study and some social welfare organizations are highly interested in providing health care service to the elderly, and will support future operations if the results are satisfactory. Through this project, the district hospital can extend its primary care function to communities, build up trust among people, and improve the physician-patient relationship.

Keywords: Telemedicine, Primary Care, Long-Term Care, Aging in place, Technology acceptance model, Trust

Introduction

Long-Term Care
Long-term care is a prevailing issue in every country due to the aging of population and an increasing number of chronic diseases instances. In particular, the aging index in Taiwan was 58% in 2007, and is projected to reach 100% in 2016. In Taiwan, taking care of the elderly is traditionally done by family members in a social structure dominated by the extended family [1].

Long-term care is usually divided into three types: institutional care, community care, and residential care [2]. The capacity of institutional care can support only 6% of the elderly [3], so most of the elderly wish to be taken care of either at home or in the neighborhood. Family members are thus playing a major role. The percentage of those who need medication care is only about 10% [4], with the other mainly in need of life care, so community care and residential care have been the mainstream long-term care types in Taiwan [4].

Some of the elderly under long-term care suffer from increased morbidity rate or poor prognosis so they need long-term care to survive. The others are too weak due to aging so they cannot take care of themselves. In either case, long-term care should cover the mental and physical health, as well as social life functions [2].

The main characteristics of long-term care include:
1. Target: those in the community who have deficiency in physical, psychological or social adaptation abilities.
2. Scope: preventive, diagnostic, therapeutic, rehabilitative, supportive and maintenance services.
3. Duration: more than 30 days.
4. Place: community or institutional care centers.
5. Objectives: to prevent functional degradation, and to achieve functional independence.

In health care for the middle aged and the elderly, the development of a complete and sound long-term care system is a major help for the normalization of healthcare system, and the inhibition of rising health care costs. The graduate change in social structure makes it necessary to develop a long-term care system to solve the issues faced by the elderly, the family and the society.

This study starts from how the district hospital, in difficult times, managed to construct a telemedicine system in cooperation with community welfare organizations, to extend the primary care function to the elderly in the community, to facilitate the referral process and to reduce waste of health care resources.

Primary Care
Primary care is the patient's first contact with the health care system. As the "gate keeper" of the health care system, primary care provides the general out patient service and preventive services, dealing mainly with initial screening, diagnosis and treatment, and also refer patients who need further treatment to specialized hospitals.

The ultimate goal of primary health care is better health for all. WHO has identified five key elements to achieving that goal [6]:
1. reducing exclusion and social disparities in health (universal coverage reforms);
2. organizing health services around people's needs and expectations (service delivery reforms);
3. integrating health into all sectors (public policy reforms);
4. pursuing collaborative models of policy dialogue (leadership reforms); and
5. increasing stakeholder participation.
The concept of Primary Health Care adopted at the Conference of Alma Ata in 1978 is endorsed by the NPPHCN and forms the basis of the NPPHCN definition of PHC. In 1978, the WHO explained the meaning of PHC as providing accessible and necessary health care to all individuals and families in the community. The WHO also urged all the countries to emphasize PHC [6].

The Nature of Primary Care
1. Excellent primary care is grounded in both the biomedical and the social sciences.
2. Clinical decision making in primary care differs from that in specialty care.
3. Primary care has as its core a sustained personal relationship between patient and clinician.
4. Primary care does not consider mental health separately from physical health.
5. Important opportunities to promote health and prevent disease are intrinsic to primary care practice.
6. Primary care is information intensive [7].

Summarizing the above arguments, we conclude that the primary care needs not only the information and medical technology provided by the district hospital, but also the maintenance of relationship between the elderly. Since the doctors cannot go to the villages to serve the patients everyday, local health care workers are employed to maintain the relationship between the elderly and the hospital. Traditionally, health care providers can reduce the complexity by working with other knowledgeable health care workers [7, 8].

Tele-home care
The content of tele-home care include personal care, general nursing tasks, physical therapy, social work, nutrition and health consultation, meal delivery, patient transportation, emergency help system. The service should be a holistic care that takes into account the life quality of those being cared. Community and home care are promoted by scholars and governments as the main models for aging in place, which can satisfy the needs of most of the care receivers [9, 10].

The target of the tele-home care is the people served by community or residential care. These care receiver who don't need daily medical care, can use wired or wireless communication, coupled with wearable vital sign sensors to construct a bi-directional link with the medical professionals. That will reduce transportation cost and increase the mobility of the care receivers. The health insurance spending is also lower because of early warning enabled by the long-term and immediate information flow, with the potential of transferring institutional care to residential care and becoming an important part of preventive health care.

Telemedicine
Telemedicine is defined as any health care provided to patients via technology across a distance[11, 12] Telemedicine can potentially break through barriers of time and distance currently encountered in accessing health care by using technology such as telephones, computers, and interactive video transmission [13, 11, 12]. Advanced communications technology can potentially remove geographic distance as a barrier to provider–patient interaction and information retrieval, thereby providing a more equitable healthcare distribution [11].

Background

Health in Taiwan
National Health Insurance (NHI) has changed the healthcare seeking behavior of the Taiwanese people. NHI covers every citizen and provides a wide range of health care services. The increased accessibility of health care services has boosted the satisfaction of the people [14]. But the convenience and low fare has caused a abnormally high rate of 17 times of out patient services on average, more than twice as many as the number in developed countries [15]. Most of the Taiwanese people prefer to seek health care in large hospitals and medical centers because they believe the service quality is better there. But the excessive number of patients has actually reduced the service quality, which in turn leads to lower cure rate and thus more visits to the hospitals. This vicious cycle has caused waste of the national health care resources and the increasing deficit of the NHI.

Because the NHI did not impose a strict referral system initially, people in Taiwan are not used to it and still have the blind faith that the equipment and doctors in medical centers. The importance of primary care and family physicians is neglected. This has caused the withering of local hospitals and vicious competition between medical service providers. The failure of a referral system has caused the lack of long-term monitoring of patients with chronic diseases. Patients with acute problems also suffer from the lack of a referral system because of repetitive examinations and the increased possibility of complication. In order to build a proper hierarchy of health care, the NHI has established a referral system in 2005 to improve the quality of health care and reduce waste of resources.

The referral system encourages the patient to seek health care service in primary care first, before being referred to hospitals if necessary. In this way, the patient can be referred to proper higher-level medical institutions without repetitive examinations. Larger hospitals can thus focus on patients with more serious problems. Under this referral system, a better cooperation between health care organizations
Aging in place (getting old in a familiar environment) is a strongly-held faith that is rooted deeply in Taiwanese people's traditional mindset. Especially in rural societies, the people are linked to the land and their families. The phenomenon of aging society has derived problems such as shortage of medical resources and reduction of quality in healthcare services. To cope with these problems, Taiwan government has actively planned and promoted various telemedicine and long-term care projects in recent years.

The accelerated aging and the increasing morbidity rate of chronic disease have increased the danger of disease and functional deficiency among the elderly. In a study commissioned by the Department of Health showed that the percentage of the elderly who have at least one deficiency in activity of daily life (ADL) is 9.0% [14]. To accommodate the aging population, an important direction for the government to promote a home-based health care service is a model based on residential and community care, using the information technology combined with health care service to construct a new type of THC service.

Aging in place

Aging in place (getting old in a familiar environment) is a strongly-held faith that is rooted deeply in Taiwanese people's traditional mindset. Especially in rural societies, the people are linked to the land through life-long struggles and cooperation. The sense of place and the identification of the residents are collected [18]. A survey by the Ministry of Interior showed that more than 80% of the elderly wish to live with their children or their spouse, or next door to their children [19]. The fulfillment of aging in place can thus satisfy the need of the elderly [20].

The western countries have a concept of "successful aging", meaning the individual can adapt to the aging process, stay fit physically, and enjoy his or her own life [21]. The three key indicators of successful aging are [22]:

1. low probability of diseases and disease-related
2. high cognitive and physical functional capacity
3. active engagement of life

Crowther added the positive spirituality as the fourth factor of successful aging, emphasizing the importance of religious belief in supporting the older adults when facing aging [23]. Summarizing the above arguments, there four points regarding to long-term health care for the elderly that have to be observed:

1. Make them independent, not just cure their diseases.
2. Integrated: the care provided should include medical, rehabilitative, and social, economical aspects.
3. Continuous: The process of long-term care should be continuous, including an emphasis on prevention than treatment, and not only in-hospital treatment. The form of care provided should also be continuously changed as the physical condition of the patient changes.
4. Resources allocation: It's a waste of medical resources if chronic patients occupy the hospital beds for acute diseases. The invasive examination in the hospital cause by the lack of referral data is also unnecessary. The coordination of different medical organizations can bring proper allocation of resources [24].

So a local primary care organization should pay more attention to the long-term care of the elderly, to meet the requirements of successful aging.

Theoretical background

Technology acceptance model

The original technology acceptance model suggests that two beliefs – perceived usefulness and perceived ease of use – are instrumental in explaining the variance in users’ intentions. Perceived usefulness is the degree to which a person believes that using a particular system will enhance his or her job performance. Perceived ease of use is the degree to which a person believes that using a particular system will be effortless. These determinants are also easy to understand for system developers and can be considered during system requirement analysis and other system development stages. These factors are common in technology-usage settings and can be widely applied to solve the acceptance problem [25].

Information systems researchers have investigated the technology acceptance model, and found it to be valid in predicting the individual’s acceptance of corporate IT systems [26, 27, 28]. Venkatesh and Davis [29] proposed an extension, TAM2, which consisted of social influence processes (subjective norm, voluntarism, and images) and cognitive instrumental processes (job relevance, output quality, result demonstrability, and perceived ease of use), but it omitted attitude to use due to weak predictors of either behavioural intention to use or actual system use. In addition, Agarwal and Karahanna [30] have extended the technology acceptance model with constructs such as cognitive absorption, product involvement and perceived...
enjoyment.

**Trust**

Paul and McDaniel [31] examined the relationship between interpersonal trust and virtual collaborative relationship (VCR) performance by studying a telemedicine project. Out of the four types of trust identified, if any one is negative, then it is very likely that VCR performance will not be positive. One way to facilitate trust building was proposed by Stewart [32], who showed that when an unknown target is related to an organization one already trusts, the trust can be transferred to the new target.

In the past, the promotion of tele-care service was based on the technology acceptance model (TAM), concentrating on the ease of use and usefulness. But in Taiwan, the elderly are more conservative and are generally not willing to go to hospitals unless they have to. They are more inclined to stay with their family and not willing to get to nursing houses. The elderly are usually not comfortable with new technology and do not trust the measurement equipment. About 80% of the elderly have not heard of tele-health care (THC), and worry about the difficulty of learning how to use the equipment, how much they have to pay, etc. [33]. The study [34] showed that patients expect THC service to be easy to operate. All these factors contribute to the failure of previous projects using the B2C model. In the past, the promotion of tele-care service was based on the technology acceptance model (TAM), concentrating on the ease of use and usefulness. But in Taiwan, the elderly are more conservative and are generally not willing to go to hospitals unless they have to. They are more confined to their family and not willing to get to.

**Community care system operation**

The environment for hospitals in Taiwan has been increasingly difficult, with the number of hospitals shrinking from 514 in 1992 to 359 in 2004 [Department of Health]. The health care resources are not fairly distributed to district hospitals, with the audit and payment of the NHI favoring large hospitals. The referral system is not properly enforced so the income of district hospitals is heavily affected. After the 921 earthquake, two sizable hospitals (with more than 100 beds) in Nantou were closed [35].

The project was executed in Nantou County, the only land-locked one in Taiwan. The project was executed in Nantou County, the only land-locked one in Taiwan. The main economic activity in Nantou is agriculture so the aging problem is more severe than that in the large cities. The common characteristics of the elder population in the rural areas are 1. living alone or only with their spouse and with older age; 2. less educated, without enough knowledge about health care; 3. insufficient in social resource; 4. illness-plagued and in need of long-term monitoring and care. The communities are closed and the residents are not familiar with preventive health care. The Chushan Township is located in a mountainous area where travel is not very easy. The Show-Chwan Hospital now shoulders the health care responsibility of this area.

In such a difficult environment, the Show-Chwan Hospital needs to build a good relationship with the local residents and extends its function as a primary care organization. By providing the integrated health care to the elderly, the hospital can concert from a district hospital to a long-term care hospital.

By adding the trust transfer factor, the hospital wish to build a B2B2C model of tele-health care service, utilizing the trust to the community to facilitate the acceptance of the vital sign measurement equipment.

The Sheliao Neighborhood, selected to run the pilot project in, has a local religious center, Tzunan Temple, which also serves as a charity. The temple has been working with volunteers to provide emergency relieves and social security, including tuition fee subsidy and free lunch for school children and meal delivery to those in need. Tzunan Temple is also a place for the elderly to meet. The temple has strong interest in participate the local health care programs, so the hospital decided to cooperate with temple.

The three parties involved in this project are described separately below:

1. **Service Provider: District Hospital**

Chushan Show-Chwan Hospital is the only qualified regional health care center, with 200 general beds, 100 specialized beds, 45 doctors, and 215 nurses. The hospital has been devoted to health care services in remote rural areas, and has been positioned as a community health care service provider. The hospital has penetrated the communities, provided comprehensive health care service, and established warm relationship with the residents. It also combined with the community resources to elevate the quality of health and life of the local people.

2. **Community: religion center**

Tzunan Temple, as a service provider, is playing the role of gap-filling by concentrating in the services the government is not able or not willing to provide, but the people actually need [36].

The Han communities in Taiwan are typically shaped by the immigrant origin. Mass immigration from China around the turn of the Ming and Ching dynasties resulted in a society with hardship of leaving their homeland and fear of the unpredictable future. Religious faith became the spiritual support of the people, and many of them built temples which...
turned into the community center of settlements, "a cultural nexus of power" [37]. Temples can be found in every corner of Taiwan, as they have been associated with the destiny of the land and the people, and became a symbol of geographical and ancestral relationship, linking the people to where they had come from. Through the public rituals of religion, the community identification is intensified, and the people are more united under the same faith [38].

In the wake of modernization, religious activity is one of the few opportunities that are compatible with the social structure and residential identification for the people to recognize the community as a concrete existence. The local temples can satisfy the spiritual, social, psychological and entertainment needs of the people, linking the people with the community both in mentality and history. As a concrete symbol of the community, the temple forms a center of everyday social events and also a spiritual support when people are suffering from disasters and diseases [39].

Tzunan Temple is a popular land god temple and a local religious center that has brought prosperity to the neighbourhood and also served the community as a charity organization. The community is now facing a population aging issue as the young have moved to the big cities for a living. A tele-health care system that incorporates identification technology can send the biometric parameters, such as blood pressure, oxygen saturation, blood glucose level, etc. to Show-Chwan Hospital to be monitored. Abnormal data will trigger an alert that's sent to the elderly and their family via short messages, so that an early response can be activated, and the quality of health care service can be improved. In the planning stage, a total of 214 elderly residents were registered to receive the health care service in this project.

3. Community tele-care system:

The equipment, function and location of the system components are listed in Table 1.

(1) The user end (Tzunan Temple Community Center): vital sign monitoring equipment was installed. The equipment was linked to the hospital end, and had a simple user interface and alerting and emergency help function.

(2) The hospital end has the following functions:
   A. Remote information access function: The vital sign readings can be uploaded to a database at any time. The database can be accessed remotely for the physician to retrieve historical and latest data for analysis and diagnosis.
   B. The user interface should have the following functions:
      (a). configurable in the analysis and notification of abnormal readings.
      (b). capable for managing, editing, and sending short messages and emails about the person being monitored.
      (c). capable of replying the query from the person being monitored.
      (d). personal data management.

C. Tele-care system usage and query interface
   (a). The family members of a Id card holder can use the Id number to login the system and query the status of the card holder.
   (b). The health manager can login and query the data to be examined.

4. Emergency help system:

Figure 1 shows the community care system: the religious center is a place the elderly often visit. The identification can be done with the Id card made for this project, or the NHI card. The measurement equipment comes with user-friendly touch-screen interface, for the elderly to operate by themselves. For those who still cannot operate the system by themselves, Tzunan Temple sponsored medical personnel from Show-Chwan Hospital to help them and to provide health education.

The vital signs measured are encrypted and sent to a database located at the Show-Chwan Hospital, and screened automatically for abnormal data. The health manager will be notified if there's any abnormal data observed, and contact the subject to discuss the health status. The interaction between the health manager and the community residents builds up a good relationship between the hospital and the residents, reducing the information disparity and encouraging the residents to care more about their own health. The health manager's response to abnormal data includes sending short message to family members and family physicians to help the elderly seek further medical service.
An easy-to-use emergency help system was deployed to 50 homes with special need, at the expense of Tzunan Temple. It consisted of a central response unit and residential units. The residential unit can send a signal to the central unit when a wearable button is pressed within 50 m of a receiver connected to telephone line. The central unit will notify the health manager and send short messages to family members and other people who can help the elderly when there is an emergent situation. The receiver is also equipped with a video telephone so that the health manager can better communicate with the elderly to discuss immediate treatment and next steps.

The mother of the chairman of the administration committee of Tzunan Temple, aged 80, was one of the elderly participating in this project. The high social status of this lady, along with the subsidy from Tzunan Temple, and the volunteers helping the elderly in the temple, contributed to the success of the pilot project. This is one evidence that trust transfer can facilitate the acceptance of high-tech measurement equipment.

The cost of the vital sign monitoring equipment has been a huge burden for the hospital or the household. The elderly residents in mountainous areas belong mostly to low-income households that are subsidized by the government of charities.

The community charity considers this to be their responsibility and donated the equipment to 50 patients with cardiovascular diseases.

Figure 2 shows that the vital signs such as the body weight, temperature, blood pressure, blood glucose level, are send via the telephone line to database in the tele-care center for further management and analysis. The hospital can retrieve the data or when the patient is referred to another medical organization, the long-term data can also be retrieved there as a reference for diagnosis.

Family members or care-givers can query the health data via the Internet. If the software program detects abnormal readings, the health manager in the tele-care center will proactively contact the user by video telephone. The response center is staffed around the clock to respond to all incoming messages. The handling of the incoming is also recorded for later analysis.

Emergency help system: the use can press a button when immediate help is needed. A signal will be sent to family members or care-givers and the tele-care center. The tele-care center will call 119 or the hospital to help the user. The destination to be called can be set in the system and will be called repetitively until answered. Short message or email can also be used to send the alert to family members or friends of the user.

5. Data
The measurement data, chronic disease control and emergency help cases recorded during the execution period of the project are listed in Table 2.

Benefit and implication
Besides the increased acceptance of vital sign measurement equipment, we have seen several other intangible benefits:

1. District hospitals in the Chushan area were caught between the local clinic and the Taichung Veterans General Hospital because people would skip the district hospitals when they sought medical help that cannot be provided by the local clinics. After the project under study started, the elderly in local elderly people started to feel the care from the Show-Chwan Hospital and the community, and have more confidence towards the hospital. The long-term data are now stored in the database in the hospital, so the hospital can get a better picture of the overall health status of the patients, and thus provide a better service. This project has successfully raised the number of patients visiting the hospital and resulted in better medical resource allocation.

2. This project has set an example of integrated community care system built upon trust and mutual understanding. The success of this project has attracted the industry and charity organizations from around the country to assimilate this new model of community care. The exposure in the national media not only raised the image of the hospital, but also the donation to Tzunan Temple.

3. The health of the elderly is now under better management with the volunteers not only helping them with the use of the measurement equipment, but also general issues related to health care. For example, they got advice on which department in the hospital to go to.
hospital they should visit, or how to make reservations. The complaints and criticism about the hospital has decreased and satisfaction and reputation raised. Tzunan Temple is also pleased to see the combination of the hospital and the community which has made it easier to provide more service to the community.

4. The supplemental value of the hospital has increased: this project helps the elderly to extend their healthy condition, and the preventive alert system can reduce further health insurance expense and minimize the waste of medical resources.

5. This project has redefined the service model of long-term care for the elderly with a remotely accessible database of the vital signs measurement data, and close interaction between the patient and the health manager. When abnormal cases do arise, the health manager can provide suitable advises and arrangement for further medical services. The focus has shifted from treating diseases to health care and preventive medical service. This new model not only provides a new direction for Show-Chwan Hospital, but also can boost the development of relevant products and services.

**Limitation of this study and future development**

This project has resulted in abundant fruits. In the same way that trust, as social factor that affects the adoption of new technology, the social psychological requirement is also a very important part of the overall health of the elderly. For example, those who live alone and have less interaction with others might need more community involvement. After all, no technology can replace the real meaning and value of humanity.

**Acknowledgement.** This research is partially supported by Chushan Show-Chwan Hospital.

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Table 1: Tele-care data of Community Center (n=1022 instances) duration 9710-9803

<table>
<thead>
<tr>
<th>Quantitative item</th>
<th>N</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of subjects</td>
<td>214</td>
<td>1. vital signs measured in the Tzunan Temple community center 2. Total instances of measurements=1022, among which 6 were handled by the health manager, and being treated in Show-Chwan Hospital under continuous monitoring.</td>
</tr>
<tr>
<td>measurement item</td>
<td></td>
<td>number of abnormal cases</td>
</tr>
<tr>
<td>● blood pressure</td>
<td>402</td>
<td></td>
</tr>
<tr>
<td>● blood glucose level</td>
<td>68</td>
<td></td>
</tr>
<tr>
<td>● pulse</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>● oxygen saturation</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Number of households with home safety care</td>
<td>50</td>
<td>1. Accident and emergency notification. 2. Ambulance calls. 3. Emergent message dispatching. 4. Routine communication with 50 households every Wednesday or Thursday, including health education.</td>
</tr>
<tr>
<td>Control of abrupt changes in chronic disease</td>
<td>3</td>
<td>Patient 1: blood pressure remained high after taking medicine. Beside health education, the patient was referred to the hospital for outpatient treatment and monitored regularly. Now the condition has returned to normal.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Patient 2: Blood pressure remained high after several measurements. The patient was reluctant to see a doctor until repetitive health education and persuasion. The family doctor called and the patient has since accepted treatment and the condition has improved.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Patient 3: Diabetes originally treated with injective insulin, but changed to oral medicine recently. Abnormal blood glucose level observed on 2008-11-21, and the patient was advised to see a doctor. After changing back to injective treatment, the condition is now under control.</td>
</tr>
</tbody>
</table>
Patient 5: Centipede bites reported on 2008-10-05. The health manager advised the patient to use ice pack therapy and seek emergency room treatment. The health manager called the patient twice afterwards and confirmed that the patient was well without further medication.

Patient 6: Angina pectoris reported on 2008-11-11. The health manager judged it to be myocardial infarction and called an ambulance to send the patient to Taichung Veterans General Hospital for emergency treatment. The health manager learned from the hospital that the patient was in ICU the next day. The patient was discharged on 11-15 and returned to normal life, but still being monitored with the tele-home care system.

Patient 8: The emergency button was pressed accidentally when the patient fell. The health manager called and queried if there's any injury. Health education about how to deal with falls was given. No abnormal symptoms reported during continuous monitoring afterwards.

Patient 11: fainted because of low blood pressure on 2009-03-25. After treatment in the ER, the patient returned home on the next day. No abnormal symptoms reported during continuous monitoring afterwards.

Table 2: Tele-health care system (component)

<table>
<thead>
<tr>
<th>Equipment name</th>
<th>Function</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sphygmomanometer</td>
<td>Blood pressure monitor, useable on patients with heart diseases</td>
<td>Tzunan Temple (Community tele-health care center)</td>
</tr>
<tr>
<td>Blood glucose meter</td>
<td>For the residents to measure blood glucose level</td>
<td></td>
</tr>
<tr>
<td>Id card</td>
<td>An inductive card for the system to identify individuals</td>
<td></td>
</tr>
<tr>
<td>Components</td>
<td>Purpose</td>
<td>Description</td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Id card reader</td>
<td>To read the Id card</td>
<td>For the residents to measure 4 biometric parameters, with a touch screen for the elderly to use.</td>
</tr>
<tr>
<td>Multiple biometric meter</td>
<td></td>
<td>T400 and Amine button alarm system to ask for immediate help from up to 12 parties, such as the tele-care center, the health manager, family members, the hospital, and 119.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Emergency call and security video monitor accident and emergency notification, ambulance and emergency communication.</td>
</tr>
<tr>
<td>Video phones</td>
<td></td>
<td>Video phones communicate with the health manager over the telephone line.</td>
</tr>
<tr>
<td>Response center system server</td>
<td></td>
<td>Chushan Show-Chwan Hospital Response Center.</td>
</tr>
</tbody>
</table>
AN INTEGRATED DATAFLOW BASED MODEL FOR DIGITAL INVESTIGATION

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Abstract
This study developed a highly adaptive digital forensic model, applicable to various situations, which clearly describes the digital forensic process and their purposes as well as ensuring the exactness and effectiveness of digital forensic results. It examined the viewpoint of the digital evidence process flow throughout an entire forensic process, and it hoped to provide a complete explanation of the digital forensic procedure and the details of execution. In addition, it proposed three new forensic concepts: primary, supported and comprehensive forensic procedures. The structural hierarchy constructed in the model can be expanded, then divided into its simplest forms, allowing independent task assignments. It further proposed several innovative digital forensic concepts, such as a new feedback mechanism. Finally, this model could provide a detailed list of the resources necessary for an entire forensic activity, applicable to management planning. This model provided a practical description approach and established a comprehensive and uniform digital expression form. The aim is to accumulate and to share experience and knowledge, hoping to create more mature and practical digital forensic science and to provide a reference for the practitioners of digital forensics.

Keywords: digital forensic model, digital forensic procedure, forensic data, data flow, digital forensic process, systematic decomposing

Introduction
In the past forensic process of investigating human crimes, criminals would often leave behind original evidences; these traditional forensic procedures have matured through years of scientific examination and verification procedures [8]. The lack of uniqueness makes digital crimes and their evidences easy to duplicate and alter, which renders traditional forensic procedures and experiences unable to meet the contemporary demands of digital forensics [8]. For these reasons, there is an urgent global demand for advances in digital forensic technologies. Since 2000, researchers have continuously emphasized the significance and applicability of the digital forensic procedure from the field of digital forensic science.

In order to speed scientific research in digital forensics, researchers endeavor to find a universal common forensic procedure in the near future. According to Reith and Carr, the procedures followed by forensic practitioners during the collection, examination, and forensic process have not been standardized with regard to cases of digital crimes [20]. Moreover, Pollitt pointed out that, instead of publication, most digital forensic researches and experiences are either published on the Internet, or communicated in organizational seminars; therefore, these procedures and experiences are not fully accumulated and discussed. The above mentioned conditions account for the current non-standardization of the digital forensic procedure [17].

This study applied the viewpoint of the digital evidence flow throughout an entire forensic process and proposed an integrated digital forensic model. Previous digital forensic studies focused only on the digital forensic procedure or partial concepts of forensics rather than on an integrated digital forensic model, which could comprehensively describe the details and steps of execution in the forensic process and avoid that do not know how to conduct follow-up. Such a complete model has never been published in past literature. This systematic model is able to meet the above mentioned demands as well as resolving the previous model’s shortcomings of excessive conceptualization and lack of detailed execution procedures.

Furthermore, there are many other contributions in this study. It proposed three new forensic concepts: primary, supported and comprehensive forensic procedures. It proposed a creative and important feedback mechanism different from previous research, which can provide many details on the execution of said feedback to satisfy various situations. In this study, through uniform explanations of proven processes, these characteristics allow a widespread expression of collated experiences and knowledge, thus establishing a practical sharing method in knowledge management for standardized procedure groups. It also proposed a digital forensic construction dictionary, which defines requirements for personnel, technology, location, and the resources necessary to
complete a complex group of digital forensic processes, allowing practical, accurate budgetary estimations in financial management.

The research of digital forensic models is given in Section 2. Section 3 describes the proposed model and Section 4 discusses the impact of the model. Lastly, Section 5 presents the conclusions.

**Digital Forensics**

Digital forensics is commonly defined as the preservation, collection, identification, analysis, recording, and presentation of digital evidence through scientific acquisition and scientific verification methods, with the purpose of reconstruction of discovered cases of crime [8]. Hence, a comprehensive digital forensic processing framework, which can meet the above mentioned requirements, and be operated independently from any specific technology and environment, needs to be developed [20]. Within such a framework forensic practitioners of different organizations could discuss and share their forensic methods and experiences, and digital evidence results could better comply with the principles of impartiality, integrity, and correctness.

**Procedure-based digital forensic model**

Present literature on digital forensic models shows that some studies are concentrated on “forensic procedure” models [1] [2] [3] [4] [5] [6] [7] [8] [11] [12] [15] [18] [20] [22] [24]. These studies focus on describing the guidelines and concepts of various procedures without detailing how these procedures are implemented and developed from different executive levels and perspectives. In addition, some studies have emphasized the concepts of digital forensic implementation [3] [4] [14] [16] [19] [23] [25], namely, exploring and discussing some details of digital forensic concepts and guidelines, rather than how to implement the digital forensic model. Some studies have proposed the concepts of dividing digital forensics into different hierarchies [2] [3] [8] [16] [25], but only addressed conceptualized viewpoints without proposing substantial practices. To summarize, there is a lack of a comprehensive digital forensic model that can completely describe the details of the digital forensic process and decompose the execution steps, while detailing the personnel, technology, locations, and resources required for the digital forensic process.

After reviewing the 16 most commonly seen digital forensic models of digital forensic research, this study selected commonly used procedures of the digital forensic procedure from each piece of research, as shown in Table 1.

**Digital forensic process and implementation**

Although the digital forensic procedure is important, erroneous or imprecise digital forensic implementation processes and methods may occur due to lack of a thorough understanding of the subsequent details of implementation, even though good digital forensic procedural steps are available. DFRWS defined the digital forensic procedure, and briefly described the scope of these procedures [8]. Although some implementation techniques were mentioned, the study still lacked detailed explanations of the steps of execution. Previous studies focused on certain aspects, or viewpoints, without systematic and complete description of the digital forensic model. Such a situation means that practitioners are only aware of the concepts, resulting in flawed implementation details and steps, which lead to insufficient evidential power of the forensic results. For example, the “collection” procedure is mentioned by many digital forensic procedure models, but due to the unique characteristics of digital evidence (such as alterability, dissolvability, and duplicability), the question remains of how to show and validate the collected evidences. Thus, more details of the execution steps of the collection procedure should be shown, in order to guarantee the originality and undeniability of the evidence collected.

**Digital Forensic Model of Dataflow Base**

A key point of digital forensics is the necessity, and correctness, of the evidence data process flow, but not the invariable processing procedures. The evidence data process flow begins with the collection of digital evidence data, and then each subsequent step, or processing procedure, is precisely linked to the previous step.

Gane and Sarson proposed using a “Data Flow Diagram” (DFD) for presenting the computer system data processing flow [9]. Likewise, the digital forensic process could also be presented, and described, using the DFD. Since the DFD has well-known semantic expression modes in the field of computer software development, it is conducive to promoting and understanding the digital forensics from an evidence dataflow perspective.

Séamus proposed this new viewpoint of the cybercrime investigation model based on information flow [8]. Basically, in DFD, either term - information flow or data flow – may be exchanged as they have similar meanings. This study will still use the term “data flow” for two reasons. First, this study describes and develops the digital forensic process by applying DFD expressions, and the term of data flow has become a customary and well-known term in the field of computer software development. Second, because what digital forensic processing needs to deal with is forensic data, it is possibly more proper to use data flow when describing digital forensic details at the bottom level.
Digital Forensic Dataflow Model
This study incorporated the DFD with some adjustment to fit the expression of the digital forensic model, in order to propose a dataflow-based integrated digital forensic model, as shown in Figure 1. This model is based on the evidence data process flow, with an execution scope able to cover time-flow procedures as well as describing the relationship or processing in detail between mediate evidence in each procedure and execution steps. This model can be expanded to clearly and specifically describe when, how, where, and by whom the digital forensic is implemented, and what evidence was discovered, through which tools and methods.

Table 1 The common digital forensic procedure in present research
Source: This study

<table>
<thead>
<tr>
<th>Writer</th>
<th>Year</th>
<th>Preparation</th>
<th>Incident Response</th>
<th>Recording</th>
<th>Collection</th>
<th>Examination</th>
<th>Analysis</th>
<th>Presentation</th>
<th>Preservation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pollitt</td>
<td>1995</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
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<tr>
<td>Lee</td>
<td>2001</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>DFRWS</td>
<td>2001</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
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<tr>
<td>Chris</td>
<td>2001</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
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<td>V</td>
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<td>NCJRS</td>
<td>2001</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>Reith</td>
<td>2002</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
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<tr>
<td>Casey</td>
<td>2003</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>Carrier</td>
<td>2003</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
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<tr>
<td>Stephenson</td>
<td>2003</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
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<tr>
<td>Mocas</td>
<td>2003</td>
<td>V</td>
<td>V</td>
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<td>V</td>
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<td>Baryamueba</td>
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<td>V</td>
<td>V</td>
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<td>V</td>
<td>V</td>
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<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
</tbody>
</table>

Figure 1 Dataflow-based integrated digital forensic model
Source: This study

In Figure 1, the evidence data, or mediate evidence, is represented by a parallelogram; the procedure (or whole process) is represented by an elliptical symbol; the flow direction of evidence data is represented by an arrow; the development, or expansion, of each procedural phase is represented by a column. The digital forensic context diagram at the top of the figure is used to present the concept of the purpose of digital forensics, namely, applying forensic procedures throughout an entire process group, to collate the collection of digital evidence, which constructs a forensic evidence report.

Level-O data flow is used to present the fully developed, or expanded, procedures necessary for the execution of an entire digital forensic activity, and explains which procedure needs to be executed, at which stage.

Level-N data flow is used to develop, and describe, which detailed steps should be taken for any given forensic procedure. This level-diagram is often used to provide more detailed task steps to the practitioners responsible for executing a forensic procedure.

Bottom-level data flow is used to further develop, and describe, the details of execution steps, as discussed in Level-N, and is aimed to develop each step into its simplest presentation form. The said “form” is simplified enough to clearly identify the personnel, locations, tools, and approaches used to carry out the forensic tasks, as well as the expected results, and can further evolve into the status of assignable units of task assignments.

After the completion of development, all bottom-level-dataflow in the digital forensic model is converted into the specifications of bottom-level-dataflow, and all resources, such as personnel, tools, devices, etc. can be listed and summarized to establish a digital forensic construction dictionary.
Level-0 Model Development

The level-0 data flow in this model is used to present the procedure perspective of fully developed digital forensics (Figure 2). Many scholars have proposed different digital forensic procedures in the past; however, no common forensic procedures have been compiled [21]. This study reviewed 16 research papers on digital forensic models (Table 1), to aggregate the eight most commonly seen procedures of research papers, and organized a complete digital forensic procedural path, which is sequentially based on the most recent forensic procedures. The proposed procedures include: preparation, incident response, recording, collection, examination, analysis, presentation, and preservation. In addition, this study add two necessary procedures, they are feedback procedure and acceptance and handover procedure.

Based on the above, the digital forensic context diagram is developed into a level-0 data flow. In this study, three new digital forensic procedure sets are proposed, which are primary, supported, and comprehensive forensic procedure. Figure 2 depicts a comprehensive forensic procedure, wherein each forensic procedure is represented by an arc block, and numbered by a recommended processing sequence. These three procedure sets are detailed below:

![Figure 2 level-0 the comprehensive forensic procedure](image)

Source: This study

The primary forensic procedure

After the occurrence of criminal digital events, a series of forensic procedures are activated from the event data to achieve the goal of digital data forensics that can generate the intended forensic reports. This study summarized six primary procedures, of the primary forensic procedure, which are initial incident response, recording, collection, examination, analysis, and presentation. In addition, the feedback procedure is added to support the overall operation. As shown in Figure 2, the gray background part.

Under the primary forensic procedure, a procedure is carried out in succession to the previous one, given a normal situation. However, in the execution steps of the primary forensic procedure, procedural feedback mechanisms must be initiated, as necessary, to reinforce and complete the specified procedure of the intended forensic mission.

The supported forensic procedure

In addition to the primary forensic procedure, the supported forensic procedure is required to ensure the smooth implementation of the primary forensic procedure. This procedure can be independently activated to provide support under any circumstances, when necessary. In this model, the supported forensic procedure is assembled by three single support procedures, which are: preparation, preservation, and acceptance and handover procedures. As shown in Figure 2, the white background part. The details are as shown below:

Preparation (1.0): the preparation procedure in digital forensics does not simply mean the preparatory actions prior to the implementation of the entire forensic process, but rather involves corresponding preparatory requirements for each procedure. Many previous studies suggested that the first step of a forensic procedure is preparation, namely the technologies, tools, and resources necessary for all forensic procedures are accurately estimated and prepared from the beginning of the entire forensic process. However, this concept has its flaws. Because of advanced technologies and continuously emerging modus operandi, special technologies, tools and resources may be required during each forensic procedure. Thus all the necessary components of digital forensics cannot be fully estimated and prepared from the beginning, but must adapted to different situations to perform the preparation procedure necessary for supporting any forensic procedure. Moreover, some preparations by forensic practitioners in real cases may not be performed at the beginning due to different schedules of budgetary allocations, so the preparation procedure may not only be performed at the beginning.

Preservation (8.0): In the digital forensic procedure, waiting periods may occur between procedures. Also, forensic personnel required by each procedure may be different. Thus, to meet actual demands, conveyance and transfer are required for evidence data. In such cases, the evidence data should be protected and preserved during procedures, and processes, to ensure the safety, integrity and evidential power of evidence data. In addition, the preservation of evidence data may not only be performed as a final procedure. It may be required when there is lack of technology, or new evidence is
found during other forensic procedures, or failure of implementing the subsequent forensic procedure due to special causes.

Acceptance and handover (10.0): This model adds this procedure, which is a crucial and necessary action for when evidence data needs to be collected, preserved, and retrieved. Many forensic cases are suspended due to certain procedural issues, which arise from a lack of forensic technology, a need to collect new evidence, or other special causes. Under these situations, evidence data and mediate evidence must be properly, and safely, preserved for long periods of time, which demands complete acceptance of the integrity of evidence and handover procedures. In practice, evidence rooms are established by law enforcement units to provide long-term, suitable environments for protective and secure preservation and retrieval processes.

The comprehensive forensic procedure
The comprehensive forensic procedure is the combination of the primary forensic procedure and the supported forensic procedure. To ensure the exactness and effectiveness of digital forensic results, the comprehensive forensic procedure is strongly recommended by this study as the best forensic procedure if actual conditions and resources permit.

In practice, the supported forensic procedure may not be implemented, or only implemented due to shortages of budget, resources, personnel, equipment, or economies of scale. In such cases, the primary forensic procedure at least should be built into the implementation stage so that the digital forensic report will have a basic effectiveness of evidence.

New feedback mechanism
This model proposes a creative feedback mechanism which is never shown in previous models. In this study, a new feedback procedure (9.0) is adopted as feedback mechanism, which can directly return to the procedure that is necessary to redo, but not only return to the previous procedure, as shown in Figure 2. In order to provide strict, admissible evidential forensic results, most research on digital forensics has pointed out that a feedback mechanism is required for the digital forensic procedure [1] [2] [3] [4] [5] [7] [8] [11] [15] [18] [20] [22]. To enhance the forensic requirements of the digital forensic procedure of any given stage, the feedback mechanism is a means of returning to a previous procedure, depending on the situation or data needed. 

Previous studies have indicated that the feedback mechanism can only return to the previous procedure one by one till the initial problematic one is found rather than being return to the initial problematic procedure directly. There is a serious shortcoming to this approach that is obviously very rigid and can not meet the diverse needs of the situation. The main reason is each of the procedures with analysis and diagnosis can only return to its previous one and accept the request for its next one. For example, if the last procedure is found wrong, incomplete or without sufficient data in the very beginning of the forensic procedure occurred, it must be rigid to return to the previous procedure one by one till returning to the very beginning of the problematic procedure. This will cause waste of resources and inefficiency in forensics. Therefore, this model proposes the feedback procedure (9.0), which is very flexible and effective in solving this problem.

Level-1 model development
Previous studies have only provided conceptual explanations, lacking detailed explanations regarding expression of the execution of details. The purpose of this level is to present, and to describe, how each forensic procedure is developed and processed. Each “process” in this level is presented by an arc block, and numbered in recommended sequence. The numbering principle is based on procedure numbering used in level-0, with one more digit. For instance, “4.1” means the first procedure of the fourth forensic process.

Figure 3 depicts a reference example of collection (4.0) procedure in the forensic procedure. The processing process may be designed linearly, where applicable, or in combination with the internal feedback mechanism, if necessary, for cases such as searching (4.2).

![Figure 3 progression of “collection” procedure](source: this study)

Level-N model development; and continuing development until bottom-level-dataflow
This model development aims to subdivide and decompose necessary forensic tasks into their simplest presentation form, covering the simplest sources of data, implementation processes, and interim results. This form of presentation is conceptually referred to as a bottom-level-dataflow. In such cases, the simplest presentation form means that the tasks are already simplified enough for
individual operation, or individual assignments. As illustrated in Figure 4, the simplest presentation form is obtained after searching (4.2) is developed.

Figure 4 Forms of presentation developed into their simplest presentation form
Source: This study

The key point of the development content of level-N is the description of the processing process. If any process in level-1 is still complex, it means that it is not yet developed into its simplest presentation form, such as data identification (4.1), as shown in Figure 5. In other words, if additional sub-processes are required by any process, the development needs to continue from level-2 to the next level, until all sub-processes are decomposed into their simplest presentation form and, regardless of follow-up, would continue to develop the number of levels, such as the bottom-level-dataflow, as illustrated in Figure 4.

Figure 5 Decomposition diagram of sub-process
Source: This study

From level-2 to the bottom level, the source of data and interim results would use a parallelogram symbol to represent the mediate evidence. The process described herein is also represented by an arc block. Similarly, for every additional level, corresponding numbers are added to the previous level, and the numbers in the same level are numbered sequentially.

Specifications of bottom-level-dataflow
When all procedural processes are decomposed into their simplest presentation form, the process is simplified enough to know how to execute these processes. In this level, the main purpose is to add forensic personnel, forensic tools, forensic site descriptions and forensic results to the previously developed bottom-level-dataflow, which is then converted to a presentation form of “assignable units of task assignments”. In this model, this form is conceptually referred to as the specifications of bottom-level-dataflow. In other words, the process can be described as an assignable, or an executable, unit of task after the specifications of these factors are explained.

In this level, the forensic site is represented by a cubic symbol, the forensic personnel (including number of people) is represented by a triangular symbol, and the forensic tools, or method (including the quantity), is represented by a hexagonal symbol, as shown in Figure 6.

Figure 6 Specifications of bottom-level-dataflow
Source: This study

Mapping from bottom-level-dataflow to specifications, then mapping to digital forensic construction dictionary

Another important problem is realizing the amount of resources required to meet forensic demands throughout the entire digital forensic process. Namely, which area of specialty, how many professionals, specialty tools, and equipment are in need of preparation? These are factors affecting budgetary planning, staffing, training, and equipment procurement scheduling of enforcement units. Thus, this study proposes a digital forensic construction dictionary for addressing the problems faced by the digital forensic practitioners.

A digital forensic construction dictionary aims to list types, quantities of all forensic task forces, tools, and any equipment necessary for the entire digital forensic process. As discussed above, these data for each individual process can be obtained from the specifications of bottom-level-dataflow and could be statistically collected and sorted, which is the perspective of a digital forensic construction dictionary, as shown in the lowest part of Figure 7. Table 2 is an example table of a digital forensic

Table 2 Specification of bottom-level-dataflow

construction dictionary.

Figure 7 Conversion diagram of digital forensic construction dictionary
Source: This study

With the use of a digital forensic construction
dictionary, digital forensic practitioners can easily list and estimate the types and quantities of professionals, tools, and equipments needed, as well as the procurement time. When level-0 the comprehensive forensic procedure is fully developed, it is possible to obtain a digital forensic construction dictionary, comprised of the fullest range of resources for the digital forensic process, and is therefore, referred to as an integrative digital forensic construction dictionary. It is also recommended by this study.

**Table 2 Example table of digital forensic construction dictionary**

Source: This study

<table>
<thead>
<tr>
<th>Staffing requirements</th>
<th>XXX Table</th>
<th>Equipment requirements</th>
<th>XXX Table</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task assignment</td>
<td>4.1.4</td>
<td>4.2.1 ......</td>
<td>Total</td>
</tr>
<tr>
<td>Types of personnel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collector</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Examiner</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Analyst</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Converyer</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

However, the digital forensic practitioners in different sizes of organization may find it difficult to establish an integrative digital forensic construction dictionary due to budget restrictions or limitations of scale. Therefore, this study suggests that practitioners should select their most necessary resources, according to an integrative digital forensic construction dictionary, and build a basic resource list based on their actual budget to meet their digital forensic processing needs. The preparation of a basic list of resources can facilitate smooth budgetary planning and procurement procedures as well as the fundamental digital forensic procedure implementation. It is referred to as a fundamental digital forensic construction dictionary.

**Discussion**

The establishment of the digital forensic procedure can be regarded as the establishment of a forensic system. To the management level, the establishment of a “system aspect” is important; however, the practitioner is more concerned with how to handle each procedure and how to connect the processes in practice. In other words, previous researchers highlighted the discussion of the system’s aspects (procedure level: level-0 in this model), but neglected the “executive aspect” (how to develop: level-1 to bottom-level-dataflow in this model). This study proposed a solution for the above situation. Thus, this comprehensive combination of system and executive aspects could be realized to join together the feasible framework. In addition, this model proposes a digital forensic construction dictionary for a detailed description of the requirements from a “resource aspect”, making contributions to actual budgetary planning and procurement processes.

**Conclusions**

This study proposed the expandable integrated digital forensic model, not only to present new concepts of digital forensics, but also describes, in detail, the methods of execution. This model can also provide a comprehensive basis for guidance and practical implementation steps for forensic practitioners, model guidance and practical
execution can be complementary. In the model every developed process can be noted in a uniform digital expression form, in order to promote understanding and facilitate sharing experiences.

Though this model seems to provide a static description method, different digital forensic practitioners can employ different procedural combinations, as based on various actual forensic missions offering different modus operandi, in order achieve dynamic descriptions. In addition, since this model is presented systematically, with straightforward symbols, almost all digital crime cases can be described, and recorded, in digital forensics, thereby establishing a digital forensic library for knowledge management and sharing.

References


MODELING AND EVALUATING OF BUSINESS REVENUE MODELS UNDER DIFFERENT PRODUCT LIFE CYCLES USING SYSTEM DYNAMICS SIMULATION

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Abstract 
Business revenue modelling is one of the important aspects of enterprise planning to create values for enterprises. In this study, we construct a system dynamics simulation model to evaluate various business revenue models applied to e-platforms. Machining tools industry is investigated as a case study. Products with different life cycles are examined as applying different business models. Computational experiments are conducted and results are discussed. Specific research issues/contributions of the study include: 1. To propose four effective business revenue models in such an industry. 2. To evaluate the proposed business revenue models as well as their advantages/disadvantages by a system dynamics simulation. 3. To address managerial implications of these business revenue models to the industry. As a conclusion to our research, we show that: (i) Firms with products under growth or mature stage of life cycle adopt/switch appropriate business revenue models conforming to their requirements in different stages and result in high performance outcomes than those remaining in a single business revenue model. (ii) Business revenue models represented by causal loops of system dynamics and examined by system simulation can capture not only steady states but transient states of business activities. By taking advantages of the proposed approach, managers can thus efficiently make right decisions for reducing time and cost.

Keywords: Business Revenue Model, System Dynamic, Operate Performance Evaluate, Technology Life Cycle

Introduction 
Business model is important to enterprise for earning profit [1,2,3,4]. Even an enterprise has excellent quality of products and services, the lack of a good business model still cannot obtain high profit. Enterprises cannot find their suitable business model by try-and-error which would leads to fatal failure. System Dynamics (SD) and simulation is a powerful tool to examine suitable business models for enterprises [5,6,7].

In this study, a case company in the measurement instrument industry is investigated. It currently follows a traditional business model, in which the firm's products are sold through direct sales force, distribution, OEM and sales agents to customers. However, the quality and technical ability of the products provided by the other firms in this industry is almost the same. There is few gaps between the firm and its competitors and thus weaken the ability of its revenue growth [3,5]. This study aims at examining potential profitable business models, and opened the gap with its competitors.

According to above description for the background and motivation has established the following three objectives: 1. To propose potential business models. 2. To develop a system dynamics simulation model to assess the advantages of the proposed models. 3. To assist enterprise applications in the business model.

The rest of this paper is organized as follows. Literature review in section two is conducted to define business model, performance evaluation and system dynamics modeling methodology. In section 3, we establish several novel business models and use system dynamics to represent their system architecture. Section 4 uses scenario-based simulation to investigate the outcomes of different models. Finally, conclusion and recommendation is in given in section 5.

Literature Review 
Business model is defined by Magretta [8]. Business model is actually a story of how to operate a company and is a plan to make money. System dynamics (SD) is a powerful tool in the creation of feedback theories. Many guidelines and case studies have been developed by founders and practitioners of this field for the model building process and a series of tests to build confidence in the models created. An SD approach can be used to demonstrate how managing processes of accumulation and depletion of strategic assets, detecting inertial effects of decisions to help entrepreneurs in understanding opportunities and pitfalls related to e-commerce strategies. SD is a method of solving problems by computer simulation. Like many simulation methods, it offers
the promise of less expensive learning to experiment with the effect of new policies on a computer model than on a real system with real people, equipment, and processes. SD can be applied in various fields, such as analyzing mine disasters, dealing failure and robustness in single development projects, and working on e-commerce strategies. SD can also be combined with other management tools: for instance, to combine system dynamics with conjoint analysis for strategic decision making.

This study not only constructs a common business model, but also constructs the other two new potential business models. This study uses Powersim® simulation software to build the system dynamics models and evaluates via scenario-based simulation for the case company of this study.

**Model Construction**

For the construction of business models, this study sets the followings assumptions: (1) Only a single product exists. (2) The demand of a product subjects to a normal distribution (Normal ($\mu = 2.5$, $\sigma = 0.8$) (Number / Day). The forecast uses a naive method that the forecast of the upcoming period is equal to the actual sales of the last period. (3) No backorder. (4) The payment collection risk subjects to a Uniform distribution (Uniform (0,1)) (5) The account receivables will not recover if such failure occurs. (6) The payment collection risk subjects to a Uniform distribution (Uniform (0,1)) (5) The account receivables will not recover if such failure occurs. (7) Product unit cost is inversely proportional to its remaining life cycle. (8) Installment interests uses a simple interest calculation. (9) After the product reaches its maturity stage in life cycle, it continues to be sold.

In this study, the product life cycle and technology development is classified as Sustained Matured Products (Type A), Rapid Matured Products (Type B), Slow Matured Products (Type C) and Entire Life-Cycle Products (Type D). The following section describes the technology life-cycle cost and price assumptions.

**Product types**

There are four types of products addressed in the study, sustained mature products, rapid matured products, slow matured products and entire life cycle products.

The technology life-cycle curve of Sustained Mature Products (Type A) is constant, such as daily necessities. The demand is stable. The product technology is difficult to get a breakthrough. The unit price and cost is constant as shown in Figure 1.
during products introducing to the market, and the scale of demand and production is small. When the product technology is matured, the price and cost is lowered. The S-curve formula is defined as follows: 

\[ P_t = \left( \frac{Y_t - u_1}{K_2 - u_1} \right) \left( \frac{K_1 - u_1}{K_2 - u_1} \right) \]

where \( P_t \) is the price at time \( t \); \( K_1 \) is the upper limit of technology performance; \( K_2 \) is the upper limit of price; \( u_1 \) is the lower limit of technology performance; and \( u_2 \) is the lower limit of price.

The cost and price curve of rapid matured product is shown in Figure 3.

The third type of products is defined as slow matured products (Type C). The products require long time for the phase of its maturity stage owing to such as technological development bottleneck, difficulty in promotion, low customer acceptance or other factors. The technology life cycle curve and the price and cost curve are shown in Figures 4 and 5.

The Entire Life Cycle Products (Type D) are the type of luxury was launched with very significant features becoming a pioneer (Figure 6). The customer is attracted to buy it under initial stage of market hot, but the competition increases dramatically. Then, the amount of the consumers and profits will reduce quickly. The curve of the entire life cycle technology presented by Gamma distribution as follow: 

\[ Y_t = u_1 + t \cdot e^{-t/\alpha} \] where \( Y_t \) is the technical performance at time \( t \); \( K_1 \) is the upper limit of technology performance; \( \alpha \) is the parameter of lower limit of technology performance; \( \beta \) is the shape parameter.

The price and cost relation is as follows: 

\[(K_1 - u_1) \left( \frac{K_2 - u_1}{K_1 - u_1} \right) \]

where \( P_t \) is the price at time \( t \); \( K_1 \) is the upper limit of technology performance; \( K_2 \) is the upper limit of price; \( u_1 \) is the lower limit of technology performance; \( u_2 \) is the lower limit of price. The price and cost curve of Entire-Life-Cycle Products is shown in Figure 7.

Business models

There are three business models addressed in the study, basic business model, sale-combined-with-installment-service business model, and with-installment-and-agent business model.

The basic business model (denoted as m1) is shown in Figure 8. A company employs sales records as the basis for demand forecasting and develops its production plans. When the demand is less than planned production, inventory is kept in a warehouse. After shipping, customers pay by checks of three-months.
According to the basic business model this study develops a causal feedback loop as shown in Figure 9. The performance indicator of business model of instrument manufacturer is represented by sales profit. The sales profit considers revenue and sales cost. There are two types of costs, inventory cost and the risk of disbursement payment for goods by checks. Base on the causal feedback loop as aforementioned, we construct system dynamics of the basic business model by using Powersim as shown in Figure 10. The system dynamics model also includes two subsystems of the technology performance and sales loss.

A sale-combined-with-installment-service business model (denoted as m2) is proposed by the study as follows. In the basic business model as aforementioned, customers pay the payment by checks for three months. Since the credit investigation ability of the instrument manufacturer is not good enough, the checks have high risk that cannot be cashed and thus cause loss of sales. Financial service industry of leasing, installment and factoring is well-developed up-to-date. The installment service industry can provide installment service for customers. From the instrument manufacturers’ perspective, by integrating installment service companies in the existing business model, they can receive the payment for goods quickly to increase turnover rate and transfer the risk to installment service companies. From the customers’ aspects, they can reduce the pressure of gathering mass capital and reserve cash on hand to decrease the managerial risk. From the installment service providers’ viewpoint, they can earn the installment interest from the instrument manufacturer. The business model structure of sale-combined-with-installment-service is shown in Figure 11. According to the sale-combined-with-installment-service model, we develop a causal feedback loop as shown Figure 12.

The with-installment-and-agent business model (denoted as m3) is proposed as follows. Instrument manufacturers expect to reduce the pressure of inventory and expend the market share, so they can cooperate with financial service companies and agents to develop this business model with installment and agents, as shown in Figure 13.
The agents ask discounted price to instrument manufacturer for purchasing products. The manufacturer sells the products to agents who respond for sales and channel management. The agents bear finish goods cost and take the margin between of market price and discounted price. Furthermore, the financial service companies provide the installment service to earn interest. In this model, the manufacturer transfers the receivable payment risk and inventory cost to its partners. According to the with-installment-and-agent business model we develop the causal feedback loop as shown in Figure 14. Table 1 is a comparison of three proposed models.

Table 1. Comparison of the business models

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Business Scenario</th>
<th>Inventory Cost</th>
<th>Arrear Risk</th>
<th>Installment Risk</th>
<th>Discount Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>0.1 (103 NT/Unit)</td>
<td>0.02</td>
<td>5%</td>
<td></td>
<td>85%</td>
</tr>
<tr>
<td>Worst</td>
<td>0.2 (103 NT/Unit)</td>
<td>0.03</td>
<td>6% (to decrease # customers by 10%)</td>
<td>80%</td>
<td></td>
</tr>
<tr>
<td>Desired</td>
<td>0.05 (103 NT/Unit)</td>
<td>0.01</td>
<td>4% (Customer +10%)</td>
<td>90%</td>
<td></td>
</tr>
</tbody>
</table>

Resulted from the simulation, the measurement instrument company is suggested to adopt the following strategies as shown in Table 3. For instance, in order to deal with the sustained mature products (Type A) the company can employ Sale-combined-with-installment-service business Model (m2). For the rapid matured products (Type B), slow matured products (Type C) and entire life-cycle products (Type D), in the initial stage of product introduction, the With-installment-and-agent business model (m3) are adopted, when the products become mature, the models are suggested to shift to the Sale-combined-with-installment-service business model (m2).

Table 3. Business model suggestions for the measurement instrument company

<table>
<thead>
<tr>
<th>Product Type</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>m2</td>
<td>m3→m2</td>
<td>m3→m2</td>
<td>m3→m2</td>
</tr>
<tr>
<td>Worst</td>
<td>m2→m1</td>
<td>m1</td>
<td>m1</td>
<td>X</td>
</tr>
<tr>
<td>Desired</td>
<td>m2</td>
<td>m2</td>
<td>m2</td>
<td>m3→m2</td>
</tr>
</tbody>
</table>

**Simulation results**
Resulted from the simulation, the financial service company is suggested to adopt the following strategies as shown in Table 4.

### Table 4. Business model suggestions for the financial service company

<table>
<thead>
<tr>
<th>Product Type</th>
<th>Business Scenario</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td></td>
<td>m2</td>
<td>m3</td>
<td>m3</td>
<td>m3</td>
</tr>
<tr>
<td>Worst</td>
<td></td>
<td>m2</td>
<td>m3</td>
<td>m3</td>
<td>m3</td>
</tr>
<tr>
<td>Desire</td>
<td></td>
<td>m2</td>
<td>m2</td>
<td>m2</td>
<td>m3</td>
</tr>
</tbody>
</table>

Resulted from the simulation, the agents always loss under the worst situation. The profit performances of the other two scenarios (Default and desired) are depicted in Figures 15 and 16.

**Figure 15. Channel agent profit under the default scenario.**

**Figure 16. Channel agent profit under the desired scenario.**

### Conclusions

This study has developed three business models which have been justified by system dynamics simulation in different settings of situations to advise the case company for choosing its appropriate business model against various product life-cycles. Profitable suggestion for applying as well as shifting to the most appropriate business model are given for different viewpoints of instrument manufacturers, channel agents, and financial service companies. The proposed system dynamics evaluation method can reduce survey time for business and lower operational cost.

As a conclusion to our research, we have shown that: (i) Firms with products under growth or mature stage of life cycle adopt/switch appropriate business revenue models conforming to their requirements in different stages and result in high performance outcomes than those remaining in a single business revenue model. (ii) Business revenue models represented by causal loops of system dynamics and examined by system simulation capture not only steady states but transient states of business activities. By taking advantages of the proposed approach, managers can thus efficiently make right decisions for reducing time and cost.

### Acknowledgement

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### References

BUILDING TRUST IN ONLINE SHOPPING: THE MODERATING EFFECT OF INDIVIDUALISM AND COLLECTIVISM

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Abstract
As online shopping becoming more global, consumers with different culture had different consideration when shopping online. Thus, this study attempts to investigate how one specific dimension of culture, individualism-collectivism, moderates the relationship between online trust and its determinants. The determinant factors under investigation include perceived risk, privacy, security, social exchange and information content. Data collected from customers of online shops from Hong Kong and Switzerland were used to test the research model. The result indicated that perceived risk had a negative relationship with trust. Perceived risk had a stronger effect on trust for collectivists than individualists. Also, Security had a positive relationship with trust. The study showed that information content was positively related to trust of online vendors. Information content had a stronger effect on trust for individualists then collectivists.

Keywords: Culture, Individualism-Collectivism, Online Shopping.

Introduction
Online shopping is getting very popular and becoming more global. Consumer from different countries may shop at the same website. IS researchers have long been interested in how culture affects various aspects of information systems, such as utilization and development. In a review of the application of Hofstede’s theory to IT research, Gaspay et al. [1] conclude that research on how culture affects e-commerce is lagging behind other research areas.

Many studies have examine the role of trust in electronic commerce [2],[3]. There is a question that whether trust differs in different culture. Some studies have claimed that different cultures exhibit differing social norms and propensities to trust [4],[5]. Greenberg et al. [6] found that Hong Kong consumers showed lower trust than U.S. consumers. These indicate that cross-culture differences do exist in online shopping. Most of the studies compare subjects from different countries in order to understand the impact of culture on e-commerce consumer behavior. However, as pointed out by Doney et al. [5], different cultural dimensions may have different impact on the trust building processes. Thus, this study attempts to investigate how one specific dimension culture, individualism, moderates the relationship between online trust and its determinants.

The study compared the consumer behavior of individualists and collectivists. The data from Swiss and Hong Kong people was collected. About 88% of Swiss shops online. This percentage shows that Switzerland is one of top twenty countries with high internet purchase rate [7]. On the other hand, Hong Kong has a high level of Internet use but lower rate in online purchase [8]. This study can test whether the dimensions of culture affects the trust of online shopping. Online vendors may need to fine tune their strategies for different countries to meet consumers’ need

Literature Review
Individualism-Collectivism Cultural Dimension
According to Hofstede [9], culture is the collective programming of the mind that distinguishes the members of one group or category of people from another.

Based on Hofstede [10] and Franke, et al. [11], there are Five Dimensions of Culture. They are Power Distance, Individualism and Collectivism, Uncertainty Avoidance, Masculinity and Femininity and Long versus Short term Orientation. Williams et al. [12] suggested that Individualism/Collectivism is widely studied dimension and highly relevant to the cross-nationals business relationships. Hui et al. [13] and Parks et al. [14] have claimed that one’s propensity to trust in most cultures is influenced by the culture’s collectivist and individualist orientations. Chau et al. [15] and Okazaki et al. [16] have also examined the consumer behavior of individualists and collectivists towards trust. Doney et al. [5] has put forward a model which postulates that individualism-collectivism dimension affects the trust building processes.

In an individualist culture, people would like to achieve his/her own interests and neglect others’ welfare. While in a collectivist culture, people would give a high priority to groups’ interests and norm [17]. Triandis [18] has a further explanation
about individualism and collectivism. He suggested that individualism and collectivism are multidimensional. They can be divided into 4 dimensions, either vertical or horizontal. Vertical Collectivism means that people are willing to sacrifice their personal identity to their in-group (family, coworkers). In contrast, Horizontal Collectivist is merged with the in-groups. In-groups are important to them but they are not subordinate to the in-groups. On the other hand, Vertical Individualists think that competition is the law of nature and they have a strong desire to win all the competition. For the Horizontal Individualists, people would not compare with others. They tend to do their own thing and seek individuality.

**Trust**

Divergent meanings and operationalizations of trust have been used in the studies of trust in the area of electronic commerce. One study’s trust is another study’s antecedents to trust. Some researchers use the term “trust” when they mean other things [19]; and some confuse trust with other concepts, such as honesty, confidence, and faith [20]. Mayer et al. [21] summarize the problems of the study of trust as the lack of clarity in the relationship between risk and trust; confusion between trust, its antecedents and outcomes; lack of specificity of trust referents; and failure to consider both the trustee and the trustor. Similar criticism has been raised in the area of electronic commerce studies involving trust. As pointed out by Shankar et al. [22], most of the studies on online trust do not make a clear distinction between the underlying dimensions and antecedents of online trust.

This study use the definition of trust offered by Rousseau et al. [23] after an extensive cross-disciplinary review of the concept of trust. Trust is defined here as “a psychological state comprising the intention to accept vulnerability based upon positive expectations of the intentions or behavior of another”. This definition separates the construct of trust itself from its antecedents and its outcomes, and thus is more appropriate for the objective of the current study.

**Research model and Hypothesis**

Trust is a crucial predictor of Internet use because the Internet environment is characterized by uncertainty and risk [24],[25]. There are a lot of factors affecting consumer trust towards online shopping. Perceived risk, privacy, security, social exchange and information content have been found to be important in previous studies. How the individualism-collectivism dimension moderates the effect of these factors will be discussed.

**Perceived Risk**

Perceived Risk is the consumer’s perception of the uncertainty and concomitant adverse consequences of buying a product or service [26]. Some studies found that consumers’ trust is associated with perceived risk [25],[27]. These studies also concluded that there is significant difference in the effect of perceived risk on purchasing goods or service online access difference culture.

According to Jarvenpaa et al. [25], Individualist consumers tend to have higher trust and lower perception of risk. They claimed individualists are willing to trust others normally only when they are given some reasons not to trust. On the other hands, collectivists trust others according to the relationship with first-hand knowledge.

H1: Perceived Risk has a negative relationship with consumer trust on Online Shopping.

H2: Comparing to Individualists, the Perceived Risk has a stronger effect on trust of Online Shopping for Collectivists.

**Privacy**

When consumers purchase online, consumers usually need to provide personal information. Consumers do not want their personal information used by the third party. Privacy means that the right of an individual to be left alone and to be able to control the flow of personal information and providing reasonable assurance that personal information is kept secure. Several studies [28],[29] have addressed that the relationship of privacy and trust in electronic commerce. To gain consumers’ trust, online vendors should convince consumer that the personal information can be protected. If online vendors can use more mechanism to protect privacy, consumers can trust the website more.

However, according to Liu et al. [30], there are no relationship between privacy and culture. Since everyone concerns about their privacy a lot, culture cannot bring any moderate effect to the privacy towards trust.

H3: Privacy has a positive relationship with consumer trust on Online Shopping.

**Security**

Security can be defined as an online institutional status on its payment system and the consumer’s perceived extent of risk involved [31]. According to some studies [28],[29], security would influence consumer trust. Consumers are worried about credit card fraud. That means if the web site has a better security to protect them from credit card theft, the consumer trust would be enhanced. Liu et al. [30]
also claimed that culture would not affect security towards consumer trust. Security is important for everyone who purchases online.

H4: Security has a positive relationship with consumer trust on Online Shopping.

Social Exchange
Social Exchange is that consumers can share their information with one another. Hawkins et al. [32] claimed that stronger development of the social interactions in the use of network communication is likely to put a greater focus on the means of acquiring products and services electronically. That meant it has relationship between social exchange and consumer trust. Trust can be improved if consumers can share their opinion on the website.

Higher levels of trust are evident in social exchanges among group members in collectivist cultures [13],[14]. In these cultures, one is unlikely to be trusting and cooperative with individuals outside of the group. Group membership influences whether a person is trusted. On the other hand, the propensity to trust people in general, including strangers who are not from one’s social group, has been shown to be greater among individuals in societies characterized by higher individualist orientations [33]. Lee et al. [34] mentions that Korean which is a relative collectivist country provides more group-oriented content such as bulletin board and product review than US. They can share similar view. Collectivists would like to have more interaction with other consumers. It can show that collectivists would enhance the trust if they can share the information.

H5: Social Exchange has a positive relationship with consumer trust on Online Shopping.

H6: Compare to individualists, the Social Exchange has a stronger effect on trust of Online Shopping for collectivists.

Information Content
Information Content can be defined as the information that gathered by consumer on the website so as to make the purchase decision. They include product/service information, background of company and so on. More comprehensive of the information, the higher trust. That means there is positive relationship with information content and trust. [35].

According to Hofstede [9], Individualist consumer would like to get more product information than collectivist consumer. And Lee et al.[34] has claimed that USA is a relatively individualist country and information of US websites tends to focus on product and purchase specifics and does not reflect the perspective of a reference group.

H7: Information Content has a positive relationship with consumer trust on Online Shopping.

H8: Compare to individualists, Information Content has a weaker effect on trust of Online Shopping for collectivists.

Research Methodology
Subject
This study emphasizes on the relationship between factors and trust and how individualism/collectivism moderate the factors affecting trust. In order to widen the range of the values of the individualism/collectivism dimension, we chose to collect data in Hong Kong and Switzerland.

Switzerland and Hong Kong have different culture according to Hofstede [9]. Switzerland’s score (68) is higher than Hong Kong’s (25) in the individualism-collectivism dimension. Switzerland ranks 14 and Hong Kong ranks 37 worldwide in this dimension. Switzerland is relatively individualistic than Hong Kong. That means Swiss are expected to consider personal interests over interests of group and value individual decision making. On the other hand, Hong Kong is relatively collectivistic, compared to Swiss. Hong Kong people are interdependent among people. They tend to change themselves to fit in rather than to change the environment. Since the people in these two countries have different in individualism-collectivism dimension, it would be easier to compare the individualists and collectivists.

The target respondents are the individual who has purchased goods and service online. That means they should have the experience on online shopping. Since the study attempts to compare the behavior of collectivists and individualists, data of students and working population from Switzerland and Hong Kong were collected.

Both paper-based questionnaire and Internet-based questionnaire were distributed to the Internet user of Hong Kong and Swiss. A total of 230 usable questionnaires were returned where 125 of them were from Swiss and 105 of them were from Hong Kong. Swiss questionnaires were mainly paper-based. There were 106 Swiss paper-based questionnaires and 19 internet-based questionnaires. For Hong Kong, 50 of them were paper-based and 55 of them were internet-based questionnaire.

For Swiss respondents, 49.6% of them were male while 50.4% of them were female. 47.2% of Swiss respondents were 17-25 years old. Over 30%
of them were 26-35 years old. The result showed that over 50% of them education level were tertiary or above. Around 37% of them were secondary education level. More than 60% of Swiss respondents were students and around 23% of them earned below CHF1000 each month. 53.6% of them reported that they purchased 1-3 times during the past six months.

For Hong Kong, 56.2% of respondents were male and 43.8% of them were female. Over 55% of them age between 17 and 25. More than 67.6% of them education level attained university or above. Around 45% of Hong Kong respondents were students and 24.8% of them had average monthly income below $4000. 45.7% of them had purchased 1-3 times during the past six months while only around 6% of them had no purchase experience during the past six months.

Measurement
Scale of the questionnaire was adopted from previous studies with appropriate adjustment of wording in order to fit in the data collection of this research. Five-point Likert scale was used to rank the results of each item, ranging from strongly agree (5) to strongly disagree (1). The demographic information including the gender, age, occupation, education level and average monthly income were also collected.

Individualism and Collectivism: Sixteen items from Choiu [36] were used to measure the individualism-collectivism dimension.
Perceived Risk: Perceived risk was measured using 4 items which were adapted by Stone et al. [37].
Privacy: Privacy was measured using 4 items where 2 items were from Dinev et al. [38] and the other two were from Liu et al.[30].
Security: Security provided by the website was measured using 4 items where 2 items were adapted from Chen et al. [39], 1 item was adapted from Bressolles et al. [40] and the other one was adapted from Dinev et al. [38].
Social Exchange: Social exchange was measured using 4 items. One was adapted from Kim et al. [41] and another was adapted from Chen et al. [39]. Two items was developed for this study.
Information Content: 6 items were used to measure information content that provided by the website where 3 item were from Bressolles et al. [40], 2 items were from Park et al. [42] and one of them was from Kim et al. [41].
Trust: Consumer trust towards the online vendors was measured using 5 items. Two items were adapted from Cyr et al. [43] and the other two were from Heijden et al. [44]. The last item was from Chen et al. [39].

Analysis and Findings
The statistical Package for Social Science (SPSS) 16.0 for Windows was used to analyze the data. Reliability Analysis and Multiple Regression Analysis were used.

Reliability of the instrument
Cronbach’s Alpha was used to test the internal reliability of the scales. All Alphas are greater than 0.7 (from 0.77 to 0.96). The test demonstrated that the measures of Individualism-Collectivism, Perceived Risk, Privacy, Security, Social Exchange, Information Content and Trust are reliable.

Test of the Research Model
Multiple regression analysis has been performed with Perceived Risk, Privacy, Security, Social Exchange, Information Content, and the interaction terms as independent variables and Trust as dependent variable.

Individualism-Collectivism acted as a moderator variable which moderates the effect of Perceived Risk, Social Exchange and Information Content towards Trust. As pointed out by Echambadi et al. [45], the cross-product term in moderated regression might be collinear with its constituent parts. This made it difficult to detect main and interaction effects. Mean-centering can reduce the covariance between the linear and the interaction terms. As a result, mean-centering was used to calculate the interaction terms in the current study.

Table 1 Trust in online vendor affected by Perceived Risk, Privacy, Security, Social Exchange, Information Content

<table>
<thead>
<tr>
<th>Variables ß P-value</th>
<th>ß</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PR</td>
<td>-0.201</td>
<td>0.000*</td>
</tr>
<tr>
<td>P</td>
<td>0.044</td>
<td>0.250</td>
</tr>
<tr>
<td>SEC</td>
<td>0.162</td>
<td>0.000*</td>
</tr>
<tr>
<td>SE</td>
<td>0.033</td>
<td>0.228</td>
</tr>
<tr>
<td>IC</td>
<td>0.557</td>
<td>0.000*</td>
</tr>
<tr>
<td>clxcPR</td>
<td>0.113</td>
<td>0.003*</td>
</tr>
<tr>
<td>clxcSE</td>
<td>0.001</td>
<td>0.983</td>
</tr>
<tr>
<td>clxcIC</td>
<td>0.079</td>
<td>0.042*</td>
</tr>
<tr>
<td>R² = 0.870, Adjusted R² = 0.865</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PR= Perceived Risk P= Privacy SE= Security
SEC= Social Exchange IC = Information Content
cI= Mean Centered of Individualism/Collectivism cPR= Mean Centered of Perceived Risk
cSE= Mean Centered of Social Exchange cIC= Mean Centered of Information Content
Hypothesis 2 is supported. A negative effect on perceived risk towards trust. supports that collectivist would have a stronger towards trust would be weakened. As a result, it supports that collectivist would have a stronger negative effect on perceived risk towards trust. Hypothesis 2 is supported.

Privacy ($\beta = .044$), social exchange ($\beta = .033$), and the interaction of social exchange and individualism-collectivism do not have a significant effect on trust. On the other hand, security ($\beta = .162$) and information content ($\beta = .557$) do have a positive effect on trust. Moreover, the interaction of information content and individualism-collectivism ($\beta = .079$) is significant. Higher score of individualism-collectivism indicates that the consumer is more individualistic. The effect of information content towards trust is stronger for individualists.

### Discussions

The main objective of this study is to investigate the effect of perceived risk, privacy, security, social exchange and information content on trust and how individualism-collectivism moderate the effect of these factors on trust.

As data were collected from Switzerland and Hong Kong, it would be useful to compare the level of individualism-collectivism in these two places. The mean score of individualism-collectivism of Swiss and Hong Kong were 3.0140 and 2.6767 respectively. A t-test showed that the mean scores are significantly different. It indicates that Swiss is more individualistic, which collaborate with the result of Hofstede’s study.

The results of current study shows that perceived risk has a negative relationship with trust of online vendors and individualism/collectivism moderate the effect of perceived risk on trust. The result is consistent with previous research [25],[27]. Individualists are easier to trust other than collectivists. Collectivists still think that online shopping is riskier than individualists.

As perceived risk has a stronger negative effect on trust for collectivists, online vendors can put more efforts on the measures that can reduce the concern of collectivist consumers for example improving the products quality and their reputation so as to build up the confidence of consumers.

Security is important for every consumer. A higher level of security would enhance the consumer trust. This result is consistent with previous study [28],[29]. Online vendors can try to improve their security systems and explain the security system that they use on the website. All these can improve the trust of many consumers.

Information content was found to have a positive relationship with trust and it is stronger for individualists. The result is quite consistent with previous studies [35],[9]. As suggested by Park et al. [46], the amount of information would not be an important factor of trust, consumer could not handle large quantity of information. Consumers want to have in-depth and relevant information. That means consumers believe quality of information would be more important than quantity. They would like to have high quality information. If the information is accurate and relevant, their trust would be improved. As information content is an important determinant for trust, online vendors have to pay more attention on the information content of website. Consumers would consider the quality of information rather than quantity of information especially for the individualist. Online vendors should focus on the accuracy of information.

In this study, social exchange was found to have no significant effect on trust of online vendors. The result is different from Hawkins et al. (1999). Although it is popular for online vendors to provide forum or bulletin board to let consumer to communicate with each other, consumer would not treat social exchange as an important factor that affecting trust. This study shows that security, perceived risk and information content are more important than social exchange. When consumers share opinion or read opinion on forum or bulletin board of website, they can know more about the quality of the product and service. Through this interaction, they can gain more information about the website and their perceived risk would be weakened. When they find that other consumers have a good purchase experience, they would think that buying products from this website is less risky. Due to this reason, social exchange may have an indirect relationship with trust.

Perceived risk, security and information content have a relationship with trust. Online vendors have to pay attention in these aspects so as to attract more new consumers. Consumers with different culture would concern different factors of trust. Online vendors need to know what kind of people they target so as to appropriate marketing strategies. For the above T-test, Swiss was more individualistic than Hong Kong people. For individualist, Swiss online vendors would concern
the quality of information content more than other factors. Providing accurate and in-depth information can help improve the confident of consumers towards the website.

However, it is different for collectivists. Hong Kong people are more collectivistic compared to Swiss. They think that perceived risk is more important. Therefore, online vendors can put more efforts on it such as enhance the product quality and reputation so as to improve the trust of consumer and thus consumers’ confident towards the website.

There are some limitations for this study. First of all, the sample was only 230 which is not large enough to reflect the whole population. Secondly, the respondents are only from two countries, Switzerland and Hong Kong. The discussion of culture difference is limited. Thus future study can be carried out in difference countries with larger sample. Another limitation is that only one culture dimension has been studied. There are other culture dimensions, such as power distance, uncertainty avoidance, masculinity and femininity and long versus short term orientation, that can also used as moderator.

Conclusion
In this study, a research model was developed to study the moderating effect of individualism-collectivism on the determinants of online trust. Perceived risk, privacy, security, social exchange and information content were examined for their relationship with trust towards online vendors. The model was tested using data from Switzerland and Hong Kong. It was found that the cultural dimension of individualism-collectivism does moderate the relationships. This suggests that it is fruitful to study the effect of individual cultural dimensions in addition to study nations as a whole. As cultural dimensions were found to have moderating effect, online vendors should take this into account as online shopping is becoming more

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A TECHNOLOGICAL CATCHING-UP MODEL OF MODULARIZED INDUSTRY IN DEVELOPING COUNTRIES

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Abstract
This article discussed the technological catching-up problem of modularized industry in developing countries. Firstly, this article analysed the relationship between technical level, technology learning capability, technological innovation capability and technological capability; then, stated that the technological catching-up of modularized industry in developing countries is the integration of catching-up in technical level and technological capability. After comparing the developing mode of modularized industries in developing countries with that in developed countries, this article puts forward a technological catching-up model of modularized industry in developing countries.

Keywords: modularized industry; technological catching-up; technological capability; developing countries

Introduction
The ‘absence’ of key technology is the main obstacle of Chinese manufacturing industries. With the development of industrial modularization, it has become more difficult to obtain ‘industrial key technology’ for China. Therefore, research on technology development and technological capability cultivating of modularized industry is very important for China, to achieve industrial technology improvement and industrial upgrading.

Based on fundamental principle of modularity, this article stated the hierarchy characteristics of industrial technology. After analyzing the synergetic and dependant relationship among different technological hierarchies of modularized industry, this article pointed out that technology platform of modularized industry is the ‘key module hierarchy’. Then, this article analyzed the relationship between technical level, technology learning capability, technological innovation capability and technological capability; and stated that the technological catching-up of modularized industry in developing countries is the integration of catching-up in technical level and technological capability. Finally, after comparing the technology development mode of modularized industries in developing countries with that in developed countries, this article puts forward a technological catching-up model of modularized industry in developing countries.

The development of technological hierarchy in modularized industry
Modularity is a procession of disaggregating a complex system into several interlinked sub-systems by certain rules (Masahiko, 2003). The core characteristics of modularity are: ① Independence of single module and interactions between modules in complex systems. ② Decomposed a complex system by modularization simplifies the interfaces of a system. Based on the widely used technology modularity in products design and manufacturing, industry modularization grew and developed. Industry modularization drives industry system hierarchy development, and further deepens the development of industrial technology system hierarchy.

So technology in modularized system can be divided into ‘system technology hierarchy’ and ‘module technology hierarchy’. Module technology consists of key module technology and common module technology. System technology is the technology about system entire structure, design and coordination; it composes of structure technology, interface technology and standard technology. Modularity technology is a set of internal knowledge combination that helps modules implement their performance and achieve the requirements of systems.

Key modules are very important for the existence and development of whole modularized system. Key modules have the following three characteristics: ① Complexity of technology inside key modules is much higher; ② More interactions between key modules and other modules. Key modules have great influence to the whole systems. ③ Key module’s function is the main function of super modules or the main body of super module’s functions. Therefore, ‘key module hierarchy’ which includes key modules and interactions between key modules in modularized system, is the core of the whole system.
Figure 1. The hierarchy structure of technology in modularized system

Technology development of the whole modularized industry needs the synergetic development of each technology hierarchy. That is, technology in key module design hierarchy is the key of the technology platform; technology developing in other hierarchies mutually is based on technology in key module design hierarchy; as a result, the synergetic development for technology in the whole modularized industry is achieved.

Technological catching-up of modularized industry in developing countries

The technological catching-up of modularized industry in developing countries should achieve two kinds of catching-up, one is the catching-up in technical level, shorten the technology gap with developed countries; the other is the catching-up in technological capability, achieving the sustainable development of technological catching-up.

Through analyses the connotations of technological capability, technical level, and their relationships, this chapter discusses the synergetic development mode in developing countries and in developed countries respectively, and illuminates the technological catching-up mechanism of modularized industry in developing countries.

The connotations of technological capability, technical level and their relationships

Technological capability is the capability of obtaining advanced technology and information, creating new technology and knowledge, realizing technological diffusing, and increasing the storage of technology and knowledge (Wei & Xu, 1996). It has two sub-dimensions: technology learning dimension and technological innovation dimension. Technology learning is the learning activities through acquirement, learning and absorption from current technological system. Technological innovation is activities of introducing a new production, procession or service into market, realizing their economic benefits. Technological innovation is new technologies’ creating and diffusing, the direct outcome and final destination is to improve the technical level. Technical level refers to the technological qualities, it has three dimensions: innovation, advancement and reliability.

Seen from the definitions above, technical level is ‘stock conception’, technological capability is ‘incremental conception’. Technological capability can promote technical level through technology learning and technological innovation. So this article made a definition of the relationship between technological capability, technology learning capability, technological innovation capability and technical level as follows: technological capability is the integration of technology learning capability and technological innovation capability, are the first derivative of technical level. Technical level is a concave function. The main reason is the effect of “learn by doing” and “experience curves”. Technology learning and technological innovation have a continuous improvement, and also the technological capability, so the improvement of technical level is accelerated.

The function of their relationships is as follows:

\[
\begin{align*}
TC(t) &= \alpha TSC(t) + (1 - \alpha)TIC(t) = LT(t) \\
LT(t) &= \int\alpha TSC(t) + (1 - \alpha)TIC(t) - \int TC(t)
\end{align*}
\]

\( t \) is independent variable of time, \( TC(t) \) is the function of technological capability, \( TSC(t) \) is the function of technology learning capability, \( TIC(t) \) is the function of technological innovation capability, \( LT(t) \) is the function of technical level, \( 0 \leq \alpha \leq 1 \).

The development mode of modularized industrial technology in developed countries

The development of modularized industry stems from the formation of technology platform. The stabilization of platform technology is the result of drastically competition between different technical standards and dominant designs. So in a long period, the platform technology will be stable, until a more advanced platform comes into being.

Seen from the dimension of technological modularization, the synergetic development of system technology, common module technology and key module technology is shown as figure 2 (TL refers to technical level). A’B’D’ is the development track of key module technology (platform technology), O’B’E’ is the development
track of system technology and common module technology.

Seen from the dimension of industrial organization modularization, the synergetic development of manufacturing technology and design technology appears a similar mechanism. Shown as figure 3, the development track of design technology is $A^2B^2D^2$, $O^2B^2E^2$ is the development track of manufacturing technology.

Figure 2. The synergetic development between system technology (ST), common module technology (CMT) and platform technology (Key module technology, KMT) in developed countries

Figure 3. The synergetic development between manufacturing technology (MT) and design technology (DT) in developed countries

The development mode of modularized industrial technology in developing countries

The development of modularized industry in developing countries is under the condition of technology diffusing and global division of labor. So developing countries can learn system technology and common module technology through technology diffusing, and acquire manufacturing technology through global division of labor. The design technology in key module hierarchy-- platform design technology, which is in a form of ‘technological black box’, can’t be learned or acquired through technology diffusing or technology purchasing. The design technology in key module hierarchy should be improved through industrial practices. So it is different from the ‘key technology→peripheral technology’ mode in developed countries, the development mode in developing countries is “peripheral technology→key technology”.

Figure 4. The synergetic development between system technology (ST), common module technology (CMT) and platform technology (Key module technology, KMT) in developing countries

Figure 5. The synergetic development between manufacturing technology (MT) and design technology (DT) in developing countries

Seen from the dimension of industrial technology modularization, there is a similar synergetic development between system technology, common module technology and key module technology (platform technology). Shown as figure 4, the development track of key module technology is $O^3B^3D^3$, $A^3B^3E^3$ is the development track of system technology and common module technology.

Seen from the dimension of industrial organizational modularization, it appears a similar mechanism of synergetic development between design technology and manufacturing technology. Shown as figure 5, the development track of design technology is $O^4B^4D^4$, $A^4B^4E^4$ is the development track of manufacturing technology.

A technological catching-up model of modularized industry in developing countries

‘Creative destruction’ is the main obstacle of technological catching-up in modularized industries faced by developing countries. The leaping development of ‘technology platform’--the fundamental change of technology platform caused the radically changes in the technological system of modularized industry. Based on A-U Model, the changes of technology platform need a long time,
once happen, there is a radically change in the
whole industry. The direct result of the upgrade of
technology platform is the totally invalidation of
old platform, and the technical level based on old
platform will lost totally. Figure 6 describes the
technological catching-up of modularized industry
in developing countries under different technology
platforms. A'B'D' is the development track of
system technology, common module technology
and manufacturing technology, O'B'C' is the
development track of design technology of
platform (’ show the different development stage of
platform).

In the initial O', the platform design technical
level of developing countries is zero, the
technology gap is OA'(the platform design
technical level of developed countries is over A'B').
In stage I, the development track of system
technology, common module technology
and manufacturing technology is A'B'D', the
development track of platform design technology is
O'B'C'. Before B', the modularized industry is in
the introduction period, the level of system
technology, common module technology
and manufacturing technology is over A'B', the level
of platform design technology is promoted to the level
of A'B' through industrial practice, and achieve
synergetic development between different hierarchies.
After B', the development of modularized industry
came into independent development period, the
technology innovations in other hierarchies of
modularized technology system, pull the
development of innovation in platform design
technology, the level of platform design technology
advanced to B'C'. At the end of stage I, technology
gap reduce to C'A'.

When the modularized industry developed
form stage I to stage II, because the effect of
‘creative destruction’ in platform technology, the
technical level based on old platform is totally
invalided. At the jumping-off point of stage II--O'',
the technical level of modularized industry in
developing country reduce to 0. There is a totally
loss in technical level in developing countries
under new platform, but the technological
capability cultivated in stage I has no loss, it
continued developing in form of technology
learning capability and technological innovation
capability in stage II. There is a similar
development track in all of the hierarchies in
modularized industries, and we only illuminate the
development track of platform design technology.
In introduction period, the growth of technological
capability is the improvement of technology
learning capability, technological innovation
capability is stable; when stepped into independent
development period, the growth of technological
capability is the improvement of technological
innovation capability, technology learning
capability is stable. The growth of technology
learning capability and technological innovation
capability has the characteristics of continuous; it
can’t loss for the sake of the upgrade of platform
(Shown as figure 7).

In stage II, technology learning capability in
introduction period is higher than that in stage I.
The growth rate of platform design technology is
accelerated, so developing countries can achieve
the synergetic development in different technology
hierarchies in a short time, the length of
introduction period is shorten. During independent
period, the growth rate of system technology,
common module technology and manufacturing
technology is also higher than that in stage I. So
the pulling effect is distinctly increasing. So at the end
of stage II, the technology gap reduces to C'A''
Through several upgrade of technology platform,
developing countries should achieve technological
catching-up in stage N. At the ending point of stage
N-1--O''', the technology gap is 0, developing
countries achieve the technological catching-up.

The function of the continuous of TC is as
follows:
\[
\begin{align*}
SMTL'_{(1)}(B^1) &= SMTL'_{(II)}(O^{II}) \\
SMTL'_{(1)}(D^1) &= SMTL'_{(II)}(B^{II}) \\
SMTL'_{(II)}(B^{II}) &= SMTL'_{(III)}(O^{III}) \\
SMTL'_{(II)}(D^{II}) &= SMTL'_{(III)}(B^{III}) \\
&\vdots \\
SMTL'_{(N-1)}(B^{N-1}) &= SMTL'_{(N)}(O^{N}) \\
SMTL'_{(N-1)}(D^{N-1}) &= SMTL'_{(N)}(B^{N}) \\
PTL'_{(I)}(C^1) &= PTL'_{(II)}(B^{II}) \\
PTL'_{(I)}(C^{II}) &= PTL'_{(II)}(B^{III}) \\
&\vdots \\
PTL'_{(N-1)}(C^{N-1}) &= PTL'_{(N)}(B^{N}) \\
\end{align*}
\]

SMTL'_{(n)}(T) is the function of the level of
system technology, common module technology
and manufacturing technology in stage \( n \);
PTL'_{(n)}(T) is the function of the level of
platform design technology in stage \( n \).
Conclusions

This article explained the synergetic development and mutual growth of different hierarchy technologies in modularized industry. The main conclusions are as follows:

(1) The development of industrial modularization drives the hierarchy development of industrial technology. There are mutual developments among different hierarchies of the whole technology system in modularized industry, which include mutually developed system technology, common modular technology and platform technology, design technology and manufacturing technology.

(2) The technology development mode of modularized industries in developing countries is different from that in developed countries. The technology development mode of modularized industries in developed countries is the synergetic development of ‘key technology  peripheral technology’; while the technology development mode in developing countries is the synergetic development of ‘peripheral technology  key technology’.

(3) There are two parts of technological catching-up in developing countries—technical level catching-up and technological capability catching-up. Technological capability is the driving force of the development of technical level. Technical level’s catching-up of modularized industry in developing countries is discontinuous. Technological capability grows based on R&D system, and is sustainable.

(4) Through a theoretical analysis of technological catching-up of modularized industry, we can see that the technology catching-up of modularized industries in developing countries should start from a certain hierarchy platform. It should not to pursue costly advanced technology platform. In advanced technology platform, the sustainable growth of technological capability makes the introduction period getting shorter and the independent development period getting longer; industrial technology capability is getting improved. Through several platforms of modularized industry updating, the modularized industry in developing countries achieves the industry technological catching-up gradually.

References

A PRACTICAL CASE STUDY OF THE INTERACTIVE TV SERVICE AS A TIME-CRITICAL PRODUCT

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Abstract
In this paper, we conducted a case study of time-critical goods - NG goods. We expected the study to integrate the field of information management and the TV broadcasting field, thereby creating a new wave of potential for the information management field after e-commerce. We suggest two perspectives germane to industry development: the development of the whole industry, and, the operation of the individual companies.

1. Background and motivation
As the number of television channels is increasing at an exponential rate, the broadcasting industry is forced to constantly adapt its standards without inflating costs. Older syndication strategies are unlikely to be flexible enough in such a context. This has led to attempts to interest the audience in various forms of interactive TV services, such as on-demand content, ordering stock and purchasing movie tickets [18]. For consumers, the appeal here is having greater individual control over both which programs they watch and when they watch them. Indeed, these imperatives are very much in keeping with expectations about multi-media services generally [8]. Interactive TV services have entered the pilot phase in European countries and the United States [8]. Even older, established companies such as Time Warner have been willing to acknowledge, at least in principle, the value of two-way interactive TV services [7] However, the practical operational realization of this prospective ideal has proven more difficult, and there is little consensus at this stage as to how it should be promoted.

The global financial crisis has had a corrosive effect on many business and individual livelihoods alike. A 2009 Nelson consumer report noted that more than 60% of consumers have become very sensitive about price fluctuations. Time-critical goods are especially affected in such a rapidly changing environment, with travel vouchers and plane tickets falling in value as their date of use approaches, albeit without affecting their quality. The same can be said about goods such as NG foods with superficial flaws, such as damage to the packaging, which have little bearing on the taste or nutritional value of the product. Therefore, people refer to NG goods as time-critical goods in Taiwan. Given the growth in the market for NG goods, the Internet is the medium most likely to exploit the demand for time-critical goods.

Despite their ready accessibility on the Internet, price remains a cause of concern. This is especially the case for groups of late adaptors, such as housewives and the elderly, who are less inclined to change their regular TV viewing habits. However, television could prove an effective medium even to these groups, thanks to the advertising of NG goods, particularly where NG goods can be traded using a remote control.

We conducted a case study of time-critical goods - NG goods. Our working assumption was that the study could integrate two fields: information management and TV broadcasting. This would in turn revitalize the information management field with respect to e-commerce.

2. Literature review
The basis of this section is the ITV service and time-critical product fields. However, time-critical products are a new development, and there are no strong theories. Therefore, we reviewed literature in the critical product field.

2.1 Interactive television services
The definition of interactive television services according to Britain’s Independent TV Committee is, “interactivity is a function and not a special form of service, and it can be used in many different situations” [6]. Viewers can be involved in the exchange in the following ways. The first is through changing the content that appears on-screen, like choosing television programs or advertising background information, or scene selection. They can also watch a secondary program while watching one of these programs. Secondly, through providing information to television stations through return channels (usually phone lines), such as when ordering goods, providing opinions on television programs and through voting or participating in game shows. These services, whether provided via satellite, cable or wireless digital, can only be used by members of the public with digital equipment. Furthermore, Britain’s Independent TV Committee...
argues that the general approach of interactive television services differs from network services. Its content and services are developing well; however, only in an environment with the support of more broadly identifiable standards can station managers, advertising representatives and viewers, become more willing to trust and utilize each other.

Yu-li Liu[7] argues that although two-way interactive television services have both narrow and broad definitions, feedback is the essential factor in both. The narrow definition refers to the system (or channel) operator placing the scheduled programs into the video server, which at any time can respond to subscriber demands. Consumers can receive all their desired programs and services through their television set via transmission networks, transmitted program signals, and digital decoders. The broad definition refers to interaction with the programming source, not necessarily through a network. Communication can be over the telephone, such as song selections, call-in shows, and responding to voice and multimedia information. These all come under the broad definition.

Brown and Anderson[1] argue that the concept of interactive television services, where the level of audience participation is clearly increasing, is suggestive of how consumers can become programming managers and enter information and areas of entertainment-in effect transforming television into a consumer entertainment center and shopping cart. Additionally, ITV services emphasize initiative and immediacy by providing users with a large amount of information that can be presented as user opinions and lists.

Galperin and Bar[4] believe that ITV is a pull strategy insofar as subscribers request services from multi-channel video programming distributors (MVPD), which are not necessarily linked to specific video programming. ITV has already surpassed the concept of a simple expansion of current television. Furthermore, viewers themselves take the initiative to send requests to providers. Services are not actively provided on the supply-side.

Galperin and Bar[4] categorize ITV as follows. One is a program-related ITV service, which is integrated with any particular video stream, and the other is a dedicated ITV service, which is not integrated with any particular video stream. The former is directly linked to one or several video streams and can be used to strengthen and expand the core business of television stations. The latter is independent from any specific program stream, and is sent with multi-channel video programming to third parties who have signed contracts, such as those pertaining to information, shared content and services for car salespeople and bankers.

Multi-channel video programming is sent to station managers and subsequently offered to third parties for their input.

According to Tsaih et al[13], interactive television services can be split into the categories of “walled gardens”, where multi-channel video programming controls the transmission, and online “wild forests”, which are not restricted by multi-channel video programming. The difference between the two ITV services hinges on whether or not the consumer can receive third party content or services that are not in collaboration with multi-channel video programming.

Pramataris et al[10] argue that in terms of the level of interactivity of ITV, it is believed that different types of interactive television programs can lead to different levels of viewer interaction. Therefore, interactivity is a two-dimensional structure. Firstly, the level of interactivity depends on the nature of the content. Secondly, the level is the inclination of viewers to interact. Yu-li Liu [7] argues that the two-way interactivity of ITV services can be separated into five levels (as in Table 1). The higher the level, the more sophisticated the level of interactivity.

Table 1: Levels of two-way ITV services

<table>
<thead>
<tr>
<th>Level of interactivity</th>
<th>User operation model</th>
<th>Communication medium</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>None (0)</td>
<td>Linear broadcast, users can change the channel and program</td>
<td>Telephone</td>
<td>Similar to pay-TV video-on-demand</td>
</tr>
<tr>
<td>Low (1)</td>
<td>Linear broadcast, users can talk to the host of the provided content and have the same control over programming as in the operation of</td>
<td>Cable TV, not in real time</td>
<td>Pay-TV video-on-demand</td>
</tr>
</tbody>
</table>
2.2 A critical product

According to Yang Zhuxing’s [16], critical products originate in the influence of culture and a high level of involvement with the product. They can be distinguished from traditional consumer (convenience, leisure, optional and special) goods. Furthermore, Zaichkowsky’s[17] research demonstrates that where consumers have a high level of involvement in purchasing a product, they also spend more time seeking information or planning. They can sense the possibility of making the wrong purchase and so the perceived risk is high. Studies by Murray and Sehlater[9], Capon and Burke[2], and Cronin, Brady and Hult [3] also show that the degree of perceived risk when purchasing unique products influences the level of satisfaction of consumers (the lower the perceived risk, the higher the level of satisfaction). Richins and Bloch’s[12] study also shows that the level of consumer involvement with unique products is on par with their level of satisfaction (also, the greater their pre-purchase knowledge, the higher their level of satisfaction with the product).

Yang Zhuxing [16] also offers suggestions to companies selling unique products: (1) Improve the company’s own competitive edge through significant and supportive processes in the value chain; (2) offer consumers channels and methods to participate, and improve the level of consumer interaction to reduce their perceived risk and increase their level of satisfaction; (3) establish customer sales methods and improve marketability by establishing a public reputation; and (4) form relevant alliances to offer consumers the convenience of one-stop-shopping. There are also suggestions for those consumers purchasing unique products. They should carefully evaluate the significance of this product to avoid overspending. They should also avoid making impulse purchases induced by the shopping environment, and they should consider the size of their budget, the service quality and product content to minimize any impact on their level of satisfaction.

3. The research method and case study

The topic of this study is relatively new, and the research method and limitations are unique. They are described below.

There is no practical operation. Therefore, our research methodology includes an exploratory study and a case study.

3.1 The research method

3.1.1 Explanation of exploratory study

The main purpose of this study is to discuss internal and external issues and topics concerning the company’s development of a time-critical product into an ITV service in order to establish an operational model. However, (1) There are no domestic practical case studies; (2) The phenomenon of time-critical products as a key business operation has only existed for a short period of time, and there are very few theories on these operations; and (3) currently in Taiwan, explorations into new and developing industries are just beginning and their achievements are still not clear. Therefore, meticulous testing for this study is inappropriate.

This is instead an exploratory study, consistent with the view of Taiwan University’s Professor Kuo-shu et al[17]. Emphasis is accordingly placed on exploring the facts and conducting a thorough study of internal and external factors framed by discussion of a real situation.

3.1.2. Explanation of the Case Study
Before carrying out this study, we conducted a literature review on ITV services and time-critical products in order to support its theoretical foundations. Nevertheless, when conducting the literature review, we discovered that the scope of literature was limited; few people were able to participate in the topic area. Currently there are no strong theories to provide support and the topic of this study is one where the flow of information naturally evolves.

According to Wu Chung-Fern [15], a case study is suitable for research topics which are relatively new, where little research has been conducted, there are no strong supporting theories, and the real-world environment is naturally evolving. Therefore, this study principally uses the case study, electing to interview relevant businesspeople and collated literature as supplementary research.

3.2 The Case study
In selecting the company, we took the following into consideration:

1. Time dedicated
   Firstly, the duration of the case study was relatively short and the analysis of internal and external factors is a relatively new area. Also, the vehicle with which the company is expanding its business is just starting out. Therefore, through carrying out this study, we can truly understand the philosophy of people in this company and conclude that the research duration was completely appropriate.

2. Objectivity of information
   Secondly, there is no fixed policy and we cannot rely on first impressions. In the absence of an established information division, there is ample room to discuss a wide range of opinions. We have effectively collected information from a broad range of sources, so it is relatively objective.

3. Earnest attitude in providing assistance
   Ultimately, the policymakers and service personnel in this company all want to use ITV services. This is extremely important for the company’s operation and future development. Therefore, they were greatly supportive of and helpful throughout the course of this research.

4. Case study
Exploration of the case is divided into two sections

4.1 The case background

4.1.1 The operational concept and marketing strategy
The operational concept is “the closer the product is to its date of use, the cheaper it is”. These products are not sold through main channels, or the traditional business model cannot sell them. Examples include airplane seats which have not been sold close to the date of departure, as well as hotel rooms and travel tickets which have not been sold. Customers are particularly sensitive to the price of these products, and often pay close attention to discount sales/auctions.

In terms of the marketing strategy, the inclination is to connect suppliers and consumers. On the basis of the unused conditions and surplus value of products in different industries, the price of the product is lowered as time passes, and the price reduction model is “the more you buy the cheaper it is”. The aim is to connect suppliers and consumers immediately to encourage an immediate transaction.

4.1.2 Development
In March 2009, the company secured subsidies and a related trading platform from the Ministry of Economic Affairs, and on March 13 it received the support of the Ministry to continue to preparatory work on “BidSale”, including supplier talks, core mechanism plans, website requirements and webpage designs, development of the Demo and other matters. It is expected to be online in late 1998.

Aside from the basic office equipment for employees, along with the hardware and software needed for the website, there is no investment in a business location, shop front or other related facilities. On the contrary, a high quality professional staff is the key factor in its success. The development of research and integration of knowledge from all industries, planned operational processes, transaction mechanisms, system logic design, product management and business savvy, are all of key importance to the company.

4.1.3 The operation aims to:
1. Provide timely and beneficial information on time-critical products so they can be immediately and effectively cleared;
2. Attract customers, with an emphasis on holding clearances for products approaching their date of use, and offering interactive participation in real time to access online products and services immediately;
3. Offer integrated system mechanisms and online services to give sellers an immediate market and avoid a rapid decline in price or even non-sale of surplus value products. At the same time, it aims to offer buyers (end users) low-price products to save them money;
4. Use young people’s social networking groups as a blueprint, as their time elasticity is high and they often like to buy time-critical products; and
5. Provide an immediate interactive response for young people in society, as serious internet users, through encouraging an understanding of the internet environment and the demands of Internet users.

4.2 The case plan
After the above literature review and situational analysis, three plans are provided below:

4.2.1 ITV service and content type

According to Huang[5], ITV services can be separated into viewing, shopping and business categories. Content can also be divided into relay, attached and inserted content. As it has the structure and operation of an enterprise, the company has the following characteristics:

1. Its business model is principally the marketing of products, not offering film and television programs. Thus, it is not appropriate to have viewing services for ITV.

2. Its operational scope is that of a small to medium sized enterprise, and it is in the development stage. It cannot provide additional resources to create content for ITV broadcasts.

3. Its current task is principally to provide information services on time-critical products and not be involved in purchase and post-purchase logistical procedures (such as delivery, payment and customer service). Further, the products that it recommends are primarily time-critical products approaching their date of use, so they must actively and constantly pass on this information to consumers before the deadline to stimulate the consumers’ desire to purchase. Evidently, ITV shopping services involving logistical activities and waiting on consumers are also inappropriate.

In light of the above analysis, and as the core ability of the company, the website’s e-commerce is fundamental for the company to adopt the ITV business model in its development. The main content types are inserted ITV content and attached ITV content.

4.2.2 The business model

As ITV is its main business model, its operators provide visual communication through the company website. Therefore, it can develop its business model into an online business model. According to Michael Rappa [11], there are nine types of online business model (Brokerage Model, Advertising Model, Informdiary Model, Manufacturing Model, Community Model, Affiliate Model, Merchant Model, Subscription Model, and Utility Model). Turban et al.[14] identify six types of e-commerce business models from the standpoint of coordinating mechanisms for product and information flows (markets and hierarchies): business to business-B2B, business to customer-B2C, customer to customer-C2C, customer to business-C2B, Non-Profit EC, and Intranet EC. However, as its current business model is the one below, there are a limited number of models it can adopt.

1. It currently employs serious Internet users to promptly recommend time-critical products [nearing their date of use] to consumers with whose consumption habits they are familiar. They are responsible for immediate interaction in order to complete transactions.

2. The company primarily advertises time-critical products or provides recommendations. In order to widely distribute information, the company has created consumer groups who like to purchase time critical products approaching their date of use. A real-time interactive website has been developed for the benefit of this group.

According to our analysis, the company can adopt the Advertising Model with income from product or business advertising. The Informdiary Model can be used in conjunction with transaction commissions for matching buyers and sellers, whilst the Community Model may provide information on consumer habits. It should also observe coordinating mechanisms for product and information flows. It currently provides individual consumer recommendations from the standpoint of an enterprise, so it has adopted the business to customer-B2C Model. It has not developed to allow individual consumers to also give recommendations, as in the customer to customer-C2C Model, nor let them sell products, as in the customer to business-C2B Model.

Reference


[18] Zheng, Ming Zhung, To change a manner to watch TV, Taipei: Yang-Chi Publisher. 2003
PROFILING INTERACTIVE TELEVISION RESEARCH: A BIBLIOMETRIC REVIEW

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Abstract
Though the recent revolution in digital processing ushers the broadcasting industry into a new era, the interactive television (iTV) has been regarded as the third generation of broadcasting services and relevant issues of iTV have gained tremendous interests from both academics and practitioners. This article endeavours to profile the scholarly development of the interactive television literatures by utilizing bibliometric technique to review the literature material in SCIE, SSCI, and A&HCI databases appeared in 1970 to 2009. There are 228 documents in total. The analysis is conducted on such as most productive authors, authors’ background, geographic diversity analysis (including countries and institutions), subject areas, publication year, and the citation analysis. The conclusions about the promising future, research direction, and the attribute of interactive television research are derived from this study.

Keywords: Interactive TV, Bibliometric, SCIE, SSCI, A&HCI

Introduction
Since the interactive television issue was firstly raised in the early 70s, both academia and practitioners have endeavoured to explore the various innovations either from technology or application perspective. In addition to the technological breakthroughs, the interactivity has been regarded as tremendous competitive differentiator. The deployment of interactive television opens many exciting opportunities for businesses and users, ranging from television-based electronic commerce to interactive educational programming. [4] Moreover, Tsaih, R. et al. envisioned a potential commerce boom based on the interactive television business concept and an evolution on value chains of all industries [6]. All these innovative developments will evolve as broadcasters, soft vendors, equipment makers, and users experiment with novel ways to enhance and perhaps transform the television experience altogether. [4]

This increasing focus on the interactive television issue provides strong motivation to review the past contributions. The aim of this paper is to provide a systematic review of the related interactive television research publication in order to extract some insights for future study.

The overall aim is realized by means of the following objectives. Firstly, to profile the distributions by year; to identify the most productive authors; to determine the background of contributing authors; to determine the geographic location of contributing authors; to identify the leading research institutions; to identify the distribution of source title and the subject category; finally, to determine the research impact of the most influential authors and studies.

Research Methodology
In order to create a profile of interactive television research, we conduct a bibliometric analysis of all iTV related publications in Science Citation Index Expanded (SCIE), Social Science Citation Index (SSCI) and Arts & Humanities Citation Index (A&HCI) databases from 1970 to 2009. The key words we adopt include internet-TV, web TV, web television, web-based TV, web-based television, interactive TV, and interactive television. Totally 228 papers are examined and the number of contributors is 552. Varieties of information are recorded such as all author’s productivity and their background, the contributors’ geographical locations and regions, and the institutions that all authors are affiliated with.

Web of Knowledge provides the basic tools for analysing the pattern of all articles, including the distribution of publication year and the type of documents, however, in order to illuminate the productivity of authors, previous researches suggest that normal count approach should be adopted. [3][4] A normal count means that each publication counted as one for all authors, regardless of the number of co-authors. [1][3] This adjusted approach is used in leading institutions, geographical locations, and geographical regions analysis as well. The citations of most productive authors and most influencing articles are presented by both the ISI citation counts and Google’s scholar citation counts. As for the categories of regions analysis, we adopt the AIS guidelines and Dwivedi’s seven-region classification...
[2] to describe the regional difference in interactive television development.

Findings and Discussion

Distribution of publications by year

Table 1 presents the distribution of publications by year. The first paper about interactive television was written by Callahan, W. in 1970, and the name of the article is “Interactive Television – What It Means to Cable Television” published in the journal of the society of motion picture television engineers. At the outset, interactive television issue does not gain too much attention. As the Internet and e-commerce prevail, the publications related to interactive television start to boom as well. This phenomenon can be observed in Figure 1, the red straight line shows the significant increase of articles number during the late 90s.

Document type analysis

Total 228 papers were retrieved and the type of document is described in Table 2, 64.5% (N=147) of documents are articles, 15.4% (N=35) are proceedings papers, followed by 7.5% (N=17) are editorial material, 6.1% (N=14) are meeting abstract, then, four are letters, three are notes, and only one is reprint. As we analyse in previous part, the first paper published in interactive television issue is a meeting abstract. (see Table 2)

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Document type

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Figure 1 iTV Publication Trend

Co-authors analysis

Table 3 shows the co-authorship in total 228 articles, 37.72% (N=86) of the articles were written by single author and form the largest category, excluding the anonymous papers, 57.46% (N=131) of articles were written by multiple authors. Moreover, 19.30%
Adaptive and customisable agent for personalised digital learning – a "myopia" of the learner, a testbed for an intelligent learning experience

The 9th International Conference on Electronic Business, Macau, November 30 - December 4, 2009

Table 3: Pattern of co-authorship

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Most productive authors

An analysis of most productive authors was conducted to identify the authors that published the most articles between 1970 and 2009. Palvia et al. [5] suggested that all authors who contributed to the publication should be equally counted, which means an article with multiple authors would offer one count for each author, and this adoption of normal count approach provided the profile that a total of 552 authors contributed to 228 articles.

Table 4: Most productive authors' analysis

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<td>Japan</td>
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</table>

Except for 11 anonymous papers, a total of 519 authors publish interactive television articles in SCIE, SSCI, and A&HCI databases. There are 318 authors (58.8%) from academia and 223 authors (41.2%) are

Authors' background analysis
practitioners. This result indicates that research in interactive television draw the attention both from academia and practitioners, and the line chart in Figure 2 showing the trend of publication from two different sectors. We observe that the number of articles published by practitioners equals to that published by academia in 1999 and the year 2000 can be regarded as an inflection point for iTV academic researchers. After that year, the articles published by academic group are far more than that by practitioners. (see Table 5 and Figure 2)

Table 5 Distribution of authors according to background and publication year

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<tr>
<td>Total</td>
<td>318</td>
<td>225</td>
<td>543</td>
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</table>

% 58.8% 41.2% 100.0%

Authors' geographic regions analysis by publication years

According to the category of geographic regions which is suggested by Association for Information Systems (AIS), the geographic regions are classified three divisions, which includes R1 (Americans), R2 (Europeans), and R3 (Others). Table 6 illustrates all the geographical locations. The largest part of contributors were located in the USA (183, 33.83%), followed by UK (84, 15.53%), the third largest category was located in Japan (35, 6.47%), then Spain (32, 5.91%), Netherlands (29, 5.36%), Greece (19, 3.51%), South Korea (15, 2.77%). Moreover, Finland, Germany and Taiwan are in the eighth place (14, 2.59%), followed by Italy (12, 2.22%), Brazil (11, 2.03%), France (10, 1.85%). (see Table 6)

Table 6 Contributors' geographical location

<table>
<thead>
<tr>
<th>Country</th>
<th>Count</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
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<td>USA</td>
<td>183</td>
<td>33.83%</td>
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<tr>
<td>UK</td>
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<td>15.53%</td>
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<td>Japan</td>
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<tr>
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<td>5.36%</td>
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<tr>
<td>Greece</td>
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<tr>
<td>Taiwan</td>
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<tr>
<td>Italy</td>
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<tr>
<td>Brazil</td>
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<td>2.03%</td>
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<tr>
<td>France</td>
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<td>1.85%</td>
</tr>
<tr>
<td>Austria</td>
<td>8</td>
<td>1.48%</td>
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<tr>
<td>China</td>
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<td>1.11%</td>
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<tr>
<td>Ireland</td>
<td>6</td>
<td>1.11%</td>
</tr>
<tr>
<td>South Africa</td>
<td>6</td>
<td>1.11%</td>
</tr>
<tr>
<td>Sweden</td>
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<td>1.11%</td>
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<td>Norway</td>
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<td>Poland</td>
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<tr>
<td>Australia</td>
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<tr>
<td>India</td>
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<tr>
<td>[AIOH]</td>
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<td>2.03%</td>
</tr>
<tr>
<td>Total</td>
<td>543</td>
<td>100.0%</td>
</tr>
</tbody>
</table>
Moreover, Dwivedi et al. [1] modified the classification and divided the above category into six sub-divisions for profiling the information systems research, which involves R1 (USA & Canada), R2 (Europe & UK), R3 (South Korea, Singapore, Hong Kong, Taiwan, China, Japan, India), R4 (Australia & New Zealand), R5 (Middle East & Africa), R6 (Latin America & South American Countries).

Due to the regional difference in interactive TV service deployment, we adopt the modified classification scheme for providing a clearer picture of iTV research, and the result is illustrated as Table 7. Excluding the anonymous papers, the number of articles from USA & Canada (101, 47%) outstrips that from Europe & UK (82, 38%). Moreover, the third largest category is found by the Region 3—South Korea, Singapore, Hong Kong, Taiwan, China, Japan, India with 20 (9%), followed by the category with 8 articles across 2 regions. The result indicates that North America (USA & Canada) had an early development of interactive television, which conforms to the history of American cable television. The evidence was revealed in the Time Warner Cable Northeast Timeline, where recorded that Warner Cable launched the first interactive television programming with its QUBE system in Columbus, Ohio in 1977. Table 7 also presents that the article published from R2 are increasing, and this phenomenon can echo the contemporary deployment in Europe region.

### Leading Institution Analysis

Authors from 198 universities or organizations published the interactive television articles from 1970 to 2009. Table 8 presents the institutions and associated countries that contributed more than 2 papers. The top institution is BT in UK, which contributed eight papers, followed by Indiana University in USA contributed seven articles, CWI (Center for Mathematics and Computer Science) in Netherlands contributed six papers, National Institute Information and Communications in Japan contributed five papers, then, City University London in England and Microsoft contributed four papers each. Other institutions of contributors are listed in Table 8.

### Category Field Analysis

ITV research involves in multi-discipline issues, the articles are shown in 68 category fields. The fields with more than 3 papers published are illustrated as Table 5. The largest category is Engineering, Electrical & Electronic category (580, followed by Telecommunications category (43), Computer Science, Theory & Media (36), Computer, Information Systems (26), Computer Science, Software Engineering (26), and Communication (21). The result indicate that the interactive television issue gains much more attention from the technology and its related discipline, such as computer science, telecommunications, engineering, information science and imaging science. (see Table 9)
Table 8 The institutions publish more than two papers

<table>
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<th>Institutions</th>
<th>Country</th>
<th>Count</th>
</tr>
</thead>
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<td>BT</td>
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</tr>
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<td>USA</td>
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</tr>
<tr>
<td>Cyberspace &amp; Informatics</td>
<td>Netherlands</td>
<td>6</td>
</tr>
<tr>
<td>NICT</td>
<td>Japan</td>
<td>5</td>
</tr>
<tr>
<td>City University London</td>
<td>England</td>
<td>4</td>
</tr>
<tr>
<td>Minnesota Corp</td>
<td>USA/China</td>
<td>4</td>
</tr>
<tr>
<td>AT &amp; T</td>
<td>USA/Netherland</td>
<td>3</td>
</tr>
<tr>
<td>Kyoto University</td>
<td>Japan</td>
<td>3</td>
</tr>
<tr>
<td>Massachusetts General Hospital</td>
<td>USA</td>
<td>3</td>
</tr>
<tr>
<td>Philips</td>
<td>Netherlands/CHINA</td>
<td>3</td>
</tr>
<tr>
<td>Sahting University</td>
<td>Austria</td>
<td>3</td>
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<tr>
<td>Samsung</td>
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<td>South Korea</td>
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<tr>
<td>Hospital Severo Ochoa</td>
<td>Spain</td>
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</tr>
<tr>
<td>IBM</td>
<td>USA/Chao/Japan</td>
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<td>Kwangju University</td>
<td>South Korea</td>
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<tr>
<td>National Chiao Tung University</td>
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<td>Greece</td>
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<td>Suseor</td>
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<td>Swiss Fed Inst Stat &amp; Techn</td>
<td>Switzerland</td>
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<td>Tampere University</td>
<td>Finland</td>
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<td>Tech University Munich</td>
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<tr>
<td>University of Art &amp; Design Helsinki</td>
<td>Finland</td>
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Table 9 Category field analysis

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<td>Computer Science, Software Engineering</td>
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<td>Film, Radio, Television</td>
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<td>Business</td>
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<td>Computer Science, Cybernetics</td>
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<td>Education, Scientific Disciplines</td>
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<tr>
<td>Ergonomics</td>
<td>6</td>
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<tr>
<td>Imaging Science &amp; Photographic Technology</td>
<td>6</td>
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<tr>
<td>Instruments &amp; Instrumentation</td>
<td>6</td>
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<td>Computer Science, Interdisciplinary Applications</td>
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<tr>
<td>Gerontology</td>
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<td>Humanities, Multidisciplinary</td>
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<tr>
<td>Medicine, General &amp; Internal</td>
<td>4</td>
</tr>
<tr>
<td>Social Work</td>
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<tr>
<td>Biology</td>
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<td>Business, Finance</td>
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<tr>
<td>Psychology</td>
<td>3</td>
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</table>

Source Title Analysis

A total of 139 journals published 228 articles and Table 10 lists the journals that publish more than three interactive television papers. The highest count is from Lecture Notes in Computer Science (16), the second is IEEE Transactions on Consumer Electronics (10), followed by Journal of Telemedicine and Telecare (6), Multimedia Systems (6), then, British Telecommunications Engineering (5) and Electronics (5). The remaining journals are illustrated in Table 10.

Table 10 Source title analysis
Most Influential Articles Analysis

Table 11 Most Influential Articles

<table>
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<tr>
<th>No.</th>
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<th>Year</th>
<th>ISI Citation</th>
<th>Google Citation</th>
<th>Fluent Author</th>
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<td>Telepsychiatry-Psychiatric Consultation by Interactive Television</td>
<td>1993</td>
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<td>A Web-based Tree View (TV) Program for the Visualization of Phylogenetic Trees</td>
<td>2002</td>
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<td>4</td>
<td>From Online to Online World: Examining the Content and Structure of Broadcast TV Stations' Websites</td>
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</table>

Conclusions

This paper aimed to illuminate the development of interactive television research published in SCIE, SSCI, A&HCI databases from 1970 to 2009. The result provides a systematic review of total 228 publications involved with different dimensions of examination including yearly publications, document type, co-authors, productive authors, background, countries, geographic regions, leading institution, category fields, source titles and most influential articles. Whereas the findings are profound, there still exist some research limitations. For instance, the databases we gathered data from, which covers most journal publications but high impact conferences, other databases such as Emerald and Scopus both are worthy for further exploration.
The following are some implications revealed from the analysis. According to the development path of interactive television related study, we can foresee a promising future. The category field analysis shows that interactive television issue gains lots of attention from technology and its related fields, however, the major goal of interactive television deployment is making profit, hence, conducting researches by adopting an applicative lens in terms of management and business perspectives should be taken into account. Although North America has contributed a lot in this topic, the increasing output from Europe countries will by all means prosper the related research. To the end, interactive television is a practice-oriented research issue, apart from the efforts of research organizations (universities and institutions), world’s leading enterprises such as BT, Microsoft corp. AT & T and Philips all endeavour to participate in this interactive television arena.

References
THE ANALYSIS OF ANTECEDENTS FOR THE VIDEO TELEPHONY SERVICE ADOPrION: FROM THE VALUE-BASED PERSPECTIVE

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Abstract
Korean Telecommunications Industry has a large scale market and boasts on high service quality and high technologies enough to provide the Video Telephony Service (VTS) satisfactorily. For many years, Korean telephone companies have been investing enormous sums to advertise their services widely and to allow their customers to change their cell phones for the third-generation (3G) devices indispensable for the service. However, despite their efforts, the VTS adoption rate in Korea is very low and it seems that customers seldom feel the necessity to use. From this viewpoint, it becomes necessary to find the antecedents influencing the intention to use for the VTS empirically. For this purpose, we proposed several hypotheses from the perspective of the Value-based Adoption Model (VAM). VAM is a conceptual model suggested to overcome some limitations of the Technology Acceptance Model (TAM) in explaining the adoption of new Information and Communication Technology (ICT) such as Mobile Internet where customers play the role of service consumer rather than simply technology users. We conducted a survey on 125 samples and found that customers perceive the value of VTS when they can recognize the service is functionally useful (Perceived Usefulness) and when they feel they can put themselves forward by using it (Self-Expression). On the other hand, the other factors including Technical Complexity, Privacy Concern and Perceived Price (Fee) don’t have statistically significant influences on the Perceived Value of VTS.

Keywords: Video Telephony Service, Technology Acceptance Model, Value-based Adoption Model, Perceived Value, Self-expression

1. Introduction
Since CDMA was commercialized 10 years ago, the Korean telecommunication market has significantly matured with skyrocketing numbers of subscribers exceeding 41.1 Million (almost 80% of the total population) as of March. 2007 [22].

Given this, telecommunication service providers in Korea have started seeking new profit sources, focusing on the highly advanced, WCDMA-based Video Telephony Service (VTS).

To win the full-blown VTS battle starting from March of 2007, the service providers have significantly invested in distributing WCDMA-based terminals widely, as a sound platform for VTS expansion.

As a result, the number of VTS-enabled handset holders among total mobile subscribers has reached 16 Million as of October, 2008.

However, despite such efforts, VTS usage rate has remained remarkably low.

For instance, the statistics of the providers indicates that the number of users utilizing VTS more than once, via free promotion, has been on the rise, but this growth has not been translated into actual sales [26] [40].

Additionally, a public survey on VTS showed that the majority of 51.1% responded expressing that they had “Feeling no need for VTS” [29].

In short, the role of VTS in daily life has not yet materialized in Korea [30].

There were similar attempts to expand VTS usage in Japan and America, but this effort mostly failed.

Many researchers concluded that VTS technical issues such as ‘Image quality’ or ‘system quality’ did not fully satisfy customer expectation, but at the same time, the overstretched attempt to create a new market based on the perspective of supplier/technology capability, without sufficient analysis on customer needs, also largely contributed to the failure [36] [45].

Therefore, Korean telecommunication providers should not pursue the same strategy, but rather create a service extension strategy based on a full understanding of customer needs.

A starting point of understanding customer needs in this area begins with an understanding of the critical elements that create user appreciation arising from the VTS service value proposition.

However, most VTS studies have focused on technological aspects of VTS.

Typically that is the direct motivation behind this VTS study, aiming to answering the following two questions.

I. What elements do have impact on VTS adoption?
II. Among them, what is the most decisive element in evaluating VTS value?

In the following Chapter, the definition and implication of a Value-based Adoption Model, the key Model of this research, will be discussed.

Then, it establishes a major research hypothesis based on the theory, in order to develop a quantifiable model through regression analysis, highlighting its implications.

This study will help observe when and in which case users appreciate the value of VTS, bringing practical benefits in creating a new marketing strategy to the telecommunication service providers.

2. Background and Hypotheses Building

2.1. Value-based Adoption Model (VAM)

Discovering the full value of an equipment or device requires users to have the ability to sufficiently use it. And its sufficient usage requires users to adopt it as his or her personal device, both physically and psychologically.

Many IT researchers have recognized the importance of User Acceptance and consistently studied what is the prerequisite in making a new technology valuable to users.


Among them, the Technology Acceptance Model (TAM) is simple to understand and highly reasonable, and well-explained, thereby it is widely accepted by researchers. Davis(1989) insisted that elements directly affecting the level of User Acceptance are Usefulness and Ease of Use [9].

However, TAM was designed based on the scenario where a user must use IT Artifact, including a mandatory system or process and the supporting technology, to carry on his or her job as a member of a specific organization [27].

Given that characteristics, TAM has its own limitation in observing User Acceptance when a user is both a technology user and service consumer such as for mobile internet usage [27].

Before moving on to more details, it is worth considering the meaning of ‘Perceived Value’.

Perceived Value is the value that users appreciate, following product or service consumption, and is calculated by subtracting total costs(sacrifice) required up to the final purchase decision as well as its usage costs from benefits gained during the course of its consumption [63].

Also it was confirmed that Perceived Value positively influences purchase (adoption) intention [33] [53].

In a company introducing TAM, the company itself, instead of a user, takes business cost required for utilizing IT Artifact (IT functionality). (In fact, TAM does not cover the sacrifice specifically, but only focuses on the benefits resulting from new IT functionality usage, including Usefulness and Ease of Use)

Particularly, in most cases, the purpose of a new IT functionality is decided by the organization itself as a company policy, instead of by users directly. Furthermore, the authority to determine the value of its consistent use is unlikely to be granted to users [27].

As for mobile-Internet, however, its consistent use is dependent on intended requirements of individual users and its future usage is also largely determined by user’s appreciation of the value following their service consumption [27].

Kim et al.(2007) understood the area that cannot be explained by TAM, then suggested Value-based Adoption Model(VAM) to complement TAM [27].

The following Figure 1 is a conceptual model of VAM.

![Figure 1. Conceptual Model of VAM](image-url)

As Figure 1 shows, VAM is designed based on Perceived Value of Zeithaml(1988) [63]. In other words, Perceived Value of products or services is produced through a total sum of benefits and costs following consumption.

Just like the mobile internet, VTS users can be both new technology adopters and service users.

Having said that, establishing a VAM-based research model helps analyze which elements impact VTS Adoption Intention by users.

2.2. Perceived Benefit

When do consumers start to recognize value?

Sheth(1983) suggested a Integrative theory of exploring consumer repurchase motivation, asserting that there are two motivations at play in buying products or services [48]. The first is ‘functional need’, indicating an easy access to and availability of products that consumers want to purchase and the second is emotional and subjective values that consumers expect after
consumption [48].

Since then, many researchers have further developed this theory into a specific concept. Particularly, Rintamaki et al. (2006) categorized values following consumption into Utilitarian value, Hedonic value, and Social value and corroboratively proved that they are mutually exclusive [42].

Utilitarian value is appreciated by removing the functional needs that Sheth (1983) conceptually distinguished [48]. For instance, when consumers save costs during service consumption (monetary savings) or feel convenience (convenience) as a result of using this service, they are thought to be appreciating Utilitarian value [42].

Hedonic value defines the sense of pleasure being enjoyed during the course of consumption itself [6] [21].

Social value originates from consumer belief that they are distinguished among the public by consuming specific products or services [7] [49] [51].

Given the study history above, this document covers the values sensed by VTS users, from the three aspects of Perceived Usefulness, Enjoyment, and Self-Expression.

2.2.1. Perceived Usefulness (PU)

Many IS researchers have studied diverse variables affecting new technology adoption and stressed the significance of user’s conviction or attitude [12] [17] [18] [24].

Especially, the concept of Perceived Usefulness has been recognized as a critical determinant of user behavior [9] [43] [46].

Here, Perceived Usefulness is defined as ‘the confidence in specific systems improving personal work performance [9].

The result of different IS studies confirms that Perceived Usefulness is significant for technology adoption [27].

Considering such study results above, following hypothesis can be established for this VTS study.

**H1. The stronger conviction that VTS is useful, the higher Perceived Value that users appreciate.**

2.2.2. Enjoyment (EN)

Consumers are pursuing fantasies, feeling, and fun in their consumption. Holbrook & Hirschman (1982) define this phenomenon as ‘Hedonic Consumption’ and explain that it significantly defines consumer behavior [21].

Many marketing studies prove that a consumer’s emotion and feeling, following their consumption, serve as critical variables in their appreciation of the value of a service (e.g., [32]).

If the previously mentioned ‘Perceived Usefulness’ is related to Utilitarian value, product or service functional value, the Hedonic value is more subjective and emotional.

Turel et al. (2007) coined the expression of Emotional Value, indicating the comprehensive feeling of Enjoyment, Pleasure or/and Anxiety following the usage of product or service [58].

Among those feelings, this study particularly focuses on Enjoyment coupled with ‘VTS’ usage.

Davis et al. (1992) confirmed that Enjoyment affects Intention to use by extensively applying existing TAM. However, he added that its impact is smaller than the one expected from Perceived Usefulness and Ease of Use [10].

However, Heijden (2004) argued that such analysis results from insufficient categorization, by purpose, of Information system in relation to this study. He insists that we need to separately observe the system designed to provide effective function and the system that delivers pleasure to users. He names the first as the Utilitarian system while the second as the Hedonic system [59].

According to his corroborative study on film information websites, the impact of Enjoyment on Intention to use in the Hedonic system is much larger than that witnessed in Perceived Usefulness (Heijden, 2004).

Given all of the above, VTS becomes one of the Hedonic system examples, thereby new assumptions are established as follows:

**H2. The more users enjoy VTS, the higher their Perceived Value would be.**

2.2.3. Self-Expression (SE)

According to existing studies, consumption itself can be described as ‘social activity of expressing the individual to others’ [49].

Consumers strongly confirm or strengthen their social identity during product or service consumption [16]. At the same time, they express their social status [42] and further consolidate personal relationships thanks to unlimited time and space in displaying their own interests in others [31].

Leung & Wei (2000) argued that mobile service usage would be one of the greatest ways to display strong personality and social status [31]. And Pihlstrom & Brush (2008) confirmed that the social value delivered by the mobile service largely determines the service value [41].

This study focuses on Self-Expression, the level of confidence in the strong power of expressing a user social status and individuality following VTS consumption.

**H3. The stronger that the VTS user feeling is that
their social status and personality can be displayed following VTS usage, the higher Perceived Value they can appreciate.

2.3. Perceived Sacrifice
Perceived Sacrifice means the portion that users have to give up or sacrifice for acquiring a product or service. It consists of monetary and non-monetary aspects.

Product price and service fees are a great example of monetary sacrifice while personal effort, time, and complaints about lower-than-expected service quality are examples of non-monetary sacrifice [27].

This study considers monetary and nonmonetary sacrifice, expected to be experienced following VTS consumption, from four perspectives of Technical Complexity, Quality Uncertainty, Privacy Concern, and Perceived Price.

2.3.1. Technical Complexity (TC)
Complexity coupled with new innovation, impacting potential users, serves as an obstacle to its extension and application for business tasks [57].

Here, complexity is defined as the difficulty in understanding and using the innovation content and value [44].

Many MIS studies on IT adoption confirmed that such complexity affects Adoption Intention, but the negative impact gradually declines following user’s adaptation to the new technology [27] [56] [60].

Following the launch of the VTS service 2 years ago, its market penetration is still low.

Having said that, most users are still unfamiliar with VTS and for them, it is still difficult to operate VTS terminals and its features.

And ultimately it is reasonable to infer, such a position is likely to undermine the service usage value.

H4. Complexity following VTS usage affects Perceived Value on VTS.

2.3.2. Privacy Concern (PC)
VTS was once thought to offer more natural and better communication than voice phone, becoming the choice of communication in the market [38].

However, against this expectation, VTS failed to deliver business success [36], because the attitude of the majority VTS users, during a call was more likely to be formal, exaggerated, and unnatural, compared to the voice call [47].

Especially, the users had privacy concern due to VTS power of revealing the details of the backgrounds during calls [38].

Against this backdrop, a hypothesis can be established as follows.

H5. The bigger privacy concern following VTS consumption, the lower Perceived value it has.

2.3.3. Perceived Price (PP)
Helson (1964) developed a ‘Adaptation-Level theory’, explaining how consumers build their attitude toward product price.

According to this theory, consumers consider objective price, actual price, as well as their own internal reference price to evaluate the appropriateness of the price [19] [20].

As a psychological price in consumer cognition system, the internal reference price serves as a standard to decide whether the actual price is high or low [15] [19] [34] [62].

The internal reference price is decided or adjusted by consumer’s purchasing experience and expectation derived from similar products [19].

Another study based on a similar logic, where consumer attitude toward mobile-internet service is affected by consumer’s long-term experience of a free wired internet service [2], supports that previous consumption experience influences a customer attitude toward further purchases.

The Adaptation-Level theory implies that there is no appropriate price that all consumers can generally accept. In other words, the objective price cannot be a valid concept when evaluating the co-relationships between price and quality or between price and value, like in this study.

Against this backdrop, Perceived Price (PP) appears to supplement the objective price. In short, PP indicates consumer’s subjective evaluation of the price, decided via the mechanism between the objective price and the internal reference price [25].

Chang & Wildt(1994) confirmed that the objective price and the internal reference price forge a positive and negative relationship with Perceived Price, respectively [8].

And Perceived Price undermines Perceived Value, according to various studies (e.g., [8] [13] [55] [27]).

VTS charges a higher objective price than a voice call. Furthermore, the fee of the voice call (serving as the internal reference price to VTS users), which is the long-term user choice and VTS-similar service, is relatively more affordable.

Given that, VTS Perceived Price is likely to be decided at a higher level. Such a higher Perceived Price is expected to reduce VTS’s Perceived Value.

Therefore, another hypothesis can be established as follows.
H6. The higher VTS Perceived Price, the lower VTS Perceived Value.

2.4. Adoption Intention (AI)
Intention is the anticipated or planned future behavior of individuals, meaning the subjective probability of user conviction and attitude being translated into actual behavior [14].

A “Behavioral intention in decision-making” model directly defines a specific behavior [23] and Ajzen & Fishbein(1980) insisted that such a behavioral intention is highly likely to be translated into actual behavior [1].

Intention behavior in marketing indicates the user’s psychological state created right before actual product purchase. Many studies prove that the behavioral intention is highly correlated with the actual purchase [28].

Diverse marketing studies confirm that Perceived Value does decisively influence the consumer purchase intention and purchase decision-making [33] [39] [63]. Therefore, it is reasonable to infer that high VTS Perceived Value can be translated into a high adoption intention.

H7. The higher VTS Perceived Value, the higher adoption intention.

3. Research Methodology
3.1. Data Collection
To statistically verify the hypotheses, a survey was conducted, targeting people in their 20s to 50s who once used or are using VTS.

As a result, 125 samples were verified by sorting out meaningless answers from a total of 176 samples.

The demographical distribution of respondents is as follows.

The following Table 1 shows that people in their 20s and 30s account for almost 84% of total respondents.

<table>
<thead>
<tr>
<th>Age interval</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 ~ 25</td>
<td>16%</td>
</tr>
<tr>
<td>26 ~ 30</td>
<td>40%</td>
</tr>
<tr>
<td>31 ~ 35</td>
<td>28%</td>
</tr>
<tr>
<td>36 ~ 40</td>
<td>12%</td>
</tr>
<tr>
<td>41 ~ 45</td>
<td>2%</td>
</tr>
<tr>
<td>46 ~ 50</td>
<td>1%</td>
</tr>
<tr>
<td>51 ~ 60</td>
<td>1%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
</tr>
</tbody>
</table>

Job distribution shows that respondents with jobs represent majority, followed by students of 31% and professionals of 17%.

3.2. Operationalization of Constructs
The operational definitions on construct and measure items employed in this study are stated in Appendix A.

4. Data Analysis and Results
4.1. Reliability and Validity of Measure Items
Factor analysis was conducted to confirm the construct validity of measure index and Cronbach’s alpha value was checked to ensure internal consistency among relevant measure index.

Analysis results confirmed that in most cases, the factor loading of the measure index recorded higher than the general standard of 0.7 and Cronbach’s alpha value was also above the standard of 0.7 [37], indicating the validity and reliability of the measure index.

However, Perceived Usefulness and Enjoyment appear to be combined as one factor. That will be covered in detail in the Discussion section below.

4.2. Hypotheses Test
Multiple regression analysis was conducted with SPSS 12 in order to statistically verify the cause and effect among constructs and the following is a review summary of the resulting hypothesis.

<table>
<thead>
<tr>
<th>PU</th>
<th>SE</th>
<th>TC</th>
<th>PC</th>
<th>PP</th>
<th>PV</th>
<th>AI</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.55***</td>
<td>0.16*</td>
<td>0.07</td>
<td>0.03</td>
<td>0.12</td>
<td>0.70***</td>
<td>0.48</td>
<td></td>
</tr>
</tbody>
</table>

Analysis results show that Perceived Value (PV, β = 0.70, p < 0.01) has a meaningful impact on Adoption Intention (R² = 0.48).

Also Perceived Usefulness (β = 0.55, p < 0.01) and Self-Expression (β = 0.16, p < 0.10) among 6 independent variables meaningfully
influences Perceived Value ($R^2 = 0.43$).

Checking the Variance Inflation Factor (VIF) was required to verify Multicollinearity among constructs, and its value was somewhere between 1.05 and 1.53, much lower than a generally accepted standard of 10, proving there is no multicollinearity issue.

Meanwhile, according to the methodology of Baron & Kenny (1986) [5], the mediating effect of Perceived Value was reviewed to see which mediating effect is working between independent and dependent variables, or in other words, whether it is a partial or perfect mediating effect. However, the analysis scope was only limited to Perceived Usefulness and Self-Expression which have statistically significant effect-and-cause relationship with Perceived Value.

The following table displays the test result of mediating effects.

**Table 3. Testing the mediating effect of Perceived Value**

<table>
<thead>
<tr>
<th>Step</th>
<th>DV</th>
<th>IV</th>
<th>Beta</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>PV</td>
<td>PU</td>
<td>0.648***</td>
<td>0.415</td>
</tr>
<tr>
<td>1.2</td>
<td>AI</td>
<td>PU</td>
<td>0.702***</td>
<td>0.488</td>
</tr>
<tr>
<td>1.3</td>
<td>AI</td>
<td>PU</td>
<td>0.429***</td>
<td>0.588</td>
</tr>
<tr>
<td></td>
<td>PV</td>
<td></td>
<td>0.420***</td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>PV</td>
<td>SE</td>
<td>0.450***</td>
<td>0.196</td>
</tr>
<tr>
<td>2.2</td>
<td>AI</td>
<td>SE</td>
<td>0.366***</td>
<td>0.113</td>
</tr>
<tr>
<td>2.3</td>
<td>AI</td>
<td>SE</td>
<td>0.028</td>
<td>0.480</td>
</tr>
<tr>
<td></td>
<td>PV</td>
<td></td>
<td>0.686***</td>
<td></td>
</tr>
</tbody>
</table>

*** $p < 0.01$  ** $p < 0.05$  * $p < 0.1$

The test result proves that Perceived Usefulness has a partial mediating effect between its perceived value and adoption intention while confirming a perfect mediating effect between Self-Expression and Adoption Intention.

### 5. Discussion and Conclusion

#### 5.1. Discussion and Conclusion

As we confirmed above, when users feel that the VTS service is useful (Perceived Usefulness) and that they can better express themselves (Self-Expression), they will appreciate the VTS value proposition.

However, as the analysis demonstrates, the construct of Perceived Usefulness is combined with the construct of Enjoyment.

The reason behind this can be explored from different perspectives. Among them, the most compelling logic is that the process of experiencing Usefulness itself can also be a sense of Enjoyment to users.

In short, the mobile phone is a personalized device and people enjoy its contents including VTS, to satisfy personal needs, thereby a user judgment that the service is useful itself cannot be separated from the personal joy of using the device.

Of course, such a finding might result from an imperfect construct and measurement design, but the measurement system used was not entirely new, it was built with borrowed concepts proved via several tests and studies on measurement validity and reliability. Therefore, it is unlikely that the design of the measurement system caused the coupling of user Perceived Usefulness and Enjoyment.

The hypotheses on Technical Complexity, Privacy Concern, and Perceived Price that were supposed to be discussed in Cost were not developed. The reason why they do not have any meaningful influence on Value appreciation will be covered later, but before its discussion, it is worth noting the demographical characteristics of participants in this research.

As mentioned above, by age distribution, the proportion of respondents in their 20s and 30s accounts for 84% of the total, while students and professionals represent 31% and 17%, respectively by job distribution.

By considering that point, we can see why Technical Complexity does not have any significant impact. According to the age distribution, most respondents are in the age range where a flexible and active response to new changes is expected. Particularly, respondents in their 20s to early 30s have been directly and indirectly influenced by IT innovation from their childhood, so VTS’s functional complexity and sophisticated features are not necessarily a material challenge to them.

Meanwhile, they pursue lifestyle following consumption, more than any generation, and make more phone calls than the average. So the current VTS fee is less likely to undermine their appreciation of service value.

The fact that Self-Expression has a meaningful impact on VTS value appreciation can be a good starting point in discussing Quality Uncertainty and Privacy Concern issues.

Amongst users who significantly value the fact that they can express themselves via VTS, the privacy concern is less likely to serve as a big variable.

This studies results imply that telecommunication service providers should leverage the aspects of Usefulness (and Enjoyment) and Self-Expression in order to promote VTS to their customers in the 20s and 30s age range.

At the same time, the widely employed
marketing methods such as ‘Easy Use’ and ‘Low Price’ are unlikely to be effective in positioning VTS or in promoting its consumption, at least in the VTS target market of consumers in their 20s to 30s.

5.2. Limitations and Future Research
This study has several limitations as follows.
First, the majority of survey respondents were in their 20s and early 30s, thereby it is somewhat unreasonable to generalize the results obtained. Particularly, 4 constructs (e.g., Technical Complexity and Sacrifice) were shown not to have any significant impact on Perceived Value, largely attributable to the concentrated demographic distribution as above. Therefore, any future study should include respondents in their late thirties and above in order to allow a wider generalization of the result. Alternatively it might be useful to survey diverse age layers, across demographic boundaries, to compare the result by age distribution thereby enabling conclusions to be drawn in this key aspect.

Second, Perceived Usefulness and Enjoyment were coupled as one construct in the process of cause analysis, but the root cause of this is not fully explained. Any future study needs to confirm that the relationship between Perceived Usefulness and Enjoyment is truly equal, as inferred in the Discussion part.

Appendix
Appendix A. Operationalization of Constructs and Measure Items

<table>
<thead>
<tr>
<th>Construct</th>
<th>Operational definition</th>
<th>Measure item</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived Value</td>
<td>Consumer’s overall assessment of the utility of a product/service based on perceptions of what is received and what is given</td>
<td>Evaluation whether it is worth paying the cost for VTS use</td>
<td>[50]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Recognition the need for investing time and effort for more comfortable VTS usage</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Appreciation of comprehensive VTS value</td>
<td></td>
</tr>
<tr>
<td>Adoption Intention</td>
<td>VTS usage intention</td>
<td>Plan or determination to use VTS at present or in the future</td>
<td>[9]</td>
</tr>
<tr>
<td>Perceived Usefulness</td>
<td>Perception of the usefulness of VTS functions</td>
<td>The sense of usefulness that VTS contributes to business tasks</td>
<td>[9]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Confidence that VTS improves working performance</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Confidence that VTS saves time and effort supposed to be invested in works</td>
<td></td>
</tr>
<tr>
<td>Enjoyment</td>
<td>The sense of joy following VTS use</td>
<td>Appreciation of convenience following VTS usage</td>
<td>[52] [59]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The sense of joy VTS would bring</td>
<td></td>
</tr>
<tr>
<td>Self-Expression</td>
<td>Conviction that VTS utilization expresses their own social status and personality to others</td>
<td>Feeling that VTS usage makes themselves early adopters, moving ahead of others.</td>
<td>[42] [52]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Confidence that using VTS displays their own personality</td>
<td></td>
</tr>
<tr>
<td>Technical Complexity</td>
<td>The level of difficulty in utilizing VTS terminal and specific features</td>
<td>The level of difficulty in using VTS functions</td>
<td>[9] [11]</td>
</tr>
<tr>
<td>Perceived Price</td>
<td>User’s psychological perception on VTS fee</td>
<td>Perception that VTS fee is expensive</td>
<td>[61]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Perception that VTS fee is reasonable</td>
<td></td>
</tr>
<tr>
<td>Privacy Concern</td>
<td>Privacy concern following VTS usage</td>
<td>Concern of both a caller and receiver about privacy exposure</td>
<td>[38]</td>
</tr>
</tbody>
</table>

Acknowledgement
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STUDY OF THE BASIC CHARACTERISTICS OF AN INTERACTIVE TV SERVICE

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Abstract
The iTV service was too conceptually nebulous to readily comprehend. It was variously mistaken as referring to a network television service and a digital television service. To avoid further setbacks, it is very important that we clarify the basic characteristics of iTV service for the benefit of the fields of information technology, MIS, broadcasting, commerce and so on. After conducting literature reviews and interviews, we were able to delineate the basic characteristics of iTV service as follows: 1. The contents of iTV service; 2. The supply and use process, and components of the iTV service.

Format Instructions
1. Background and motivation
The fall out from the financial tsunami has severely affected every industry. Without exception, enterprises are actively seeking new business opportunities to ward off its effects. With the developed networks of the current era, e-commerce is receiving particular attention and making serious waves. The embedding of advertisements on the World Wide Web is growing in prevalence. However, only 50% of this embedded advertising is seen by users. This is considerably smaller than the 93% of advertisements seen in the Yellow Pages and the 97% seen on television. Indeed, it demonstrates that the development of e-commerce has been largely unsuccessful. In addition to holding the highest rate of television advertising, Tsaih, Chang and Huang [22] state that transmitted ITV content has the following four characteristics and each of them can be referred to as a (customer) value driver of the proposed ITV business: appeal, direct interactivity, accessibility of information, and customization. Therefore, enterprises are again focusing on television, and are using the interactive model of e-commerce to guide the development of interactive television services. In turn, this is prompting the evolution of other services such as in the digitalization of book content. This evolution forms as a background to the current study.

Given the novelty of interactive television services, it is easy to form misconceptions. A simple example is the misunderstanding that network television and digital television can provide interactive television services. This has affected the development of these services, thereby delaying the next wave of business. In addition, this also affects the reach and evolution of related services. The major tasks and purposes of this study are to determine how to define the fundamental characteristics of interactive television services, to effectively grasp the focus of development and to encourage the realization of new business opportunities and services.

2. Literature review
The following literature review was carried out to establish the foundation and coherent development of this research.

2.1 Television services
Kim and Sawhney [14] argue that television services have the ability to generate and exchange control information. Culturally, the audience passively receives the services provided by the company (television station and system operator). Institutionally, television services are controlled by government and supervisory bodies. Technologically, television services preserve the social structure under the central government and the audience passively receives services from the company (television station and system operator).

Television services present content in the televising equipment of the audience during the process of broadcasting (as in Figure 1 [5]). However, for each generation of television services the business models, control strategies and regulatory models are different (see Table 1: Galperin and Bar, [10]).

<table>
<thead>
<tr>
<th>Demand: Operating Equipment</th>
<th>Supply: Backend System (Ex; Video Server &amp; System, Transaction System, Client Service System etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand: Set Box</td>
<td>Supply: Management System-Data Recording System</td>
</tr>
<tr>
<td>Demand: TV Set</td>
<td>Supply: Broadcasting System</td>
</tr>
</tbody>
</table>

Figure 1: Process

Table 1: Table of comparisons of three generations of broadcasting

Source: Chiung-Yu Huang [5]
Interactivity that is not integrated with media technology is simply face-to-face dialogue. If it is integrated with media technology, then there are three approaches: communication, mediated environment and empowerment of the users [14]. With regard to communication, it is argued that the key components for interactivity are information analysis and exchange. The emphasis is on the scope of awareness and depth of experience in terms of the mediated environment, and the communication in the mediated environment is highly valued. By empowering users, it is believed that interactive media can provide a platform for different levels of communication through the generation and exchange of control information on consumer usage.

Kim and Sawhney [14] argue that new interactive media can provide all kinds of objectives for users, such as communication platforms for entertainment or knowledge sharing. Therefore, new interactive media should include communicability – which can take the form of any type of communication (such as one-to-many, many-to-many, or many-to-one); malleability – so that it can adapt to the needs of individuals and groups and provide them with a voice; information and images are also elastic; programmability – so it can design information platforms to handle and generate information; and creativity – so the potential is created for individual news. Therefore, interactive television has consumer power of control at the center and has already surpassed traditional television media, which only offers a complete set of programmed content. It is different from traditional television media, where control is centralized and cannot be transferred.

Pramataris et al [17] argue that the greatest contribution of interactive television is the new opportunity for personalization of the media. In traditional media, sellers or advertisers have to use direct consumer surveys from market research companies in order to obtain information about customer responses. Thereafter they can improve their advertising or implement enhanced customized services. However, with this method it is very difficult to verify whether these services or advertisements are really being provided to potential target consumer groups. With interactive media, customers can directly or indirectly provide their viewing or usage information through their interactive behavior. In addition, they can also amend or present individual customer information, rather than information for a large consumer group.

2.3 Interactive television services

The definition of interactive television services according to the Independent TV Committee in Britain is that “interactivity is a function and not a special form of service, and it can be used in many different situations” [13]. Viewers can be involved in the exchange in the following ways. Firstly through changing the content that appears onscreen, like choosing television programs or advertising background information, or scene selection. They can also watch a secondary program while watching one of these programs. Secondly, through providing information to television stations through return channels (usually phone lines), such as ordering goods, providing opinions on television programs and through voting or participating in game shows. These services, whether provided via satellite, cable or wireless digital, can only be used by members of the public with digital equipment. Furthermore, Britain’s Independent TV Committee argues that the general approach of interactive television services is different from network services. Its content and services are developing well, but only in an environment with the support of more broadly identifiable standards can station managers, advertising representatives and viewers become more willing to trust and utilize each other.

Yu-li Liu [25] argues that although two-way interactive television services have both narrow and broad definitions, feedback is the essential factor in both. The narrow definition refers to the system (or channel) operator placing the scheduled programs

<table>
<thead>
<tr>
<th>Generation</th>
<th>First generation: Fordist television</th>
<th>Second generation: Multi-channel television</th>
<th>Third generation: ITV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service</td>
<td>One-way broadcasting of few video channels</td>
<td>One-way broadcasting of multiple video channels</td>
<td>Two-way delivery of multiple video channels and other services</td>
</tr>
<tr>
<td>Business model</td>
<td>Mass advertising and/or license fees</td>
<td>Mass advertising, license fees and subscriptions</td>
<td>Targeted advertising, subscriptions and transaction fees</td>
</tr>
<tr>
<td>Control strategy</td>
<td>Property rights over spectrum license</td>
<td>Integration of distributio and content assets</td>
<td>Access control and proprietary standards</td>
</tr>
<tr>
<td>Regulatory Model</td>
<td>Public trustee (incumbent protection)</td>
<td>Mix of public trustee and limited utility regulation</td>
<td>Yet to be defined</td>
</tr>
</tbody>
</table>

Source: Galperin and Bar [10]
into the video server, which at any time can respond to subscriber demands. Consumers can receive all their desired programs and services through their television set via transmission networks, transmitted program signals, and digital decoders. The broad definition refers to interaction with the programming source, not necessarily through a network. Communication can be over the telephone, such as song selections, call-in shows, and responding to voice and multimedia information. These all come under the broad definition.

Brown and Anderson[4] argue that the concept of interactive television services, where the level of audience participation is clearly increasing, is that consumers can become programming managers and enter information and areas of entertainment, transforming television into a consumer entertainment center and shopping cart. Additionally, ITV services also emphasize initiative and immediacy; it can provide users with a large amount of information and can immediately present information such as user opinions and lists.

Galperin and Bar[10] believe that ITV is a pull strategy: subscribers request services from multi-channel video programming distributors (MVPD), which are not necessarily linked to specific video programming. ITV has already surpassed the concept of a simple expansion of current television. Furthermore, viewers themselves take the initiative to send requests to providers. Services are not actively provided on the supply-side.

Galperin and Bar[10] categorize ITV as follows. One is a program-related ITV service, which is integrated with any particular video stream; and the other is a dedicated ITV service, which is not integrated with any particular video stream. The former is directly linked to one or several video streams and can be used to strengthen and expand the core business of television stations. The latter is independent from any specific program stream, and is sent with multi-channel video programming to third parties who have signed contracts, such as those pertaining to information, shared content and services for car salespeople and bankers. Multi-channel video programming is sent to station managers and subsequently offered to third parties for their input.

According to Tsaih et al.[22], interactive television services can be split into the categories of “walled gardens”, where multi-channel video programming controls the transmission, and online “wild forests”, which are not restricted by multi-channel video programming. The difference between the two ITV services is in whether or not the consumer can receive third party content or services that are not in collaboration with multi-channel video programming.

Table 2: Levels of two-way ITV services

<table>
<thead>
<tr>
<th>Level of interactivity</th>
<th>User operation model</th>
<th>Communication medium</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>None (0)</td>
<td>Linear broadcast, users can change the channel and program</td>
<td>Telephone</td>
<td>Similar to pay-TV video on-demand</td>
</tr>
<tr>
<td>Low (1)</td>
<td>Linear broadcast, users can talk to the host of the provided content and have the same control over programming as in the operation of a VCR</td>
<td>Cable TV, not in real time</td>
<td>Pay-TV video on-demand</td>
</tr>
<tr>
<td>Middle (2)</td>
<td>Wireless broadcast, users can talk with the host of the provided content and have similar control programming as in the operation of LD</td>
<td>Cable TV network in real time</td>
<td>E-catalogues</td>
</tr>
<tr>
<td>High(3)</td>
<td>Wireless broadcast, users can select servers and terms of service</td>
<td>Cable TV network in real time</td>
<td>Electronic banking</td>
</tr>
<tr>
<td>Complete (4)</td>
<td>Wireless broadcast, users can select servers and terms of service, and can have video conferencing and multi-</td>
<td>Cable TV in real time, and can also provide real time</td>
<td></td>
</tr>
</tbody>
</table>

Pramataris et al. [17] argue that in terms of the level of interactivity of ITV, it is believed that different types of interactive television programs can lead to different levels of viewer interaction. Therefore, interactivity is a two-dimensional structure. Firstly, the level of interactivity depends on the nature of the content. Secondly, the level is the inclination of viewers to interact. Yu-li Liu [25] argues that the two-way interactivity of ITV services can be separated into five levels (as in Table 2). The higher the level, the more sophisticated the level of interactivity.
There are many areas where knowledge is limited or new, its promotion requires new mechanisms and industry support. Further, as the topic is relatively (broadcasting and technology) policy, legislation and discussion on governmental and national exploration of related topics. It is also related to elements and data return) to benefit future operation (such as operation contents, process, ITV services and confirm the key criteria for their...

The purpose of this study is to clarify the concept of ITv services and confirm the key criteria for their operation (such as operation contents, process, elements and data return) to benefit future exploration of related topics. It is also related to discussion on governmental and national (broadcasting and technology) policy, legislation and industry support. Further, as the topic is relatively new, its promotion requires new mechanisms and there are many areas where knowledge is limited or relevant factors have not been confirmed.

Therefore, the nature of this study is similar to the qualitative research described by Marshall and Marshall and Rossman[16], which stretches across several different directions and social phenomena, has a naturalistic orientation and has an interpretive quality. Furthermore, the purpose of this study is, as Marshall and Marshall and Rossman[16] describe, an exploration into a novel and relatively uncharted system, and explore the relevant factors which have not yet been confirmed. This study has the value of qualitative research, it will therefore adopt this as its research method.

For qualitative research, the specific history and context is very important. This information largely exists in data and literature which must be reviewed. Then it is possible to describe meticulously and in detail specific values and beliefs [16]. Therefore, this study expands upon the analysis of Li Zhengxian[26]:

a. Organized data; b. Determined categories, themes, styles and patterns; c. Organized data into groups according to category, theme, style or pattern; d. Tested emerging rational understanding gradually; e. Sought other possible explanations; f. Ordered key points and wrote a report; and g. Conducted deeper explorations and conclusions in the hope of bringing forward rational and objective content.

3.2 Research limitations
This study's research limitations are mainly in the limited literature and nature of the research.
A. Limited literature
a. Exclusive literature is limited; b. Significant literature focuses on technology, and there is confusion and overlap with the situation of network television; c. All current experiments and case studies are overseas, services are limited and first-hand information is difficult to obtain.
B. Research limitations
This study has innate qualitative research limitations, such as no supporting quantitative data, no statistical significance as analogy, no genuine empirical hypothesis and no structured research sequence.

4. The basic characteristics of interactive television
From the above analysis, it is clear that ITv can come under the categories of service or operation. However, both use the platform of television, have an interactive nature and fundamentally can derive content, process and key factors, and feedback material. This is described below.

Characteristic 1: Content of ITv
ITv service content, also called ITv content, refers to the ITv enhancement of television content. This offers users another interactive television content code which enables them to click and interact. Currently, the code is not embedded. The World Wide Web can be used to ameliorate understanding of the above terminology. Web pages are text with coding for hyperlinks, where another page of content appears after the user clicks on them. Currently, television content is just like the above-mentioned webpage text without the added hyperlink coding. ITv content, however, has the addition of this coding. Clicking on ITv links brings forward more ITv content, just like clicking on a web page hyperlink brings another web page.

ITv content can appear as soon as a subscriber turns on the television, and can also appear after the user clicks. Three explanations are given below of the key points in the appearance of ITv services and user exchange:

1. ITv broadcasted Contents:
   This content is relayed according to a fixed schedule and is actively transmitted via the video stream of the channel in question. Subscribers only need particular equipment (currently a remote control) to select a channel and view content. This content can be either programming or advertising. The option for interactive television is included in transmitted ITv content. Subscribers can use this function to click and make selections, and transmit their opinions or view parallel ITv content. This is the origin of interactive television. In other words, for subscribers, ITv content provides scheduled programming and (still in its infancy but emerging nonetheless) windows for interactive television activities.

2. ITv enchanced contents
   This content requires users to click within interactive television content for embedded ITv enchanced contents coding. Only then can they receive transmitted video files from video sites.
   The ITv enchanced contents contains the...

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option for embedded ITV coding. Users can utilize their equipment to click and make selections, and transmit their opinions or view parallel ITV content. This is an extension of ITV services. In other words, for users, ITV provides additional viewing content and is continuing to provide windows for interactive television activities.

3. ITV inserted contents

This content is actively displayed in marquees or other small windows from broadcasting systems or video sites to present the text strings or graphics in ITV content or ITV enhanced contents. It does not require users to click as it automatically appears. Within inserted ITV content there is the option for embedded ITV coding, and consumers can use their equipment to click and make selections. They can also transmit their opinions or view parallel ITV content. In other words, for users, inserted ITV content provides additional viewing content, and with greater prevalence is providing windows for interactive television services.

For example, when users are watching an interactive television transmission of baseball from a broadcasting system, they can use the remote control to make selections from ITV enhanced contents, such as the uniform numbers of team members, sponsoring organizations, team member histories, or commercial product descriptions. If promoted products appear in the marquee, the remote control can be used to make a selection and receive the product description. Users can even conduct purchases or exchange pre- and post-purchase opinions. Also, if users are watching the broadcast of a political commentary, they can use the remote control to directly participate in public opinion polls.

Characteristic 2: Process and key criteria for ITV services

The discussion below is from the standpoint of consumers on the demand-side and system operators on the supply-side who directly come into contact (via cable television) with consumers.

A. Process

The enjoyment process for subscribers on the demand side is as follows:

Step 1: Watch. View the interactive television content.

Subscribers view the interactive content on a particular channel.

Step 2: Request. Submit a request for interactive television services.

When subscribers wish to submit a request for interactive television content, they can use certain equipment (currently a remote control) to make selections from broadcasts or inserted content and transmit requests for broadcast information or additional interactive content.

Step 3: Respond to ITV service requests.

Broadcast information should be entered into operating equipment according to its instructions. To change the channel, return to Step 1. To view the requested ITV enhanced contents, go to Step 4.

Step 4: Continue or conclude a request – to continue or conclude an ITV service request.

When subscribers wish to continue their requested ITV service, that is, use their equipment again to select ITV (additional or inserted) content (such as transmitting their opinions, or again requesting ITV enhanced contents), or change the channel, they should return to Step 3.

When subscribers wish to end their request for ITV services, they use the equipment to click on the corresponding selection and return to Step 1. They can also directly select channels and return to Step 1, or turn off the television.

The provision process for supply-side (cable television) system operators is as follows:

Step 1: Broadcast. Broadcasting ITV content.

After (cable television) system operators obtain the content station managers include in their ITV broadcasts Contents, it is broadcast through the transmission system. Short relevant ITV enhanced contents can also be transmitted at the same time and temporarily stored in the consumer’s set top box.

Step 2: Handle requests. Responding to and logging ITV service requests.

If the corresponding ITV enhanced contents is already stored in the consumer’s set top box when the consumer submits a request for ITV services, the set top box can immediately display the content on the consumer’s television screen. Through the return channel it can transmit related consumer usage data in regards to ITV services to (cable television) system operators to use when handling the main system and usage data logging system.

If the corresponding ITV enhanced contents is not temporarily stored in the consumer’s set top box, then the set top box will immediately send a request for corresponding ITV enhanced contents through the return channel to the relevant back end system (such as a video server system, exchange system or customer service system) in the far-end video site. Through the return channel it will also send relevant usage information to (cable television) system operators who handle the main system and data logging.

The provision of the above ITV services, usage processes and relevant equipment can be seen in Figure 1.

B. Key criteria

The provision of content or services

The providers of television content or services can include program producers, television station managers, and advertising agents and companies (or third parties). Providers responsible for content or services should have the right skills, materials, hardware and software, and financial resources in...
order to fulfill the two criteria below: providing interactive television content or services, and ensuring the procedure is smooth.

The first criteria for providing interactive television content or services:
1. Produce ITV content or services.
2. Manage and control ITV content or services.

There are two methods in producing ITV content or services:
Method 1: Revise traditional television content to become interactive;
Method 2: Produce interactive television content directly.

Both methods must include the following:
(a) Content must be planned and produced for MPEG video streaming, which is necessary for ITV content;
(b) ITV coding should be embedded in the program content described in (a); (c) This television content must be managed and controlled.

Method 1 adds the function of ITV content to traditional television content: 1. Produce MPEG video streamed television content; 2. Replan and reproduce television content described in (1) so it conforms to the requirements of ITV content, such as the production of MPEG video streamed content requesting and explaining user responses; 3. Embed corresponding interactive television coding and related functions for the MPEG video streamed television content mentioned in (1) and (2); and 4. Manage and control the above-mentioned ITV content. Content or service providers can take full responsibility for these tasks. Tasks 1 and 2 can be entrusted to other program producers, station managers, or advertising agents, or ITV service providers can take responsibility for Tasks 2, 3 and 4.

Tasks in Method 2 are to directly produce ITV content. There are two main forms:
1. Directly plan and produce television content so that it is suitable for interactive television services, and enter interactive content, such as requests for consumers to respond to topics and explanations after these responses, into MPEG video streaming before embedding the necessary code for additional ITV into the content; and 2. Manage and control the above-mentioned ITV content. ITV service providers can also take full responsibility for these tasks, or Task 2 can be entrusted to an ITV service supplier.

Integration and presentation of channel (broadcast) content

Individuals who integrate and present ITV content may be station managers or system operators. They must have the right skills, source material, hardware and software, and financial resources to fulfill the criteria below: to provide pre-integrated ITV content for channels and ensure it is presented in its entirety.

Criterion 1 is to provide pre-integrated ITV content (including programs and advertisements) for channels. This refers to the integration of ITV relay, attachments, inserted content and non-interactive TV content to become content for one or many channels.

As for Criterion 2, which is to ensure the delivery of ITV content in its entirety, it is necessary to sign a contract with the broadcasting channel’s (cable television) system operators to obtain the commitment to ensure that there will be no disturbance to the broadcast. This commitment includes: the verification that there are no problems with pre-integrated ITV content for the channel; verification that there are no problems with the relay of additional and inserted ITV content; and the guarantee that the set top boxes or home terminals of subscribers can handle and present all the ITV content.

Transmission of ITV channel content and handling of ITV services

Those who handle the transmission of ITV channel content and ITV services can be system operators. They need to have the right skills, source material, hardware and software, and financial resources to completely fulfill the two criteria below: transmit ITV content in its entirety and comprehensively handle ITV services for customers.

The task for Criterion 1, which is the complete transmission of ITV services, is to provide a broadcast system and signal channels for transmission systems to broadcast ITV content.

Criterion 2 is the comprehensive handling of ITV customer services. The four main items are: 1. A return channel to transmit signals of user service requests to system operators’ video sites, and transmit ITV (additional and inserted) content from back-end systems (such as video server networks of content providers or station managers) to subscribers; 2. Video sites, back-end systems and network connections to receive and decipher signals of user service requests, and respond to these requests; 3. Subscriber set top boxes or home terminals to show the ITV content from the operator; and 4. Information systems to record customer usage information.

According to Galperin and Bar’s (2002) description, it is best to use a broadband internet connection for the return channel described in Criterion 2. Video sites are responsible for handling and recording user requests for services. They receive and decipher service request signals transmitted by subscriber set top boxes or other systems, record user-related response data, and command self-related systems or back end system operations to respond to user requests. These video sites usually include a main system and data logging system. The back end system receives video site commands and transmits appropriate responses to all kinds of ITV service requests to subscriber set top boxes. This usually includes video server computer
systems, exchange systems, and customer service systems. The video server computer system is the most important in presenting television content. It can deposit a large amount of attached ITV content and receive commands and transmit appropriate attached ITV content to subscriber set top boxes.

Operators themselves can handle tasks related to additional ITV services in Criterion 1 and 2, and can wholly or partially entrust responsibility to ITV service suppliers.

C. Enjoyment of services

To enjoy ITV services, subscribers must first order them from their ITV service provider (such as the cable television system operator). Second, they need to have a set top box or home terminal equipment which can receive and handle ITV services or content and link up with the main video servers of ITV service providers, and also equipment which can activate additional code for ITV services or content and convey requests for ITV services, such as a remote control.

The composition of the structure of the ITV service criteria can be seen in Figure 2.

Characteristic 3: Return information for ITV services

It is necessary to obtain user information in the processes of providing and enjoying ITV services, and carry out follow up work. As this information is transmitted through return channels, it is called return information. If the information is processed, it is called processed return information.

![Figure 2: Components](image)

Figure 2: Components

If users have a response or reaction towards ITV services or content, they can directly record this themselves through subscriber terminal equipment (currently a set top box), or after the user transmits to the above-mentioned subscriber terminal through certain operational equipment (currently a remote control), he or she can handle the main system and data logging systems of video sites achieved with the two methods through the return channels of system operators who log return information.

Detailed information can be separated into 1: Situational details (responses): when a subscriber opens, changes or lingers over certain ITV content, such as when the subscriber turns on the television, or changes the channel or content. The subscriber’s home terminal equipment records the information in detail, such as the program viewed, the content, or time period. With this data it is possible to effectively understand actual consumer responses. 2. Opinion details (replies): when consumers enter selections or numbers with particular equipment, such as entering numbers representing their selections and voting for the best performer or topic, entering data to participate in service quality evaluations, or entering selections that represent their opinions and opinions on the service quality. With this information it is possible to effectively deduce viewers opinions and the particular demands that subscribers hold toward their ITV usage.

From the above it can be observed that return information is a consumer response or reply to ITV services. But how can (cable television) system operators record and handle return information? First and foremost, in the process of organizing and analyzing the data, they may derive the positive and negative aspects of the broadcast or provided content and make improvements in order to promote an increase in ratings. Secondly, system operators may offer or sell the first-hand return information or processed return information, and obtain tangible or intangible benefits such as cooperation or direct profit. If system operators liaise with producers and station managers, they may further understand the viewing habits and opinions of consumers. This can promote a better understanding of consumer preferences, behaviour and time periods in which they watch television. It may also aid the further development in the area of ITV and, more generally, contribute to increasing television ratings.

The technological development of video-on-demand, broadcasts, and news reports continues to gain pace. Meanwhile the cost of relevant hardware and software is decreasing, along with the difficulties in recording return information and cost of resources. Recorded content is also becoming deeper and wider. However, as operators collect return information they should be cognizant of the fact that the main objective of subscribers using ITV services is enjoyment, and not return information. Therefore, when operators wish to collect return information, they need to offer suitable rewards. Only then will they attract enthusiastic responses. Moreover, the greater the number of items and the more time consuming the process, the more likely it is that they will be dissatisfied and responses will be harder to obtain. Attention must be paid to legal standards; personal information should be respected; and there should be adjustment for psychological resistance and encouragement to take the time required.

5. Conclusion and recommendation
As ITV is a new service, and in order to encourage the practical usage of ITV services, this study explored the fundamental characteristics as to offer a more comprehensive understanding of the necessary processes and key criteria for television relay, additional and inserted content; demand-side subscribers and supply-side (cable television) system operators; and the basic characteristics of return information on specific situations (responses) and opinions (replies).

However, ITV not only affects the development of television services, it also creates a new direction for viewing digital content. Therefore, in order to promote its effective expansion, this study also suggests the use of ITV services in national libraries. Finally this study recommends digital content, such as flashback query services (for television news), (multi-channel) meaning comparison search services and video-on-demand services.

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A FAIRNESS HEURISTIC ANALYSIS OF THE PRIMACY EFFECT OF REPUTATION ON PERCEIVED OF PRIVACY POLICY AND PRIVACY SEALS

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Abstract
When faced with the risk-benefit dilemma in online era, how would users make their decisions by procedural justice information as distributive justice information is uncertain? The literature implied reputation, privacy policy and seals can be regarded as the factors, which would eliminate users’ privacy concern, build trust and incentivize transaction. However, research-to-date is lacking of a comprehensive model to indicate practitioners whenever and however which factor is the core compared with others or their efforts are equal. Drawing upon the fairness heuristic theory, this paper explores the impact of the three factors on them. The results from an experimental study show that the primacy effects of reputation on perceived of privacy policy and seals exist. Theoretical and practical implications arising from our results were offered.

Keywords: Privacy Concern, Trust, Transaction Intention, Reputation, Fairness Heuristic Theory, Perceived of Privacy Policy, Perceived of Privacy Seals

Introduction
The advent of the Internet and emergence of new information technologies (IT) have enhanced the capabilities of personal information collection, storage, use and communication [1]. The result is that there is a marked increase in the possibility of users’ personal information and online transaction records being tracked, misused, intercepted and captured. Even though online users enjoy benefits such as plentiful data source, convenient and personalized services, they have to face with the risks of information disclosure and misuse [2]. Their concerns on privacy have become an important issue and potential obstacle of user participation in various online activities [1, 3-7]. Besides privacy concern, trust has grown to become a crucial factor of behavior intention that had been discussed in information privacy research area (i.e., [8, 9])

When faced with the cost-benefit dilemma, users know exactly what they can get within the fix exchange/transaction, but the potential costs, such as privacy invasion, are uncertain. At this point, the outcome information that can be used to make the judgment of distributive justice is lacking. According to Van den Bos et al [10] and Flint et al [11]’s report, when comparative information about outcomes is absent or ambiguous, individuals are proned to make fairness judgments relying on procedural justice (i.e., judgment depends on procedural information)

In addition, scholars [12] suggested that firms and online information collectors need to be aware of users’ evaluations both in terms of outcomes and procedures on their online business practices, because failing to do so would lead to negative users’ behavior. As the procedural information, privacy policy and privacy seals are the two most general mechanisms adapted by websites and have been verified to increase users’ trust [13] and decrease privacy concern [14] in some ways.

Till now, besides privacy policy and privacy seals, the bulk of the extant research focused on the effect of trust and privacy concern on behavior intention have examined antecedents such as reputation [15], firm size, website presences [16] and so on. Regrettably, these studies have investigated the influences of these factors unilaterally, rather than in an integrated manner. As a result, their combined outcomes on privacy concern elimination and trust building is unclear when websites have different level of reputation, varying degrees of privacy policy and privacy seals.

Furthermore, contrary to earlier research [17, 18], recent research [2, 19, 20] found that privacy seals have no significant impact on trust and behavior intention. The conflicting empirical results have bewildered government and e-commerce firms, and made them wonder whether it is necessary to fund third party assurance services or whether privacy policy is enough to build trust and decrease privacy concern. Therefore, when the reputation level of the website is confirmed to be different, exploring the influences of privacy policy and seals on users’ trust, privacy concern and behavior intention can help government and enterprises make the decision as to whether to develop third party assurance services and to utilize privacy seals to build users’ trust.

To provide some answers to these questions,
this paper draws upon the “trust building” theory [21] and Fairness Heuristic Theory [22] to investigate the primacy effect of website reputation, compared with privacy policy and privacy seals, on privacy concern, trust, and transaction intention. An experimental study was performed to test the proposed model and hypotheses. Subsequently, we offer some theoretical and practical contributions based on our empirical findings.

Research Model and Hypotheses

Zucker’s Trust Categories

Much research has been conducted on trust in the e-commerce literature, where trust is defined as a set of specific beliefs about another party that positively influence an individual’s intention to conduct online transactions [23-28]. According to Zucker[21]’s “trust building” model, there are three major categories to build trust, including process-based (i.e., reputation, experience), characteristic-based (i.e., disposition, website characteristics), and institutional-based (i.e., third-party certification, assurance). Noticeably, while trust-building model indicates the role of three types of measures on trust building and privacy concern elimination, it cannot exactly anticipate and explain whether some indicators have primacy effect compared to others. To explore and anticipate their relationships and their influences on other outcomes, we further draw upon the fairness heuristic theory to guide our conceptual developments.

Fairness Heuristic Theory (FHT)

Fairness heuristic theory asserts that people use their judgments of fairness as a heuristic to guide decisions about the appropriate level of personal investment and involvement in groups, organizations, and institutions [22]. When fairness heuristic processes are engaged, people will use information from a variety of sources, such as interpersonal experiences, characteristics of formal rules and procedures and distribution of outcomes across group members, which was used to derive a general impression on how fairly he or she is being treated [22].

In the Internet era, the uncertainty of personal information collected, used and treated is pervasive. Consequently, users show concerns of information privacy, and then invoke protection intention to prevent the unauthorized intrusion [14]. They need the evidence to convince themselves to make the judgment as to whether to engage in online activities. The collectable evidence is bounded. Fairness heuristic theory [29] can be used to explain and anticipate which factors have stronger influences on users’ attitude and intention when faced with the potential risks of privacy intrusion. As while, the theory can be used to explain why some measures do not work as people’s expectation.

In traditional procedural justice research, reputation was mostly discussed as individual’s characteristics. In this paper, reputation is the attribute of a website. Users are more likely to trust firms with a good reputation [30]. Firms with high reputation would be deemed to maintain and fulfill their stated promise compared with the low reputation ones. Thibaut et al [31] first introduced the role of third party into the procedural justice. Privacy seals are regarded as one of the third party certifications that can impact users’ judgment on procedural justice. Privacy policy, as a type of normative standards published on website detailed how the firm will use users’ information and how they will treat them, belongs to the category of procedural justice [12]. Privacy policy which comply with industry self-regulation was regarded as one of the important variables that shape users’ justice perceptions [32]. Thus, online users make their judgment through the perceptions of the usefulness or fairness of privacy policy.

Extant research suggests that justice (or fairness) is regarded as an antecedent to trust and privacy concern [9, 33]. The impact of privacy concern on trust [34] and their respective impacts on transaction intention [1, 35] have been presented in previous research. The FHT suggests that fairness judgments are more strongly influenced by information that is available at an earlier stage of interaction with the authority than by information that becomes available later [10]. It is well known that reputation exist objectively before privacy policy and privacy seals utilized for some online firms, especially for the click and mortar ones. Notably, in some area, the well-know level of privacy seals is limited, thus firm’s reputation would have impact on the perceived of privacy policy (self) and privacy seals (third party). Moreover, when distributive justice information is ambiguous, users make their justice judgment depending more on the procedural justice information. Thus, we proposed the research model in Figure 1.
Privacy Concern, Trust and Transaction Intention

Trust and privacy concern have been found as the mediators of privacy policy, privacy seals [13], and reputation [36], and have an effect on transaction intention [37, 38]. Meanwhile, previous research had provided ample evidence that privacy concern has negative effect on trust [34, 39]. Thus, we proposed that:

H1: Trust has positive effect on transaction intention
H2a: Privacy concern has negative effect on trust
H2b: Privacy concern has negative effect on transaction intention

Privacy Policy

The published privacy policy may be seen as a signal about the trustworthiness of an online enterprise [40, 41], as well as convince users that their personal information will not be violated. At present, majority of the firms post privacy policies or statements regarding collection, usage and dissemination of personal information in order to enhance users’ online purchasing confidence [42-44]. Privacy policy is one of the most precious information sources available for users to judge whether or not their own privacy threshold correspond with the website [45]. Withal, it has been reported that privacy policy has negative effect on privacy concern [14] and users show more trust to a website with clear and comprehensive privacy policy [13, 40]. Therefore, we expect that:

H3a: Perceived of Privacy policy has negative effect on privacy concern
H3b: Perceived of Privacy policy has positive effect on trust

Privacy Seals

Privacy seals issued by independent third parties are utilized by online firms to show that a particular website can be trusted [20]. Much research provides empirical support that privacy seals promote feelings of security and trust [17, 18]. However, more recent findings since 2005 revealed that respondents do not fully understand the form or function of privacy seals and seldom see them as important to trust [19]. One of the reasons result in the disuse impression would be the unawareness of users on privacy seals. Means as users perceived privacy seals exist and understand what they do, the performance of privacy seals can be improved. Drawing on institution-based of trust building theory and consistent with Milne et al [46]’s view, we proposed that:

H4a: Perceived of Privacy seals have negative effect on privacy concern
H4b: Perceived of Privacy seals have positive effect on trust

Reputation

In the present study, reputation is conceptualized as the users’ perception of a website’s reputation, and was defined as the extent to which users believe an enterprise is honest and concerned about its customers [47]. Reputation can be an important antecedent of trust building for both direct marketers [47, 48] and web vendors [49], particularly in the preliminary trust phase [36]. For novice users, high reputation could help them to have more confidence to visit or purchase from the website. For veteran consumers, it can help boost their beliefs about vendor competence, benevolence and integrity [36]. Therefore, users would present more trust and lower concern on privacy to the well-known websites compared to the lesser-known ones.

Reputation is a strategic asset that takes time to build and requires significant investment [15]. Gefen et al and Milne et al [26, 46] suggest that firms’ reputation serves as a symbol to provide assurances that their information is safe and would be regarded as a substitute for reading privacy policy. Meanwhile, firms with higher reputation would engender more favorable perceptions from users with regard to privacy policy and privacy seals. Thus, we propose that:
H5a: Reputation has negative effect on privacy concern
H5b: Reputation has positive effect on trust
H5c: Reputation has positive effect on perceived of privacy policy
H5d: Reputation has positive effect on perceived of privacy seals

Method

Experimental Design

An experimental study was designed to test the research model and hypotheses. A scenario method was utilized to increase the realism of the experiment to the participants. Specifically, subjects were shown three mechanisms sequentially. First, participants were told the target website's name and then their perceived reputation of the website was measured. Depending on the treatment, they were informed whether this website has complete privacy policy and/or privacy seals. Subjects were able to read the content of privacy policy and click on the privacy seals link. To reflect a realistic online environment, four real-life Chinese B2C websites were chosen, including dangdang.com (DD), guopi.com (GP), amazon.cn (ZY), and m18.com (MY). Privacy policy and privacy seals were manipulated in 2×2 factorial design. A pre-test was performed to verify the level of privacy policy. The treatments with high level of privacy policy (PP=H) had complete and comprehensive contents while the website with low level of privacy policy (PP=L) did not have any privacy policy or statement. The website with the privacy seals (Chinese EC Seal) was regarded as high level of privacy seals (PS=H), while the website without the privacy seals were regarded as low level of privacy seals (PS=L). We arranged the same content of privacy policy and signature of privacy seals to each higher level of privacy policy and seals conditions. The detailed experimental design is shown in Table 1.

Measurements and Participant

We measured the independent variables, privacy policy and privacy seals in two steps. Firstly, we asked users' perception on the privacy policy which reflects a website's commitments on protection of user's personal information, including the collection, storage, usage, transformation, etc. Next, we assessed their perception on privacy seals, which is an approval programs belonging to the third party that will ensure proper treatment of users' personal information pertaining to the local legal rules and itself statement on policy. Secondly, questions were asked whether the website has privacy policy and/or privacy seals (yes or no; 1 or 0), the aim of which is to check out whether users know whether the website has privacy policy and/or privacy seals. Those two steps made up of weighted scored computation by multiplying the binary score in step two. The remaining of the measurement scales including reputation, privacy concern, trust and transaction intention were adapted from previous research with 7-point Likert scales. All Likert scales had the anchors 1=totally disagree and 7=totally agree in this study. Table 2 presents the source of each scale.

The actual experiment was conducted in a large Chinese university from September to December in 2008. A total of 472 students took part in the experiment, 379 completed and usable samples were received (Table 3), resulting in a response rate of 80.3%. Majority of the respondents' age is 21-22 years old (65.4%) with over 50% of the samples being male. The average Internet experiences are 5.01 years. Over 40% respondents have online purchasing experience. Nearly 40.9% of respondents have ever used credit card.
card to pay. The characteristics of them are certain to CNNIC [50] reports described that the student online users features

**Manipulation Checks**

The ANOVA analysis results of manipulation checks for privacy policy Weighted Mean for Low=3.39, Weighted Mean for High=6.66, T=-28.230, p<.01) and privacy seals Weighted Mean for Low=3.56, Weighted Mean for High=6.78, T=-28.459, p<.01), showed that the manipulations were successful. In addition, to ensure the selected websites’ reputation include both high and low level, ANOVA analysis see Table 4) was performed, the results showed that the websites of DD and ZY have higher level of reputation compared with the websites of GP and MY.

### Table 2 Measurement Scale Sources

<table>
<thead>
<tr>
<th>Scale</th>
<th>Item</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reputation</td>
<td>3</td>
<td>[23]</td>
</tr>
<tr>
<td>Trust</td>
<td>7</td>
<td>[51]</td>
</tr>
<tr>
<td>Privacy Concern</td>
<td>4</td>
<td>[37]</td>
</tr>
<tr>
<td>Transaction Intention</td>
<td>6</td>
<td>[51, 52]</td>
</tr>
<tr>
<td>Perceived of Privacy Policy</td>
<td>1</td>
<td>The privacy policy introduced why and how online firms would collect, use, store and treat users’ personal information, which is the consent to not use the information out of the initial stated usage. revised from [14]</td>
</tr>
<tr>
<td>Perceived of Privacy Seals</td>
<td>1</td>
<td>The privacy seals belong to a third party, which will monitor online firms’ usage of users’ information compliance with its privacy policy “revised from [53]”</td>
</tr>
</tbody>
</table>

### Table 3 Statistic Information of Samples (N=379)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Number</th>
<th>Proportion</th>
<th>Characteristics</th>
<th>Number</th>
<th>Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td>Online Purchase</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>204</td>
<td>53.8%</td>
<td>times</td>
<td>0</td>
<td>199</td>
</tr>
<tr>
<td>Female</td>
<td>175</td>
<td>46.2%</td>
<td></td>
<td>1-3</td>
<td>104</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-20</td>
<td>81</td>
<td>21.5%</td>
<td></td>
<td>4-10</td>
<td>44</td>
</tr>
<tr>
<td>21-22</td>
<td>247</td>
<td>65.4%</td>
<td></td>
<td>11+</td>
<td>26</td>
</tr>
<tr>
<td>23-25</td>
<td>50</td>
<td>13.2%</td>
<td></td>
<td>None</td>
<td>224</td>
</tr>
<tr>
<td>Internet Experience</td>
<td>Ave</td>
<td>5.01 Year</td>
<td></td>
<td>Ever</td>
<td>155</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 4 Manipulation Check – Reputation

<table>
<thead>
<tr>
<th>Website Comparison</th>
<th>Mean Differences</th>
<th>Std.</th>
<th>t-value</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>DD→ZY</td>
<td>-.18</td>
<td>.12</td>
<td>.477</td>
<td>DD’s reputation is same high with ZY</td>
</tr>
<tr>
<td>DD→GP</td>
<td>1.11</td>
<td>.11</td>
<td>.000</td>
<td>DD’s reputation is higher than GP</td>
</tr>
<tr>
<td>DD→MY</td>
<td>.99</td>
<td>.11</td>
<td>.000</td>
<td>DD’s reputation is higher than MY</td>
</tr>
<tr>
<td>ZY→GP</td>
<td>1.30</td>
<td>.11</td>
<td>.000</td>
<td>ZY’s reputation is higher than GP</td>
</tr>
<tr>
<td>ZY→MY</td>
<td>1.17</td>
<td>.11</td>
<td>.000</td>
<td>ZY’s reputation is higher than MY</td>
</tr>
<tr>
<td>GP→MY</td>
<td>-.13</td>
<td>.11</td>
<td>.719</td>
<td>GP’s reputation is same low with MY</td>
</tr>
</tbody>
</table>

### Results

Partial Least Squares (PLS) as implemented in SmartPLS-2.0 [54] and SPSS 11.5 was utilized to conduct the data analysis.

**Measurement Model**

In order to examine the convergent validity and discriminant validity of the instrument, we tested the measurement model. Three tests were performed to determine the convergent validity of measured reflective constructs in a single instrument, they are items’ reliability, constructs’ composite reliability and average variance extracted by constructs [53]. The item loadings should exceed 0.707 and the average variance extracted [55] of the construct should exceed 0.50. The composite reliability score should exceeded 0.7 [53]. The Cronbach's alphas were higher than 0.7. The square root of the variance (diagonal) shared between the constructs and their measures are greater than the correlations (non-diagonal) between the constructs and any other constructs, which verified the different constructs are distinct. Thus, the measurement of each construct was verified valid and reliable (Table 5).

**Structural Model**
A bootstrapping technique was used to estimate path coefficients significance. The structural model explained 30.3% of the variance in transaction intention. Trust has significant positive effect on transaction intention. Privacy concern has significant negative effect on trust contrary to the transaction intention. Thus, H1 and 2a were supported, but H2b was not significant. The significant positive effect of privacy policy on trust was verified, thus H3b was supported. However, the effects of privacy policy and privacy seals on privacy concern and the effect of privacy seals on trust were not significantly, hence H3a, 4a, and 4b were not supported. As hypothesized, reputation has significant positive effect on trust, privacy policy and privacy seals but negative effect on privacy concern, thus H5a, 5b, 5c, 5d were supported. The data analysis results were presented in Table 6 and the revised model was shown in Figure 2.

Table 5 Descriptive Statistics of Constructs

<table>
<thead>
<tr>
<th>Construct</th>
<th>M</th>
<th>S.D.</th>
<th>CR 1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Reputation</td>
<td>4.21</td>
<td>0.97</td>
<td>0.85</td>
<td>0.81</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Privacy Concern</td>
<td>5.29</td>
<td>1.09</td>
<td>0.91</td>
<td>-0.24</td>
<td>0.85</td>
<td></td>
</tr>
<tr>
<td>3. Trust</td>
<td>4.36</td>
<td>0.76</td>
<td>0.89</td>
<td>0.43</td>
<td>-0.20</td>
<td>0.73</td>
</tr>
<tr>
<td>4. Transaction Intention</td>
<td>3.68</td>
<td>1.06</td>
<td>0.92</td>
<td>0.45</td>
<td>-0.18</td>
<td>0.54</td>
</tr>
</tbody>
</table>

Note: Shaded elements along the diagonal represent the square root of the variance shared between the constructs and their measures.

Table 6 Results of Hypotheses Testing

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Path Estimate</th>
<th>t-value</th>
<th>Supported</th>
<th>Hypothesis</th>
<th>Path Estimate</th>
<th>t-value</th>
<th>Supported</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1: T→TI</td>
<td>0.531**</td>
<td>12.827</td>
<td>YES</td>
<td>H4b: PS→T</td>
<td>0.040</td>
<td>0.770</td>
<td>NO</td>
</tr>
<tr>
<td>H2a: PC→T</td>
<td>-0.106*</td>
<td>1.966</td>
<td>YES</td>
<td>H5a: RE→PC</td>
<td>-0.244**</td>
<td>3.916</td>
<td>YES</td>
</tr>
<tr>
<td>H2b: PC→TI</td>
<td>-0.127</td>
<td>1.140</td>
<td>NO</td>
<td>H5b: RE→T</td>
<td>0.430**</td>
<td>6.504</td>
<td>YES</td>
</tr>
<tr>
<td>H3a: PP→PC</td>
<td>0.014</td>
<td>0.240</td>
<td>NO</td>
<td>H5c: RE→PP</td>
<td>0.199**</td>
<td>3.730</td>
<td>YES</td>
</tr>
<tr>
<td>H3b: PP→T</td>
<td>0.148*</td>
<td>2.845</td>
<td>YES</td>
<td>H5d: RE→PS</td>
<td>0.126*</td>
<td>2.058</td>
<td>YES</td>
</tr>
<tr>
<td>H4a: PS→PC</td>
<td>0.036</td>
<td>0.565</td>
<td>NO</td>
<td></td>
<td>R2</td>
<td>30.3%</td>
<td></td>
</tr>
</tbody>
</table>

*p<0.05, **p<0.01

Discussion, Implications and Limitations

Our findings provide substantial empirical support that privacy concern has negative effect on trust, consistent with previous research, such as [46], but its influence on transaction intention is not significant, which is inconsistent with [37]'s findings. Trust has significant positive effect on transaction intention. A plausible explanation is that according to Wirtz et al [9], privacy concern mediates the relationship between antecedental justice dimensions and prevention-focused behaviors. Correspondingly, trust mediates the relationship between antecedental justice dimensions and promotion-focused behaviors. The behavior intention to transact belongs to one of the promotion-focused behaviors.

Consistent with prior research, such as [13, 40], this study has verified the positive effect of perceived of privacy policy on trust. Conversely, its negative effect on privacy concern was not significant. The effects of perceived of privacy seals on both privacy concern and trust were not significant. On the contrary, both the negative
effect of reputation on privacy concern and its positive effect on trust were confirmed significantly. Reputation has significant positive effect on perceived of privacy policy and privacy seals, which means that users’ perception on privacy policy and seals would be influenced by the website reputation. One of our most significant findings is that reputation, compared with the other two antecedents - privacy policy and privacy seals, has more significant positive effect on privacy concern and trust. These outcomes indicate that when reputation exists, privacy policy and privacy seals do not play as important role as reputation does. Noticeable, this finding was gotten in the condition of the well-know level of privacy seals is limited. Thus, in B2C e-commerce environment, the reputation of website would be more meaningful to decrease privacy concern, increase trust and further incentivize users’ intention to transact especially when the privacy policy and seals are not stronger enough.

Furthermore, our findings could help explain the emerging contradictory results on the impact of privacy seals because prior research did not consider the influences of reputation on the role of privacy seals. Without considering the primary effect of reputation on perceived of privacy seals, the declaration on whether the privacy seals are useful or not is indiscriminate. Our study overcomes this limitation as it examined three mechanisms simultaneously. The aim of the firms post privacy seals over the website is to enhance users’ trust and eliminate their concern on privacy, while, users’ feedbacks are not consistent with firms’ expectations. These findings indicate that the current privacy seals, as one kind of third party certification, have not strong enough to persuade users to trust and decrease concern compared with websites’ reputation.

It is worth mentioning that majority of the extant Fairness Heuristic Theory research has explored the primacy effect of distributive justice information and procedural justice information on judgment when their sequence were presented successively. This study complements that the primacy effect exist among three procedural justice information as well.

Implications, Limitations and Future Research
Our results present two direct suggests to online B2C firms. Firstly, establishing higher reputation for their website would be more effective than publishing privacy policy or post third-party certification- privacy seals, especially as the privacy policy and seals are general not but specialties at this time. Secondly, the form and content of privacy policy need to be enhanced to show the firm’s idiographic property. Objectively, as third-party certification, privacy seals should play an independent role, but the outcomes verified they are influenced by website reputation, means which do not bear the burden. Of course, the third party company, industry and government should pay more efforts to update and revised the privacy seals (i.e. the appearance, famous level, disseminate) or create new way to provide the third party monitor.

This paper provided some new insights to explain users’ perception when the distributive information (transaction outcomes) is uncertain. It elucidates the influence of the three mechanisms on privacy concern, trust and behavior intention based on fairness heuristic theory. Considering the effects of the three procedural justice information together help explain the effect of privacy policy and seals on privacy concern and trust when the websites’ reputation level is fixed. This finding provides more concrete guidance for practitioners compared to past research. Meanwhile, the use of FHT in individual information privacy research area provide a new perspective for future research, for instance, scholars could compare between procedural and distributive (i.e., reward, monetary incentives) information on privacy concern, trust and behavior intention, similar to what Lind et al [22] have done in organizational behavior.

While our results offer substantial managerial and theoretical contributions, there are several limitations in this study that should be acknowledged. The generalization of the outcomes is limited to only the experiment study characteristics but also the type of websites selected and university students targeted. Therefore, future studies could overcome these shortcomings with a large scale survey, and examining different types of websites and using adult online users as participants.

Conclusions
Drawing on trust-building model and fairness heuristic theory, this paper investigated the effects of three factors namely, reputation, privacy policy and privacy seals on privacy concern, trust and transaction intention. Overall, the findings provide implications for online marketers that the importance of reputation in reducing privacy concern and trust building. In particular, attention should be paid to the importance of the primacy effect of reputation and its influences on users’ perception of two types of procedural justice information. Future work can perform more investigations on how procedural and distributive justice information may impact on privacy concern, trust and behavior intention in order to uncover the most essential factors to incentivize users’ online participation.
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[24] Luo, X.M., Trust Production and Privacy...


A PROPOSED CROSS PLATFORM PRIVACY AND SECURITY FRAMEWORK FOR SUPPLY CHAIN INFORMATION SHARING

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Abstract
Information sharing has become eminent to supply chain management, as it allows supply chain partners to collaborate more closely. However, currently supply chain partners are often on disjoint information platforms, which prevent them from effectively sharing critical supply chain information. One of the main barriers of information sharing is revealing confidential information to unintended parties and thus the disclosure of privacy. Therefore the information sharing needs and characteristics of a supply chain has been analyzed and subsequently a cross platform privacy and security framework to allow safe information sharing has been proposed.

Introduction
Supply chain management (SCM) has become a much discussed topic and as believed by many, business does not compete on a product level any more, but business competes and differentiates on a supply chain level [1]. It is inevitable that information sharing is needed for businesses to cooperate and many argue that information sharing is a key ingredient for a successful SCM [2]. The advent of RFID technology takes the information sharing detail level to an even higher level, as it can provide information about the physical product movement on an item level. Basically, RFID allows supply chain partners to integrate the physical flow with the information flow.

There are currently many service platforms to facilitate information sharing between supply chain partners. However, sharing information between these service platforms is not a common practice. There is therefore an urgent need to share information across these disjoined service platforms, as the number of service platforms expand. Privacy and security in its broadest sense is a barrier for companies to share information [3] [4]. In general, the privacy and security are in place for individual service platforms, but there lacks a privacy and security framework for sharing information across platforms. Thus in order to facilitate cross platform information sharing, a privacy and security framework needs to be developed first to lower the barrier of information sharing between supply chain partners.

The objective of this study is to develop a privacy and security framework for cross platform information sharing for supply chain partners. In order to satisfy the supply chain needs, we analyze the information sharing requirements based on the following areas:

- Supply chain information sharing issues and concerns on security and current measures typically in use, and,
- Typical scenarios of supply chain management practices in the context of privacy and security.

The paper is organized as follows: In the next section we provide an overview of information sharing across supply chains, subsequently we present the findings of our case study. Based on the case study, we propose a cross platform privacy and security framework to safeguard confidential information sharing. Moreover, the proposed platform is illustrated by a typical information sharing scenario. Finally, we conclude and give some remarks on our future work.

Literature review
There are currently many platforms available to share supply chain information. Many of the existing platforms focus on parts of information sharing, e.g. EPCglobal, focuses on RFID data and Dell’s VMI system focuses on suppliers. However, in order to gain visibility, supply chains partners may need information that reach beyond RFID data and beyond only the suppliers segment. [5][6] for instance described that inventory information sharing across the entire supply chain can lessen the order placing distortion, also known as the Forrester effect and the Bullwhip effect respectively. Therefore supply chains are in need for a platform and cross platform to share information among its supply chain partners.

Information sharing across enterprise boundaries in supply chains involves many issues. In a generic supply chain, there are raw material/parts/semi-finished goods, suppliers, logistics services provider, manufacturers, wholesalers, retailers [7]. Wholesalers or retailers
process purchase orders to suppliers, and logistics services providers will deliver the requested materials to manufacturers and they will deliver the finished goods to wholesalers and then retailers. Back and forth information flow across these parties could sometimes happen on more than one supply chains. For example, a dye manufacturer order raw materials from a vendor, the information flow here impact both a garment brand store’s supply chain as well as a painting oil brand store’s supply chain. Such multi-parties and multi-supply chain scenario makes the information sharing more complicated, and the privacy issues arises here [8].

Other privacy concerns include specific products’ volume, relationship, and contracts, price, manufacturer’s customer contacts; the nature of relationship can be viewed as vendor-manufacturer [6], upstream-downstream partners, distribution center-retailer (warehouse charges), and retailer-consumer (CRM) [9][10]. Most privacy-protecting schemes for RFID have focused on the consumer privacy problems. Industrial privacy, i.e. data secrecy and business confidentiality, is important too, but less frequently considered [11].

As aforementioned, supply chains can exist of many different supply chain partners. Usually supply chain partnership is characterized as a buyer-supplier relationship [12]. The supply chain partnership can vary from being fixed e.g. by contracts [13] to being dynamic e.g. ad hoc collaboration [14]. Fixed supply chain partnership has the characteristic of being lasting in which the relationship is clearly defined. Dynamic supply chain partnership on the other hand is ad hoc and can change from transaction to transaction. Therefore, dynamic partnership brings a new element to privacy and security in a supply chain context where it has to adapt to both the established and changing supply chain partnerships.

Methodology
The main objective of this study is to create a privacy and security cross platform information sharing framework for supply chains. However, the current literature lacks examples of how information is shared among supply chain partners and platform. Therefore a case study is used as an illustration of a typical supply chain. This research methodology is well suited for this problem, as it can bring out the problems that arise during information sharing. Moreover, case studies can provide information about a given context and eventually deduce theories from it [15].

Case study
For this study we studied a supply chain for power tools, e.g. power drills. The supply chain consists of a supplier, a manufacturer, a trader, and a retailer. The supplier and the manufacturer are both located in China, where the supplier provides the parts and accessories and where the manufacturer assembles the power tools. A trader, located in Hong Kong, functions as a middle man between the manufacturer and retailer to source, to WPK (warehousing packing kitting), and to ship the products to the retailer. Obviously, the trader does not actually perform the all the activities, e.g. WPK and the shipping. The trader outsources these activities to a 3PL and a carrier respectively. Finally, the retailer, located in the USA, owns several stores and DCs in order to sell the power tools to the consumers.

The power tools supply chain partners are distributed among three platforms, with the manufacturer, trader, DC, and retailer as the main information sharing partners (see Figure 2).

The manufacturer is on a platform called the “manufacturer platform” and on this platform the supplier can share information with the manufacturer, e.g. part delivery tracking information. Therefore the manufacturer can be considered as the data owner and where the supplier only provides information to the manufacturer.

Figure 1. Case - supply chain setting
Furthermore, the trader is on a platform called the “trader platform” and where the 3PL and carrier can share information with the trader, e.g. shipping tracking. Trucker A and warehouse X in their turn can share information with the 3PL, e.g. warehouse receipt confirmation, who subsequently can pass

![Figure 2. Case - Supply chain information sharing infrastructure](image)

the data to the trader. Therefore the trader can be considered as the data owner and where the 3PL, carrier, trucker A, and warehouse X only provides information to the trader.

Finally, the DC and the retailer are on the “retailer platform”. Store, trucker B and warehouse Y can provide information to the DC and retailer, e.g. inventory status. Therefore the Retailer and DC can be considered as the data owner and where the store, trucker B, and warehouse Y only provides information to the retailer.

Currently, the information sharing between platforms are performed manually, e.g. by email, phone, and fax. The data that needs to be shared is in general already detailed by means of contracts. The depicted supply chain (Figure 2) shows that the supply chain partners already share information within their supply chain segment (platform), but cross platform information sharing is less well established. The information sharing between data owners, and in this case the major supply chain partners, are generally predetermined by contracts, and in some cases by ad hoc project, and can usually be obtained manually. However, there are cases, where for instance warehouse X needs information of the DC. In such case, this information sharing might not be covered by contracts, as they might not even be aware that they are within the same supply chain, and the trial to obtain the particular information can become a dreadful process. First warehouse X needs to contact the 3PL, who needs to contact the trader and who in its turn, contacts the DC for the particular information. Subsequently, the

Cross platform privacy and security framework

We propose the following cross platform privacy and security framework (CPPF), in order to allow supply chain partners seamlessly share information across platforms. The proposed CPPF must have the following in place:

Cross platform environment – There exists a technology that allows us to single uniquely identify (SUI) each item, e.g. similar to EPC code for RFID information and MAC address for computer network cards. Moreover, there exist some form of 3rd party e-service [16] that can discover per SUI request of all platforms that contain information about the SUI. For now we call this service the SUI discovery service (SUI-DS). Some Internet-aware addressing form will be provided as a pointer to the platform containing the SUI data. Let us take the Object Name Service (ONS) of EPCglobal as an example of how this is performed for RFID data [17].

Information portal – Each portal knows three roles 1) Sole Operator (SO), which is the platform itself, e.g. manufacturer platform as described by the aforementioned case study 2) Data Owner (DO), the supply chain partner who owns the data, e.g. manufacturer as described in the aforementioned case study, and 3) 3rd Party
Contributor (3PC), the supply chain partners who act as data providers, e.g. the supplier in the manufacturer platform as described in the aforementioned case study.

**Data dimension** – For the CPPF we categorize the data by their data dimensions, which include location, sensitivity, and ownership. Data can be stored in different locations, e.g. local database, intranet, and Internet, and we assume that information stored on the platform are considered as information that can be shared with selected supply chain partners. Data sensitivity implies that data can be classified according to different sensitivity levels, e.g. high, medium, and low. Where high sensitivity contains item specific data that can reveal “trade secrets” and these data should only be shared with close supply chain partners. While low sensitive data contains generic data and can be shared with less close supply chain partners. Finally, data ownership in this framework includes the roles as described above, namely data owner and third party. The reader is referred to [18][19][20] for further readings about the data dimensions.

**Privacy preference** – This is the preference of the requested information provider in terms of privacy protection when sharing information [21], meaning what information to share with what type of relationship, e.g. sharing of high sensitive data with “close” supply chain partners and sharing of low sensitive data with indirect supply chain partners. The privacy preference concept is initially developed to collect personal information of any user [22] and in this project we extend the concept to a B2B context. Thus each supply chain partner can specify sharing information preference, for different types of supply chain partners. The data sharing is determined based on the privacy preference at the time of data request and therefore can support both fixed and dynamic relationships [21].

**Security Scheme** – One party is the receiver (of information) and the other party is the sender. The ‘send’ and ‘receive’ can actually be implemented by ‘grant’ and ‘access’ (the sender granting the access to the receiver, and the receiver accessing the information intended to be shared by the sender). The general practices, such as simple rights as read-only, write-only or read-and-write, are to be adopted along with other more fine grained access control at such the best visibility can be obtained with the maximum protection of privacy.

The general information sharing follows these similar steps:

1. **Data request of a DO** – A request from a DO, the receiver for information is posted to an information portal.
2. **SUI-DS determines data location** – The information portal queries the SUI-DS, and the data location pointers are returned.
3. **SOs matches privacy preference** – The information requesting DO submits its privacy preference, and the information sender DO does the same. Based on an authorization scheme, the characteristics of information sharing are determined.
4. **Exchange of information** – The receiver obtains the information as intended by both parties with privacy and security ensured.

**Information sharing across platforms scenario**

We will discuss one typical scenario to better explain and illustrate CPPF. In this scenario we portray that the supply chain partners are in a cross platform environment as described by CPPF, trucker B of the retailer platform wants to obtain information of the carrier of the trader platform, e.g. delivery note (DN), as shown in Figure 3 with the thicker lines depicting the information sharing path. Previously, trucker B had to call or fax the trading company to obtain the DN, who in its turn had to obtain it from the carrier operator. However, with CPPF trucker B can access the DN via existing
Table 1: Data sensitivity

<table>
<thead>
<tr>
<th>Vendor</th>
<th>Transparent</th>
<th>Translucent</th>
<th>Opaque</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer XYZ</td>
<td>123 street name</td>
<td>China</td>
<td>01 January 2010</td>
</tr>
<tr>
<td>China</td>
<td>01 January 2010</td>
<td>9 cartons</td>
<td>-</td>
</tr>
<tr>
<td>ETA</td>
<td>01 January 2010</td>
<td>100 – 200 kg</td>
<td>-</td>
</tr>
<tr>
<td>Quantity</td>
<td>Product A – 50 pieces in 5 cartons</td>
<td>Product B – 80 pieces in 4 cartons</td>
<td>-</td>
</tr>
<tr>
<td>Gross weight</td>
<td>Product A – 100kg</td>
<td>Product B – 80kg</td>
<td>-</td>
</tr>
<tr>
<td>Price</td>
<td>Product A - $25/piece</td>
<td>Product B - $10/piece</td>
<td>$10 - $30 per piece</td>
</tr>
</tbody>
</table>

1. **Data request of a DO** – Trucker B is a 3PC and in CPPF the SOs only are aware of the DOs, as described by the information portal of CPPF. Therefore trucker B sends out a data request to the DC, as the DC is the data owner. The DC in its turn sends out a data request of the specific DN to the retailer platform.

2. **SUI-DS determines data location** – Thus the DC queries the retailer platform for the specific DN on behalf of trucker B. The retailer platform subsequently queries the SUI-DS, and the SUI-DS web service returns a pointer with the platform (trader platform) containing the specific DN.

3. **SOs matches privacy preference** – The DO requester (DC) submits its privacy preference and the DO provider (trader) submits its privacy preference. In our scenario the privacy preference is a fixed relationship, by means of a contract, and the relationship predetermined a security scheme that only a translucent view, see below for an explanation of the translucent view, of DN should be shared to the DC.

4. **Exchange of information** – Since the privacy preference allows a translucent view of the DN to be shared with the DC, the DC receives the translucent view DN information from the trader platform via its own retailer platform and passes the DN to trucker B.

In our scenario we consider that the DN data is stored on the platform and therefore can be shared with supply chain partners. Moreover, we propose three views of the DN (based on the data sensitivity) in our security scheme, namely transparent, translucent, and opaque [23]. In the current practice we usually either completely share the data (transparent) or not share the data at all (opaque). However, this might not be adequate to facilitate the needs of the supply chain and we therefore propose a third view, namely translucent. In the translucent view supply chain partners can share only selected/aggregated data. An illustrative simple version of the DN is shown in Table 1.

The translucent view provides trucker B with adequate information to anticipate and to prepare the transportation of the products, without disclosing sensitive information of the trading company (e.g. manufacturer name and price). With this view we can create a mutual benefit, where trucker B can plan their operations in advance and where the trading company does not have to worry about disclosing sensitive information.

**Concluding remarks**

In order to facilitate information sharing across entire supply chains, a solution is needed to connect the disjoined platforms. This study addressed the privacy and security issues of this solution. We have proposed a novel information sharing platform to safeguard confidential information shared across platforms. Literature has been reviewed and a case study has been utilized to portray a typical supply chain set up. The framework is designed in such a way that both fixed and dynamic partnership can be facilitated. Moreover, a scenario is developed to illustrate the framework. We believe that this framework can contribute to the development of solutions that can connect disjoined platforms for supply chain integration with proper protection for business confidentiality.

This study is an initial step that allows us to anticipate how cross platform privacy and security can be implemented and what issues it brings. Although CPPF has been demonstrated by the aforementioned scenario, it still lacks an actual implementation. Moreover, CPPF is based on a supply chain configuration and it therefore might not be applicable to all supply chains. However, CPPF is designed to handle both fixed and dynamic partnership and can therefore support many different supply chain partnerships. Moreover, there are still areas in the study that require further investigation to establish a holistic foundation for the privacy and security issues and concerns in CPPF. The following potential further investigation...
can be the suggested: Relation based access control method, the data characteristic models, and the privacy preference scheme.

CPPF is actually a part of our study to develop web services methodologies that allow information sharing across platforms. The study will continue to advance and in continuation a prototype will be developed. Technologies such as P3P (Platform for Enterprise Privacy Practices), EPAL (Enterprise Privacy Authorization Language), ISTPA (Internet Security & Trust Privacy Alliance), SAML (Security Assertion Markup Language), and XACML (eXtensible Access Control Markup Language) are currently being evaluated for implementation of the prototype in our study.

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References


WHY DO BLOGGERS SHARE WITH STRANGERS?

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Extended Abstract

Web 2.0 applications are becoming more and more popular at a surprising speed since their emergence. Among them, Weblog, or called blog, is a web-based application that uses a variety of tools to facilitate self-description and interaction with others. People use blogs for various reasons: about 70\% of bloggers use it as an on-line diary [4]. Unlike in the old days peoples lock their diaries secretly from others, including their family and close friends, today many are willing to share their life stories, sometimes are very sensitive, to strangers. There have been numerous cases where an individual was fired from his/her job or arrested after confessing to commit a crime on their blog [3] [9], so as many individuals post information and photos of their companies in their blogs without considering the possible repercussion in case their employers can view them from the cyber spaces [7].

In this research, we aim to identify important factors that influence bloggers’ information privacy concerns. Many research significantly contributing to the understanding on the issue that providing information privacy protection are believed to be a critical factor to the success of electronic commerce [1]. However, little research was done to explore the privacy concerns in the context of Web 2.0 applications. In fact, it is not appropriate to directly apply the findings on e-commerce to the use of blogs since blogs and e-commerce have fundamental differences in term of users’ motivations. Moreover, in blog, the information is provided in the combination of both passive and active manner. That is, on one hand, many private information, such as address or phone number, oftentimes are reluctant to be given out, are requested when a blogger registers as a user. On the other hand, bloggers voluntarily provide substantive information on habit, family, preference, and many others, to the readers. Therefore, the privacy model is different from what have been studied for E-Commerce, and subsequently deserve further examination. Our focus here is on the diary-like blogs and on bloggers’ active sharing activities.

This study focuses on two folds. First, Blogs have a special social relevance because they allow their bloggers to create and maintain a network of weak social ties. Rooted on social network theory [2], this study captures interpersonal factors from a perspective of “ties”. Relations between bloggers and readers are perceived as either strong ties or weak ties. In this perspective, information redundancy and relational embeddedness are two key factors to distinct the strength of a tie. We adopt the multi-dimensional construct IUIPC (Internet Users’ Information Privacy Concerns) [8], which consists three dimensions, i.e. collection, control and awareness, to measure information privacy concerns.

Second, we look into the reason why bloggers tend to share their private information with unknown audience. We borrow the concepts of self-awareness in psychology and test its role in mediating the effects of tie strength on bloggers’ information privacy concerns. Prior research has shown that the Internet users tend to have the reduced public self-awareness along with the aroused private self-awareness [5] [6]. The concepts of tie strength and private/ public self-awareness are related with the hope to examine bloggers’ behind psychological reasons for sharing personal information willingly and actively in their blogs.

A pilot study will be conducted to assess the measurement development. We will then seek for a partnership with an existing blog website for data collection to promote an online survey. We will try to minimize the common method bias by using both procedural and statistical remedies [10]. It is hoped that this study can have early contribution to the discussion on information privacy issue of Web 2.0 applications. We expect to identify important determinants that impact bloggers’ information privacy concerns and also find out why these factors have impacts. It is hoped that the result will generate practically useful implications and contribute to business world as privacy concern is a potential barrier for users’ participations in web 2.0 applications. Hopefully, this study could provide vendors a better understanding of the customers’ demands.

Keywords: Information Privacy Concerns, web 2.0, strength of ties

References


IT OUTSOURCING SUCCESS IN HEALTHCARE INDUSTRY: BUILD YOUR CAPABILITIES ON MULTIPLE FRONTS WITHIN THE INSTITUTIONAL FRAMEWORK

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Abstract
In this manuscript we report the findings from an in-depth case study about the factors that determine IT outsourcing success in the healthcare industry. Healthcare organizations in Taiwan are faced with increasing institutional pressures in the forms of hospital accreditation systems and national insurance program requirements. We found that organizations appeared to have adopted similar outsourcing practices under institutional pressures. However, whether or not an organization could successfully implement an outsourcing decision depends on the organization’s IT capabilities, governance capabilities, and capabilities to manage its relationship with the vendor. Research implications of these results are discussed.

Keywords: IT outsourcing, healthcare industry, institutional pressures, capabilities

Introduction
The phenomenon of IT outsourcing has attracted wide research attention in the past two decades [1] [2] [3] [4]. Previous researchers have applied various theories to explain why organizations outsource their IT functions, what IT functions tend to be contracted out, how outsourcing decisions are implemented, and how outsourcing choices affect business processes and outcomes [1]. Despite the abundant literature, the previous research on IT outsourcing has far from been conclusive. This is partly because the phenomenon itself is continually evolving and new issues keep coming up. For example, while outsourcing started as a cost-reduction tool, it now has evolved into an important component of a firm’s overall business strategy [5]. Previous research has been limited also because relatively fewer studies have examined what happen after the outsourcing deal is arranged. In their extensive review, Dibbern and colleagues [1] suggested that a major gap in the previous research is the relative lack of attention to the relationship between the client and the vendor. Another gap is the lack of research on the effects of industry- and country-level factors on IT outsourcing patterns and outcomes.

To address these gaps, this study explores the relationship between the client and the vendor in IT outsourcing implementation. Using in-depth qualitative data collected from two hospitals in Taiwan, we intend to answer two questions:
(1) In the heavily regulated healthcare industry, how do institutional pressures in the forms of laws, government regulations, and professional standards influence companies’ IT outsourcing decisions?
(2) What types of capabilities does a healthcare organization need to have in order to ensure successful outsourcing implementation?

We draw upon the discussions about organizational capabilities and client-vendor relationships [4] [6] [7] [8] as well as the case findings to develop a capability-based model of outsourcing success. We argue that three types of organizational capabilities (IT capabilities, governance capabilities, and relationship management capabilities) work together to contribute to outsourcing success. That is, success depends on the organization’s abilities to understand the strategic implications of IT functions, select qualified vendors, monitor vendor behavior through well-designed outsourcing contracts, and maintain smooth work relationships with the vendor(s). We also argue that institutional forces in the healthcare industry may lead to increasingly homogenous outsourcing decisions (a result of the legitimacy-seeking and imitation processes), but whether or not those outsourcing decisions can be successfully implemented largely depends on the extent to which organizations possess the above-mentioned key capabilities.

While most previous studies have focused on how the characteristics of an IT activity may influence outsourcing mode and degree, we suggest that the capabilities of the organization that carry out those IT activities are equally important for understanding the processes and results of IT outsourcing.

The rest of this paper is organized as follows. The next section provides a brief review of the relevant literature. We then describe the empirical
setting – Taiwan’s healthcare industry, with a focus on hospital information system (HIS) development and outsourcing trends. This is followed by a description of the cases used in the study. Critical findings emerging from our analysis are reported. The last section is devoted to the implications of the findings.

Theoretical Background

Chaudhury, Nam and Roa [9] defined IT outsourcing as “the contracting of various information systems’ sub-functions by user firms to outside information systems vendors.” Dibbern et al. [1] proposed a two-stage model of IS outsourcing in which the decision process (Phase 1) is related to three issues – why, what, and which to outsource, and the implementation stage (Phase 2) is related to the how issues and outcomes of outsourcing. Early studies placed an emphasis on the phase one issues, particularly the determinants of the outsourcing choice (“make or buy”) and the degree of outsourcing (total vs. selective). This stream of research has been greatly influenced by transaction cost economics (TCE) [10] and, to a lesser degree, by institutional theory [11] [12]. Recent studies, in comparison, have paid more attention to the phase two issues, e.g., implementation processes of outsourcing decisions. Rather than focusing on the IT- and institutional-level factors, this stream of research suggests that implementation effectiveness is largely a function of organizational and interorganizational factors, including the organization’s resource base/capabilities and the relationship between the client and the vendor. The predominant theoretical perspectives in this line of research include the resource-based view of the firm (RBV) [2] [13] [14] and various relationship theories emphasizing cooperation, communication, and trust [15] [16]. In the following paragraphs, we will review the main arguments derived from these theories and discuss the gaps that have not yet been addressed in previous outsourcing research.

Transaction cost economics (TCE)

Assuming that the parties to an economic transaction are both boundedly rational and opportunistic, TCE proponents argue that for certain types of transactions, the market mechanism may fail and organizations will choose to “make” certain products rather than “buying” them on the free market. Transaction costs refer to the effort, time, and costs incurred in searching, creating, negotiating, monitoring, and enforcing a contract between buyers and suppliers [17]. Three key features of a transaction, asset specificity, uncertainty, and frequency, are associated with high transaction costs and hence making it impossible for transaction parties to reach a “complete contract.” Applied to the outsourcing context, TCE predicts that IT functions / activities highly specific to the firm’s business operations will be less likely to be outsourced to external vendors because high asset specificity of these activities leads to high transaction costs, making it difficult to protect the client’s interests with effective contractual terms and conditions [18]. Similarly, organizations are less likely to outsource IT activities characterized by technological, measurement, and demand uncertainty [19] [20]. Finally, TCE suggests that organizations are less likely to outsource IT activities frequently taking place in daily operation in order to avoid contracting risks. Overall, TCE presents a set of IT function-level factors that determine the organization’s choice between outsourcing and in-house IT development.

Institutional theory

Institutional theory focuses on explaining the homogeneity of organizational forms and practices in organizational fields [12]. Different from the theoretical approaches emphasizing organizational-level and IT-function-level determinants of outsourcing, institutional theory suggests that forces originating from the organization’s external business and institutional environments will influence the ongoing patterns of organizational activities. Such external constituents as regulatory agencies, the media, trade associations and other stakeholders place pressures on the organizations to adopt “legitimate” practices. Since organizations care about their image and reputation, they will tend to follow peer organizations’ successful practices or adopt management methods appealing to outside stakeholders. Over time, organizations operated in the same field (e.g., the same industry) may become increasingly similar to each other in their structures and strategies. Relatively few studies have explored the effect of institutional forces on outsourcing, but it has been widely acknowledged that Kodak’s 1989 decision to outsource its IT function “legitimated” outsourcing as an acceptable, even fashionable, practice [1]. In their study on IS outsourcing in the U.S. banking industry, Ang and Cummings [21] found mixed support for institutional theory. Consistent with institutional theory, they found that federal regulators exerted substantial influence on bank practices and operations. Since the regulators conduct periodic examinations to ensure that banks conform to rules, e.g., rules about the bi-annual audit of banks’ electronic data processing practices, banks respond to these institutional pressures by adopting similar IS practices. When institutional pressures came from peer banks, however, banks responded less to
These pressures but more to internal transaction cost concerns. These authors also found that large banks were less subject to institutional pressures than were small banks. These findings indicate the necessity to consider the external/institutional factors and the internal/organizational factors simultaneously, which may be particularly relevant in highly regulated industries.

**Resources and capabilities**

The RBV considers an organization as a collection of resources or capabilities [2]. Barney [13] suggested that persistent superior performance can be attributed to the possession of valuable and rare resources that are difficult to imitate and for which there are no substitutes. Whereas resources could include both tangible and intangible assets, capabilities are defined as the capacity to deploy resources using organizational processes [22]. In the outsourcing context, researchers have proposed different typologies of organizational capabilities and linked them to outsourcing success. For example, Feeny and Willcocks [23, 24] identified eight core IS capabilities in four areas: business and IT vision (ability to integrate IT with business strategy), IT development skills, delivery of IS services (capabilities to implement information systems and to deal with vendors/customers) and IS leadership and informed buying. Informed buying, essentially, refers to capabilities to design and manage a contract and create a shared knowledge base for managing outsourcing relationships among vendors, users, and IS staff members. In other words, effective outsourcing implementation also depends on governance capabilities, or capabilities to control the contracting process and to monitor vendor behavior [8], and relationship management capabilities that enable the client to see beyond the contractual conditions and to create a positive dynamic cooperative relationship with the vendor in the post-contract process.

**Client-vendor relationship studies**

Various models regarding the client-vendor relationship dynamics have been proposed. These models share a common argument, that is, legal outsourcing contracts are imperfect and the ultimate success depends on the abilities of the client and the vendor to develop a flexible, trust-based long-term relationship [7]. Many researchers have conceptualized the key elements of the client-vendor relationship from a sociopsychological perspective. For example, Lee and Kim [7] proposed a model based on behavioral-attitudinal theory in which two sets of relationship-specific variables affect outsourcing success. Three behavioral variables (shared knowledge, mutual dependency, and organizational linkage) are proposed to influence outsourcing success through three psychological variables (perceived mutual benefits, perceived commitment, and perceived predisposition). Essentially, their model suggests that sharing behaviors displayed by the client and the vendor facilitate the formation of positive attitudes towards their relationship, which in turn, determine outsourcing success. Kern and Willcocks [15], by comparison, distinguished between two relationship focuses—contractual and embeddedness. Moreover, they suggested that, over time, the client and the supplier are engaged in cooperative behaviors in their daily interactions.

We argue that these theoretical approaches offer complementary rather than conflicting explanations for successful implementation of outsourcing decisions. They examine the influential factors at different levels of analysis (environmental, organizational, IT functional, and dyadic/relation) and can be integrated into a dynamic model of IT implementation. To explore this theoretical possibility, we conducted an in-depth case study on two Taiwan-based hospitals. The design of the study and the key findings are reported as follows.

**Empirical Setting and Research Methods**

Advanced information technologies are dramatically changing the way healthcare organizations are operated. In general, hospital information systems (HIS) consist of two primary classes of systems, administrative and clinical [25]. The former stores administrative and financial data related to personnel management, accounting and billing, and other operational matters. The latter stores clinical information used for diagnosing and treating a patient. In Taiwan, hospital information systems (HIS) started in the 1990s with administrative applications such as patient billing and accounting processing and gradually expanded to include clinical applications in the 2000s. Nowadays, HIS have grown into large, comprehensive and complex systems that support both daily hospital operations and critical management decisions.

In recent years, many healthcare organizations have increasingly relied on IT outsourcing to control costs and improve patient service quality. But it is worth noting that IT outsourcing in the healthcare industry has been driven not only by the cost-benefit considerations but also by increasing institutional pressures from government agencies. The laws, rules, and accreditation standards issued by the government directly affect the types of healthcare information
systems that most healthcare organizations maintain to ensure patient confidentiality and legal compliance [25].

Changes in governmental regulations have greatly impacted IT outsourcing in Taiwan’s healthcare industry. Several major policy changes have occurred in the past two decades. In 1988, all healthcare organizations went through a comprehensive accreditation process monitored by the Department of Health. The system applied to two types of hospitals: general hospitals and teaching hospitals. Each type of hospitals was further classified into three groups: medical centers, regional hospitals and area hospitals. In 1999, the Taiwan Joint Commission on Hospital Accreditation (TJCHA) set up a reformed joint hospital accreditation system, under which all hospitals are evaluated against a set of predefined quality standards every three to four years.

Besides the hospital accreditation system, hospitals in Taiwan are operated under another important institutional framework: the National Health Insurance (NHI) Program, which was launched in 1995. The NHI program provides the public equal access to medical care. The Bureau of National Health Insurance (BNHI), the government agency in charge of health insurance, reimburses hospitals for services using a cost-based reimbursement methodology. All citizens of Taiwan and foreigners who have lived in Taiwan for more than four months are required to join the NHI. Note that a hospital’s accreditation rating is related to the amount of medical insurance payment it can obtain from the BNHI. A higher-ranked hospital will be reimbursed more for its service. Faced with the same accreditation and insurance regulations, hospitals in Taiwan have developed similar management practices, including approaches to IT outsourcing.

Since very few studies have examined the IT outsourcing issues in Taiwan’s healthcare industry, we chose a case study method in order to gain an in-depth understanding of the factors affecting outsourcing decisions and implementation. Two hospitals (labeled “Hospital A” and “Hospital B” thereafter) were selected as our research sites. Both hospitals had been actively involved in IT outsourcing for more than 10 years. Data were collected from various sources including historical documents, interviews and direct observations. We interviewed a group of top management team members, IT managers and IT professionals in each hospital. Each interviewee was interviewed at least twice and the interviews lasted from 40 minutes to 2 hours.

Research Findings

Hospital A
Table 1 provides a summary of outsourcing history in Hospital A. This hospital was founded by a Christian missionary in 1954. As described on its website, the hospital’s mission is to “actively serve the minority groups and provide necessary care to those in need to fulfill the calling from God.” Its 14-member MIS department had 3 sections responsible for software development, infrastructure and maintenance and support respectively. The software section was in charge of development and implementation of HIS. The infrastructure section was responsible for the operation of server, network, telecommunication and associated infrastructure maintenance. The support group was responsible for database management, user support, and PC-based maintenance.

The development of HIS in Hospital A had experienced three phases. In the 1987-1994 period, the hospital installed its first-generation HIS with the focus on accounting and billing applications. The HIS was established in response to the newly launched hospital accreditation system. Its application was limited, only basic patient demographic information and health provider information was collected. The second phase lasted approximately 5 years (1994-1999). The focus of HIS development was to meet the requirements of the BNHI. Since the hospital must file monthly cost reports with the BNHI, the management team realized the need to automate both accounting and clinical information systems. Consequently, a second-generation HIS was introduced in 1996, which was dedicated to patient billing and NHI-related reporting. This HIS was eventually expanded upstream to the patient registration/the medical record departments and downstream to the pharmacy. An automated telephone registration system was added. In 1998, a hospital-wide office automation system was put into use.

In 1999, the 2nd-generation HIS appeared to have reached its maximum capacity. At the time, more and more hospitals started to install the computerized physician order entry (CPOE) system at physician clinics and in hospital wards. Following this trend, Hospital A made the development of the CPOE system its top priority. As a result, the hospital introduced its third-generation HIS in 2000, with a focus on the outpatient CPOE system. Physicians were able to enter the diagnosis and treatment data directly into a computer. The implementation of the 3rd-generation HIS was also driven by two institutional changes. One, the BHNI began to use NHI IC cards in 2004, which enabled hospitals to track a patient’s medical history. Two, a new 3-year hospital accreditation system was initiated in 2005.
Given these changes, Hospital A decided to implement a more comprehensive HIS.

Hospital A outsourced the development of its 1st- and 2nd-generation HIS totally to outside vendors. The first outsourcing contract was signed in 1987. The hospital's MIS department “found” the vendor based on informal recommendations by some IT professionals working in other organizations. In 1995, the department decided to outsource the 2nd-generation HIS to the same vendor. Although the two companies had worked well together in their first outsourcing deal, unexpected problems occurred the second time. Hospital A encountered difficulties with the automatic medication dispensing system designed by the vendor. The machine failed to pass the inspection test. Worse, the hospital’s engineers suspected that the vendor provided a used rather than a brand-new machine. Unfortunately, the two parties had only signed a very short, simple contract before getting into the outsourcing deal. What actually happened was nowhere specified in the contract and the relationship between Hospital A and the vendor became intense. The case ended up in court and turned out to be “lose-lose” situation for both parties.

After this negative experience, Hospital A became more cautious when deciding to outsource its 3rd-generation HIS. Two changes took place. First, instead of developing a customized system (as it did in the cases of 1st- and 2nd-generation HIS), the hospital decided to purchase the source codes of custom packages that had been implemented by other hospitals. Second, a much more rigorous vendor search procedure was used and the contract terms and conditions were carefully worded with a special section about dispute resolution. Once the second vendor was selected, Hospital A asked the vendor to modify the source codes purchased from a similar hospital according to its own business needs. This outsourcing deal was successfully completed.

**Hospital B**

This hospital was founded by a Buddhist charity organization in 1986 with a mission to persist the life-respect principles in the spirit of Buddhism, practice medical care of patient-orientation. Table 2 describes the hospital’s HIS development and outsourcing history. Its MIS department employed 18 professional, who were in charge of four functions – healthcare systems development, administration application, system control, and auditing & performance. In terms of HIS development, Hospital B had followed a similar path as Hospital A, moving from 1st-generation HIS, 2nd-generation HIS to 3rd-generation HIS. But there were some noticeable differences between the two hospitals. First, Hospital B was larger than hospital A with a greater number of hospital beds and more budgets, although its history was shorter than Hospital A. Second, the examination of the educational and career backgrounds of Hospital B’s MIS staff members revealed that this hospital employed more experienced IT professionals. Third, different from Hospital A that took little time to do a pre-outsourcing situation analysis (particularly in its first outsourcing deal), Hospital B took effort to evaluate the existing hospital processes from the beginning. For example, before introducing the 2nd-generation HIS in 1998, the MIS Director first implemented a smaller pilot system in the Chinese Medicine Department in 1996. This pilot run enabled IT professionals to get familiar with the new system and to identify potential problems without causing significant trouble.

**Implications for Future Research**

Several observations emerged from our study. We briefly summarize the common themes as follows.

**Effect of institutional pressures**

Healthcare organizations in Taiwan are faced with increasing institutional pressures on standardizing and automating their operational procedures. Even some hospitals (e.g., Hospital A) might not feel ready to install advanced IT systems, they were pressured to jump on the IT-bandwagon and outsourcing became a popular practice used for meeting the institutional requirements. Note that institutional pressures may have a direct impact on the organization’s decision to outsource, we will discuss in the next paragraphs that institutional factors may not be related to outsourcing success. For future research, we propose the following:

**Proposition 1:** Institutional pressures imposed by regulatory agencies are positively related to the healthcare organizations’ likelihood of adopting IT outsourcing.

**Effect of IT capabilities, governance capabilities, and relationship management capabilities**

Our case findings indicate that successful outsourcing implementation is primarily a function of the organization’s IT capabilities. Hospital B had stronger IT capabilities than Hospital A, other things being equal. Although Hospital B still needed to seek outside vendors’ help, it was better prepared than Hospital A before going out to search for a vendor.

Moreover, consistent with Mayer and Salomon’s findings [8], this study shows that IT capabilities actually had a positive relationship with governance capabilities, defined as the ability
to identify qualified vendors, evaluate vendor proposals, write contracts, and monitor vendor behaviors. Governance capabilities can be developed through experience and can also take the form of formal processes. In our study, Hospital A had learned from its experience of contract failure. It was able to develop a more rigorous vendor selection and evaluation procedure, which led to outsourcing success.

Table 1. Summary of IT Outsourcing in Hospital A

<table>
<thead>
<tr>
<th>Category</th>
<th>Hospital Information Systems</th>
<th>1stG-HIS</th>
<th>2ndG-HIS</th>
<th>3rdG-HIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outsourcing approach</td>
<td>Developed externally and maintained in-house</td>
<td>Developed externally and maintained in-house</td>
<td>Modified externally and maintained in-house</td>
<td></td>
</tr>
<tr>
<td>Type of application system</td>
<td>Customized systems</td>
<td>Customized systems</td>
<td>Custom package solution (purchase of source code)</td>
<td></td>
</tr>
<tr>
<td>Type of governance mode</td>
<td>Technical supply</td>
<td>Business service</td>
<td>Business service</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Technical supply</td>
<td>Technology partnering</td>
<td></td>
</tr>
<tr>
<td>Decision Phase</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motivation</td>
<td>![External]</td>
<td>![External]</td>
<td>![External]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Few vendors available</td>
<td>- NHI program</td>
<td>- More vendor available</td>
<td></td>
</tr>
<tr>
<td></td>
<td>![Internal]</td>
<td>![Internal]</td>
<td>![Internal]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Lack financial and human resources</td>
<td>- Lack financial and human resources</td>
<td>- Lack financial and human resources</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Technical capabilities</td>
<td>- Technical capabilities</td>
<td>- Technical capabilities</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Risks</td>
<td>- Risks</td>
<td>- Risks</td>
<td></td>
</tr>
<tr>
<td>Strategic focus</td>
<td>Cost efficiency</td>
<td>Access to technical skills</td>
<td>Focus on core IS activities</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cost efficiency</td>
<td>Process improvement</td>
<td></td>
</tr>
<tr>
<td>Scope</td>
<td>System development and enhancement (useful commodity)</td>
<td>System development (critical commodity)</td>
<td>System development (critical differentiator)</td>
<td></td>
</tr>
<tr>
<td>Outsourcing arrangement</td>
<td>- Selective outsourcing</td>
<td>- Selective outsourcing</td>
<td>- Selective outsourcing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Single vendor</td>
<td>- Single vendor</td>
<td>- Multiple vendors</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Contract-out</td>
<td>- Contract out</td>
<td>- Contract out</td>
<td></td>
</tr>
<tr>
<td>Implementation Phase</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluation</td>
<td>- Criteria: reputation and experience</td>
<td>- Criteria: established trust based on prior positive experience</td>
<td>- Criteria: reputation and experience</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Process: word-of-mouth from peer hospitals</td>
<td>- Process: no detailed evaluation</td>
<td>- Process: site visit and detailed evaluation</td>
<td></td>
</tr>
<tr>
<td>Contract</td>
<td>- Standard contract (project-based)</td>
<td>- Loose contract (project-based)</td>
<td>- Detailed contract (project-based)</td>
<td></td>
</tr>
<tr>
<td>Conflict resolution</td>
<td>No major conflict</td>
<td>- Negotiation</td>
<td>- Negotiation</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Court arbitration</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Table 2. Summary of IT Outsourcing in Hospital B

<table>
<thead>
<tr>
<th>Category</th>
<th>1stG-HIS</th>
<th>2ndG-HIS</th>
<th>3rdG-HIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outsourcing approach</td>
<td>Developed externally and maintained in-house</td>
<td>Developed externally and maintained in-house</td>
<td>Developed in-house</td>
</tr>
<tr>
<td>Type of application system</td>
<td>Customized systems</td>
<td>Customized systems</td>
<td>Customized systems</td>
</tr>
<tr>
<td>Type of governance mode</td>
<td>Technical supply</td>
<td>Business Alliance</td>
<td>Technology Partnering</td>
</tr>
<tr>
<td><strong>Decision Phase</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motivation</td>
<td>■ <strong>External</strong>              - Few vendors available</td>
<td>■ <strong>External</strong>              - NHI program</td>
<td>■ <strong>External</strong>              - More vendor available</td>
</tr>
<tr>
<td></td>
<td>■ <strong>Internal</strong>              - Lack financial and human resources</td>
<td>■ <strong>Internal</strong>              - Human resources with moderate technical capabilities</td>
<td>■ <strong>Internal</strong>              - More human resources with strong technological capabilities</td>
</tr>
<tr>
<td></td>
<td>- Lack technical capabilities</td>
<td>- Risks</td>
<td>- Risks</td>
</tr>
<tr>
<td>Strategic focus</td>
<td>Cost efficiency</td>
<td>Business restructuring and expansion</td>
<td>Technology leadership</td>
</tr>
<tr>
<td>Scope</td>
<td>System development and enhancement (useful commodity)</td>
<td>System development (critical differentiator))</td>
<td>System planning and consulting (critical differentiator)</td>
</tr>
<tr>
<td>Outsourcing arrangement</td>
<td>- Selective outsourcing</td>
<td>- Selective outsourcing</td>
<td>- Mostly insourcing</td>
</tr>
<tr>
<td></td>
<td>- Single vendor</td>
<td>- Single vendor with several subcontractors</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Contract-out</td>
<td>- Contract out</td>
<td></td>
</tr>
<tr>
<td><strong>Implementation Phase</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluation</td>
<td>- Criteria: reputation and experience</td>
<td>- Criteria: global reputation</td>
<td>- Criteria: reputation and experience</td>
</tr>
<tr>
<td></td>
<td>- Process: word-of-mouth from peer hospitals</td>
<td>- Process: no detailed evaluation and no open bidding</td>
<td>- Process: site visit and detailed evaluation</td>
</tr>
<tr>
<td>Contract</td>
<td>Standard contract</td>
<td>Mixed contract</td>
<td>Standard contract</td>
</tr>
<tr>
<td>Conflict resolution</td>
<td>No major conflict</td>
<td>Negotiation</td>
<td>Not applicable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Payment delay</td>
<td></td>
</tr>
</tbody>
</table>

Hospital B’s case calls for attention to the performance implications of relationship management capabilities. Besides formal contracts, Hospital B also relied on constant interactions with the vendor in the process of implementing outsourcing. Regular information exchange and knowledge sharing keep both the client and the vendor on the same page. Problems, if any, can be identified as early as possible. Conflicts and disputes can be resolved in less costly ways. Based on these
observations, we propose the following:

Proposition 2a: IT capabilities, governance capabilities, and relationship management capabilities each will have a positive direct effect on outsourcing success in healthcare organizations.

Proposition 2b: The three types of capabilities may have an interaction effect on outsourcing success in healthcare organizations.

Conclusions
This study reports qualitative findings from two healthcare organizations. Admittedly, the study has some limitations (e.g., limited generalizability of the findings). But by closely examining the historical patterns of IT outsourcing in the case hospitals, we expect to draw a distinction between the determinants of outsourcing choice and the determinants of outsourcing success. Results show that institutional changes significantly influence healthcare organizations’ IT outsourcing practices, but it is the organization’s capabilities to manage the IT function in question, the contract, and the social relationship with the vendor that ultimately affect outsourcing success. Future research is needed to further examine the direct and interaction effects among the institutional and capabilities factors.

References
pp.36-44.


THE ROLE OF CORPORATE CULTURAL SIMILARITY FOR OUTSOURCING RELATIONSHIP QUALITY AND OUTSOURCING SUCCESS

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Abstract
What is the impact of corporate cultural similarity (CCS) on outsourcing success? In this paper, we use data from a survey with the largest 1,000 banks in Germany to show that CCS has a substantial effect on outsourcing success which is mainly mediated by different dimensions of outsourcing relationship quality. The more comparable the corporate cultures of the vendor firm and the client firm, the higher is the outsourcing success from the client’s perspective. Finally, we highlight our future steps of research in investigating the impact of particular types of corporate culture in an IT outsourcing context.

Keywords: IT Outsourcing, Organizational Culture, Cultural Similarity, Relationship Quality

Introduction
Research on IT outsourcing has reached a quite mature stage within the IS discipline. Nevertheless, firms still frequently complain about outsourcing failures or bad outsourcing relationships. This motivated us to investigate the dimensions of relationship quality in outsourcing relationships, their impact on outsourcing success, and particularly to identify and validate factors that explain outsourcing relationship quality. This paper presents first quantitative results regarding the role of one particular factor – usually treated as contingency factor – being the corporate cultural similarity (CCS) between the vendor and the client firm, on both outsourcing relationship quality and outsourcing success. Our results show that CCS positively affects outsourcing success and that this impact is mediated by the quality of the relationship between vendor and client.

Related Research
Outsourcing Relationship Quality
Relationship quality (RQ) of outsourcing arrangements has been the research focus of rather few but quite fundamental works. In earlier times, most research on how to design effective outsourcing scenarios examined the contractual governance issue (what are the necessary contract and control items in order to ensure sufficient service quality?). While even this part of outsourcing governance has not been fully researched, yet, as the latest MISQ publication on outsourcing shows [1], relational governance, i.e. the question of how to achieve and maintain high outsourcing RQ, has received much less attention [2].

One of the earliest and most important works on the role of RQ or “partnership quality” for outsourcing success has been conducted by Lee and Kim [3] who adopted the social exchange theory and the power-political theory in order to test the linkage between partnership quality determinants, partnership quality dimensions, and outsourcing success. They found the RQ dimensions of trust, benefit & risk sharing, business understanding, level of conflict, and commitment to be highly relevant for explaining outsourcing success.

Some years later, the works of Goles and Chin [4] [5] dedicatedly focused on developing a measurement instrument for RQ in an outsourcing context. They developed an 11-dimensional RQ construct which was validated by a survey. Unfortunately, they used quite sparse reflective measurement models containing only two items and thus claimed that this issue is an important avenue for further research [5]. This motivated us to follow up on this research and to develop a richer RQ operationalization which also allows to be applied in different outsourcing contexts (such as software development vs. provision of IT operations). In a series of studying almost 30 outsourcing cases, reaching from ICT operations to BPO in a bank’s loans business, the different dimensions of RQ derived from the previous literature [3] [5] [6] [7] [8], from the social exchange theory [9] [10], and from the literature on social business/IT alignment [11] [12] [13] were tested regarding their relevance for outsourcing success and richer concepts for operationalization were derived [14] [15] [16].

Corporate Culture and Corporate Culture Similarity
Culture in general and culture in organizations (or: corporate culture) in particular, is a very ambiguous and frequently used term which has been defined and conceptualized by completely different disciplines such as anthropology, sociology, psychology, and management science [17]. By publishing their book “In Search of Excellence”, Peters and Waterman
have put corporate culture irrevocably into scientists’ and practitioners’ attention. They describe corporate culture as dependent from particular values and norms, which are visible within the corporate borders and which receive a common sense and acceptance by the firm’s employees.

One of the most important researchers on organizational culture is Edgar Schein. In our paper, we follow his functionalist perspective which defines corporate culture as one of more variables describing the firm and as a component of the socio-cultural system. The approach assumes that culture can be manipulated and actively changed. Schein defines corporate culture as: "a pattern of shared basic assumptions that the group learned as it solved its problems of external adaptation and internal integration, that has worked well enough to be considered valid and therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems." [18, p. 9]

In short, corporate culture is a system of assumptions and values, which have been developed by the firm’s members in order to solve problems. Schein [18] proposes culture to consist of three layers which differ in their visibility and which are mutually affecting each other. On the most visible layer, culture becomes manifest in artifacts such as objects, organizational structures, procedures, and rituals, or individual behavior, styles, and even clothing. The middle layer represents the values and norms while the lowest layer consists of unconsciously perceived assumptions and beliefs by the individuals which form the core of the culture. The basic assumptions on the lowest layer have become, in contrast to the values, to something self-evident. The employees’ notions of these assumptions usually do not differ. The assumptions are permanent and usually are not discussed, but have the strongest impact on the employees’ behavior. They determine the perceptions, feelings, and behaviors of the employees and therefore are the essence of corporate culture.

This lowest layer has the strongest impact on the individuals’ behavior, but is hardly observable or measurable in any form; intensive long-term observations and interviews or self-analyses by the employees would be necessary. By contrast, the topmost level of artifacts can be easily observed, but is very difficult to decode since the same artifacts can result from different combinations of different values. Consequently, solely observing artifacts does not allow capturing the culture behind. By contrast, values are less observable because they cannot be objectively measured and discussed. Nevertheless, they can be captured by interviews or surveys [18]. Values and norms result from statements made by members of an organization in or about particular situations. If values match with the underlying basic assumptions on the lowest layer, they can be formulated as a corporate philosophy and thus give a picture of identity to the members. In this context, Schein highlights the leading influence of executives or founders. Following Schein’s concept of corporate culture, values are not only congruent with corporate values but also contain directives from the organizational leaders.

The model of Schein has gained high popularity both in science and management. Nevertheless, there are other important models such as the model of Hofstede et al. [19] who also specified culture as a multi-layer concept with different layers (values, rituals, procedure, heroes, symbols) which show different degrees of observability.

When investigating the role of corporate culture in B2B cooperation (such as outsourcing relationships), not only the corporate cultures of the partners themselves are relevant but rather their similarity or compatibility, respectively.

Morgan and Hunt define cultural compatibility as “…the extent to which partners have beliefs in common about what behaviors, goals, and policies are important or unimportant, appropriate or inappropriate, and right or wrong” [20, p. 25]. Rijamampanina and Carmichel combine this definition with Schein’s perspective and state that the level of cultural compatibility between firms will be high, if cultural (core) values are identical [21]. Similarly, Das and Teng [22] and Sarkar et al. [23] focus on the similarity of values when measuring corporate cultural similarity. They found that shared values lead to decreasing coordination costs and offer a valuable norm for effective interaction behavior between the cooperation partners.

The Role of Corporate Cultural Compatibility (CCS) in Outsourcing Relationships

The role of cultural compatibility in outsourcing relationships has been considered in only a few studies, yet. First of all, based on case studies with firms in the UK, Kern [6] examined “cultural adaptation” between client and vendor as an important aspect in order to maintain a good relationship. A first quantitative study was conducted by Lee and Kim [3] who applied “culture similarity” as a contextual factor in their outsourcing partnership quality model. Their results showed this factor to have no influence on outsourcing RQ and outsourcing success.

As already noted above, Gole and Chinh [5] were among the first to develop a RQ measurement instrument. In their model, “cultural compatibility” is considered and empirically validated as a distinct attribute or dimension of outsourcing RQ, but not a determinant. Subsequently, Chakrabarty et al. [24] also considered “culture” as a dimension of RQ and quantitatively validated its overall impact on user
satisfaction in outsourcing relationship.

Summarizing, we can argue that corporate cultural compatibility has been considered both as a relevant determinant and dimension of RQ in IT outsourcing research. Nevertheless, it has neither been in the main focus with focusing on its particular impact nor has there been any conceptualization on how and why different dimensions of cultural compatibility affect RQ and outsourcing success. For instance, in all of the works referred to above, the used measurement instruments have been very generic and reflective only and they sometimes even only measured the outcome of cultural compatibility or cultural tolerance. The main examples are: “Both the outsourcing vendor and the company communicated well with each other” [24], “has a hard time understanding one another’s business rules and forms” and “had different corporate cultures from another” [3] [24], “have compatible corporate cultures from another” [5] or “accept the other’s culture” [5].

Research Model

Our research model combines corporate cultural similarity with its different facets with relationship quality and further outsourcing success.

Conceptualizing Corporate Cultural Similarity

In order to tackle the shortcomings of previous research in conceptualizing and operationalizing corporate cultural similarity (CCS), we draw on the Competing Values Framework (CVF) [25] which has originally been developed to evaluate a firm’s effectiveness based on competing values. The CVF is based on the assumption that the main and essential part of corporate culture consists of values and that culture can be evaluated based on the analysis of the observable values [26]. The CVF has been acknowledged to appropriately and consistently match with the understanding of “values” as the basic values of a team culture.

The CVF consists of two dimensions: focus (internal vs. external) and dynamism (stability/control vs. flexibility/change). These two dimensions form four quadrants with each of them representing a basic corporate culture type and being formed by a set of particular values (cf. Figure 1) [31]. Within a firm, all of these values will be available but will differ regarding their extent. Usually, a firm will show more emphasis on values in one or two of the quadrants [32] and thus expose a particular type of organizational culture.

Figure 1: Competing Values Framework. (based on [31])

In our research model, we argue that conformity in the extent of these values (i.e. high level of CCS) between vendor and client will lead to higher RQ and thus outsourcing success. In the following, we hypothesize why congruence of vendor and client firm regarding the single values (and thus aspects of corporate culture) is important for establishing high outsourcing RQ.

Team culture: loyalty, team orientation, and tradition are the basic values of a team culture.

- High loyalty within both firms’ cultures will drive inter-organizational loyalty towards the outsourcing partner as well. Mutual loyalty is strongly related with outsourcing satisfaction, for instance [33]. Loyalty leads to more efforts being put into the relationship by the partners [20]. By contrast, in a relationship with only one firm exposing high loyalty within its corporate culture, conflicts between the employees from both parties are inevitable because the different mindsets will collide.

- Team orientation leads to effective team work, which is highly important in successful outsourcing relationships. For example, inter-organizational teams will be set up to establish effective information exchange and joint planning and project success [34] [35, p. 52]. By contrast, imbalanced degrees of team orientation between both firms will lead to difficulties in information exchange and thus to conflicts [33].

- Tradition is an important value in many firms. On the other hand, we can argue that many provider firms in the IT industry are rather young, which leads to tradition playing a minor role. Nevertheless, missing sense for tradition on the provider side might lead to insensitive behavior against the outsourcer firm’s employees who in turn might react with blockades from their side. Therefore, similarity in the tradition value might not be the main requirement, but at least sensitiveness regarding the potential value of tradition in the outsourcer firm is proposed to be important.

The entrepreneurial culture is mainly characterized

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- **Flexibility** represents a major goal in outsourcing relationships. Consequently, congruent acknowledgement of flexibility within the corporate cultures is proposed to drive RQ and outsourcing success since it allows for overcoming contractual imperfections and for jointly reacting to changes in the environment. Employees on both sides need to be flexible and willing to adopt new technologies, procedures, and knowledge about new business domains [36]. We could argue that high degrees of flexibility (from a corporate culture perspective) are only necessary on the vendor side; but, this often is too oversimplified since the client still needs competencies to successfully manage the vendor and the services received [37].

- **Openness** is another cultural attribute which facilitates the establishment of a partnership-oriented outsourcing relation [38]. Openness will only work on a mutual basis. Without, trust cannot be created and, even worse, distrust might corrode the relationship [39]. On the other side, a too high degree of openness towards the business partner is threatening and not intended, consequently, a similar degree of openness in both firms’ corporate culture will be a good base to draw on.

- Generally, **risk sharing** between two business partners is an essential component of a strategic partnership [3]. Mutual risk taking leads to the willingness of supporting each other in difficult situations and permanently looking for improvements. Give-and-take as well as flexible and cooperative behavior are indicators for this type of cultural value.

The **hierarchical culture** combines the values of hierarchy, administration, and discipline.

- **Administration** describes a bureaucratic orientation of the firm. Bureaucracy can facilitate effective control structures, which are important in an outsourcing context, but can also paralyze an organization in terms of flexibility. In case of different ideals regarding the level of bureaucracy in the partner firms of an outsourcing relationship, substantial conflicts can occur. Firms that already have established highly administrative and detailed monitoring systems, will intend to establish them in an outsourcing relationship, as well [40]. If both firms “think” similar regarding this issue, this will make the establishment of a well-controlled and valuable service exchange easier and thus lead to higher outsourcing satisfaction.

- **Hierarchy** covers the valuation of different organizational concepts within the organization. How many hierarchy levels do exist? How many of them are involved in making particular kinds of decision? How centralized is the organization? Cooperation of firms that follow different organizational philosophies regarding the degree of centralization and hierarchy, can occur conflicts [36]. Hierarchical orientation reflects the kind of decision making, therefore, similar structures and values within the partner firms will lead to a better mutual understanding of decision procedures and to easier getting in contact with the right people (i.e. corresponding management levels) in case of a particular problem.

- **Discipline** becomes manifest in consequent compliant behavior of the personnel. Rules and responsibilities can be complex within an outsourcing relationship, but their strict enforcement is important [41]. If both firms show similar attitudes towards this cultural value, it will be more likely that both parties will act in a compliant way on all hierarchical levels.

Finally, we briefly discuss the **rational culture**, which can be described by efficiency, control and goal orientation. All of these values basically are highly relevant for every firm that wants to be successful. Of course, it depends on the kind of business strategy, how important efficiency is for the firm, but, efficiency orientation of business units and employees is a dominant feature by definition. Therefore, we believe that there might be differences in the extent of the values between a client and its vendor, but that the difference itself will not be a significant determinant of RQ and outsourcing success. Obviously, inefficiently acting vendors and clients that do not exhibit a sufficient degree of control behavior will suffer from poor outsourcing relationships, but this is not in the focus of explaining the role of cultural **similarity** in a close sense. Similarly, goal orientation is important and it is necessary that there is an overlap regarding the goals both firms are focusing on [7]. Nevertheless, this is a question of aligned strategies and not of cultural similarity which is about the degree of how strong a firm is focusing on and following its goals – whatever these are.

**CCS as Determinant of Relationship Quality and Outsourcing Success**

In our research model, corporate cultural similarity is modeled as determinant of relationship quality and outsourcing success. This is in analogy with previous works from Lee/Kim [3] and Chakrabarty et al. [24] who applied the social exchange theory in order to test the role of relational governance and RQ for outsourcing success. Therefore, we adopt their theoretical arguments and propose, based on the derivations above, that CCS with its different facets is an important factor for explaining outsourcing success and that it is fully mediated by RQ. We conceptualize RQ as a multi-dimensional concept, as
done in [2] [3] [5] [24]. We adopt the RQ dimensions concept from [2] (commitment, communication quality, conflict, consensus, mutual understanding, trust) because the author merged and critically discussed the dimensions used by the earlier authors. For our goal variable of outsourcing success, we apply multiple dimensions, as well, because they reflect different aspects of success. First, some research works use the responsible manager’s overall satisfaction [42] on client side as success variable. Some others use the degree of goal achievement to conceptualize outsourcing success from a strategic perspective [3] [42] [43]. Finally, one can also use the concept of service quality to describe the operational perspective of outsourcing success. Service quality itself is a multi-dimensional concept; we applied the dimensions of reliability and responsiveness from the SERVQUAL instrument [44] [45] because these dimensions are particularly relevant in an outsourcing context. Reliability is defined as the “ability to perform service dependably and accurately” while responsiveness describes the “willingness to help customers and to provide support services” [44, p. 23].

The following figure shows the resulting theoretical model.

![Research Model](image)

**Figure 2: Research model**

**Approach**

**Data Collection and Analysis**

The research model is empirically tested based on data from the German banking industry, where we surveyed the IT outsourcing relationships between banks and those IT service providers that run and maintain the main loan systems of the bank. We collected our data by distributing a survey among Germany’s 1000 largest banks. The person responsible for managing the vendor that provides the main loan system (which represents one of the main information systems within most banks) was personally identified by a phone call and asked (a) whether a loans system is in place, (b) whether its provision is done by a third party (i.e. outsourced), and, in case of (a) and (b) being answered with “yes”, (c) whether he or she would be willing in taking part in the survey. In case that (a) or (b) was answered with “no”, we replaced the bank by the next smaller one. Afterwards, the questionnaire was sent out by postal mail to the 1,000 vendor managers who had been identified. Two weeks later, a reminder followed, and another two weeks later, we called the managers again and asked for reasons why he or she did not have replied the questionnaire, yet. The overall data collection process resulted in 171 completed questionnaires (i.e. response rate of 17.1%).

In order to minimize the risk of common method bias, we used two variants of questionnaires (different orders of questions), placed theoretically unrelated marker variables within them, and used different scales for the RQ dimensions vs. CCS. Group comparisons and correlation tests with the marker variables showed no indications on CMB; similarly the Harman single-factor test and the single-factor procedure described in [46] [47] applied to the items and data used in the following did not substantiate any CMB threats.

The data analysis was done by using SPSS 17 (basic analyses and factor analyses (PCA)) and applying PLS (by using smartPLS 2.0 M3 [48]).

**Operationalization**

The six RQ dimensions and three of the four outsourcing success dimensions were operationalized by reflective measurement models consisting of between three and five items each; all of them were derived from the literature and are listed in Table 4 in the Appendix (original questionnaire was in German). Goal achievement was operationalized by a formative measurement model which aggregates the different outsourcing objectives (cost reduction, transparency, quality improvements, and stronger focus on core competencies) (cf. Table 5 in the Appendix).

Corporate cultural similarity was operationalized in a formative way in order to take the criticism on previous measurement instruments (cf. above) into account. We captured the different value dimensions proposed in the model development section by one item each and asked whether the particular value is in higher gear in the client or in the vendor firm (e.g.: “Openness to new ideas is more pronounced: within our firm … equally … within the vendor firm” (7-step scale)). Again, Table 5 in the Appendix shows the translation of all items used. For determining similarity, the middle value of the 7-step scale was transformed to the highest value (i.e., 4), while each step to either the left or right anchor degreased the score by 1.

For achieving first results from testing the research model, we aggregated the CCS items towards a single CCS score, using a confirmatory factor analysis, which gave us the aggregation weights, and then summed up the weighted scores of the single
items to the overall CCS score. Thus, we used single item construct for CCS during the PLS analysis. In later analyses we will also test for differential impacts of the different cultural models, proposed by the quadrants of the Competing Values Framework (cf. Figure 1)).

First Results

For testing the relationship between CCS and outsourcing success (OS) and the mediating effect of RQ, we have to test two different models. One links the CCS single-item construct directly to each of the four OS dimensions (direct model) while the second connects CCS to each RQ dimension and to each OS dimension while the RQ dimensions in turn are connected to the outsourcing success dimensions, as well (mediated model). If the paths from CCS to OS are significant in the direct model, but become insignificant in the mediated model and if the paths of CCS to RQ and from RQ to OS are significant, our mediation hypothesis is supported [49].

The following tables show the test results of both models (path coefficients with levels of significance and R² of RQ and OS dimensions).

<table>
<thead>
<tr>
<th>Impact of CCS on:</th>
<th>Path coefficient and level of sig.</th>
<th>R² of OS dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal achievement</td>
<td>.204*</td>
<td>.042</td>
</tr>
<tr>
<td>Overall satisfaction</td>
<td>.225**</td>
<td>.050</td>
</tr>
<tr>
<td>Service quality – reliability</td>
<td>.222**</td>
<td>.049</td>
</tr>
<tr>
<td>Service quality – responsiveness</td>
<td>.339***</td>
<td>.115</td>
</tr>
</tbody>
</table>

Table 1: Direct model: impact of CCS on OS (here and below, the levels of significance are determined based on 500 bootstraps)

<table>
<thead>
<tr>
<th>Impact of CCS on:</th>
<th>Path coefficient and level of sig.</th>
<th>R² of RQ/OS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal achievement</td>
<td>.039</td>
<td>.284</td>
</tr>
<tr>
<td>Overall satisfaction</td>
<td>.065</td>
<td>.445</td>
</tr>
<tr>
<td>Service quality – reliability</td>
<td>.013</td>
<td>.383</td>
</tr>
<tr>
<td>Service quality – responsiveness</td>
<td>.101</td>
<td>.581</td>
</tr>
<tr>
<td>Commitment</td>
<td>.174*</td>
<td>.030</td>
</tr>
<tr>
<td>Communication quality</td>
<td>.248**</td>
<td>.062</td>
</tr>
<tr>
<td>Conflict</td>
<td>-.203*</td>
<td>.041</td>
</tr>
<tr>
<td>Consensus</td>
<td>.190*</td>
<td>.036</td>
</tr>
<tr>
<td>Mutual understanding</td>
<td>.310***</td>
<td>.096</td>
</tr>
</tbody>
</table>

Table 2: Mediated model: impact of CCS on RQ and OS

Table 3: Mediated model: impact of RQ on OS

The results show that our hypotheses are basically supported. In the direct model, CCS is significantly and positively related with any of the outsourcing success measures. In the mediated model, none of the direct paths from CCS to OS remains significant, but CCS now is significantly and positively related with all dimensions of relationship quality (please note that conflict is a “reverse” dimension of RQ, thus, a negative path coefficient represents a positive relationship between CCS and RQ). Moreover, many of the links from RQ to OS are significantly positive, particularly from commitment to any OS measure, and from most RQ measures to responsiveness. Interestingly, goal achievement and reliability remain quite unaffected by RQ; they are only positively related with two out of the six RQ dimensions. The missing link between RQ and goal achievement might stem from the different frames these concepts are embedded in: while RQ is associated with the ongoing relationship, goal achievement is also affected by comparing the former in-house operations with the situation today. Thus, conditions for achieving goals are already rooted in the pre-outsourcing period where the goals are set in relation to the in-house situation. The literature shows many reasons why these goals become over-emphasized, poorly specified, not exactly stipulated etc. In the subsequent relationship, RQ can hardly heal these issues and thus only marginally contribute to goal achievement. A similar argumentation can be derived regarding the weak link between RQ and the reliability dimension of service quality. Reliability results from the basic business capabilities of the vendor, either they have the capability for running and maintaining the systems or not; RQ cannot contribute much to improve the situation.

Looking at the R²s, we found substantial parts of all OS dimensions to be explained by our model (mostly by relationship quality). Although usually treated as a minor contingency factor, CCS shows slight but significant effects both on OS and on RQ, such as explaining up to 11.5% of the variance of responsiveness, for instance.

Finally, it should be noted that both PLS model estimations (direct and mediated model) meet the usual quality criteria regarding sample size, reliability, convergent validity, and discriminant validity of all measurement models, although we did not provide all the figures here in order to meet the page count restrictions.

Implications, Limitations, Next Steps

Our conceptualization of corporate cultural similarity (CCS) and the empirical validation of its relevance in IT outsourcing relationships shows that considering
In our next step, we will dig deeper into the goal variable of outsourcing success. The importance of the different aspects regarding our approach gives room to determine the relative equivalent. Nevertheless, the formative measurement aspects of cultural compatibility to be structurally affect the results. Further, we modeled the different tradition or team-orientation in both firms will also only in terms of compatibility. The absolute level of that we did not consider culture in absolute terms but objects of outsourcing, one particular limitation is organizational forms of outsourcing, and other non-generalizability to other contexts, other shortcomings related with this kind of methodology, with the approach chosen. Beside the typical shortcomings related with this kind of methodology, such as the threat of single source bias, non-generalizability to other contexts, other organizational forms of outsourcing, and other objects of outsourcing, one particular limitation is that we did not consider culture in absolute terms but only in terms of compatibility. The absolute level of tradition or team-orientation in both firms will also affect the results. Further, we modeled the different aspects of cultural compatibility to be structurally equivalent. Nevertheless, the formative measurement approach gives room to determine the relative importance of the different aspects regarding our goal variable of outsourcing success.

In our next step, we will dig deeper into the relevance of the CCS construct. Our measurement instrument allows for separating the different cultural types from the Competing Values Framework (or at least the three most relevant ones: team culture, entrepreneurial culture, and hierarchy culture) and testing the differential impact of different cultures on vendor vs. client side on RQ and OS, since the measurement items of CCS not only are formative, but also allow to use the scales in its original form.

Conclusion

This paper presented a conceptualization of corporate cultural similarity between an IT vendor firm and its client, the development of a causal model that explains the impact of CCS on outsourcing success, and a first empirical validation based on data from the German banking industry. We find that CCS significantly explains minor parts of outsourcing relationship quality and of outsourcing success and we therefore argue that CCS as a object of management concern needs to be more thoroughly understood and made manageable within IT outsourcing relationships. It was our aim to show new directions of interesting and relevant IT outsourcing research and we hope to make a substantial contribution regarding the role of CCS and of different cultural types of organization for a successful IT outsourcing relationship by future research steps.

Acknowledgement

This work was developed as part of a research project of the E-Finance Lab, Frankfurt am Main, Germany (www.efinancelab.com). We are indebted to the participating universities and industry partners.

Appendix

The following table shows the reflective measurement instruments used and the related loadings from the PLS calculation. The loadings stem from testing the mediated model and all of them are highly significant (p<.01).

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Concerning the single source bias, we asked all respondents to invite their contacts on vendor firm side to participate in a subsequent vendor-side survey. Unfortunately, this did not result in a sufficient number of returns to do any statistical tests.

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Table 4: Reflective measurement models and quality criteria
Table 5 shows the remaining instruments which have been measured in a formative way (outsourcing goal achievement) or by aggregating the items (CCS) as described in the section on “Operationalization” above.

<table>
<thead>
<tr>
<th>Construct</th>
<th>Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conflicts between the vendor and us are solved quickly and effectively.</td>
<td>.848</td>
</tr>
<tr>
<td>There are many conflicts in our relationship.</td>
<td>.768</td>
</tr>
<tr>
<td>The service provider is slow in solving escalating problems.</td>
<td>.811</td>
</tr>
<tr>
<td>There are numerous issues with the provider that have not been remedied for some time.</td>
<td>.824</td>
</tr>
<tr>
<td>Escalation is the only effective governance instrument in the relationship.</td>
<td>.798</td>
</tr>
<tr>
<td>Both parties show great willingness to come to a compromise.</td>
<td>.722</td>
</tr>
<tr>
<td>We’ve defined shared goals with the vendor.</td>
<td>.768</td>
</tr>
<tr>
<td>We have defined joint goals with the vendor.</td>
<td>.731</td>
</tr>
<tr>
<td>Problems are commonly solved so there is no negative impact on the overall relationship.</td>
<td>.805</td>
</tr>
<tr>
<td>The vendor staff with whom I usually speak has good banking know how.</td>
<td>.833</td>
</tr>
<tr>
<td>The vendor understands our credit business.</td>
<td>.894</td>
</tr>
<tr>
<td>The vendor understands our strategic goals.</td>
<td>.878</td>
</tr>
<tr>
<td>The vendor advises well regarding the feasibility of implementing business solutions.</td>
<td>.819</td>
</tr>
<tr>
<td>Both parties in the relationship can be trusted to do business fairly.</td>
<td>.865</td>
</tr>
<tr>
<td>Our vendor acts in our best interests.</td>
<td>.864</td>
</tr>
<tr>
<td>None of the parties in the relationship will behave opportunistically.</td>
<td>.880</td>
</tr>
<tr>
<td>Our goal of raising quality of service has been [completely – not at all] achieved.</td>
<td></td>
</tr>
<tr>
<td>Our goal of focusing on core competencies has been [completely – not at all] achieved.</td>
<td></td>
</tr>
</tbody>
</table>

Table 5: Formative measurement models

<table>
<thead>
<tr>
<th>Construct</th>
<th>Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>The 9th International Conference on Electronic Business, Macau, November 30 - December 4, 2009</td>
<td></td>
</tr>
</tbody>
</table>

References


EXPLORING THE COLLABORATION MODEL OF OFFSHORE OUTSOURCING: A STUDY OF IT SOFTWARE DEVELOPMENT

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Abstract
The practice of offshore software development is now as part of global trend adopted by some Western companies. The software development projects operating under geographically-separated settings present the tremendous challenges and require collaboration-intensive activities. This study examines the factors contributing to the success and failure within the context of offshoring software development projects. Furthermore, this study intends to develop a collaboration model for offshore software development that describes the key components operating under distributed development environment. The initial results and limitations of research are also discussed.

Keywords: collaboration model, offshore outsourcing, software development, transaction cost economics

Introduction
As part of the global trend, enterprises are increasingly outsourcing their internal IT work to external service providers to focus their valuable and rare resources on core competencies and businesses. Recent development indicates that offshore outsourcing is now an accepted practice for many firms in the US and Western Europe [1] [2].

Offshore outsourcing (offshoring) involves the practice of handing over IT development and services to offshore sites outside the host country [1] [3]. For instance, some western firms have transferred their software development tasks to offshore sites in the countries such as India and China. While prior research indicates firms may benefit from offshore outsourcing with lower cost, time to market, resource leverage and disperse risks [2] [3] [4], equally-weighted difficulties are reported in literature, such as cultural and time zone difference, communication ineffectiveness, geographic dispersion and language barrier [1] [2] [5] [6].

In particular, the process of software development work consists of many steps from planning, to coding, testing, implementation, and maintenance [3]. The projects of software development require more intense communication and coordination work. Offshore outsourcing operating under the globally distributed setting inevitably increases the difficulty and complexity of software development work. While prior research in offshore outsourcing may focus on the mitigation of transaction costs and the setup of effective computer-based communication environment [1] [6], little attention has been paid to more comprehensive understanding of collaboration mechanisms for distributed software development. The purpose of this study is to explore best practices operating under distributed environment and factors contributing to the success of offshoring software development projects. Furthermore, this study intends to develop a collaboration model for offshore IT software development that aims to effectively minimize the transaction costs and risks under distributed development environment. Our approach is to focus on the collaboration setting faced by host teams, remote teams and external vendors when sourcing software offshore.

Theoretical Background
Transaction cost economics (TCE)
Transaction costs arise due to information asymmetry and incomplete contracts that lead to subsequent renegotiations when the balance of negotiation power shifts between the transacting parties [7]. Transaction costs refer to the effort, time, and costs incurred in searching, creating, coordinating, negotiating, monitoring, and enforcing a contract between buyers and suppliers [8]. Drawing on TCE theory, outsourcing is considered to be favorable, when transaction costs are low in the external market [9] [10] [11]. Therefore, the decision of offshore software development is often viewed as a rational choice made by firms with lower overhead cost and more skilled labor in offshore sites.

The TCE theory provides the foundation of identifying the factors contributing to various transaction costs under the context of offshore software development, such as communication, coordination, negotiation and supervision. The setup of the multiple-team collaboration between clients and vendors across multiple locations may increase these transaction costs. This study adopts the previously-developed framework in literature that identifies people, process and technology as the basic components to present the collaboration mechanism from various offshore software development projects.
[6]. Figure 1 provides the initial collaboration model derived from Bhat’s work.

![Figure 1: Collaboration Model of Offshore IT Outsourcing](image)

**Research Methods**

Given the lack of prior research on offshore collaboration, the case study methodology was used to examine the phenomenon of offshore outsourcing arrangement within the context of software development. Qualitative data were collected through interviews and documentation during 2009. The initial phase of data collection was to identify the key components of the collaboration mechanism in offshore settings. The analysis unit based on each outsourced software development project.

The client firm, Company A, is a US-based international high-tech company manufacturing computing products. In order to achieve competitive advantage in the global market, Company A has been outsourced the software development task of various computing products (i.e., network devices) to offshore vendors for many years. This study examined the components consisting of globally distributed development setting and the difficulties associated with offshore software development.

**Findings**

Our initial findings have shown that communication obstacles increased due to cultural differences and language ability. Time-zone differences added to the difficulties of coordination work and geographic separation hampered knowledge migration. These hidden costs often offset outsourcing benefits such as cost reduction, risk minimization, and agile responses to business needs. Through years of failed experience, Company A arranged the existing working model to effectuate the project coordination and shorten the communication cycle. The project team for offshore software development consisted of the host team in US, the offshore team in Taiwan and the offshore vendor team in Taiwan (as shown in Figure 2).

![Figure 2: Offshore Outsourcing Team Arrangement](image)

This collaboration arrangement was further analyzed based on three components, that is, people, process and technology. First, the addition of the remote team helped Company A to minimize the transaction costs associated with communication, coordination, and monitoring challenges. The members of the remote team were recruited by Company A to ensure team members’ language ability and technical knowledge met the project requirements. Second, the processes of offshore software development project needed to be clearly defined, including project plan and deadline. Monitoring the project progress can be through the formal or informal discussion and the submission of progress reports. Third, the use of IT technology was also important to collaborate the multi-teams in different locations within an offshoring setting, such as Email, online chatting and conferencing tools, software development version control tool, and knowledge repository for prior projects. Prior research has also indicated that computer and communication technologies enable offshore system development [12]. As a result, the derived collaboration model for IT software development addresses the potential hidden costs and leads to the success of outsourcing relationships by facilitating the communication and coordination of offshore software development. Table 1 summarizes the initial results of the case in this study.

<table>
<thead>
<tr>
<th>Collaboration Components</th>
<th>Best Practices</th>
</tr>
</thead>
<tbody>
<tr>
<td>People</td>
<td>Tri-team concept</td>
</tr>
<tr>
<td>Process</td>
<td>Project plan and schedule</td>
</tr>
<tr>
<td></td>
<td>Formal and informal discussions (face-to-face and virtual)</td>
</tr>
<tr>
<td></td>
<td>Progress report, standard templates</td>
</tr>
<tr>
<td>Technology</td>
<td>Email, online conferencing tools (video and voice)</td>
</tr>
<tr>
<td></td>
<td>Software development version control tool</td>
</tr>
<tr>
<td></td>
<td>Project repository for best practices</td>
</tr>
</tbody>
</table>

**Conclusions**

This study only presents the initial results of the collaboration mechanisms for offshoring software development from a High-Tech firm. In fact, the existing collaboration arrangement within distributed development environment is still evolving. It takes tremendous effort to plan and manage offshore outsourcing projects in details. Future research is needed to further examine the relationships among the multi-team located in geographically separated locations. Despite the promising results, the study has the limited generalizability of the findings using the case methodology.
References


ASSESSING THE IMPACT OF SUPPLY CHAIN INTEGRATION THROUGH AN ERP SYSTEM

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Abstract
Many organizations have implemented Enterprise Resource Planning (ERP) systems, hoping to use the information integration these systems provide to improve process efficiency and effectiveness. In particular, ERP systems may be instrumental in realizing Cooperative Planning, Forecasting, and Replenishment (CPFR). In this paper, we present an experimental approach that will be used to assess the real impact of the implementation of CPFR through an ERP system.

Keywords: Cooperative Planning, Forecasting, and Replenishment (CPFR), ERP simulation, supply chain integration.

Context
Enterprise Resource Planning systems (ERP) are commercial software applications that integrate data and processes throughout the enterprise [1]. These systems aim to replace existing functional systems that typically work in silos, creating inefficiencies due to their lack of integration. The hope of enterprises in using ERP systems is to improve process efficiency and effectiveness, and in the long run to develop competitive advantage. Implementing ERP systems has proven to be a complex task, full of challenges, human and technical, and requires huge investments from the enterprise. It has been estimated that 60 to 80% of these investments were aimed at the organizational transformation that necessarily comes with such implementation [2][3]. Yet, the impact of these investments on the enterprise’s results is often suboptimal, as workers find it difficult to reap the full potential of such systems. Studies have shown that the potential of advanced intra- and inter-enterprise collaborative decision making tools is underutilized [4]. Yet, these systems are one of the main factors contributing to making an enterprise a world-class business. By not using these tools efficiently, an enterprise eventually loses its competitive edge against more agile and flexible competitors.

It has been demonstrated that intra- and inter-organizational collaboration is of high value for managers and practitioners [5]. IT literature greatly values the use of integrative and collaborative technologies, such as ERPs. In the context of supply chain management, collaboration occurs with two or more enterprises within a supply chain share planning, management, execution and performance data [6]. Collaboration within the supply chain leads to better performances of the collaborating enterprises, as compared to enterprises acting independently [7]. Within a supply chain, collaboration may take many forms, for instance: Collaborative Planning, Forecasting, and Replenishment (CPFR) and Vendor-Managed Inventory (VMI). Electronic collaboration, mediated by information systems or electronic commerce tools, may also help in integrating the activities of enterprises in the supply chain. These IT-based innovations were fuelled by the development of the ERP systems, in particular their goal to improve the flexibility and the integration of the supply chain, to extend the business process of an enterprise to its partners using e-commerce technologies and the Internet.

Web technologies and other technical innovations in telecommunications are also important factors contributing to the emergence of virtual teams [8]. For enterprises, it then becomes crucial to take advantage of their employees’ potential, wherever they are located on the planet. However, this does not come without challenges, especially in time-limited projects where knowledge transfer and routinization is limited [9]. In recent years, using and coordinating expertise within geographically distributed virtual teams has been the focus of many research projects (e.g., [10][11][12]). These teams are typically defined as a group of interrelated individuals, physically separated from each other, who are using information technologies and tools to their advantage.
to cooperate [13]. For these teams, success strongly depends on their capacity to use information technologies to create the appropriate coordination mechanisms.

From a methodological standpoint, past research on team collaboration may be structured in three main categories: conceptual studies, empirical studies, and mathematical models. Conceptual studies mainly aim at identifying the causes of technology adoption for supporting collaboration relationships across the supply chain and identifying the critical success factors for implementing such technology within the supply chain. Empirical studies focus on testing a number of hypothesis using case studies and surveys. Results from these studies are mitigated. Some studies [14][15] conclude that networks composed of large organizations (prime manufacturers, integrators) show a high level of collaboration and integration, while other studies show that only a few enterprises have the capacity to attain the level of integration required to fully reap the benefits of inter-enterprise collaboration [16]. Finally, studies based on mathematical models and on simulation may be used to assess the potential impact of collaboration within the supply chain. This is achieved by modeling the impact of information exchange on operational and financial performances of the supply chain. However, these quantitative models are not typically based on real collaborative processes nor on real data, therefore reducing the impact of their results.

**An Experimental Approach Proposal**

In this work, we are interested in the impact of using ERP systems to support the integration of a whole supply chain, in particular when collaborating enterprises are using the CPFR approach. Using an experimental approach, we seek to study how the combined use of these technologies can help integrate the operations within the supply chain. The experimental environment will reproduce the technological settings that would be available to a manager.

The proposed experimental approach should allow us to reach two main research goals: (i) identify organizational and technical factors that impact on the IT-mediated collaboration within a supply chain and (ii) measure the impact of the IT-mediated collaboration on decision making and organizational performance.

Of prime importance in this context is the notion of the coordination required to achieve collaboration. Consequently, the proposed approach should facilitate the study of the main coordination mechanisms, which in turn lead to efficiency and effectiveness of the supply chain. Specifically, these mechanisms are composed of the actions and behaviours performed by the supply chain participants to manage and maintain trust within the supply chain, to support decision making, and to coordinate individual and collective activities. These mechanisms may be explicit (observable interpersonal behaviours) or tacit. Explicit mechanisms have been studied in classical literature on organizational coordination and control [17][18]. Tacit coordination consists of the facilitation of activity synchronization using a common mental schema that does not require any specific communication, nor any formal managerial actions from members [19] [20]. Together, these two complementary coordination mechanism types enable the integration of members’ expertise and efforts, which in turn contributes to improve the collective decision making process.

Trust is also another important factor to consider. We will pay special attention to factors influencing the trust of members of the supply chain towards the collective decision making process at the organizational level. Although IT literature has investigated the role of trust and collaboration for IT adoption and usage, in the context of supply chain collaboration, we are more interested in on-line environments. Few studies have investigated the role of trust when collaboration is mediated by an ERP system.

Experimental approaches are seldom used by researchers in this area as it requires an IT infrastructure that is typically non-existent. As opposed to the other approaches used in the domain, the use of the experimental approach enables the systematic and controlled analysis of the different dimensions of collaboration, for instance the impact of technology, users, and the business context. The methodology we propose will recreate different experimental conditions that mimic various geographical dispersion and task segmentation within the supply chain.
One of the challenges of using an experimental approach is the ability to recreate realistic organizational environments where the IT artefact’s role is central. The ability is made possible with a simulation technology developed at HEC Montréal, namely ERPsim [21]. This technology allows for the simulation of extremely realistic collaboration scenarios through the use of an ERP system. Participants are put in a situation where they must make decisions and manage the operation of their enterprise using a real-life ERP system, such as those used by the large organizations. One primordial characteristic of ERPsim is that all decisions made by participants must be entered into the ERP system and that all the information required to make those decisions must be extracted through standard reports of the ERP system. Think of ERPsim as a flight simulator where the pilots are in a real plane in a virtual sky.

The experimental approach we propose will use the ERPsim platform to simulate a realistic supply chain environment, where a manufacturer is managing the inventory at his distributor’s site, hence performing VMI. In this context, we will investigate the impact of information sharing on the quality of planning, forecasting, and replenishment. In a first series of experiments, we will focus on the planner’s task. The planner is responsible for Materials & Production Planning (Fig. 1). Without CPFR, order forecasting can only be performed based on past orders received from the distributor. With CPFR, we can also use sales forecast and point-of-sale data to refine the forecasting process. We will conduct simulations where decisions must be made on the basis of inventory levels and demand. Different scenarios could be tested:

1. Complete CPFR: An ideal case where the planner has access to his own orders, as well as point-of-sales data and sales forecasts;
2. With sales forecast only: This scenario represents the situation where the planner has access to the sales forecasts from the distributor, but not to actual point-of-sales data;
3. Without external data: This is the worst case scenario where only past orders from the distributor can be used to perform the forecast.

In all cases, the decision maker will be informed beforehand of what data is available to perform materials and production planning. Extensions will be developed in ERPsim to support these different scenarios, and provide the necessary information to the planner.

We propose the following research protocol. At least 90 simulations will be performed using actual planners. These planners will be randomly assigned to one of the three scenarios. Each planner will be performing materials and production planning for the same company in the same economic environment with the same market trends. The other activities of the company, such as production execution and order fulfillment, will be automated by ERPsim.

Data Collection Strategy

In an ERP system, all transactions performed are recorded for audit purposes. As the business simulation supported by ERPsim is built on a competitive business environment, financial status and operational performances may be objectively measured for each company participating in a simulation. In the proposed setting, each planner will run his own company. Consequently, for each simulation, a number of data points can be collected: (i) objective IT usage data (number of transactions and when transactions were performed) (ii) operational performance and financial data for each participant, and (iii) psychometric measures (e.g., questionnaires before, during, and after the simulation).
Usage data is obtained through the auditing functions of the ERP system. These audit data are enriched with the simulated time information to track which transaction was performed at which instant during the simulation. Operational performance and financial data is calculated and recorded by EPsim at every simulated day. We are therefore able to match time-based results with user actions. Psychometric measures will include questions to ascertain the user’s experience as a planner (e.g., number of years as a planner), objective questions determining the user’s skills as a planner, and questions assessing the perceptual factors such as its perceived knowledge of the system, its attitude toward the ERP, effort expectancy and perceived trust in the data available during the simulations [22][23].

Concluding comments
In order to objectively assess the impact of using an ERP system to support CPFR, the use of a simulation approach seems the most appropriate. Indeed, a theoretical analysis of these benefits would stop short of convincing practitioners, as it would be based on suppositions and hopes. Using a simulation, we will be able to show how “real” decisions are made when additional data is available in the planning process. Simulations with a control group will be used to assess the impact of performing planning without shared data from the distributor. Here, one factor for which we cannot control is the quality of the subjects beforehand, as the three groups are independent. We can only mitigate this factor by selecting candidate for each group randomly. To date, studies on organizational collaboration are mainly based on psychometric measures, (e.g., [14][15]. The research approach proposed in this paper combines these psychometric measures with an experimental approach. Potential contributions of this research are the study of factors associated to user behaviour that are not taken into consideration by typical intra- and inter-organizational collaboration models. While in principle, many studies have highlighted the importance of user behaviour in organizational collaboration, most of these studies do not investigate the mediator or moderator effects of these behavioural factors on collaboration. The experimental approach presented herein will enable us to study these effects in laboratory settings.

References


Abstract
In recent years, more and more Chinese organizations have tried to adopt enterprise resources planning (ERP) systems to improve their supply chain management (SCM) practices and efficiencies and subsequently to increase their competitiveness in the marketplace. However, compared with their Western counterparts, the failure rate of ERP implementation for the Chinese organizations is much higher. Many of them find it very difficult to select an ERP system that fits their management practices. We believe that cultural differences could be the important reason contributing to the phenomenon that existing Western-based ERP systems cannot be directly adopted in Chinese companies. In this study, we propose a theoretical model that stipulates how organizational culture affects ERP decisions through influencing supply chain management practices. The object of this study is not only to provide insights for Western ERP vendors to modify/localize their existing systems to better fit local Chinese practices; but also to provide guidance for Chinese companies to select ERP systems or to develop their own systems. Empirical data will be collected to validate the proposed model. In order to develop measurement constructs for the survey instrument, company visits and interviews are conducted. In this paper, we shall reveal the initial findings from the interviews and discuss the steps forward.

1. Introduction
Enterprise Resource Planning (ERP) systems can help to facilitate enterprise-wide integration of information by linking suppliers, distributors and the customers together without geographical limitations (Akkermans et al., 2003). They may count as “the most important development in the corporate use of information technology in the 1990s” (Davenport, 1998). Therefore, ERP system has become a “must have” system for many firms to improve competitiveness in the past few years [Sheu et al., 2004]. The cross-functional/cross-organizational integration allows companies to improve productivity and customer service while lowering costs and inventories.

In recent years, we have witnessed a dramatic increase in ERP adoption and diffusion in China [Huo, 2002]. Some companies (mainly large corporations) selected Western-based ERP systems like Oracle and SAP, some companies chose local Chinese ERP systems like Kingdee and UFIDA, others decided to develop their own ERP systems. Whatever systems that they have chosen, Chinese companies encountered many unexpected problems and even failures when implementing ERP in their organizations as ERP systems are extremely complex and difficult to implement [Xue et al., 2005]. Compared to their Western counterparts, the success rate of ERP system implementation of those Chinese companies is very poor. It was estimated that the ERP success rate in China is approximately 10% [Zhang et al., 2003]. ERP system has not achieved its objectives and even turn into a nightmare for many firms [Davenport, 1998]. Many Chinese companies have found it is quite difficult to find an ERP system that is very fit for their daily operations and management. Also, most companies did not recognize the difficulties until they are deeply involved into the implementation.

Moreover, if we take a look at the Chinese ERP market, one can find that this market has grown with an annual rate of 25% from 2002 to 2005 [Xue et al., 2005]. Western ERP vendors such as SAP and Oracle rush into the Chinese ERP market and make great efforts to catch a piece of this ERP pie. But it’s really not easy for these Western ERP vendors to tame the Chinese ERP market. As reported by CCID Consulting (2002), only about 18.5 percent of the ERP market share was held by SAP and Oracle, who are the main Western ERP vendors in China. Western giants have not demonstrated their dominance in China ERP market the same way as they do in their Western world [Xue et al., 2005]. In addition, they meet many difficulties in localizing their software systems to facilitate the Chinese management practices. On the other hand, many local ERP vendors, who are supposedly more familiar with Chinese management practices, still find it difficult to implement their ERP systems for Chinese companies.

Therefore, in this study, we aim at helping these Chinese companies find ERP systems which fit their practices, as well as helping ERP vendors to localize or develop systems that culturally fit for the Chinese organizations.

2. Theoretical Foundations
We begin our discussion with the definition of culture. It is a big challenge for researchers who conduct
studies involving culture to arrive an understanding on what culture is, given so many definitions, conceptualizations, and dimensions used to describe this concept (Leidner and Kayworth, 2006). Hofstede (1980) defined culture as “A collective programming of the mind which distinguishes one group from another”. He suggests culture be manifested by different levels of depth: symbols, rituals, heroes and values, among which values are the core of culture.

Among so many conceptualizations of national culture, Hofstede's (1980) work is one of the most popular. Based on his survey conducted in more than 50 countries, Hofstede identified four dimensions (power distance; individualism/collectivism; uncertainty avoidance and masculinity/femininity) to measure national culture; these dimensions became the basis of his characterizations of culture for each country (Hofstede, 1980). Later on, Hofstede and Bond (1988) conducted ‘Chinese Values Survey (CVS)’ and introduced the fifth dimension named ‘Confucian Dynamism’ or ‘Long/Short Term Orientation’. There are also some other cultural instruments. For example, Hall (1976, 1990) proposed polychronism versus monochronism and context as dimensions to measure national culture. Trompenaars (1996) also proposed six dimensions to describe national culture; these dimensions include universalism/particularism, affective/neutral relationships, specificity/diffuseness, achievement/ascension, long term/short term orientation and internal/external control.

Besides national culture (cross-cultural) studies, there is another stream of cultural studies called organizational culture study, which is largely separated from cross-cultural study. At the organizational level, there are also many conceptualizations of organizational culture. Here we take the approach to divide the instruments into types and dimensions of organizational culture. For the organizational culture type instrument, the Competing Values Model (CVM) developed by Quinn and Rohrbaugh (1983) is the most popular, the model measures or organizes national culture into four types: Hierarchy, Clan, Adhocracy and Market, which are the results of two pairs of competing values: internal versus external, flexible versus control; Cooke & Lafferty (1986) developed 12-dimensional instrument named organizational culture inventory (OCI) to measure organizational culture, these dimensions measure the behavioral norms as organizational culture; Hofstede (1990) proposed a six-dimension cultural framework (process-oriented/result-oriented, job-oriented/employee-oriented, professional/parochial, open/closed system, tight/loose control, pragmatic/normative) to distinguish different organizations, these six dimensions are used to measure the practices perspective of organizational culture.

Although many criticisms for Hofstede’s cultural instrument exist, this study is going to use it as it is well known for its relevancy, rigorous and relative accuracy (Ross, 1999; Sondergaard, 1993). On the other hand, we are not going to directly use the scores of Hofstede, we will measure organizational culture by using those dimensions in his instrument, which avoid most of the weaknesses of Hofstede. Hofstede’s work has a great impact on both academics and practitioners, his dimensional model has been widely used in various business areas like information systems, operations management practices, human resources management, conflict management, total quality management etc.

In information systems field, there are many studies relating culture (both national and organizational culture) with various IS/IT behaviors such as information system development, IS/IT adoption and usage, IS/IT management, IS/IT outcomes, these studies find that culture has a significant effect on certain IT behaviors (Leidner and Kayworth, 2006).

At national culture level studies in IS field, many researchers used Hofstede’s cultural scores to examine how culture affects various IT behaviors. For example, Garfield and Wastow (1998) used case study to examine the role of national culture (described by uncertainty avoidance and power distance) in the development national information infrastructure, they found that countries will follow similar development models based on their similar cultural values. For the IT adoption studies, Hasan and Ditsa (1999) used interpretive field study to examine how national culture (in terms of uncertainty avoidance) affects technology transfer success. They found that IT is less readily adopted in risk-averse cultures as technology is perceived as inherently risky. Also, Srite (2000), Png et al. (2001) also reported their findings on examining how national culture affects IT adoption. Quaddus and Tung (2002) used Hofstede’s cultural indices of the four dimensions and found that masculinity and collectivism lead to different uses of group decision support system (GDSS).

At organizational level, researchers examined how different organizational culture (in terms of cultural types or cultural dimensions) affects IT behaviors. Hoffman and Klepper (2000) studied how three types of organizational culture (networked, communal, fragmented, mercenary) link with success with new technology assimilation and found mercenary culture more be supportive of new technology assimilation. Ruppel and Harrington (2001) used competing values framework to represent organizational culture and found that developmental culture can facilitate intranet implementation. Kanungo, Sadavarti, and Srinivas (2001) used three types of organizational culture (innovative, bureaucratic, and supportive) proposed by Wallach (1983) to examine organizational culture's impact on IT strategy, they found that innovative type cultures are found to be most closely associated with firms having a delineable
IT strategy.

These IT-culture studies (Leidner and Kayworth, 2006) conclude that culture (organizational or national) plays a common role in determining patterns of IT behaviors (including IT development, adoption, use, and outcomes, management and strategy). However, the levels (national and organizational) of analyses are separated, which could be a new research opportunities for this study. In addition, there is a lack of measuring certain cultural dimension and examining its impact on certain IT behavior, in this study we try to fill in this gap.

We also found many studies relating cultural values to management practices (Newman & Nollen, 1996; Aycan et al., 1999). In operations management area, scholars attribute culture as an important factor to affect practices and subsequently affect company’s performance. For example, Some scholars examined the relationships between culture, quality management practices and performance (Prajogo & McDermott, 2005; Naor et al., 2008). These studies proved that culture has a direct impact on management practices in general.

However, all of these studies emphasize the impacts of culture on management practices and IT behaviors respectively. We believe the existence of the relationships among culture, IT behaviors and management practices. In this study, we are not going to examine all IT behaviors, we focus on the decisions an organization makes upon ERP systems, and these include the willingness to use ERP system and the choices of using certain type of ERP system. We are not going to examine management practices in general; we focus on SCM practices, as ERP is closely related to SCM. Technologically, ERP is said to be the backbone of SCM, the integration of ERP and SCM is a natural and necessary process in strategic and managerial consideration, the most important trend for ERP vendors today is the integration with SCM (Tarn et al., 2002). Therefore, we suggest that SCM practices can directly affect an organization’s ERP decisions. In addition, we also believe that different companies adopt different SCM practices under different levels of supply and demand uncertainties they face, that is, they have different supply chain strategies (SCS) and subsequently practice differently in supply chain management (Mason-Jones et al., 2000; Christopher & Towill, 2002; Lee, 2002).

3. Research Model and Hypotheses
Based on the discussion above, we suggest that cultural differences could be the important reasons contributing to the phenomenon that existing Western-based ERP systems cannot be directly adopted in Chinese companies. For most management theories (i.e. ERP, SCM etc.) developed in the Western hemisphere, they are often assumed to be universally applicable (Zhao, et al., 2006), but this supposition is based on the premise that organizational culture and practices are strong enough to overwhelm the effects of national culture (Hofstede, 1993). However, there is a lot of evidence that national culture is stronger than organizational culture and its effect is quite robust (Zhao et al., 2006). Western-based theory or tools might not be appropriate in Chinese context (Leung et al., 2005). Thus, considering that most management initiatives are designed and developed by Western professionals and the structures and processes embedded in these initiatives reflect Western cultures, which make it harder to achieve success in different cultural contexts like China.

To settle the problems regarding of ERP systems, we put forward with the following conceptual model, which represents the relationships among culture, management practices and IT behaviors.

Figure 1: the basic conceptual model

In this study, we hope to find out the cultural factors that affect SCM practices and subsequently affect an organization’s ERP decisions. In addition, we want to examine the role of supply chain strategies in SCM and ERP decisions. Therefore, we put forward with the following hypotheses.
Hypothesis 1: organizational culture has a significant effect on an organization’s decision upon ERP systems;
Hypothesis 2: organizational culture has a significant effect on an organization’s supply chain management practices;
Hypothesis 3: an organization’s supply chain strategy has a significant effect on an organization’s supply chain management practices;
Hypothesis 4: an organization’s supply chain management practices have a role as a mediator between organizational culture and an organization’s decision upon ERP systems;
Hypothesis 5: an organization’s supply chain management practices play a role as a mediator between an organization’s supply chain strategy and an organization’s decision upon ERP systems.

4. Research Methodology
To prove the existence of the relationships among organizational culture, SCM practices and ERP decisions proposed above, we adopt an empirical method and develop a structuralized questionnaire to collect data to examine the research model and hypotheses. The whole study includes three stages:
In the first stage, we conduct a comprehensive literature review and factory visits, interviews with managers (mainly CIOs, production managers). The subjects of these field studies are those manufacturing.
companies running in China, we define an ERP user company as one that has installed at least the basic modules of an ERP system. Based on the findings of the literature and field studies, we develop and fine tune a questionnaire for data collection.

In the second stage, we will conduct data collection in the industries. We choose two different industries to facilitate the future comparison of this study. This will include several comparisons: within industry comparison and between industries comparison. We also compare according to different ownerships of the companies investigated.

In the last stage, we will analyze the data and explain the findings, after which some suggestions upon ERP systems and SCM practices for ERP vendors as well as organizations that are going to adopt ERP systems will be put forward.

5. Findings, Discussion and Further Plans
To help us to validate the conceptual model and develop an instrument to prove the theory we propose, we conducted some field studies in some Chinese firms. We chose three companies which are quite different in terms of ownerships to conduct our site visits: a local Chinese state-owned enterprise (SOE) (namely S Company), a local Chinese private company (namely P Company) and a Hong Kong private company running in China (namely F Company).

Before we went to visit these companies, we used email and telephone to contact the person who is in charge. We used a draft questionnaire which is an open-ended based as a guideline to interview the managers of the companies. The questionnaire covers the constructs defined in the research model above. We asked them the facts they choose ERP systems and their usage of ERP systems, we also asked them their SCM practices in terms of supplier relationships, customer relationships, lean production, information sharing etc. the tables in appendix show the details of the findings we summarized from the site visits and the responses from the questionnaire.

From the findings in factory visits and interviews, we basically see the existence of the relationships among culture, SCM practices and ERP decisions. What is more important is to empirically prove existence of these relationships. Therefore, we have developed a questionnaire including organizational culture, SCM practices, ERP decisions and supply/demand uncertainties.

As the theory we put forward in the beginning, cultural differences could be the important reasons contributing to the phenomenon that existing Western-based ERP systems cannot be directly adopted in Chinese companies. We add efficiency-oriented vs. flexibility-oriented as a dimension of SCM practices, of which we think could be a dimension to differentiate Chinese local companies and the Western companies. We also add Guanxi (interconnections and relationships) as a dimension of organizational culture, of which we think is an important dimension of Chinese culture. In the next stage, we will fine tune the questionnaire through discussion, field study and pilot test. Especially, we want to find out those cultural dimensions to differentiate Chinese and Western culture. After this, we will conduct our data collection in China and hope to prove the theory we put forward.

References


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### Appendices: the findings from Interviews

#### Table 1: ERP decisions and usage of the three companies

<table>
<thead>
<tr>
<th></th>
<th>S Company</th>
<th>P Company</th>
<th>F Company</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ERP system used in the organization</strong></td>
<td>UFIDA U8 ERP (embedded with UFIDA finance)</td>
<td>Self-developing ERP + Kingdee finance software</td>
<td>Microsoft Axapta + Kingdee finance software</td>
</tr>
<tr>
<td><strong>Modules used in the ERP system</strong></td>
<td>Inventory management, Human resource management (HRM), Finance management</td>
<td>Production management, Purchase management, Order management, Customer service</td>
<td>Production planning, inventory/warehouse management, logistics management, order and sales management, purchase management, HRM</td>
</tr>
</tbody>
</table>

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## Supply Chain Management Practices and Organization’s Decision Upon ERP Systems

### Table 2: SCM Practices of the three companies

<table>
<thead>
<tr>
<th>SCM Practices</th>
<th>S Company</th>
<th>P Company</th>
<th>F Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategic Supplier relationships</td>
<td>Very stable in supply</td>
<td>The company is weak in bargaining with suppliers, supply uncertainty becomes a problem for the company</td>
<td>A few suppliers become strategic suppliers and they affect the company’s product development</td>
</tr>
<tr>
<td>Customer relationship</td>
<td>The demand from customers are stably forecasted</td>
<td>Many communications with customers including before and after sales;</td>
<td>Few feedback and communication with customers, but the company also builds up long term relationships with customer; stable customer groups have been built up.</td>
</tr>
<tr>
<td>Information sharing</td>
<td>N/A</td>
<td>Less information shared with suppliers but more with customers</td>
<td>More information shared with suppliers but less with customers</td>
</tr>
<tr>
<td>Internal lean production</td>
<td>N/A</td>
<td>The company completely practices pull-production, ERP system is used to facilitate the design and planning for each kitchen to reduce error and waste.</td>
<td>The company keeps compressing cycle time and reducing waste in production; they try their best to reduce inventory level and practice pull-production</td>
</tr>
</tbody>
</table>

### Table 3: Supply and demand uncertainties of the three companies

<table>
<thead>
<tr>
<th>Uncertainties in supply and demand</th>
<th>S Company</th>
<th>P Company</th>
<th>F Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Uncertainty</td>
<td>Low</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>Demand Uncertainty</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
</tr>
</tbody>
</table>

### Table 4: Organizational culture in the three companies

<table>
<thead>
<tr>
<th>Cultural dimensions</th>
<th>S Company</th>
<th>P Company</th>
<th>F Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power distance</td>
<td>High, The ranking and status in the company is clear, the organizational structure is like a pyramid.</td>
<td>Low, good relationships have been built up between common staffs and the bosses, employees participate in important decision making</td>
<td>Low, employee participate daily management issues of the company, organizational structure is relatively flat</td>
</tr>
<tr>
<td>Uncertainty avoidance</td>
<td>High, as the foods are closely related to human health and life, risk should be avoided</td>
<td>Low, the company makes many efforts to import new techniques and theories.</td>
<td>High, as the company produces dangerous chemicals, trial and errors are made very carefully</td>
</tr>
<tr>
<td>Collectivism vs. individualism</td>
<td>Collectivism, this company is a traditional SOE in China</td>
<td>Collectivism, employees like to work as a team and work for the good of the company</td>
<td>Collectivism, employees regards them as part of the company and like to work as a team</td>
</tr>
<tr>
<td>Open system vs. close system</td>
<td>Medium</td>
<td>Open system, new employees are easy to fit in the company;</td>
<td>Open system</td>
</tr>
<tr>
<td>Pragmatic vs. normative</td>
<td>Normative, the clients are mainly from their chain stores</td>
<td>Highly pragmatic, the company tries the best to get customers, and to satisfy customers</td>
<td>Pragmatic, the company tries their best to satisfy the customers</td>
</tr>
</tbody>
</table>
CORPORATE SOCIAL RESPONSIBILITY INITIATIVES OF MAJOR ASIAN AIRLINES

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Abstract
Corporate social responsibility (CSR) plays an important role in the formation of airlines’ strategies due to the unique characteristics of the airline industry. Nevertheless, CSR in the airline industry has received relatively little attention from academics. The purpose of this study is to present a preliminary exploration of the CSR issues being addressed and reported by twelve major Asian airlines. This research is exploratory by nature and is based on the CSR reports published by the selected airlines and related CSR information on the company websites. The main focuses of major Asian airlines’ CSR commitments and practices are identified, which will set the foundation for future enquiry and research.

Keywords: Airline, Corporate Social Responsibility, Asia

Introduction
Corporations are inseparable from society. Nowadays, the responsibility of corporations is not solely providing products and services; it must also take care of the welfare of the various stakeholders in society [1]. Consumers’ expectations for firms to assume more social responsibilities are rising as well. As a result, there is a growing attention to the topic of corporate social responsibility (CSR) from the corporate world.

In view of the unique characteristics of the airline industry, CSR may play an important role in the formation of airlines’ strategies. First, the flying of airplanes will adversely affect the global environment [2]. Airlines with a cause for environmental protection can create favorable public image. Second, the fact that the airline industry is characterized by growing competition and airlines are offering increasingly similar products and services in the marketplace makes the promotion of CSR an attractive differentiation strategy. Lastly, international airlines operate in multiple countries and are increasingly expected to fulfill their responsibilities as a corporate citizen to meet the expectations of various stakeholders and customers [3]. As such, airlines can take advantage of the positive effect of implementing CSR.

In response to the global trend towards CSR, this study aims to investigate the status and progress of CSR activities in the airline industry in Asia where the air transport will experience the highest growth rate among all other areas.

Corporate Social Responsibility
CSR has been gaining momentum across the business community as a growing number of companies recognize that businesses are part of society and the impacts they have on the society. There seems to be no universally agreed definition of CSR. Frankental even argues that “CSR is a vague and intangible term which can mean anything to anybody, and therefore is effectively without meaning” [4]. Holmes and Watts, on behalf of the World Business Council for Sustainable Development (WBCSD), provide a reasonably representative definition as “the continuing commitment by businesses to behave ethically and contribute to economic development while improving the quality of life of the workforce and their families as well as of the local community and society at large [5]. It is generally agreed that CSR refers to the obligations of the firm to society [6]. Carroll suggests that CSR includes four kinds of responsibilities: economic, legal, ethical, and philanthropic. The economic responsibility refers to the firm’s obligations to be productive, profitable, and to maintain wealth. Firm’s legal responsibility refers to carrying out their activities within the confines of legal requirements. Their ethical responsibility refers to having ethical codes, norms going beyond mere legal frameworks, and being honest in their relationships with their customers and their own employees. Finally, the discretionary component includes voluntary or philanthropic activities aiming to raise the well-being and development of society as a whole [7]. The Commission of the European Communities identifies an internal and an external dimension to a company’s approach to CSR. The former concerns socially responsible practices within the company while the latter extends outside the company into the local community and beyond and involves a wide range of external stakeholders [8].
The development of CSR reporting has witnessed three stages. The first stage dating from the early 1970s was mostly in the form of advertisements and annual reports that focused on environmental issues but not directly linked to corporate performance. The second stage in the late 1980s emphasized the introduction of a social audit, which examined the social responsibility performance of companies with respect to all affected stakeholders. The third stage beginning from the 1990s was evidenced by the strengthening of social audit by the introduction of externally set and certified standards [9].

**Method**

In order to review the nature of the agendas being pursued within the airline industry, twelve airlines based in Asia were selected for study. They are China Airlines (CAL), Eva Air (EVA), Japan Airlines (JAL), All Nippon Airways (ANA), Korean Air, Asiana, Cathay Pacific, Singapore Airlines (SIA), Garuda International, Philippine Airlines, Malaysia Airlines, and Thai Airways. An internet search for CSR information on the company websites was undertaken which revealed some variation of CSR information put on the websites by the selected airlines.

Only three airlines (JAL, ANA, and Cathay Pacific) produce standalone CSR Reports. Korean Air and Asiana publish a comprehensive and detailed Sustainability Report, respectively, outlining the company’s social responsibility, environmental soundness, and economic achievements. The majority of the selected airlines present their CSR information in their annual reports and one provided very limited CSR information on the company website (Table 1).

The selected airlines present CSR issues under a variety of headings. This study follows Jones, Comfort and Hiller’s classification of marketplace, workplace, community, and environment in an attempt to capture CSR agendas as reported by the selected airlines [9,10].

**Results**

**The marketplace**

Safety is the most important social responsibility for the aviation industry. All of the selected airlines stress their commitment in the pursuit of flight safety. Cathay Pacific, for example, establishes a series of safety performance targets including zero accidents, zero high risk or severe incidents, and regulatory report rates below 4 per 1,000 flights. In 2008, Cathay Pacific only has a single serious injury and zero passenger fatalities. To ensure passenger safety, Cathay Pacific has implemented an airline Safety Management System (SMS) that manages safety as an integral part of its overall business. In addition to safety, the airlines report a number of issues relating to the marketplace. Among them, customer service receives the most widespread attention. Being a service-intensive industry, responding to customers’ needs is at the heart of airline businesses. Cathay Pacific, for example, measures customer satisfaction through ongoing Reflex Passenger Survey which collects around 30,000 responses across all cabin classes for both Cathay Pacific and Dragonair per month. In the beginning of the ANA Group’s CSR Report 2009, the company reports the preventive measures for tow incidents occurred in 2008 that significantly impaired stakeholder trust in the ANA Group.

As an international business, any violation of applicable antitrust and competition rules may cost millions for airlines. Cathay Pacific announced it had reached an agreement with the United States Department of Justice under which it pledged guilty to a violation of the US Sherman Act and paid a fine of US$60 million. Cathay Pacific has a Competition Compliance Office which ensures that the airline, and all its employees, complies with the airline’s antitrust policy and other competition laws. The airline has established the competition compliance guidelines and organized workshops and training courses on this issue since 2007.

Increasingly, airlines are requesting their business partners to do their best on CSR as well. Airlines work closely with their suppliers to ensure that ethical standards and practices are implemented throughout the procurement and supply chain management processes. Cathay Pacific’s suppliers were sent a Supplier Code of Conduct questionnaire in 2007 and 2008. No bribery case was reported in 2008. Further, Cathay Pacific encourages its partners to make significant contributions on their social and environmental performances in their respective fields.

**Workplace**

All the selected airlines emphasize that safety and people are at the core of their organizational culture and they continually strive to provide a safe and harmonious work environment.

Cathay Pacific sets a variety of safety performance targets in the areas of operational safety, passenger safety, food safety, staff safety, and public health. The company stresses the importance of employee engagement in the form of consultation with different members of its staff and ensures that adequate feedback mechanisms are available. At Cathay Pacific, the Cabin Crew Consultative Group composed of a diverse range of cabin crew helps identify and articulate issues such as an alignment of...
retirement age, absence management, hourly paid crew issues, and the different aspects of their working environment. For example, a great deal of attention has been focused on galley services and equipment as well as handling baggage which accounted for the majority of the cabin crew injuries in 2008.

Korean Air reports a special section of Ethical Management at the very beginning of its Sustainability Report of 2009. The company instituted the Korean Air Ethical Charter in 2000, which provides guidelines for the employees regarding ethical behavior in business activities. In addition, Korean Air entered into the UN global Compact in 2007 to further upgrade the standard of its ethical management practices and to actively fulfill its corporate social responsibilities. In order to improve workplace relationships and employee morale, Korean Air has created an Employee Counselling Center to resolve complaints and receive suggestions from employees. The company is also proud of its industry-leading level of wages and incentives which is effective in promoting financial stability and fostering a positive workplace environment. As an example, new employees with Bachelor degree are paid at a rate of 310% of Korea’s legal minimum wage.

Community
The selected airlines recognize the impacts they may have on the communities within which they operate and they all report on these issues in their CSR reports and information. The majority of airlines report their efforts to charity contributions to local and international organizations. Asian, for example, has been working with the Korean Committee for UNICEF (United Nations Children’s Fund) to conduct Change for Good collections on its international routes. In spring each year, the company has held a bazaar, in which they sell food and goods donated by its employees to contribute the profit to help the underprivileged. Korean Air contributes to the well-being of local communities through global art and cultural sponsorships; for example, it enters into a sponsorship of a multimedia guiding service in Korean language with three of the world’s most famous museums.

Cathay Pacific engages in a variety of activities both in Hong Kong and the countries to which it flies. The “English on Air” educational program is designed to provide students with a chance to practice English with the multinational English-speaking pilots, cabin crew, and staff while visiting Cathay Pacific City. The Cathay Pacific Volunteers Team, set up in 2007, contribute significantly to various community activities in Hong Kong. Being an international airline, Cathay Pacific’s community investments also extend to communities outside of Hong Kong. For example, staff in Sri Lanka pool efforts for a community project at the Children’s Convalescent Home, which provides refuge for abandoned children. In Singapore, the company is involved in various initiatives supporting Habitat for Humanity, a non-profit organization addressing poverty and housing needs.

The JAL Group started a “Wings of Love” program in 1988. With this program, students from children’s homes across Japan are invited for a three-day trip to Tokyo. Every January, two employees from the JAL Group are selected to run the “Wings of Love” program office and plan safe and practical activities for the children. In addition, JAL collaborates with the JAL Foundation by providing air tickets to participants in various programs. Interestingly, JAL gets close to the community through sports, such as women’s basketball, men’s rugby, and cheer leaders. The women’s basketball team participates in the national tournament each year and holds training sessions for young students in different cities.

Environment
All of the selected airlines recognize the aviation industry’s relatively small but growing contribution to the environment and all report on environmental issues and agendas. These environmental issues include climate change, fleet modernization, air traffic management, aircraft maintenance, noise management, inflight waste management, and initiatives on the ground.

Cathay Pacific, for example, was among the 140 major companies signing the Poznan Communique’ on Climate Change and became a founding member of the Aviation Global Deal Group, which aims to contribute to the debate to include emissions from international aviation in a global climate change treaty. CO2 accounts for the majority of the greenhouse gases, which are believed to be the primary cause of global warming. Fuel burn is the major source of CO2 emissions. In 2008, Cathay Pacific produced a total of 14.4 million tonnes of CO2 emissions, bringing in a total efficiency of 22.5% since 1998 and achieved an efficiency gain of 6% over 2005. The company also continues its fleet modernization plan by introducing newer and more fuel-efficient aircraft such as 777-300ERs, 747-400ERFs, and Airbus 330-300s and phasing out older aircraft types. This will exert positive impacts on fuel efficiency through reduced fuel consumption and fleet maintenance costs. To increase air traffic efficiencies, Cathay Pacific used two new shortened routes on Hong Kong to Europe routes and resulted in 330-300s and phasing out older aircraft types. This will exert positive impacts on fuel efficiency through reduced fuel consumption and fleet maintenance costs. To increase air traffic efficiencies, Cathay Pacific used two new shortened routes on Hong Kong to Europe routes and resulted
in a savings of between 0.6-0.9 tonnes of CO₂ per flight on these routes. Cathay Pacific also makes use of real time wind data to generate flexible flight tracks for dynamic flight planning. By flying these optimized routes, Cathay Pacific is able to reduce the amount of fuel burn and CO₂ emissions. In addition, Cathay Pacific is famous for its carbon offset program, FLY greener, which offers passengers the options of using cash or frequent flyer miles to pay for their offsets. In 2008, the program has encouraged its passengers to offset 3,457 t CO₂. Cathay Pacific has set up an Environmental Affairs Department to ensure the implementation of its environmental commitments and the company has been accredited the ISO 14001 Environmental Management System. As to noise management, Cathay Pacific continues to invest in quieter aircraft such as Boeing 747-8 freighter equipped with new GEnx engines, and follow noise-reducing operating procedures during take-off and landing. A Boeing 747-8 will make these aircraft quieter at take-off than a Boeing 747-400.

JAL addresses a number of environmental issues in its CSR Report. In 2006, JAL established the Operations Division Team-6%, which communicates directly with all flight crew members to fight against global warming. Some simple measures are adopted by JAL’s flight crew to reduce fuel burn, such as taxiing to the arrival gate on three rather than four engines and making aircraft lighter by offloading unnecessary personal effects. Other measures include introducing porcelain tableware, which is 20% lighter, for the meal service in First and Business classes, using new lightweight cargo containers, uploading fewer amount of water on each flight, etc. In 2006, JAL’s total CO₂ emissions were 15.8 million tons, down 6.5% from the previous year. In 2008, the ANA Group received the “Eco-First” designation from the Ministry of the Environment of Japan. The company presents a section of “JAL and the Environment” on its website, outlining its efforts on environmental action program, conservation initiatives, and social action program.

Conclusion
The majority of the major Asian airlines demonstrate their commitment to CSR in different ways of reporting. These reporting identify priority areas of most concern from both the company and the society. Nevertheless, the content and extent of these reporting exhibit marked variations.

Cathay Pacific, JAL, and ANA produce dedicated and detailed CSR reports on annual basis. Korean Air and Asiana report their social responsibility initiatives in a broader and comprehensive Sustainability Reports. Some airlines, like China Airlines and Eva Air, devote a portion of their annual reports to CSR. The general themes of social responsibility reported in this study appear to cover issues in the marketplace, the workplace, the environment, and the community. Flight safety stands out as the most important social responsibility, followed by customer relations.

It must be pointed out that simply having produced a CSR report does not imply that it is implemented. On the contrary, companies may actually support and contribute significantly to social responsibility without producing a CSR report [8]. Further, it is suggested that an industry-side framework for CSR reporting be developed to allow inter-airline comparisons to be made [11].

References
Table 1. Forms of CSR reporting

<table>
<thead>
<tr>
<th></th>
<th>Standalone CSR Report</th>
<th>Standalone Sustainability Report</th>
<th>Standalone Environmental Report</th>
<th>CSR information in annual report</th>
<th>CSR information on company website</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAL</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>EVA</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>SIA</td>
<td>✓ (-2008/2009)</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
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<tr>
<td>Garuda</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Philippine Airlines</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malaysian</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Thai Airways</td>
<td></td>
<td></td>
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</table>
THE RELATIONSHIPS AMONG SEA-FOOD RESTAURANT SERVICE QUALITY, PERCEIVED VALUE, CUSTOMER SATISFACTION AND BEHAVIORAL INTENTIONS USING STRUCTURAL EQUATION MODELS: A CASE OF PENGHU

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Abstract
To identify the relationships among sea-food restaurant service quality/perceived value/satisfaction and behavioral intentions, this research establishes a study structure and formulates six hypotheses from the related literature reviews. Structural equation models were used to validate the relationships based on the surveyed sample collected from the restaurants’ tourists. The findings indicate that overall sea-food restaurant service quality positively and significantly influences perceived value, and overall sea-food restaurant perceived value had a significant role in influencing satisfaction. Additionally, overall sea-food restaurant perceived value and satisfaction are significant predictors of customer’s behavioral intentions. Customer satisfaction can act as a partial mediator in the relationship between overall sea-food restaurant service quality, perceived value and behavioral intentions. Restaurant’s service quality did not positively influence either the customer satisfaction or the behavioral intentions.

Introduction
During the peak seasons April to September, there are on average 500,000 tourists visiting Penghu Island to undertake the tourism/recreational activities related to humanities, geography, and natural scenery. Eating seafood became a very important activity while the tourists travel to Penghu. To satisfy the demand for sea-food, there exist a lot of seafood restaurants totaled 200 in 126.7 km² and most of them (215) are located in Makung Island where is political and economic center of the County and also the hub of traffic, having the density of 6.32 (215/34) (no of restaurant/ km²) higher than the density of 2.33 (86,000/36,000) in Taiwan Island.

In addition, the tourism at the area has distinct seasons of peak and off-peak. The competitions among seafood restaurants in spatial and temporal dimensions are intensive and unavoidable, and therefore, how to increase the market share via the differentiation, attract the tourists via the special operational properties, and thereby establish the unique image to formulate the word of mouth and increase the royalty of consumers to retain and develop the sources of customers are the important issues for the owners or operators in operation management. Due to the inconvenience of traffic and the constraints of the geographical location such as less information received and six-months off-season, Penghu County only formulates the similar operational models of the seafood restaurant. In addition, the restaurant management tends to be conservative. Most of the seafood restaurants do not have much concept of service quality. Moreover, the concept of customers’ perceived value needs to be introduced, identified and measured, even though customers’ satisfactions are highlighted by the operators. For example, the owner usually asks the guests a common question such as are you full after finished meals? The operators care about customers’ patronage but not understanding that both service quality and perceived value are the pre-causes of the customer satisfaction and also the important impact factors on the customer patronage. Therefore, the purpose of the study is to explore the relationship among service quality, perceived value, customer satisfactions and behavioral intentions in seafood restaurants and then provide the knowledge to the operators to improve the operational qualities.

Previous studies investigated the relationship among service quality, perceived value, customer satisfactions and behavioral intentions were abundant. In general, previous studies concluded that service quality directly influenced the customer satisfactions or via the perceived value to influence the customer satisfactions, and the customer satisfactions further influenced the behavior.
intentions.

In addition, the service quality and perceived value can probably influence the behavioral intentions. From the study of Oh (2000) for the customers of the independent fine dining restaurant, the main factors influencing the behavioral intentions were perceived value, customer satisfactions, past consumption experience and its reputation. Yüksel and Yüksel (2002) explored the critical factors of customer satisfaction for the customers of independent non fast-food restaurant and found that the service quality was the significant factor on the customer satisfaction. Sulek and Hlensley (2004) explored the main crucial factors to the customer patronage and dining experience, and found that food quality was the significant factor on the customer patronage only.

Lglesiás and Guillén (2004) employed the linear structural equation model to validate the decisive factors to the restaurant customers’ revisiting. From the study, they concluded that perceived value positively influenced the customer satisfaction. Chow et al. (2007) studies the relationship among service quality, customer satisfaction, and the frequency of customer patronage, by using the structural equation model for the customers of full service restaurant. It is found that the cause effect relationships between service quality and customer satisfactions, and service quality and customer patronage were significant. However, the relationships between customer satisfactions and patronage were not significant. Ryu et al. (2008) studies the relationships among restaurant image, perceived value, customer satisfaction, and behavioral intentions by using regression analysis for the customers of quick casual restaurant. The results showed that restaurant service quality significantly influenced perceived value, and image and perceived value affected customer satisfaction significantly. In addition, image, perceived value, and customer satisfactions positively influenced the behavioral intentions. Fan (2006) explored the relationships among service quality, utility value, recreational value, and behavioral intentions by using the structural equations model for the customers of chain-restaurants. The results showed that service quality positively affected consumer value, utility value, and recreational value. The perceptions of values such as utility and recreational value would be the sources of restaurant differentiation. Lin (2006) studies the relationships among service quality, perceived value, customer satisfactions, and behavioral intentions by using the structural equation model for the customers in hybrid restaurants. The results showed that the consumer’s perceived sacrifices had the negative influence on the perceived value. The perceived service quality positively affected perceived value, customer satisfactions, and behavioral intentions. The perceived value directly affected satisfactions and behavioral intentions. Wang (2006) explored the relationships among service quality, customer satisfaction, and loyalty to the customers of retrospective restaurants. From the results of regression analysis, service quality positively affected satisfactions, and satisfactions also positively influenced the loyalty. In addition, service quality positively influenced the loyalty.

From the literature reviews, we know that there are few studies aimed at the customers’ behavioral intentions in the sea-food restaurants. Therefore, the study focused exploring on the relationships among service quality, perceived value, customer satisfactions and behavioral intentions in sea-food restaurants.

**Research structure and hypothesis**

Based on the literature reviews, the research structure is shown in Figure 1. Since conservational regression methods can not be used to analyze the cause-effect relationships between the latent variables with multiple constructs, six hypotheses will be validated by using the linear structural equation models.

The six hypotheses are listed as the following statements:

- **H1**: Sea-food restaurant service quality positively influences the perceived value.
- **H2**: Sea-food restaurant service quality positively influences the customer satisfaction.
- **H3**: Sea-food restaurant service quality positively influences the behavioral intentions.
- **H4**: Sea-food restaurant perceived value positively influences the customer satisfaction.
- **H5**: Sea-food restaurant perceived value positively influences the behavioral intentions.
- **H6**: Sea-food restaurant customers’ satisfaction positively influences the behavioral intentions.

![Figure 1 The research structure](image)

**Data collection**

Eleven sea-food restaurants’ customers (tourists) were surveyed via the questionnaires by using the convenience sampling method to collect the data for analysis, and 385 questionnaires were obtained. The effective questionnaires of 365 were used to conduct the analysis. The questionnaires are divided into six parts including basic data, dining characteristic, service quality, perceived value,
The Relationships among Sea-Food Restaurant Service Quality

Customer satisfaction, and behavior intention. Where the part of the service quality we used from the scale of DINESERV to obtain the measurements composed of five constructs with 29 items. Perceived value is measured by using four items to present the perceived value of monetary price, and the customer satisfaction and behavioral intention have two items respectively. The measurement of each item employs the seven points of Likert scale including extremely disagree, strongly disagree, slightly disagree, no comment, slightly agree, strongly agree, and extremely agree.

Data analysis

The study firstly validated the simple construct by using confirmatory factor analysis, and then conducted the analysis of model fitting by using structural equation models. The values of construct reliability are in the range of 0.66~0.84, and the value of AVE are within 0.42~0.70. The factor loadings of the constructs conform to the standard suggested by Chin et al. (1997). Therefore, the four constructs fitting with internal consistency, and with constructs reliability. We used the computer software-LISEREL for specifying, fitting, and evaluating structural equation models. The model fitting results are shown in Figure 2, and Table 1. From the Table 1, we can know that the models are well fitted, for example, the value of each index is greater than the suggested value. From Figure 2, the path diagrams show that service quality (SQ) significantly affects perceived value (PV), but not significantly influences customer satisfaction (CS) or behavioral intention (IB). The perceived value significantly affects the customer satisfaction and behavioral intention. The customer satisfaction significantly affects the behavioral intention. In effect, service quality via the perceived value affects the customer satisfaction and then the behavioral intention. Table 2 summarizes the validation results of these 6 hypotheses. In addition, the service quality can be measured by using the items of the responsiveness, tangibles, and reliability, and the perceived value can be measured by using the items of food quality, reasonable price, accessibility.

Table 1 Model fitting indexes

<table>
<thead>
<tr>
<th>Index</th>
<th>Suggested Value</th>
<th>Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>χ^2/df</td>
<td>&lt;3 (Carmines &amp; McIver, 1981)</td>
<td>1.66</td>
</tr>
<tr>
<td>GFI</td>
<td>&gt;0.9 (Bentler &amp; Bonnett, 1980)</td>
<td>0.97</td>
</tr>
<tr>
<td>AGFI</td>
<td>&gt;0.8 (Hu &amp; Bentler, 1999)</td>
<td>0.95</td>
</tr>
<tr>
<td>NFI</td>
<td>&gt;0.9 (Bentler &amp; Bonnett, 1980)</td>
<td>0.99</td>
</tr>
<tr>
<td>NNFI</td>
<td>&gt;0.9 (Bentler, 1999)</td>
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</tr>
<tr>
<td>CFI</td>
<td>&gt;0.9 (Bentler, 1990)</td>
<td>1</td>
</tr>
<tr>
<td>RMSEA</td>
<td>&lt;0.08 (Hu &amp; Bentler, 1999)</td>
<td>0.04</td>
</tr>
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</table>

Table 2 Validation results of hypotheses

<table>
<thead>
<tr>
<th>Hypotheses</th>
<th>Standardized coefficient (t-value)</th>
<th>Significant or not? (α = 0.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td>0.89 (19.04)</td>
<td>yes</td>
</tr>
<tr>
<td>H2</td>
<td>-0.04 (-0.31)</td>
<td>no</td>
</tr>
<tr>
<td>H3</td>
<td>-0.06 (-0.67)</td>
<td>no</td>
</tr>
<tr>
<td>H4</td>
<td>0.86 (7.16)</td>
<td>yes</td>
</tr>
<tr>
<td>H5</td>
<td>0.31 (2.59)</td>
<td>yes</td>
</tr>
<tr>
<td>H6</td>
<td>0.68 (9.37)</td>
<td>yes</td>
</tr>
</tbody>
</table>

Conclusions

(1) From the dining properties of tourists, most of the travel groups are composed of friends or relatives, and they obtained the messages of sea-food restaurants through the introduction of word-of-mouth and travel agents. The sea-food quality and price rationality are the main factors for tourists choosing the restaurants. Most of customers are over 5 persons in a party, and the average consumption amount per person is in range of NT$200~600. The dining frequencies of one time per half year are the most. The ratio of patronage is around 32.2%.

(2) From the results of t-test, the variable of sex significantly affects the perceived value. That is female customers have lower recognition of perceived value than male ones.

(3) From the validation results of model fitting, sea-food restaurant service quality significantly affects the perceived value, but not to the customer satisfaction and behavioral intention. However, perceived value significantly affects the customer satisfaction and behavior intention. Customer satisfaction significantly influences the behavioral intention. There are four hypotheses are valid. In general, sea-food restaurant service quality via perceived value to affect the customer satisfaction and customer satisfaction further affects the customers’ behavioral intention. In addition, the items of responsiveness, tangibles, and reliability can be used to present the latent variable of service quality, and the perceived value can be measured by using the items of food quality, rational price, and accessibility.

Suggestions

(1) Since sea-food restaurant service quality is via the perceived value to affect customer satisfaction and
behavioral intention, in operational management, the operators should emphasize on the properties of responsiveness, tangibles, and reliability, especially the responsiveness, for example, maintaining the service speed and quality (such as control of serving and the frequency of table cleaning), providing instant and speedy service (such as replenishment of warm or cold water and dining utensils), satisfying the special requirements of customers (such as cooked food without monosodium or garlic). To increase the tangibles, restaurants must have the attracting appearance, convenient parking lots, readable menu, comfortable decoration, clean toilet and dining area, comfortable seats, etc. Since these properties can increase the perception of value, the customer’s satisfaction can be increased and then results in the increase of customer patronage. However, to formulate/build customers’ perceived value is the main considering factors in management for the sea-food restaurant operators. For example, maintaining the high quality of seafood, pricing rationally, renewing or innovating menu, and creating or improving cooking methods are useful methods to increase the customers’ perceived values. In addition, the establishment of brand and possession of word-of-mouth, and retaining good relationship with travel agents are also critical issues in operation.

References
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THE SELECTION MODEL FOR COMPOUND OR PORTFOLIO RELATIONSHIPS ORIENTED IN SUPPLY CHAIN

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Abstract
As the environment changed, the inter-organizational in Supply chain has been transferred from simple relations to complex relations “Compound or Portfolio Relationships”. The main purpose of this research is to integrate external/internal resource and maintain flexible volatility of inter-organization for helping organizations/firms could increase the competitive advantage for them. To survey the current researches which discuss inter-organization in supply chain, it could be found that most literatures are focused on each simple relationship or portfolio relationship about their types and features. Our research uses multiple relative theory and interviews to perform the research. To develop theory model and analyse the nature of relations about compound relationships oriented and portfolio relationships oriented. The theoretical framework model concerns the influence of the difference selection factors between inter-organizational in supply chain. We hope this research will contribute to further studies and provide some suggestions for implementing management of the relationship between supply chains.

Keywords: Relations Oriented Selection model, Compound Relationship, Portfolio Relations, Logistic Regression, Discriminate Analysis

Introduction
With the rapidly change of business environment, the inter-organizational in Supply chain has been transferred from simple relations to complex relations. In past research on inter-organizational relationships in supply chain, lots of researchers have delved into organization development, history, partnership relations selection, relationship management, relations network formation or long-term relationship management issues. As mentioned earlier, we found that organization select which relation types will cause inter-organizational network connection and long-term relations. Furthermore, which relationship types would contribute to more benefits and synergy in an organization. Lots of pasted researcher discussed that organization development, history, partnership relations selection, relationship management, relations network formation or long-term relationship management issues. According to current literature, we found there are two types of simple relationship in inter-organizational context, Compound Relationships & Portfolio Relations. Portfolio Relations provide a mechanism for conceptualizing and managing the customer, supplier and indirect sets of relationships which surround a firm. The relations linkage may be competitive, or cooperative. Each relations linkage will cause positive or negative effects. Compound Relationships defines these complex relationships (see Figure1). Formally, we define a compound relationship as being composed of two or more simple relationships between a pair of firms. We define simple relationships as separate and distinct relationships that occur between these same two firms, such as supplier to customer, competitor to competitor, or joint partners. Essentially, a compound relationship is the set of individual simple relationships between two firms. Our research hope to build up a mechanism process to integrate external/internal resource and maintain flexibility of inter-organization to help organizations/firms could increase their own competitive advantage.

Literature review
Compound relationship
A relationship is a connection between two entities (entities can be organizations, people, societies, or even nation-states), such that the entities have explicit roles for which there are expected norms of behavior. Ross & Robinson narrow our thinking to the types of simple relationships that two firms may have with each other—for example, a supplier–customer relationship or a competitor–competitor relationship. [1]
To understand this, consider a given firm and its relationships with another firm. Ross & Robinson categorize the simple relationships that it and the other firm might undertake into four basic types: customer to supplier, in which the firm buys a product or service from the partner firm; supplier to customer, in which the firm sells a product or service to the partner firm; competitor to competitor, in which the two firms compete with each other for some resource (e.g., customers); and partners, in which the two firms work together, formally or informally, to achieve a common goal.[1]

Each simple dyadic relationship that we have discussed can be envisioned as containing a political economy and existing within a environment. Each firm must pay attention to its behavior with the other firm. Second, and conversely, performing well in one simple relationship may harm other simple relationships. Third, performing well in one simple relationship may lead to additional-relationships.

**Portfolio relationship**

This externalization of value activities is dependent on creating strong supplier partnerships in those activities that have high strategic relevance for the customer firm. The externalization process is well documented and led hierarchical structures consisting of several tiers of suppliers forming complex supply chain networks. A relationship may also have an effect on other relationships. The majority of relationship portfolio models are based on customer or supplier relationship portfolio modeling. Moreover, indirect relationships often be analyzed and managed in the purpose for competitors. The best-known models include both two and three dimensional axes along with single, two and three phase analyses [2]. The most often cited relationship portfolio models include the ones by Fiocca, Campbell & Cunningham, Krapfel, Salmond & Spekman, Olsen & Ellram and Turnbull & Zolkiewski [2, 3, 4, 5, and 6].

The definition of interconnectedness points out another important characteristic of interconnectedness. Between any two relationships (x) and (y) there can be an effect of (x) on (y): “a relationship affects other relationships.” At the same time there can be an effect of (y) on (x): “a relationship is affected by other relationships [7].” Thomas develop six different cases of interconnectedness between any two relationships [7]:

1. **Neutrality Effect**: No interconnectedness between two relationships exists when the two relationships are totally independent.
2. **Assistance Effect**: A one-sided positive effect between two relationships can occur when experiences made in one relationship can be used in the other.
3. **Hindrance Effect**: If one relationship is hindering the other and there is no impact in the opposite direction, there is a one-sided negative effect.
4. **Synergy Effect**: Two-way positive effect means that both relationships support or even necessitate or presuppose each other.
5. **Lack Effect**: Between two relationships a positive and a negative impact can coexist.
6. **Competition Effect**: Two relationships can also weaken or even exclude each other.

Thomas proposed that portfolio relationship
have some features. The following examples illustrate interconnectedness of relationships [7]:

**System selling**
Within the process of system selling, heterogeneous contributions of more than one company are brought together in order to provide a “complete” or “complex” solution to the customer. Taking computer systems as an example, hardware, software and installation as well as customizations or adaptations will be offered in one package to the customer by different, but cooperating companies.

**Combination advantages**
Combination advantages occur when companies allow access to, or pool, one another’s (homogenous) resources.

**Mediation**
Companies can mediate inter-organizational relationships through actively promoting the relationship initiation process between two companies (e.g., the European Commission pays mediators which initiate inter-organizational cooperation’s within the SPRINT network).

**Surety**
Like the previous examples, surety can only be understood by analyzing at least three parties. In an industrial setting, a surety can be given by one actor for enabling two other actors to do business together.

**The interact factors for compound or portfolio relationship**

**Dominate relationships**
An issue to consider is which of the simple relationships that constitute a compound relationship is likely to be more important than the others. Ross & Robinson (2007) expected that the dominant simple relationship between the two firms is the competitor–competitor relationship and that the supplier–customer relationship is less important, though this may change with time and changing market circumstances [1]. The first of these, and we speculate the strongest, is path dependence [8], expressed in this case in the primacy of the original relationship. Two firms that began with a certain relationship (e.g., supplier to customer or competitor to competitor) may find it difficult to introduce norms that are appropriate to other simple relationships into the compound relationship. The other two factors are perhaps more rational; they consider the economic and strategic realities of the various simple relationships. There may be other factors that influence which simple relationship is the dominant relationship, but we believe that these three are especially important ones. **H1:** The dominant relationships are positively effect the selection of compound relationships and negatively effect selection of portfolio relationships.

**Relations stability**
Relationship stability is a consistent reflection of dyadic favorable relational attitudes in an active working relationship which continues for a period of time.

**Bidirectional Relationship**
The two firms might simply be influencing each other in one simple relationship (e.g., a partner relationship in which influence is bidirectional). Anderson & Narus (1990) proposed that Bidirectional relationship [9].

**Long-term Relationships**
In the present study, two firms build trust to sustain interfirm long-term relationship development. On the other interfirm trust will decrease the partnership to against the opportunism [10]. The literature on trust suggests that confidence on the part of the trusting party results from the firm belief that the trustworthy party is reliable and has high integrity. Essentially, future interaction between exchange partners provides an opportunity to reward good behavior and punish opportunism [11].

**Relative Powers**
All relationships have power levels; that is, the two firms in the relationship each have some power [1]. **H2-1:** Bidirectional relationships are positively effect the selection of compound relationships and negatively effect selection of portfolio relationships. **H2-2:** Long-term relationships are positively effect the selection of compound relationships and negatively effect selection of portfolio relationships. **H2-3:** Relative powers are positively effect the selection of compound relationships and negatively effect selection of portfolio relationships.

**Relational Risk**

**Opportunistic Behavior**
Many scholars posit that when a party believes that a partner engages in opportunistic behavior, such perceptions will lead to decreased trust and increase the competitiveness between each other [12, 13, and 14]. Ross & Robinson (2007) mentioned that compound relationships can act as a safeguard against opportunism in at least two ways

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The 9th International Conference on Electronic Business, Macau, November 30 - December 4, 2009
H3-1: Opportunistic behavior is positively effect the selection of compound relationships and negatively effect selection of portfolio relationships.

Conflict
Conflict is refer to Firat et al. (1975) & Etgar (1979) marketing channel members to comprehended keeping other channel members from reach goals. Conflict represents the overall level of disagreement in the working partnership [11]. Conflict is between partners’ goals, resource share and degree of incompatibility of activities [17].

H3-2: Conflict is negatively effect the selection of compound relationships and positively effect selection of portfolio relationships.

Uncertainty
Uncertainty is referring to transaction cost theory [11] and somewhat contrary to the transaction efficiency approach, resource dependence theory [19]. Ross & Robinson (2007) have raised issues related to how the relationship works both socially and economically [1]. We now turn to the political economy framework [20, 21, and 22] and explicitly delineates the internal sociopolitical and economic structures and processes of an institution and the external environment that influences them.

H3-3: Uncertainty is negatively effect the selection of compound relationships and positively effect selection of portfolio relationships.

Intelligence Property
About this topic we interview with some corporate, senior South Asia Business Unit Commissioner, Kenda Rubber, Information Division Section chief, Formosa Plastics Gao Sheng Commissioner. After interview with those corporate, we can sort out that many mature products and technologies had their own patents. Each vendor conduct the business strategy to protect the development of its products and intellectual property, that means patents become one of business strategy. Therefore, at this time, before moving on to the products and technology developers, can significantly reduce its research and development costs, but the risk will stop improvement. For those who follow the products and technologies, wishes to reduce the risk and lower the cost of research and development for product innovation, we provide the hypothesis 4 as following.

H4: Intelligence property is negatively effect selection of compound relationships and positively effect selection of portfolio relationships

End customer orders allocation
Mentzer et al. (2001) that the Organization for customer orders allocation will be part of the four individuals linked quality, to receive orders to ship the number of quality information and ordering process, the four organizations will become part of the control orders Possession of the main factors [23]. The aim of the customer-oriented and establish a good communication mechanism to avoided the bullwhip effect, we provide the hypothesis 5 as following.

H5: End customer orders allocation is positively effect selection of compound relationships and negatively effect selection of portfolio relationships

The cost of one-stop
In economics and cost accounting, cost of one-stop describes the total economic cost of production and increase variable costs, which vary according to quantity produced such as raw materials, plus fixed costs, which are independent of quantity produced such as expenses for assets like buildings.

H6: The cost of one-stop is positively effect selection of compound relationships and negatively effect selection of portfolio relationships

Research Method
We started a point of view as the firms’ production managers of top 2000 manufacturing firms in Taiwan. The scope of research includes all the activities like forwarder got the freight from the owners’ cargo, to order the shipping space from marine transportation companies, and to deliver the freight to the destination or receiver.

Contents Validity
All measures of the survey instrument were developed from the literature. The expressions of the items were adjusted. Where appropriate to the context of marine transportation logistics. The items were to be measured on a seven-point Likert scale, ranging from ‘Strongly disagree’ (1) to ‘Strongly agree’ (5).

Pre-test and pilot-test
A pre-test was performed with four managers from different enterprises and four Ph.D. students on a questionnaire consisting of 18 items of the survey instrument for improvement in its content and
appearance. Then several large marine transportation firms were contacted to help with the pilot-test of the instrument. The respondents were asked to complete the questionnaire and provide comments on the wording, understandability and clarity of the items, as well as on the overall appearance and content of the instrument. The responses suggested only minor cosmetic changes and no statements were removed. After minor changes being made and further review by two other expert academics, the instrument was deemed ready to be sent to a large sample in order to gather data for testing our research model.

Data collection

Two rounds of survey were conducted by distributing the survey instrument in the form of questionnaire to the production managers of top 634 IT industries in Taiwan. These firms were listed in the directories of the top 5000 companies in Chinese Credit 2007 (Taiwan’s leading credit company). Therefore, the result of this survey was 64 effective responses with the total response rate of 10.09%. There was no discrepancy from the industry distribution of firms used in this survey when facilitating a chi-square to analyze the industry distribution of respondents. This suggested no non-response bias in the returned questionnaires.

Result

Assessment of the discriminate analysis

Cause that this study just confers two groups as compound or portfolio relationship oriented. Means we have just one differentiation function for our study. Per the synchronous estimation, we can have 12 forecast variables and result as table 2 and show the verification on table 3.

<table>
<thead>
<tr>
<th>Item</th>
<th>Std</th>
<th>Inter-group Std</th>
<th>F Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>History</td>
<td>0.7953</td>
<td>0.0810</td>
<td>0.88* (0.0001)</td>
</tr>
<tr>
<td>Economic importance</td>
<td>0.6093</td>
<td>0.0240</td>
<td>0.13 (0.7181)</td>
</tr>
<tr>
<td>Strategic value</td>
<td>0.6013</td>
<td>0.1184</td>
<td>3.32* (0.0001)</td>
</tr>
<tr>
<td>Bidirectional Relationships</td>
<td>0.7399</td>
<td>0.0652</td>
<td>0.65 (0.4197)</td>
</tr>
<tr>
<td>Long-term Relationships</td>
<td>0.6659</td>
<td>0.0369</td>
<td>0.26 (0.6114)</td>
</tr>
<tr>
<td>Relative Powers</td>
<td>0.7793</td>
<td>0.0109</td>
<td>0.9</td>
</tr>
</tbody>
</table>

Table 3 Verification

<table>
<thead>
<tr>
<th>IT Industry</th>
<th>Selected Portfolio Relationship</th>
<th>Compound Relationship</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portfolio Relationship</td>
<td>19</td>
<td>8</td>
<td>27</td>
</tr>
<tr>
<td>Compound Relationship</td>
<td>7</td>
<td>21</td>
<td>28</td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>29</td>
<td>55</td>
</tr>
</tbody>
</table>

Correct rate: 72.73%
Type I error: 29.63%
Type II Error: 25.00%

\[ C = \left( \frac{27}{55} \right)^2 + \left( \frac{28}{55} \right)^2 = 0.499 \times 1.25 = 50.02\% \]

Reliability Analysis

Analysis of letters degree (Reliability Analysis) is a test tool for measuring volume of letters degree and stability of the main methods. Due to Davis, et al. study found that reliability differences between the samples and used methods of measuring reliability [24]. As the result show in table 4.

<table>
<thead>
<tr>
<th>Item</th>
<th>Error variance</th>
<th>Cronbach’s alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>History</td>
<td>0.59137</td>
<td>0.685</td>
</tr>
<tr>
<td>Economic importance</td>
<td>0.61223</td>
<td>0.675</td>
</tr>
<tr>
<td>Strategic value</td>
<td>0.72837</td>
<td>0.661</td>
</tr>
<tr>
<td>Bidirectional Relationships</td>
<td>0.82008</td>
<td>0.668</td>
</tr>
<tr>
<td>Long-term Relationships</td>
<td>0.62514</td>
<td>0.682</td>
</tr>
<tr>
<td>Relative Powers</td>
<td>0.79564</td>
<td>0.670</td>
</tr>
<tr>
<td>Conflict</td>
<td>0.63640</td>
<td>0.681</td>
</tr>
<tr>
<td>Opportunistic Behaviors</td>
<td>0.93900</td>
<td>0.646</td>
</tr>
</tbody>
</table>
environment and internationalization of the industry trends, business found that in global trade liberalization and to analyze this research model. After analysis, we explores 12 hypothesis paths, and 12 main factors “Compound or Portfolio Relationships” and research defines the complex relations to be In order to study the complex relations, our hypothesis paths, and 12 main factors to analyze this research model. After analysis, we explores 12 hypothesis paths, and 12 main factors “Compound or Portfolio Relationships” and research defines the complex relations to be In order to study the complex relations, our links with each other in a significant factor. Therefore, to consider these organizations will be transformed from single to complex relationships of inter-organization in supply chain would be affected by the major single existing relationship Therefore, discuss how the exited relationship affect the selection in supply chain and compare the different relationships oriented is valuable. Under the rapid change business environment, the relationships of inter-organization in supply chain will be transformed from single to complex relationships, and complex relationships could be categorized into “Compound Relationships” or “Portfolio Relationships”. Our research has 12 hypotheses include 4 hypothesizes had been supported. Per empirical result could know that the 4 hypothesizes show as below. Hypothesis 2-2: Long-term relationships are positively affect the selection of compound relationships and negatively effect selection of portfolio relationships. Hypothesis 3-2: Conflict is negatively effect the selection of compound relationships and positively effect selection of portfolio relationships. Hypothesis 4: Intelligence property is negatively effect selection of compound relationships and positively effect selection of portfolio relationships. Hypothesis 5: End customer orders allocation is positively effect selection of compound relationships and negatively effect selection of portfolio relationships.

<table>
<thead>
<tr>
<th></th>
<th>0.56761</th>
<th>0.667</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intelligence property</td>
<td>0.71562</td>
<td>0.664</td>
</tr>
<tr>
<td>End customer order placement</td>
<td>0.70780</td>
<td>0.656</td>
</tr>
<tr>
<td>Total cost</td>
<td>0.66592</td>
<td>0.667</td>
</tr>
<tr>
<td>Cronbach’s alpha = 0.678</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Conclusion

In order to study the complex relations, our research defines the complex relations to be “Compound or Portfolio Relationships” and explores 12 hypothesis paths, and 12 main factors to analyze this research model. After analysis, we found that in global trade liberalization and internationalization of the industry trends, business environment and faced with the rapid changes in the test, as well as competitive pressures, businesses and other organizations need to have a link relationship, how to manage these types of relationships based on mutual assistance and mutual benefit. The way the relationship between the two sides strike a balance in order to bring a competitive advantage for enterprises. In the supply chain in the process of interaction between organizations, manufacturers and third-party co-operation to carry out a stable relationship, the relationship between risk and so are considering links with each other in a significant factor. Therefore, to consider these organizations will affect the decision-making or production strategy, at this stage has become one of the very important subjects. In this study, logistic regression analysis of various factors, supply chain organizations to choose between composite or co-oriented relationship. Under the rapid change business environment, the relationships of inter-organization in supply chain will be transformed from single to complex relationships, and complex relationships could be categorized into “Compound Relationships” or “Portfolio Relationships”. Our research has 12 hypothesizes include 4 hypothesizes had been supported. Per empirical result could know that the 4 hypothesizes show as below. Hypothesis 2-2: Long-term relationships are positively effect the selection of compound relationships and negatively effect selection of portfolio relationships. Hypothesis 3-2: Conflict is negatively effect the selection of compound relationships and positively effect selection of portfolio relationships. Hypothesis 4: Intelligence property is negatively effect selection of compound relationships and positively effect selection of portfolio relationships. Hypothesis 5: End customer orders allocation is positively effect selection of compound relationships and negatively effect selection of portfolio relationships.

Suggestion

Following are suggestions we provided for future research: Because compound relationship and portfolio relationships have nature of difference, additional benefits also got different distribution the additional benefited at least includes knowledge storage, knowledge sharing, information sharing, information proliferation, technology creative…etc. Therefore, discussion about the different additional benefits with different types of relationships is really valuable research. Because the overall relationships within inter-organization in supply chain would be affected by the major single existing relationship Therefore, discuss how the exited relationship affect the selection in supply chain and compare the different relationships oriented is valuable. The research design of the study goes by a cross section way, collect the data on the fix time to build up this relationships oriented theoretical framework model. That means this relationships oriented theoretical framework model could just explain the specific time but could not implement to normal situation. We suggest the further researches using vertical section research design or multiple time data collect to get the sample to build up the dynamic model to discuss how different time phase affect the dynamic selection model. The data be used in this research is stated data which were collected by questionnaires. If using the panel data to evaluate the theoretical model would increase the reliability for the theoretical mode.

References


PROBLEM SOLVING EVOLUTIONARY METHOD FOR ONTOLOGY KNOWLEDGE REPRESENTATION WITH PROTÉGÉ-2000

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Abstract
This paper studies the knowledge representation with ontology method in the Protégé 2000 system. We first analyzed the various ontological methods for knowledge representation. Then we described the OWL method used in Protégé 2000 for knowledge representation. We proposed the new method named problem-solving evolutionary method (PSEM) for knowledge representation in which it is based the OWL of Protégé 2000. Then we design the interface between the Racer inference engine and the Protégé 2000. Based on the interface built, we can use the Racer inferring engine to reasoning the knowledge. We use the PSEM to experiment the professional domain knowledge of MIS in which it is based undergraduate level. Experiments have shown that PSEM based on the Protégé 2000 is able to represent some domain knowledge well and built knowledge with OWL can be inferred by the Racer.

Keywords: Knowledge Representation, Ontology, Protégé, Problem-Solving Evolutionary Methods, Racer

Introduction
The text as a concept model for knowledge presentation has been an important component in various fields such as knowledge engineering, knowledge management, intelligent system integration, information retrieval, semantic web, etc. In recent years, the ontology has been adopted in many business and scientific communities as a way to share, reuse and process domain knowledge. Ontologies are now central to many applications such as scientific knowledge portals, information management and integration systems, electronic commerce, and semantic web services. According to O’Reilly & Associate Inc. statistics in November 6, 2002, there are 52 kinds of the tools for building ontology (also called text editing tools). For example, OntoEdit[5], KAON, WebOnto and Protégé[4], OIL[11], etc. However, these tools are used mainly in manual way to build ontology, in which it leads to time-consuming and needing great effort, easily making preference mistakes and dynamically updating difficulty. Therefore, semi-automatic methods for building ontology had been proposed and developed—ontology learning. The basic concepts of ontology learning are ontology generation, ontology mining and ontology extraction. This kind of work had done in 90s of the last century. There has informed a basic system architecture for building ontology, in which the natural language processing (NLP) and the machine learning are as principle theories[6]. Some systems in corresponding these architectural systems have also been developed such asTextToOntoL3, OntoLearn, the ASIUM system, the Mo’k Workbench, OntoLT, Adaptiva, SOAT and DOGMA etc. The results of ontology learning generally are a draft that requires to confirming by domain knowledge experts before as formal ontology to be used widely. Therefore, the tools of ontology learning often have been integrated into one of typical workable platform for ontology engineering (that is, a system that is a tool for building ontology). Then the system can obtain draft ontology by the ontology learning way to assist the knowledge engineers to build ontology. In this paper, we design a new ontology presentation process based on the ontology building system Protégé. As is well known, the Protégé is a java-based open source ontology editor by Stanford Center for Biomedical Informatics Research. Due to a consistent style with that of MS Windows applications in user interface, it is easy used and learning for common users. The hierarchy of ontology is presented with the tree structure. By clicking items in nodes of tree, users could insert and/or edit class, subclass, properties and instances etc. By that way, the ontology engineers can conceptually design the domain knowledge model without knowing specific ontology presentation languages.

Ontology-based Knowledge Representation Methods

The definition of ontology
Although there are many kinds of descriptions for ontology, it has a basic acknowledge intrinsically that ontology is concerned with static domain knowledge (maybe specific domain, or more widely scope) that as a semantic foundation used for different subjects (people, agent, machine etc.) to communicate (messaging, interoperating, sharing etc.) In other words, ontology will provide clearly defined words lists that can be used to describe the relationship
among the concepts so that the users can reach a consistent concept in a specific domain. An ontology describes the concepts and relationships that are important in a particular domain, providing a vocabulary for that domain as well as a computerized specification of the meaning of terms used in the vocabulary. Ontologies range from taxonomies and classifications, database schemas, to fully axiomatized theories [4]. However, because people are not complete understanding the ontology initially, the definition of ontology is developing with the progress of technologies and studies in academia. In this paper, we follow the definition of Studer[9], that is, “an ontology is a formal, explicit specification of a shared conceptualization”. This definition is implicitly 4 level meaning[2][3][6]:

- Conceptualization: refers to an abstract model of some phenomenon in the world by having identified the relevant concepts of that phenomenon.
- Explicit: the type of concepts used, and the constraints on their use are explicitly defined.
- Formal: refers to the fact that the ontology should be machine readable, which excludes natural language.
- Share: reflects the notion that an ontology captures consensual knowledge and the concept sets that are accepts as s related domain knowledge, that is, it is not private to some individual, but accepted by a group.

**Modeling Primitive of Ontology**

López and Pérez organize the ontology with the classification methods and induce 5 basic modeling primitives[7]:

- Classes or Concepts: refers to any events, such as work description, function, behavior, policy and reasoning process etc. From the viewpoint of semantics, it is an objective set. A frame has been used for its definition, including name of concept, relationship set with other concepts, and description of concept with natural language.
- Relations: interaction among concepts in domain, formally, it is an n-dimension subset of Cartesian product: R: C1 × C2 × ⋯ × Cn. For example, subclass-of. In semantic relationship, it is corresponding to a set-tuple of objective.
- Functions: a class of specific relationship. The nth element can only be decided by the earlier n-1 elements in the relationship. Formally, F: C1×C2×⋯×Cn−1→Cn. For example, Mother-of(x, y) denotes y is the mother of x.
- Axioms: to stand for truth-functionally assertion, e.g. concept B belongs to scope of concept A.
- Instances: stands for element. An instance is an objective in semantics.

**Description Language of Ontology**

OWL (Web Ontology Language) has been appeared in 2001[2]. The aims of OWL developed by W3C Web-ontology working group is to provide a kind of language that can be used in various application languages. OWL is W3C organization recommended ontology description language in 2004. It is a semantic markup language that used to distribute and share ontology in WWW. OWL is developed on the basis of DAML+OIL (DARPA Agent Markup Language + Ontology Inference Layer) as an extension of RDF (Resource Description Framework). Its aim is to provide more primitives so that it can support more rich language representation and reasoning. W3C also published a draft framework for web service executed on OWL in order to provide cases and solutions for next generation Web service. According to different demands, OWL has three increasingly-expressive sublanguages: OWL Lite, OWL DL (Description Logics), and OWL Full.

**Conclusions Problem Solving Evolutionary Method for Ontology Presentation**

Problem-Solving Evolutionary Method is originally coming from the practical application of information technology. The aims of introducing ontology to information technologies are for the computers to understand the semantic information in knowledge domain and provide more intelligent service for humans. This process, in fact, is also a software producing procedure. Therefore, software engineering method can be used as a reference for building ontology in information technologies.

In process of software development, four kinds of activities are often conducted: making specification of software, software coding, software confirmation, and software evolution. In corresponding for this process, the basic activities in the procedure of building ontology including: 1 )Planning, this activity includes requirement analysis, domain determination, ontology specification making (aim, scope, method and use of ontology); 2 ) building ontology: knowledge acquisition, analysis, conceptualization (concept abstract, vocabulary determination), formalization (coding), integration, documenting; 3 ) Confirmation and evaluation: refining and confirmation, assessing correctness and validity; 4 ) maintaining and evolution. We find that this process is consistent with that of problem-solving method used in software engineering. This process has been noted by Fernández-López et al [2]. In the ontology research, Eriksson et al. [10] proposed a framework
for tasking modeling with problem solving method. However, they did not consider the evolutionary characteristic in problem-solving method. In the next sub-section, we introduce the problem solving methods with integrated evolutionary process.

**PSEM**

By our aforementioned analysis, we propose a new building ontology method, called problem solving evolutionary methods (PSEM). The framework is shown in Figure 1. Note that this figure is different with that of Yu et al. [1] presented in that we have integrated the evolutionary process in ontology knowledge refining process. The PSEM has the following steps to build ontology:

1) Requirement analysis. In this step, we need to clarify the objectives, scope, application and users for ontology to be built. On the face of it, building domain ontology is served for a machine (computer), and also it should be understandable for the machine. However, on the final aim, the ontology built is serving better information for human being. Therefore, similar to the process of software development, in the initial process of building ontology, we should understand and determine the application background and specific requirements. Generally, we can answer the following questions to clarify the demand: which domain knowledge will we build ontology? What kind of application does it for? Who are the target users? How long time does it need to build ontology? Which kind of describing language should it be choose?

2) Planning. In the second step, based on sufficiently understanding available resources and requirement specification, the ontology builder will work out the project specification (proposal). The proposal will include objectives, methods, task allocation, and time demanded of project development. This proposal is quite necessary in practical applications. However, in some project it is often omitted by developing team. Failure implementation in many projects is because they lack a project guide or proposal.

3) Knowledge collection and acquisition. First, developer should understand domain knowledge via various resources collecting knowledge, and the resources include experts, books, internet, journals, magazine and some others. To obtain information or knowledge, the methods may be brainstorming, interviewing, questionnaire, and internet survey such as knowledge automatic acquisition tools.

4) Key concepts and relations determination. After understanding domain knowledge sufficiently, knowledge workers will abstract key concepts and relation between these concepts in some domains and represent it with natural language accurately. Then these concepts and relations will be confirmed by the domain experts. Confirmed knowledge will be as core concept set in domain ontology. Because the experts has different concept and understanding for some concepts and knowledge workers also have different levels, this process can not be sure that all core concept and relation are key concepts and covers all domain knowledge. However, they should satisfy at least:

(1) Determined key concepts and its relations: the relationship among the concepts must be boundary of specific domain and often existing fuzzy relations, the relationship degree are not easy to determine. However, the relation degree or level should be explainable at least.

(2) Be accurately expressed with terminologies: The aim of building ontology is to provide a semantic standard for domain knowledge to be exchanged. Therefore, terminologies should be elaborately selected. It can not be too colloquial and also not too obscure (hard to understand). The basic requirement is that the terminology is unambiguous. We refer to Wikipedia with bottom-up methods to build the key concepts and its relationships about the knowledge structure in major of information system. In this step, the developer should design a set of terminology, in which it should explain the procedure of selecting terminology and to describe each terms with natural language.

(3) Define the properties of concepts and facets of concepts: if an ontology system only defines a concept system, it can not provide solutions for dynamic requirement for knowledge understanding. Therefore, it is necessary that we need to design internal structure or hierarchy among the concepts once we have set up concept systems. One property is consisted of many facets, which includes value type, allowed values, cardinality and other attributes of related property.

5) Coding

The final objective of building ontology is to understand real life of human by a machine. Therefore, the terminology used in ontology must be coded with formal language. Logic presentation is used more often in research fields. Description logic is a formal representation for ontology knowledge, and it draws the idea from KL-ONE system and a judging subset of first order predicate logic. However, it also have some difference with that of first order predicate logic in that the describing logic system can provide judging reasoning service. Among many knowledge presentation ways, formal ways have been interested in developers and researchers is because they have distinct theory foundation. It is quite suitable for representing applications by conceptual taxonomy and provides a lot of reasoning services. Currently, popular ontology describing
language often uses those of logic description languages. In this paper, we use OWL (Ontology Web Language) released by W3C in Feb. 2004 as describing language to representing the MIS filed domain knowledge. After ending the coding process, the codes and documents has to store in file forms so that it can be as standard documents for sharing.

![Diagram of PSEM](image)

Figure 1. A Diagram of PSEM

6) Evaluation
After above five steps, we have built a basic ontology core. As done in software testing, the built ontology also needs to be tested and assessed. Currently, there is no standard commenting method for ontology, so there is no standard testing set. Comprehensive reviewing evaluation method for ontology, we have following indexes for assessing the ontology: correctness, consistency, expandability, validity, scope of ontology and ability of ontology description.

7) Evolutionary
As is well known, one specific domain knowledge is very complex and its boundary is fuzzy. Domain knowledge is always cross among different domain. Therefore, it can not be built a complete ontology for domain knowledge in one-time, even it is a huge organization and have enough capabilities. In particular, for research organizations it is unreality to build a complete ontology. However, if one organization do one domain ontology development work with iterative process, or by evolutionary process, it can hope get a good ontology system. In each iterative process, the system will be recognized and evaluated by experts and users. If necessary, one can repeat the last time process. The ontology system will gradually expand and evolve into a relatively complete system.

The patterns of ontology evolution can be integrated into new ontology, complementary concepts and relations by experts and discovery new knowledge by machine learning. In addition, in semantic web building process, editing and distributing information requires the workers who know and understand professional knowledge. These workers know domain knowledge ontology building status and manually or semi-automatically use the ontology to label common page semantics. In label process, they find new concepts and relations. If we integrate the label process into ontology building process, we can easy realize the ontology evolution. This evolutionary process is more easily operate than in case of expert definition, and more accurate than the machine learning. However, this process requires an adaptable tool to support.

**Reasoning with Racer Inference Engine**
After the ontology knowledge has been constructed, the next development is to reason the knowledge and recommend more personalized knowledge to users. We integrate the Racer inference engine into Protégé system to make the knowledge reasoning. The basic framework is as shown in Figure 2.
1) Analyzing Semantics Model

Here the semantic model analysis means that we first get the factors, such as concepts, rules and relationships, those used to describe semantic models from the invoking API of Protégé. Note that in programming development it needs importing the developing package of Protégé, “import edu.stanford.smi.protege.model.*;”

(1) Accessing Protégé project

Two kinds of ways can be used for this aim: one is directly integrating the Protégé into current project. For example,

Project project = ProjectManager.getProjectManager();
KnowledgeBase kb = project.getKnowledgeBase();

Where, a project defines a Protégé project that is being used. Kb defines the knowledge base of current project. Based on this knowledge base, other elements can be obtained by invoking Protégé developing package interface. Another way to access the Protégé project is by designated saving path of Protégé building a project to analyze the model. The coding segment is as follows

Private static final String PROJECT_FILE_NAME= "e:\dxd\pprj\luoding.pprj";
Collection errors = new ArrayList();
Project project =new Project(PROJECT_FILE_NAME, errors);
KnowledgeBase kb = project.getKnowledgeBase();

Where, the string used to input the project directory path, and errors are the message string that error path met. After the project has been obtained, the corresponding knowledge base also has been built.

(2) Getting the elements of knowledge base

Next step is to obtain the elements of the knowledge base through the API provided by the Protégé. These elements include Class, Slot, and the relationship between the Class and the Slot. In Protégé semantic model, rules and relationship (except the farther-child node) all are described with Slot. Then we use the recursion process to analyze whole knowledge base to obtain the tree structure and its root nodes of all class. At the same time, we also get the slots in the knowledge model. The attributes of various concepts are existed in slot form of the protégé. By the way, the slot has a mapping with the class. However, the analyzed slots are attached in related class.

Invoking method such as,

getDirectSubclasses(), cls.getDirectSubclasses()

(3) Connecting to the database

The information of database are related with the semantic model and mapping. We can get the some concepts database model by analyzing the knowledge model. The database information includes database IP address, type, database name and table name. All these information are attached on the Slot as the OwnSlot.

2) Using Racer to reasoning

Racer system proves a interface with the protegesystem. By sending a message to Racer system, and then receive the results by the Racer reasoning. First it needs to monitor the port of Racer (default 8088), that is to check whether the Racer has started or not. If started, invoking interface provided by the Racer system to build the knowledge base. Then with RQL to search the knowledge base. The connecting operating is as follows:

RacerClient client =new RacerClient("192.168.0.88","8088");
Client.openConnection() ;//conneced to Racer
Client.closeConnection() ;//interrupt to Racer

Next, input the user’s index words into Racer to reasoning. Receive the results of Racer output. Coding segment is as follows.

StringBuffer buf = new StringBuffer();
Buf.append(connectClient().synchronoousSend(queryTe xt));
Buf.toString();

3) Analyzed model input Racer.

In our example, reasoning rules are as follows.

(in-knowledge-base MIS)

(signature: atomic concepts (business information management, supply chain management, project management, organizational culture, database, management information systems, industrial engineering, …)

:roles (( know: person knows person))

:(interest: person interests in knowledge

: domain person

: range professional knowledge in business information management
needs knowledge

: roles ((need : person

knowledge in business information management

: domain person

: range professional

ontology also provides a foundation for the

reasoning the knowledge built with the protégé.

ontology and then present it in Protégé 2000. First

ontology. Following above steps to build MIS

systems as our domain knowledge to build an

ontology, and builds the algorithm and users

personalization. Then, the Racer conducts the

reasoning and gets a tree structure in which it is of

the hierarchy of structure. In the process of

reasoning, Racer also stores the properties of

various classes, including the range and domain.

When users ask the question to Racer, the Racer

accepts this question into Abox, and the matching

these concepts with the those stored in Abox. After

the end of this matching process, matched data will

be transferred into the Tbox. Tbox represents the

inclusion relationships. By the data process, fitted

results will be output. This completes the one cycle

of reasoning.

An Experimental Example

We use the knowledge in management information

systems as our domain knowledge to build an

ontology. Following above steps to build MIS

ontology and then present it in Protégé 2000. First

we analyze the preliminary knowledge and

professional foundation courses in MIS, then

comprehensive main professional courses. On the

other hand, we investigate the requirement

knowledge in practice, particularly in IT enterprises,

we build the knowledge ontology with OWL and

then exhibit it on protégé 2000. See Figure 3. (due

to room of this paper, we don’t introduce this

eample in detail). Then we use the Racer to

reasoning the knowledge built with the protégé.

Conclusions

In this paper, we propose a problem solving

evolutionary method to build domain knowledge

ontology. We use protégé 2000 as tools to build

ontology of domain knowledge in management

information systems. Experiments have shown that

our new method can effectively improve the

ontology building process and provide a convenient

process for sharing knowledge. Built knowledge

ontology also provides a foundation for the

knowledge reference. Therefore, the next step of

our work will be design a knowledge reasoning

mechanism to refer in above knowledge ontology.

Acknowledgement. This research is partially

supported by Natural Science Foundation of China

with Project No. 70672020, and 70521001.

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Issue 2, pp.38-45.
Figure 3. MIS Ontology based on Protégé 2000
EXTRACTIONG EXPERT KNOWLEDGE AND BUILDING STRATEGIC ECISION IN INTERNATIONAL LOGISTICS AND KAOHSIUING AREA

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Abstract
Evaluating the development and investment direction of complex transportation system for Kaohsiung international logistics is very important to Taiwan. According to the effect of internal and external variables factors, it is necessary to inspect the Kaohsiung metropolitan area epistemic development plan and trend of domestic industry develop international logistics. In order to achieve the benefits of developing logistics integration; we set the Kaohsiung harbour and airport as the core of this study. Exploring that how to strengthen the international logistics function and develop the strategy to improve the economic environment of Kaohsiung area. Consequently, this study is to extract critical expert knowledge and to build strategic decision to improve the economic environment of Kaohsiung area and international logistics.

Keywords: Extracting Expert Knowledge, Building Strategic Decision, International Logistics, Kaohsiung Harbor

Introduction
Intermodal transport has received an increased attention in freight transport policy making due to problems of road congestion, environmental concerns and traffic safety [1]. A growing recognition of the strategic importance of speed and agility in the supply chain is forcing firms to reconsider traditional logistic services [1]. As a consequence, research interesting intermodal transportation problems is growing.

Kaohsiung is the most important metropolitan area in south of Taiwan. Currently, the Civil Aeronautics Administration has proposed the “Kaohsiung Airport overall planning and the future 5-year development plan” and the port of Kaohsiung has also provided “Kaohsiung overall planning and future development plans” in the light of new situation and varied investment environment for cross-strait transport and Taiwanese business industry. Which the international economic, cross-strait economic interaction and investment will effect the future of Kaohsiung airport and harbor. According to the effect of internal and external variables factors, it is necessary to inspect the Kaohsiung metropolitan area epistemic development plan and trend of domestic industry develop international logistics. Evaluating the development and investment direction of complex transportation system for Kaohsiung international logistics is also important. In order to achieve the benefits of the develop logistics integration; we set the Kaohsiung harbor and airport as the core of this study. Focus on the intermode between land (highway, railway), ocean and air transportation. Exploring that how to strengthen and develop the international logistics function and advantage by complex transportation from the level of international, inter-city and urban logistics. This study evaluates the effect of developing Kaohsiung harbor and airport by overall industry and economic environment per current international situation, development of domestic industries and cross-strait interaction. And analysis the conditions for Taiwan become international logistics center. In addition, after the airport regulation passed the feasibility of Kaohsiung maritime city also explored.

This objective of this study will be achieved by exploring the following three research questions:
1. To explore the critical variables and to extract the expert knowledge in developing international logistics in Kaohsiung area.
2. To explore the impact of critical variables constructs on developing international logistics of Kaohsiung area.
3. To build strategic decision of developing international logistics in Kaohsiung area.

The remainder of the paper is structured as follows. In Section 2, we discussed the intermodal transport and regional economy in Kaohsiung Harbor. Section 3 we described our methodology and Empirical study including interview survey, interview and extracting expert knowledge, survey
instruments, pre-test and pilot test, data collection, and sample characteristics. Next, we discussed the analysis results. Finally, section 5 presented our final conclusions and suggestions.

Intermodal Transport and Regional Economy in Kaohsiung Harbor

There is growing recognition that sustainable mobility implies inter-connecting transport systems that must provide a door-to-door service [2]. In this respect, planning intermodality offers a means of increasing the sustainability of the transport system: the better that different resources are co-ordinated so that they combine in an integrated manner, the greater the sustainability of the whole transportation system [3].

Macharis and Bontekoning [4] define intermodal transport as the combination of at least two modes of transport in a single transport chain, without a change of container for the goods, with most of the route traveled by rail, inland waterway or oceangoing vessel and with the shortest possible initial and final journeys by road. Road transport and constitutes a relatively large share of intermodal transport costs. This is mainly due to empty vehicle movements [1]. Morlok and Spasovic [5] assert that a central planning could lead to considerable cost reductions in the pre-and end-haulage of intermodal containers. The attractiveness of intermodal transport may thus be increased by organizing the road segment in the intermodal transport chain more efficiently.

In regions with an extensive ocean and air network, such as Hong Kong, Singapore, Osaka-Kobe area, to integrate the ocean and air transportation to build intermodal transport. Pre-and-end haulage by integrating various transportation systems constitutes an operational planning problem in intermodal transport in Kaohsiung airport and harbor.

Methodology and Empirical Study

The objective of this study is to build the strategic decision to improve the international logistics in Kaohsiung area. According to the objective of this study, we explore the critical variables and to extract the expert knowledge in developing international logistics in Kaohsiung area. And, based on the extracting expert knowledge, we design the instrument to investigate industry’s opinions and to extract the critical constructs.

Interview and Extracting Expert Knowledge

In this study, the core methodology philosophy is interpretivism. The core methodology philosophy belonging to epistemology, as is one of the areas of research philosophy. Some suggest that the interpretivist perspective is appropriate in qualitative method [6]. In this study, we interview eleven industry’s experts. Based on the expert’s opinions, we extract thirty-one variables (strategies) to improve the international logistics in Kaohsiung area. All of the thirty-one variables are listed below:

S1: Collecting acquired resources in developing a single free trading zone.

S2: Integrating the free trading zone, logistic center, Asia Pacific operation center, science parks, and export processing zone into single customs territory outside the free trade area.

S3: Corporatizing Kaohsiung port operation for improving operational efficiency and inviting private investment.

S4: Making port land to public access.

S5: Amending laws for streamlining customs clearance.

S6: Defining deep processing of free trade zone by referring to the international trading decrees of major trading countries.

S7: Implementing autonomous management mechanism in free trading zone for 24hr goods clearance.

S8: Incorporating clearance examine system for facilitating customs clearance.

S9: Formulating expedient measures targeted on the policy of cross-straight direct or expedient shipment.

S10: Revising the policy of Cross-Straight direct or expedient shipment.

S11: Building safety management mechanism of customs supply chain.

S12: Forming inter-ministerial collaborative mechanism in public sector (e.g. Ministry of Economics, Communications, Finance)

S13: Former the single-window unit for systematically managing affairs like port service, customs service, free trading zone, etc.

S14: Legalizing the corporation platform worked collaboratively by Kaohsiung Port and coastal second-line ports of China; besides, signing cooperation agreement.

S15: Permitting Kaohsiung port's investment in foreign ports and building operational nodes for providing goods transportation function.

S16: Incorporating the licenses and resources of cargo and freight transportation for lowering operation limits and costs.

S17: Taking initiatives in facilitating the international reciprocity agreements (e.g. dealing with the customs of trading countries, creating mutually-recognizing clearance mechanisms for facilitating customs procedures, the mechanisms are like the AEO of WCO, C-TPAT of the States).

Green economic strategy

S18: Assisting industries in forming standard...
multiple transportation procedures.
S19: Developing technology applied into clearance and fulfilling the trading facilitation & cyberization.
S21: Developing intelligent transportation system through technology in intellectualizing shipment & transportation.
S22: Improving interconnecting roads, e.g. building 2nd tunnel and high way leading directly into the port.
S23: Improving the roads within the port for bridging the linkage between ports and container terminal.
S24: Expanding the port hinterland, e.g. land reclamation, or adjacent land acquisition.
S25: Expanding the Kaohsiung container terminal of Kaohsiung port for boosting container capacity so as to reach the international standard.
S26: Negotiating the agreements that the number of flights be increased for complementing the freight capacity in Kaohsiung International Airport.
S27: Negotiating the deal that curfew of Kaohsiung International Airport be cancelled.
S28: Lengthening the runways of Kaohsiung International Airport to facilitate the landing of large 747 cargo freighter.
S29: Reviewing the establishment of southern international airport and reassessing its requirement.
S30: Reviewing the legal restrictions on multiply transportation, relaxing or amending the outmoded regulations.
S31: Relaxing the escort management measures and limitations on different ports of a terminal.

Survey Instruments
Our overall survey instrument was based on interview survey of extracting expert knowledge.
The items were to be measured on a five-point Likert scale, ranging from ‘Strongly unimportant’ (1) to ‘Strongly important’ (5).

Pre-test and Pilot Test
A pre-test was performed with three industry’s experts and two Ph.D. students using a questionnaire consisting of thirty-one items to improve the content and appearance of the survey instrument. Several large firms were then contacted for assistance with the pilot-test of the instrument. The respondents were asked to complete the questionnaire and provide comments on the wording, understandability and clarity of the items, as well as the overall appearance and content of the instrument. Based on these initial responses, all statements were retained and only minor cosmetic changes were made. After a further review by two other academic researchers, the instrument was deemed ready to be sent to a larger sample to gather data.

Data Collection
Questionnaires were distributed to the department of government and to the direct and indirect related firms with intermode transportation in Kaohsiung area. Total of 82 responses were received. However, 5 more responses were eliminated because they were incomplete. Therefore, the results of this survey are based on an analysis of 77 effective responses (effective responses rate 7.7%).

Sample Characteristics
Table 1 provides a profile of the respondents. Most responses were from private companies at 36 responses (53.62%). In terms of sales revenue, the most responses occurred in the range below 1 hundred million (New Taiwan Dollars), at 27 responses (42.86%). In the item of position of respondent, the most responses was the higher than general manager, at 28 responses (37.84%). Finally, 16 respondents (21.33%) had the intermode industry experience in the range of 26-30 years.

Table 1: Sample Characteristic

<table>
<thead>
<tr>
<th>Demographic profile</th>
<th>Counts</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry type (N=68)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Department of government</td>
<td>32</td>
<td>46.38</td>
</tr>
<tr>
<td>Freight and container transport</td>
<td>1</td>
<td>1.45</td>
</tr>
<tr>
<td>Airfreight Forwarders</td>
<td>5</td>
<td>7.25</td>
</tr>
<tr>
<td>Ocean Freight Forwarders</td>
<td>5</td>
<td>7.25</td>
</tr>
<tr>
<td>Shipping agents</td>
<td>10</td>
<td>14.49</td>
</tr>
<tr>
<td>Airlines</td>
<td>1</td>
<td>1.45</td>
</tr>
<tr>
<td>Customs agents</td>
<td>3</td>
<td>4.35</td>
</tr>
<tr>
<td>Warehousing logistics</td>
<td>7</td>
<td>10.14</td>
</tr>
<tr>
<td>Storage industry</td>
<td>1</td>
<td>1.45</td>
</tr>
<tr>
<td>Tally Industry</td>
<td>2</td>
<td>2.90</td>
</tr>
<tr>
<td>Shipping companies</td>
<td>1</td>
<td>1.45</td>
</tr>
<tr>
<td>Sales revenue (New Taiwan $) (N=63)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below 1 hundred million</td>
<td>27</td>
<td>42.86</td>
</tr>
<tr>
<td>1.1–5 hundred million</td>
<td>9</td>
<td>14.29</td>
</tr>
<tr>
<td>5.1–10 hundred million</td>
<td>4</td>
<td>6.35</td>
</tr>
<tr>
<td>10.1–50 hundred million</td>
<td>14</td>
<td>22.22</td>
</tr>
<tr>
<td>50.1–100 hundred million</td>
<td>2</td>
<td>3.17</td>
</tr>
<tr>
<td>100.1–200 hundred million</td>
<td>7</td>
<td>11.11</td>
</tr>
<tr>
<td>Above 200.1 hundred million</td>
<td>1</td>
<td>1.45</td>
</tr>
<tr>
<td>Years of establishment (N=74)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 5 years</td>
<td>3</td>
<td>4.05</td>
</tr>
<tr>
<td>6-10 years</td>
<td>9</td>
<td>12.16</td>
</tr>
<tr>
<td>11-15 years</td>
<td>10</td>
<td>13.51</td>
</tr>
<tr>
<td>16-20 years</td>
<td>5</td>
<td>6.76</td>
</tr>
<tr>
<td>21-25 years</td>
<td>4</td>
<td>5.41</td>
</tr>
<tr>
<td>26-30 years</td>
<td>5</td>
<td>6.76</td>
</tr>
<tr>
<td>Over 31 years</td>
<td>38</td>
<td>51.35</td>
</tr>
<tr>
<td>Position of respondent (N=74)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Higher than general manager</td>
<td>28</td>
<td>37.84</td>
</tr>
</tbody>
</table>

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The research model in this study is based on a sample of 77 effective responses collected from the department of government and private firms in Kaohsiung area. We calculated the mean and standard deviation of strategic items. Based on the mean value, we rank the priority of the strategies to build strategic decision. The results are shown in table 2.

Table 2: Analysis Result and Rank

<table>
<thead>
<tr>
<th>Item</th>
<th>Mean</th>
<th>Std.</th>
<th>Rank</th>
<th>Item</th>
<th>Mean</th>
<th>Std.</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>4.63</td>
<td>0.80</td>
<td>1</td>
<td>S17</td>
<td>4.33</td>
<td>0.71</td>
<td>6</td>
</tr>
<tr>
<td>S2</td>
<td>4.34</td>
<td>0.68</td>
<td>5</td>
<td>S18</td>
<td>4.01</td>
<td>0.80</td>
<td>25</td>
</tr>
<tr>
<td>S3</td>
<td>4.25</td>
<td>0.71</td>
<td>13</td>
<td>S19</td>
<td>4.41</td>
<td>0.62</td>
<td>4</td>
</tr>
<tr>
<td>S4</td>
<td>3.97</td>
<td>0.89</td>
<td>29</td>
<td>S20</td>
<td>4.10</td>
<td>0.71</td>
<td>18</td>
</tr>
<tr>
<td>S5</td>
<td>4.62</td>
<td>0.59</td>
<td>2</td>
<td>S21</td>
<td>4.00</td>
<td>0.68</td>
<td>27</td>
</tr>
<tr>
<td>S6</td>
<td>4.25</td>
<td>0.63</td>
<td>12</td>
<td>S22</td>
<td>4.29</td>
<td>0.79</td>
<td>10</td>
</tr>
<tr>
<td>S7</td>
<td>3.99</td>
<td>0.84</td>
<td>28</td>
<td>S23</td>
<td>4.30</td>
<td>0.70</td>
<td>9</td>
</tr>
<tr>
<td>S8</td>
<td>4.55</td>
<td>0.66</td>
<td>3</td>
<td>S24</td>
<td>4.10</td>
<td>0.88</td>
<td>19</td>
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<tr>
<td>S9</td>
<td>4.15</td>
<td>0.59</td>
<td>16</td>
<td>S25</td>
<td>4.03</td>
<td>0.83</td>
<td>21</td>
</tr>
<tr>
<td>S10</td>
<td>4.05</td>
<td>0.97</td>
<td>20</td>
<td>S26</td>
<td>4.03</td>
<td>0.90</td>
<td>22</td>
</tr>
<tr>
<td>S11</td>
<td>4.22</td>
<td>0.76</td>
<td>14</td>
<td>S27</td>
<td>3.78</td>
<td>1.00</td>
<td>31</td>
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<tr>
<td>S12</td>
<td>4.32</td>
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<td>7</td>
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<td>4.01</td>
<td>0.87</td>
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<tr>
<td>S13</td>
<td>4.31</td>
<td>0.78</td>
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<td>S29</td>
<td>3.91</td>
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<td>30</td>
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<tr>
<td>S14</td>
<td>4.11</td>
<td>0.85</td>
<td>17</td>
<td>S30</td>
<td>4.21</td>
<td>0.85</td>
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<td>S15</td>
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<tr>
<td>S16</td>
<td>4.03</td>
<td>0.80</td>
<td>23</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The top five ranks are as 1. S1: Concentrate the resources on the development of a single free trade area; 2. S5: Amend the laws to adopt a customs clearance and simplify customs clearance procedures; 3. S8: Integration of customs clearance to sign the trial system in order to speed up customs clearance; 4. S19: The development of technology, the establishment of customs clearance to improve the efficiency of cargo clearance. The strategy of customs service is the influencing factor to improve the efficiency of cargo clearance. The strategy of customs service contributes more to speed up the clearance, to simplify customs clearance procedures, and to integrated system of customs clearance to sign trial. The second dimension is to developing a single free trade area which would create a business environment to invest. This strategy focuses on attractive manufactures to return Kaohsiung. To be incentive investment and to create the volume of transportation when this strategy is selected, relevant parties should be integrated, such as the free trade ports, logistics centers, regional

Conclusions

Building international logistics of intermodal transport enhances the competitive advantage of Kaohsiung area as a whole. In this paper, we have extracted thirty-one strategies to improve the international logistics of intermodal transport influencing competitive advantage of Kaohsiung. With the study of Kaohsiung’s international logistics and of intermode, we have found some key strategies and rank the top five strategies. We summarize the five strategies to two dimensions. The first dimension is that customs service is the influencing factor to improve the efficiency of cargo clearance. The strategy of customs service contributes more to speed up the clearance, to simplify customs clearance procedures, and to integrated system of customs clearance to sign trial.
operations centers, science parks, and export processing zones.

With building the strategic decisions, this study makes a practical contribution in linking government policy with industry developed and its extracting strategies for helping government to create a good economic environment and to improve intermodal transport system. The extracting strategies of this study can be applied to other forms of across various industries involving expert knowledge. The results of the study provide practical insights in building how enhanced business environment can help enhance international logistic and intermodal transport system for achieving the competitive advantage to Kaohsiung harbor.

As a pioneer research in addressing the building international logistics of intermodal transport enhances the competitive advantage of Kaohsiung area. The study uses expert knowledge as a mediation to reflect the request of industry. The results of the study may serve as a starting point for develop a better intermodal transport system in Kaohsiung area.

**References**


A STUDY ON KNOWLEDGE SHARING IN VIETNAMESE ORGANIZATIONS

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Abstract
Knowledge sharing is very much a sign for the atmosphere of social interactions in the organizations, it depends on the quality of the conversation, formally or informally. In other words, for more effective knowledge sharing, communication competence is required in order to have appropriate conversation. During the past decades, most theories of communication competence have been developed on the basis of “western” conceptualization. This empirical research is conducted in order to study the organizational communication competence in a non-western country, Vietnam, and the effect of such competence to the employees’ knowledge sharing behavior respectively. Base on the data collected from 11 organizations, the effects of three culture dimensions, namely individualism, power distance, and uncertainty avoidance to the communication competence were statistically analyzed; then, stemming from the certain level of communication competence, the behavior of organizational members towards knowledge sharing was explained.

Keywords: Knowledge Sharing, Communication Competence, National Culture, Power Distance Individualism/Collectivism, Uncertainty Avoidance

Introduction
Knowledge is seen as the most strategically important resource (Nahapiet & Ghoshal, 1998) for solving problems, creating core competences, and initiating new situation for both individual and organizations (Yozgat, 1998). In the past decade, we have witnessed an explosion of approaches to knowledge management. And organizations requires managing several processes of knowledge (Probst et al, 2000) such as creation, storage, sharing, and evaluating. Among those processes, sharing is crucial for knowledge organizations. As knowledge sharing is very much a sign for the atmosphere of social interactions in the organizations, it requires individuals to share what they know.

However, knowledge sharing does not come easy; in fact, there are inherent barriers to knowledge sharing (Davenport & Prusak, 1998). It is said that knowledge transfer between individuals in organizations requires communication (Sveiby, 2001). Van den Hooft and de Ridder (1998) stated that knowledge sharing is a form of communication. Any knowledge sharing process consists of two parts: donating and collecting. Knowledge donating can be defined as “communicating to others what one’s personal intellectual capital”, whereas knowledge collecting is defined as “consulting colleagues in order to get them share their intellectual capital”.

Schramm (1955) defined communication at its simplest level as “the process of establishing a commonness or oneness of thought between a sender and receiver.” Communication helps create shared meaning, the norms, values and culture of the organization (Wiesenfeld et al, 1998). In other words, for more effective knowledge sharing, communication competence is required in order to have appropriate conversation.

However, cultural factors have long been known to influence the communication and success of organizations (Doz & Hamel, 1998). As Cooley and Roach (1984) argued, “communication behaviors that are the reflection of an individual's competence are culturally specific and, hence, bound by the culture in which they are acted out. As a result, behaviors that are understood as a reflection of competence in one culture are not necessarily understood as competent in another”.

There are many facets of culture, such as organizational culture, professional culture and national culture. In our research we choose to focus on national culture. National culture is defined as “the collective programming of the mind which distinguished the members of one human group from another” (Hofstede, 1980). In other words, the aforementioned issues are thoroughly discussed in the knowledge sharing and communication competence literatures. Yet, an issue that has been under-explored is how individual’s communication competence is shaped by different national culture characteristics and how communication competence can explain the knowledge sharing behavior distinction among individuals.

In filling such gap, this study engages in an examination of Vietnam, in term of national cultural characteristics so as to analyze the scale of communication competence of Vietnamese organizational employees, and draw the possibility of knowledge sharing among them. Thus the two
timely questions were addressed as follows: 
(1) How does national culture affect to the organizational employees’ communication competence?
(2) What is the relationship between communication competence and knowledge sharing?

Literature Reviews

Knowledge Sharing
Knowledge management is defined as "a systematic, holistic and organizationally specified process for acquiring, organizing, and communicating both tacit and explicit knowledge of employees so that other employees may make use of it to be more effective and productive in their work" (Alavi & Leidner, 1999). Sharing knowledge among organizational members is not a new phenomenon. Employees always to some extent, has been, and is, seeking to cover their lack of knowledge by asking colleagues, getting training from more experienced colleagues, receiving supervision from their superiors, etc.

Recent research on knowledge sharing has emphasized the collective character of knowledge emerging from interaction and dialogue among individuals (Cabrea & Cabrea, 2002). According to Hendriks (1999) knowledge sharing was seen to be a force of providence a link between individual knowledge workers and the level of the organization, where knowledge and expertise attains its economic and competitive value. Van de Hooff and de Ridder (2004) presented a vision: "...knowledge sharing is the process where individuals mutually exchange their tacit (implicit) and explicit knowledge and jointly create new knowledge". Medium through which knowledge is transferred has an impact on the attitude towards knowledge sharing (Abdus, 2005). Knowledge sharing, as a result, is considered a form of communication. (Van den Hoff & de Ridder, 2004). Any knowledge sharing contains two parts - donating and collecting. Knowledge donating can be defined as “communicating to others what one’s personal intellectual capital”.

In general, knowledge sharing presumes a two-way relation between at least two parties (i.e. knowing subjects), of which one communicates knowledge either consciously or not, and the other party should be able to perceive knowledge expressions and make sense of them. This process differs from information sharing, which is a one-way act referring to the extent of communicating critical, often proprietary information to the another party (Mohr & Spekman, 1994). In other words, knowledge sharing depends on the quality of conversation, formally or informally (Davenport & Prusach, 1998). In case of accessing innovative thinking, building trust and facilitating experience sharing, an expressive communication in formal setting is necessary, contrary to the instrumental communication that is necessary for accomplishing task related immediate organizational goals (Thomas et al, 2001). Thus, it can be claimed that competent communicators are needed at all organizational levels (Shockley & Zalabak, 2001).

H1: Communication competence has a positive effect on knowledge sharing.

Communication Competence
Communication is one of the most critical elements of any organization’s functioning. Myers and Myers (1982) defined organizational communication as “the central binding force that permits coordination among people and thus allows for organized behaviour”. Moreover the encoder and the decoder communicates with each other through a channel, within a specific environment - the force which enables or disables the communication process, is the physical, social and emotional context that the communication takes place in. That is to say, effective communication involves the choice of the best communications channel for a specific purpose, the technical knowledge to use the channel appropriately, and the presentation of information in an appropriate manner for the target audience, and the ability to understand messages and responses received from others (Thomson, 2007).

Some researchers employing this approach believe that the way to study organizational communication competence is to understand self and role responsibilities within the organization through examinations of individual differences among organizational members. Particularly, they operationalize competence in terms of an individual's cognitive complexity, perspective talking, empathy, persuasive ability, and selfmonitoring (Zorn & Violanti, 1996). During the past two decades, most theories of communication competence have been developed on the basis of “western” conceptualizations (Park, 1985) of “white, middle-class” Americans (Cooley & Roach, 1984). Although some competence researchers have considered cultural factors in their work (Collier, 1988, 1989), most have focused on relationships between culture and interpersonal communication competence generally, and not on culture and communication competence in organizations in particular.

Cooley and Roach (1984) argued, "communication behaviors that are the reflection of an individual's competence are culturally specific and, hence, bound by the culture in which they are acted out. As a result, behaviors that are understood
as a reflection of competence in one culture are not necessarily understood as competent in another”. Thus cultural differences may be a major factor affecting the characteristics of communication competence in different organizational and national culture (Zorn & Violanti, 1996). Since cultural variability is considered to be a major factor affecting the way that individuals in different national cultures communicate in the interpersonal, group (Gudykunst & Ting-Toomey, 1988). Hofstede’s dimensions are often employed by researchers when “international” or “national culture” issues are discussed within information system (in other fields Hofstede’s name is nearly synonymous with national culture).

As discussed above, literature has a consistent agreement on the two aspects of communication competence: communication knowledge (knowledge of appropriate communication) and communication skills (ability to use that knowledge). In a study interested in determining the effects of cultural values on the communication practices of Thai business professionals.

Thus, this study admits that the communication skills aspect of communication competence theory in western culture is applicable in non-western culture. Afterwards, if communication competence is mentioned, then it will refer to the communication knowledge (the knowledge of appropriate communication patterns of conflict avoiding, showing respect, and using correct language). This determination will be further reviewed in the following sections, reflected to another circumstance, Vietnamese culture.

H2: Organizational members’ communication competence will be affected by the national culture characteristics.

National Culture
According to Hofstede (1980), refers to “the collective programming of the mind which distinguished the members of one human group from another”. In other words, members of a culture will have similar sets of preferences built into how they view the world (Hofstede, 1980). The Vietnamese culture can be described as large power distance (70), high collectivism (20), and weak uncertainty avoidance (Ralston et al., 1999). Indeed, studies on Vietnamese culture employing Hofstede’s culture dimensions are scare. In this study, we choose to pursue further the study of Nguyen (2002), namely “Organization culture in Vietnam”, and the study of Truong and Nguyen (2002) about “Management Styles and Organizational Effectiveness in Vietnam”. In their research, they gave people a very broad view about the national culture of Vietnamese people in general, which latterly considered as a factor forming the organization culture in the Vietnamese Organizations.

Vietnamese people are said to have a capacity to grasp intuitively the emotional intricacies involved in any particular situation (Nguyen, 2002). Also referred by Nguyen (2002), the low individualistic characteristic of Vietnamese culture is also reflected in values associated with the Vietnamese kinship system. The parent-children relationship is viewed by the Vietnamese as basic to social life, and thus most Vietnamese retain very close ties with their families.

Normally, at least one child in a family assumes responsibility for aged parents. This culture facet also affects very much in the Vietnamese organizational characteristic. Moreover, because Vietnamese people tend to promote the cohesive tie strength between people, the superior-subordinate relationship is not limited within the organization; it is extended to the life outside the organizations as well. Nguyen (2002), and Truong and Nguyen (2002) characterized Vietnamese culture by large power distance. Many organizations in Vietnam are being developed based on the paternalistic; the superior’s idea is the most priority. In making decision process, it is the superior’s task to decide everything and communicate clear goal to the subordinates and the subordinates have to carry out orders without deviation.

Customarily, subordinates do not assertively challenge authority of their boss. Vietnamese superiors generally are not interested in consulting opinions from subordinates. Subordinates cannot demonstrate in public that they are more knowledgeable than their superiors but rather to save the face of the superior or make the superior look good. Observing the communicative behavior of the organizational employees, it is very easy to realize the tendency of pleasing the superior, gaining the superiors’ sympathy, which is not based on the ability of task accomplishment but the special treatment. Besides, in communicating with the other management in the same or equivalent lines they has to be formal in order to show their politeness and prevent the others from feeling that they are underestimated. Mutual respect, face-saving, and politeness dominate all levels of the relationship among organizational members (Nguyen, 2002). Lastly, Vietnamese culture is shown to be weak uncertainty avoidance (Nguyen, 2002).

In comparison with Russia and China, an important similarity between Vietnam and these two countries is the lack of sufficient regulatory environments. According to Nguyen (2002), in
Vietnamese culture, people focus on the exceptionality of circumstances and make their decision based on acquaintances or lack of acquaintance with others. Rules are not as important as circumstance and personal relation. Thus, to Vietnamese, lying, cheating, stealing, by themselves have no positive or negative connotation: they could be bad or good depending on the situation in terms of the particulars of the situation and the people judging them. One important thing that needs to bear in mind in considering about weak uncertainty avoidance culture characteristics of Vietnamese is their way of applying pronouns in society, and especially in organizations. Vietnamese pronouns is very complicated, it changes in accordance to the conversation context as well as to the gender and relations between each participants (Nguyen & Do, 2005). However, in organizations, nowadays, in addressing oneself and the others, people tend to apply a very casual pronoun. For example, using anh/chi (male/female who is a little older than us) is very popular among organizational members instead of chu-bac/co-bac (male/female who is quite older than us).

By doing so, the relationship between the speaker and the listener will be shortened and the listener will feel younger (Nguyen, 2002).

H2a: Individualism has positive effect on communication competence.
H2b: Power distance has positive effect on communication competence.
H2c: Uncertainty avoidance has negative effect on communication competence.

Methodology

Research Model
The object of this study is to examine the relationship between knowledge sharing and communication competence, bases on the Vietnamese national culture dimensions resulted from Hofstede’s (1980) study to explore the communication competence of organizational members, which latterly explains the knowledge sharing behavior. According to the literature review, this study builds a research framework as shown in Figure 1.

Sample Process and Data Analysis Methodology
To test and verify the research model, this study collected data by surveying a sample frame of 11 various organizations in Vietnamese organization with questionnaires. The measurement items for five constructs in the research model are listed in Table 1. A seven-point Likert scale was used to measure the items.

The questionnaire was directly distributed over a two-week period to, thence, 149 out of 168 questionnaires were returned. With the data collected this study used SPSS 13.0 package is used for analyzing instrument.

In order to assess construct validity and identify the unique dimension of each construct, factor analysis with VARIMAX rotation was employed. After that, all factor loadings are greater than 0.5, an minimum level suggested by reference. In addition, to ensure good internal consistency of each constructs, this study used Cronbach’s alpha to assess the internal consistency of the constructs. The results showed all the Cronbach’s alpha exceed 0.7.

Data Analysis and Results
In this study, linear regression was adopted to examine the relationships between independent variables and dependent variables to test our research hypotheses.

The relationship between organizational members’ Communication Competence and their Knowledge Sharing behavior was analysed using regression analysis. The results are shown in Table 2.

<table>
<thead>
<tr>
<th>Construct</th>
<th>Standardized Coefficients β</th>
<th>t value</th>
<th>R²</th>
<th>Adj R²</th>
<th>F value</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication competence</td>
<td>0.754***</td>
<td>13.920</td>
<td>0.569</td>
<td>0.566</td>
<td>103.778*</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Dependent variable: knowledge sharing

* p<0.01
Table 3 shows the multiple regression analysis for evaluating the relationship between the dimensions of national culture and communication competence.

<table>
<thead>
<tr>
<th>Construct</th>
<th>Standardized β</th>
<th>t value</th>
<th>VIF</th>
<th>R²</th>
<th>Adj R²</th>
<th>F value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individualism/collectivism</td>
<td>0.19**</td>
<td>3.391</td>
<td>1.165</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power distance</td>
<td>0.74***</td>
<td>14.693</td>
<td>1.189</td>
<td>0.609</td>
<td>0.683</td>
<td>107.107***</td>
</tr>
<tr>
<td>Uncertainty avoidance</td>
<td>-0.19***</td>
<td>-3.593</td>
<td>1.028</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Dependent variable: Communication Competence

***p<0.001

In this study, Statistical Package for Social Science (SPSS 13.0) was employed for measuring the properties of the scales. Based on these results, this study supposes to show the fitted model of “Effect of communication competence on knowledge sharing in organization” in the context of Vietnam. Figure 2 is derived from the research framework with beta coefficients filled.

Conclusions

Research Finding

Among many antecedents of knowledge sharing, communication competence has drawn relatively less attention by researchers in this field. In IS domain, when studying knowledge sharing, researchers tend to see it in the lens of internet-based action, in which people interact with each other via computer and contribute their knowledge to a digital repository. However, as Lim et al. (2004) noted that the knowledge sharing attitudes were more evident in a face-to-face context rather than the electronic medium. Knowledge sharing as the result is really a form of communication, formal or informal.

Thus, for more effective knowledge sharing, sharer and receiver’s communication competence is necessarily required. Such competence has long been demonstrated to be bound by national culture background of each individual. In the light of these issues, this study conducts an empirical study to examine whether communication competence really affects knowledge sharing and how it is shaped by the national culture characteristics. The result shows that the more competence communicators have, the more effective knowledge sharing among them.

This study, on the other hand, successfully reviews and extends the communication theory into a non-western country, Vietnam. More precisely, in a culture of large power distance, there are more status differences among people, respect for authority, and following to protocol; communicators tend to be more competent in order to have an appropriate conversation among people. Similarly, it reveals that the society of low individualism people (as known as high collectivism) will have more communication competence because they will express more social harmony, deference, and conflict avoidance.

In contrast, people of weak uncertainty avoidance will have less communication competence, because they feel freer and open in discussing with each other no matter what the rules and regulations say. There is little care about tactfulness, politeness, and correct form of address in conversation, which is very much related to communication competence. This study’s result and conclusion, therefore, are consistent with the previous researches.

However, this study also found out that, of three cultural characteristics (individualism, power distance, and uncertainty avoidance), power distance has the strongest influence on the communication competence. That is explained by the way the sample was chosen, 149 respondents are all organizational employees. And it is said that perceptions of power distance were largely influenced by organization climate and employees’ value systems (Tan & Chong, 2003). Thus, the finding in this research, derived from the data analysis, is reasonable.

Research Implications

This study, among very few research papers about Vietnam’s knowledge sharing literature, can be of useful for many Vietnamese organizations to apply in explaining the communication and knowledge sharing behavior of individuals. From this point, organizations can also figure out the approach to leverage the positive and eliminate the negative effect of culture background on their employees’ communication competence.
Moreover, in today’s globalization trend, there are increasingly more companies having business over national boundaries, which results in a diverse workforce environment. Understanding of communication competence pattern of each other would be effective in reducing conflict in intercultural communication, as well as reinforce and foster knowledge sharing action among organizational members, which afterwards leads to success.

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A Study on Knowledge Sharing in Vietnamese Organizations


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KNOWLEDGE SHARING IN VIRTUAL COMMUNITY: THE COMPARISON BETWEEN CONTRIBUTORS AND LURKERS

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Abstract
Internet-based virtual communities are growing with an unprecedented rate. Virtual communities have been viewed as platforms for sharing knowledge. The present study proposed an integrated model by investigating social capital and motivational factors that would influence the knowledge sharing attitude of members. Data were collected from 207 professional virtual community users (including 53 contributors and 154 lurkers). The results showed that trust and pro-sharing norms mediate the relationship between shared understanding and knowledge sharing attitude. Enjoy helping, commitment, and community-related outcome expectations enhance contributors’ attitudes toward knowledge sharing. When lurkers perceived more reciprocity in their communities and expect more community-related outcome, they incline to sharing knowledge with others. The implications of these results are discussed.

Keywords: Virtual Community, Knowledge Sharing, Social Capital Theory, Motivation

Introduction
The Internet has become a vital resource for people to obtain information. Virtual community is an efficient platform for sharing knowledge. Community members can exchange their resources and enhance their relationship with other by formal or informal ways [17, 30]. People could produce new knowledge by continuously sharing and discussing with others.

According to the properties of user, virtual community could distinguish into three types: demographic, professional, and personal interest [1]. Knowledge capital has been regard as an important factor for establishing a professional virtual community [2]. These members who come from different social networks were connected by virtual ties. They can share their resources to each other. It enables members to accumulate social capital as well as gaining related information or knowledge. How to manage a professional virtual community and encourage members to share knowledge are always important issues for managers and researchers.

Past research points out that many members of virtual community are so-called “lurker”, about 80% to 90% of total community users [25]. Lurkers are the members who surf on the website to gather the information or knowledge they need. They could be registered or non-registered members who opportunistically post articles to seek direct help. Developing virtual community initially needs to attract large number of users to participate as well as encouraging them to take part in knowledge sharing activities, such as voluntarily posting articles and replying to others. They can develop long-term relationship with the community by building up the connection with other members.

Members in virtual community come from different organizations. They even are not acquainted with others. Sharing knowledge in virtual community would spend their time and efforts. Why people in virtual community would like to share their knowledge with others? The purpose of present study is to investigate the influence of social capital and motivational factors on members’ knowledge sharing attitude. We also compare the difference between contributor and lurker to provide suggestions for community development and management.

Literature Review and Hypotheses
Virtual community is a social aggregation in cyberspace. Participators who have similar interests, goals, or experiences would discuss and interact over cyberspace [2] [8] [34]. Members view the virtual community as a knowledge sharing platform. Knowledge sharing is a kind of behavior that someone disseminates his/her knowing and experience to other members [29]. Different kinds of knowledge sharing activities are important for community to survive [7]. Therefore, it is always an important issue to discuss the factors which have influence on knowledge sharing.

Social Capital Theory
Social capital theory could be used to explain why people would engage in sharing knowledge with others and avoid opportunity for free-riding [32].
Social capital could be distinguished into three dimensions [23]: (1) Structural dimension. The influence of network type on members is considered, such as network ties, network configuration, and appropriable organization; (2) Cognitive dimension. The interaction between members would produce medium for member communication, such as shared language, symbols and stories; (3) Relational dimension. It would trigger interactions in the social network to develop individual network and achieve social goals such as social contact, identification, and reputation [9].

Granovetter [15] suggested that social capital is embedded in the social network. Devi and Ravindranath [13] proposed structural embeddedness and suggested that network density is an important property of network. Network density refers to the extent of member connection. Members interact with others by replying article on website or by sending e-mail. The more connection they build up, the higher density they have. Stronger network ties would form restriction and enable member to build up trust. Therefore, they would like to obey the norms and general behavioral models [6] [9]. Based on the argument above, we postulate two hypotheses:

**H1**: Network density is positively associated with trust.

**H2**: Network density is positively associated with pro-sharing norms.

Shared understanding refers to the similar work value, norms, philosophy, and experience for certain group [14] [24]. The knowledge sharing participants should have basic understanding about their communication language [23]. Through shared understanding, members can develop stronger trust and incline to comply with norms. We propose following two hypotheses:

**H3**: Shared understanding is positively associated with trust.

**H4**: Shared understanding is positively associated with pro-sharing norms.

Trust plays an important role in knowledge sharing [12]. Trust is an adhesive which could shorten the distance between members. If there is lack of trust, members would incline to hide their knowledge or experience and decline to spend their time and effort to share knowledge. The higher extent of trust community member has, the more sharing activities would take place [5]. The above argument is captured by the following hypothesis:

**H5**: Trust is positively associated with knowledge sharing attitude.

Extrinsic Motivations

Extrinsic motivations are extra resources that someone gains. Bock et al. [5] suggested that extrinsic motivations would trigger someone to share knowledge. One may share knowledge after balancing the costs and benefits and expect to have beneficial reward [11]. When the knowledge shared by someone had been adopted by others, contributor would increase his/her reputation and status.

Reputation is that someone perceived his/her status or image has been promoted by sharing useful and valuable knowledge [10] [21]. Constant et al. [10] found that reputation could stimulate employees to propose constructive advice and increase their participation in the activities of virtual communities. People would like to share their expertise with others for increasing his/her status and earning others’ respect [21] [22]. Based on the argument above, we propose the following hypothesis:

**H7**: Reputation is positively associated with knowledge sharing attitude.

Reciprocity is defined as someone would share with others for expecting to have similar returns or help when they in need [12]. Two strangers with weak-ties would share their knowledge in electronic virtual community is evidence of reciprocity [33]. The higher level expectation on reciprocity of members, the more motivation to share knowledge they have [32]. The above argument is captured by the following hypothesis:

**H8**: Reciprocity is positively associated with knowledge sharing attitude.

Community-related outcome expectation is defined as the assessment by someone according to the knowledge sharing behavior in virtual community [8]. Chiu et al. [8] suggested that members would like to contribute more knowledge to help the community to sustain its operation. If members care more about the community-related outcomes, they would incline to share their knowledge to help the community to achieve its goal and vision. We postulate the following hypothesis:

**H9**: Community-related outcome expectation is positively associated with knowledge sharing attitude.
attitude.

**Intrinsic Motivations**

Osterloh and Frey [28] referred that intrinsic motivations can stimulate knowledge creation and transfer when extrinsic motivations do not work. Kollock [21] suggested that one believes in altruism would share knowledge. Pro-social behaviors are derived from stimulation of intrinsic motivations. They would help others and do not expect for returns.

Davenport & Prusak [12] advocated that the pro-social behavior of knowledge contributor is derived from the aspiration to help others. Kollock [21] found that one would contribute his/her knowledge in electronic virtual community for the property of enjoyment to help others. One may enjoy the fun and challenges during problem-solving. Members would gain psychological fulfillment through pro-social behavior. We propose the following hypothesis:

**H10:** Enjoy helping is positively associated with knowledge sharing attitude.

Self-efficacy is defined that someone perceives he/she has the capabilities to finish specific work [3]. Knowledge self-efficacy is someone believes he/she can provide valuable knowledge [10] [18]. When members have strong knowledge self-efficacy, they believe that they can provide valuable knowledge to others for solving their problems. The above argument is captured by the following hypothesis:

**H11:** Knowledge self-efficacy is positively associated with knowledge sharing attitude.

Commitment is a kind of duty or obligation which would drive someone to increase participation [9]. Commitment not only exists in the relationship between individuals but also in the relationship between individual and group. Wasko and Faraj [32] found that participation of member base on shared membership. They think that they have responsibility and obligation to help others. We postulate the following hypothesis:

**H12:** Commitment is positively associated with knowledge sharing attitude.

The research model is illustrated in Figure 1.

---

**Figure 1. Research model**

**Methodology**

**Instrument Development**

The research constructs were measured by adapting existing scales to enhance validity. Network density is adapted from Devi and Ravindranath [13]. We asked the extent of respondent’s interaction with other members. The other 11 constructs were measured by five-point Likert scales, from "strongly disagree" to "strongly agree". In order to make sure the face validity and understanding of wording, we invited one manager and 11 members to conduct a pre-test. A summary of our questionnaire was shown in Table1.

**Data Collection**

Respondents were the users of a professional virtual community - “JavaWorld@TW”. This virtual community focused on the discussion of Java-related techniques. We also discriminated users as contributors and lurkers. The former are registered members and also share their knowledge. Lurkers who may be registered or non-registered do not share their knowledge.

We conducted an Internet-based survey by posting the questionnaire link on the virtual community website. The survey was conducted during March, 2009 to April, 2009 by two phases and totally returned 207 valid responses (172 for phase 1, 35 for phase 2). According to the results of non-response bias test, there is no significant difference in gender ($\chi^2 = 0.600, p > 0.05$) and
average time online per day ($x^2 = 5.136, p > 0.05$). Out of 207 respondents, 130 were male (62.8%). Most of respondents were in the age of 21 to 25 (46.9%). Many of respondents were Internet heavy users, about 80% of them spend more than 3 hours online. Most of users were non-registered (46.4%). There are 25.6% respondents had shared their knowledge on the virtual community.

<table>
<thead>
<tr>
<th>Table 1. Summary of measurement scales</th>
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</thead>
<tbody>
<tr>
<td><strong>Construct</strong></td>
</tr>
<tr>
<td>Shared Understanding (SU)</td>
</tr>
<tr>
<td>Cronbach’s $\alpha = 0.70$</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Trust (TR)</td>
</tr>
<tr>
<td>Cronbach’s $\alpha = 0.77$</td>
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<tr>
<td></td>
</tr>
<tr>
<td>Pro-sharing norms (PNR)</td>
</tr>
<tr>
<td>Cronbach’s $\alpha = 0.82$</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Reputation (REP)</td>
</tr>
<tr>
<td>Cronbach’s $\alpha = 0.72$</td>
</tr>
<tr>
<td>Reciprocity (REC)</td>
</tr>
<tr>
<td>Cronbach’s $\alpha = 0.77$</td>
</tr>
<tr>
<td>Community-related Outcome Expectation (COE)</td>
</tr>
<tr>
<td>Cronbach’s $\alpha = 0.87$</td>
</tr>
<tr>
<td>Enjoy Helping (EH)</td>
</tr>
<tr>
<td>Cronbach’s $\alpha = 0.85$</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Knowledge Self-Efficacy (KSE)</td>
</tr>
<tr>
<td>Cronbach’s $\alpha = 0.70$</td>
</tr>
<tr>
<td>Commitment (COM)</td>
</tr>
<tr>
<td>Cronbach’s $\alpha = 0.84$</td>
</tr>
<tr>
<td>Knowledge Sharing Attitude (KSA)</td>
</tr>
<tr>
<td>Cronbach’s $\alpha = 0.87$</td>
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</tbody>
</table>

**Results**

**Measurement model**

Both Cronbach’s alpha and composite reliability
(CR) were used to assess the extent of internal consistence. As shown in Table 1 and Table 2, most of them were greater than 0.7 suggest by Nunnally [26].

As to convergent validity, the loading of all items were greater than 0.60 (see table 1). In table 2, the values of composite reliability range from 0.82 to 0.94; and AVE scores for each construct range from 0.62 to 0.89 and above the 0.50 recommended level. To examine discriminant validity, as table 2 shows, the square root of AVEs for each construct is great than the correlation between constructs.

**Structure model**

The proposed hypotheses were tested with Partial Least Squares (PLS). As shown in Figure 2, 59.2% of the variance in knowledge sharing attitude was explained. Network density and shared understanding explained 27.6% of the variance in trust and 13% of pro-sharing norms.

As to social capital factors, shared understanding had positive relationship with trust ($\beta = 0.523$, $p < 0.01$) and pro-sharing norms ($\beta = 0.358$, $p < 0.01$), supporting H3 and H4. Both trust ($\beta = 0.252$, $p < 0.01$) and pro-sharing norms ($\beta = 0.165$, $p < 0.01$) had a significant association with knowledge sharing attitude, supporting H5 and H6. For extrinsic motivations, reciprocity ($\beta = 0.155$, $p < 0.05$) and community-related outcome expectation ($\beta = 0.322$, $p < 0.01$) had positively association with knowledge sharing attitude, supporting H8 and H9.

**Post hoc Analysis**

We divided respondents into two group namely contributors ($n = 53$) and lurkers ($n = 154$) to compare the difference in motivation factors. The knowledge sharing attitude of contributor was significantly influenced by community-related outcome expectation ($\beta = 0.321$, $p < 0.05$), enjoy helping ($\beta = 0.274$, $p < 0.1$), and commitment ($\beta = 0.159$, $p < 0.1$), supporting H9, H10, and H11. As to lurkers, reciprocity ($\beta = 0.148$, $p < 0.1$) and community-related outcome expectation ($\beta = 0.326$, $p < 0.01$) had positively association with knowledge sharing attitude.

**Mediation Effect Tests**

We adopted Baron and Kenny’s [4] three-step method to examine the mediating effect of trust and pro-sharing norms. Firstly, independent variable (IV) should have significant effect on dependent variable (DV). Then, IV should significantly predict the mediator (M). Finally, IV and M should simultaneously include in the analysis model to predict DV. If M is significant but IV is not, this is full mediation. If both M and IV are significant, this is partial mediation. As shown in table 3, both trust and pro-sharing norms had full mediating effect on the relationship between sharing understanding and knowledge sharing attitude.

![Figure 2. PLS analysis of research model](image-url)
Table 2. Composite reliability, AVE and corelations

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<th>CR</th>
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Table 3. Results of mediating effect tests

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Discussion and Conclusion

The purpose of present study was to investigate the influence of social capital and motivational factors on members’ knowledge sharing attitude. Our results had shown that shared understanding has positive influence on trust and pro-sharing norms. The consensus existed in the virtual community could enable the emergence of pro-sharing norms. Members with similar work experience and problem-solving method could increase the trust between virtual community members.

While higher trust and pro-sharing norms, member would incline to share their knowledge. Past research focused on the direct relationship between sharing understanding and knowledge sharing attitude. The present study found that trust and pro-sharing norms play mediating roles between sharing understanding and knowledge sharing attitude.

In general, the knowledge sharing attitude of member is affected by extrinsic motivators, such as reciprocity and community-related outcome expectation. But for contributors, they would share with others base on their enjoyment of helping and commitment. The objective of lurkers is to surf the information or knowledge they need, they would share with other only if they feel reciprocal and expect this community would have positive feedback to them.

Implications

In order to develop a successful virtual community, manager should promote more knowledge sharing activities to attract users to participate the activities of the community. Virtual community consists of people with similar knowledge background and work experience. They have shared understanding about the issues they discuss. But for new comers, this kind of shared understanding would be the barrier to share knowledge. Manager can set up a specific area for new comers to learn, such as FAQs. Manager also could establish rules and sharing principles to foster trust and pro-sharing climate.

Our results show that different kinds of users focus on different motivators. Contributor motivate by intrinsic factors such as enjoyment and commitment. However, lurker stimulate by extrinsic factors such as reciprocity. Both contributor and lurker would take community-related outcome expectation into consideration when they engage in sharing activity. Manager should have different strategies for attract lurkers and retain contributors.

Limitation and Future Research

There were several limitations in our study. Firstly, the data were collected through Internet base on self-report. Here, we focus our research on one professional virtual community. Future research could design a more comprehensive method to
compare the results from different communities. Secondly, although the items we used were adapted form past literature. Network density was measured by users’ perception of their connection level with others. Future research could adopt more appropriate measures for structural dimension. Finally, our research is cross-sectional that limited our discussion on the difference between contributor and lurker. Future research could design a longitudinal research to discuss more detailed on the variation and difference of different users. We hope our study provides needed advancement for knowledge sharing.

Reference


ASSESSING MATURITY REQUIREMENTS FOR IMPLEMENTING AND USING PRODUCT LIFECYCLE MANAGEMENT

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Abstract

Product lifecycle management (PLM) is a systematic and holistic way to approach challenges that exist in managing product related information along products’ lifecycle from product design to its disposal. There is an established set of information management approaches that address important subsets of lifecycle information management challenges, e.g. product data management (PDM), ERP and CRM. Common feature to PLM processes is that their implementation requires changes in organization, systems, conventions, and importantly, skills and capabilities. The aim of this paper is to discuss the issue of PLM implementation and how it can be aided with capability maturity assessment. Empirical part of the paper points out how capability maturity assessment can be conducted and how it is applicable in different stages of implementing and developing PLM.

Keywords: Product lifecycle management (PLM), maturity models, capability maturity model (CMM), capability maturity assessment

Introduction

Product lifecycle management (PLM) is a systematic and controlled concept for managing product related information and products throughout the whole product lifecycle [1]. The benefits gained by using PLM in the different separate phases of product lifecycle are proved by many sources, but utilizing product information together with other information types (like customer information) sets challenges for the lifecycle management (see e.g. [2],[3]), for example, combining historical information of maintenance to predicted customer needs would ease the decisions of product customization. PLM covers various types of product-related information from product design and manufacturing all the way to the end of use, after sales and service phases, as well as to the end of the lifecycle, to the scrapping of the product. Information management during the whole product lifecycle is important, and furthermore, utilizing information from multiple different operational sources and the sharing of information to support the decision making in different stages are strongly emphasized from product lifecycle management perspective.

There are several reasons why PLM and competency or capability management practices (such as maturity models) should be linked together. First, the implementation of PLM in an organization is a very extensive change process which cannot be carried out in a single step, but should be divided and managed in a series of smaller stages. It requires various changes not only at the IT systems level, but often also at the strategic level, and at the process level, and further, at the level of reward and incentive systems and individual persons’ skills and capabilities. Second, the above-mentioned changes should be carefully planned together and coordinated – due to the complex, systemic and organization-wide nature of PLM activities and systems, a single change in PLM-related IT systems, such as customer relationship management (CRM) systems, requires carefully synchronized and often simultaneous changes in related personnel skills and competences, processes and incentive systems.

According to various studies concerning the knowledge accumulation in companies and their business processes (e.g., [4],[5],[6], knowledge development and accumulation in organizations can be categorised and described in distinct phases or stages. Models that are used to describe the afore-mentioned development phases are usually called ‘maturity models’. Maturity models can be characterized as special types of roadmaps for implementing practices in an organization, and their purpose is to help in the continuous improvement of the capabilities of an organisation in certain application or management areas, such as software development [7], R&D [8], and process development [6].

In order to be able to assess and develop the knowledge maturity stages, the aggregate knowledge area needs to be disaggregated to manageable management attributes. In line with the maturity-level thinking, the development related to these management attributes should proceed more or less parallel from one maturity stage to the next (see e.g. [9]).

PLM-related maturity models can be thought to consist of maturity stages describing the
knowledge or capability levels of PLM maturity, as well as the PLM-related business dimensions, which are the critical knowledge or capability areas the maturity of which should be measured and the development of which should be coordinated and planned together.

Academic PLM-related research is, generally speaking, relatively young, and so far hardly addressed in scientific literature. According to literature study covering practically all published academic PLM literature, as well as PDM (product data management) literature, first, there are very few studies that discuss maturity model or roadmapping approaches in context with PLM implementation. Second, the literature discussing the use of not only one but several business dimensions in the context of PLM roadmapping or maturity assessment was practically non-existent. Concerning the maturity levels, the carried out literature study revealed that one relatively commonly used maturity assessment procedure in PLM context was based on CMM /CMMI (capability maturity model) literature, the origin of which is in software maturity evaluation. Following this tradition, typically, in literature is found [1] that in PLM maturity models, there were 5 PLM maturity levels, from 1 (unstructured) to 5 (optimal). Concerning the business levels, the evaluation of PLM maturity was most commonly carried out in respect of only one generic dimension, as a one-dimensional roadmap, and we found very few academic studies that included more than one business dimension in the PLM maturity evaluation, including the studies of Batenburg et al.[10,11].

The aim of the paper is to, both theoretically and empirically, examine how organizational maturity has been, can be and should be assessed in order to successfully implement and development product lifecycle management scheme. Theoretical part consists of a literature review concerning PLM and maturity model literature. Empirical study included in the paper emphasizes and clarifies the importance of maturity assessment before and during the PLM implementation process. Moreover, two cases from the manufacturing industry shed light on the topic from the perspective of praxis. Using maturity models or road maps in order to implement certain activities or to make an organizational change can be seen closely related to competency or capability assessment; therefore there is also a close link to knowledge management (KM) research. Correspondence between maturity models and competency assessment is studied in order widen the domain of managerial implications.

Main notions on using maturity assessment along the PLM process are to make the implementation of the extensive business issue of PLM better approachable and a more carefully planned process, since a significant portion of companies struggle heavily in the adoption and implementation of PLM (see e.g. [10]), and to avoid premature moves, which is to say to avoid implementing processes or systems in to an organization that is not yet able to utilize them. Different maturity levels can be comprehended as gates, i.e. development should be in parallel and simultaneously coordinated in every business dimension. Such an approach is also likely to reduce the costs and the duration of PLM implementation.

**Deployment of product lifecycle management**

Key challenge in any implementation process can be seen via organizational readiness, say maturity, to change the way it operates. When beginning a change in organization or processes the first threshold is to answer the question: “Is our organization willing and/or able to deploy a new operating procedure.” Testing willingness is somewhat easy, as if there is a need then there is will too. Several authors (e.g. [12], [11, 335], [13 41]) refer to organizational and individual capabilities as a major key success factor in development process. Lack of capabilities can inhibit or even halt the process.

Developing PLM requires a large set of changes, not only on level of systems, but also on skills and competences, procedures and mental setting. In order to deploy a single change in operation synchronous and indented changes are required processes, skills of the personnel, in organization, assessment systems and motivation system. Moreover, the “eye should be kept on the ball”, i.e. adjustments are often conducted step by step along each other. There are two general ways to approach change process. Firstly, by drawing a “road-map” with milestones needed or secondly, by refining the map by adding content to each milestone. Content is added by assessing ability to proceed.

As stated by [14, 73] capability assessment and knowledge management, in this case management of skills and abilities, play somewhat similar role in development schemes. Key question is how to take in account dynamics that is implicit part of knowledge accumulation in development. As stated by Niemi et al. (2008) change is aided by utilizing suitable competencies, i.e. it is normal that practices and technology need to evolve along the way. To put it short, what is desirable stage and setting in initial phase, can be non-functional in latter phases. Maturity assessment helps to put focus on key competencies as it has systematic and analytical operations model of recognition and measurement. Moreover, if assessment process is complete, it
should also contain set of correcting actions if any malfunctions are perceived.

In order to measure capabilities a measurement framework is needed. CMMI is an established way to asses required capabilities and capability levels [13, 213]. Batenburg et al. [11, 346-347] states that PLM implementation requires a roadmap that is an integrative plan for implementation. Capabilities and capability management can also seen as an integral part of any assessment model [16]. According to Niemi et al [16] there should be defined certain maturity stages and attributes of technology adaption. Sääksvuori & Immonen [1] defines a “one-dimensional” maturity model that takes in account the working practices, i.e. maturity levels, of PLM in general. To put more sense to assessment it should be refined by more elaborated PLM maturity assessment framework such as one described by Batenburg et al [10] that takes in account also different business dimensions.

Despite of which dimensions or maturity levels are chosen management of capabilities and skills are essential [17, 287-288]. In general, capabilities can be considered as an organizational attribute or an organizational view. Skills are closed aligned to people in organization, thus personnel view. E.g. Kneuper [12, 19-21] describes way to operationalise assessment task. Operationalisation is done by defining desired or assumed maturity levels in chosen business dimensions. Business dimensions refer to certain operational positions. By Batenburg et al (2005) positions are strategy and policy, organization and processes, people and culture and information technology. Translating this to ‘general assessment language’, PLM maturity assessment requires views, success factors and performance indicators.

Batenburg et al [10] justifies mentioned business dimensions for PLM by an empirical study. Dimensions cover different practices and stakeholders that are connected to PLM and its subprocesses. Holistic view to PLM is needed in order to avoid fading the idea of PLM only to level of product data management. Batenburg et al [11] states that PLM maturity assessment should be seen via several dimensions, especially aligning business and IT. Batenburg et al (ibid.) points out several similarities in different maturity assessment models, yet chosen model is well grounded in theory and empirically validated.

According to Dayan & Evans [14, 74] maturity assessment e.g. in PLM by CMM/CMMI is done recognizing key performance indicators (KPIs) or goals in each process area or position. Each KPI is operationalised to measurable indicators that are connected to specific practices or general practices. Batenburg at al. [10] assessment framework is chosen as analysis framework in the empirical part of this paper. Baterburg et al. [10] framework emphasizes balanced development in each business dimension (See Appendix 1).

Case study of two manufacturing companies
Case company descriptions
The studied companies will be called here EngCo1 and EngCo2. Both companies are Finnish Finland-based engineering companies that belong to the metal industry, and they work in business-to-business markets. They produce e.g. relatively complex process solutions for the process industry companies, requiring much information and sophisticated understanding of customers’ businesses. They strive at close cooperation with their customers, aiming also for close partnerships and comprehensive customer solutions. Even though producing technology products and solutions has been their main business, services including long-term service contracts has been an area for fast development. The companies have been operating for decades, and they belong to technology and/or market leaders within their industries.

EngCo1 is a daughter company of a medium-sized Finnish company with about 250 employees. It is operating mainly in Finnish markets, and there are about ten persons working in the case company. It operates in a project business where it customizes each delivery according to customer requirements.

EngCo2 is a company operating in Finnish and international markets, including offices in dozens of locations worldwide. It has around 500 employees and its turnover is ca. 100 Million euros.

Product lifecycle management implementation objectives
EngCo1 is a company with long history in PDM but the concept of PLM is a relatively fresh one. Its aims for PLM implementation include defining a PLM strategy, understanding the principles of PLM, setting a two-year development target for PLM and building a roadmap for the achievement of the target.

EngCo2 has worked with PLM for some years, and its PLM aims include the holistic facilitation of PLM in order to lengthen and widen customer relationships, the facilitation of partnerships, and the improvement of service business in a holistic manner.

In order to facilitate the companies’ PLM implementation and adoption, a PLM maturity assessment was carried out in both companies. The following results are derived from the expert assessment in the two companies, including IT and management evaluations and interviews.
Maturity assessment process and generic maturity results

The maturity assessment was conducted according to Batenburg et al. [10] (see appendix 1) model. In practice the evaluation was done by a simple scoring method in which each question concerning the individual topics of the 5 x 8 matrix was scored from 0 to 4. Levels of maturity and scores of each question varied from non-existing (0), ad hoc (1), departmental (2), organizational (3) to inter-organizational (4). Assessment result for each business dimension is average score of eight questions.

Figures 1 and 2 summarize the assessment result in a graphical form. On the basis of the maturity assessment, both the companies are relatively low in the business dimensions of the PLM maturity assessment. This is fully understandable because of their relatively short PLM history. EngCo2 has a longer history in PLM, which shows in the overall scores of the evaluation. Both the companies scored lowest in the Information technology and People and culture dimensions. Both scored highest in Monitoring and control and Strategy and policy dimensions. Organization and processes –dimension was somewhere in between these two polar dimensions.

![Figure 1 PLM maturity assessment results of EngCo1](image1)

![Figure 2 PLM maturity assessment results of EngCo2](image2)
Case companies’ evaluation of development needs for the whole PLM maturity assessment framework

The evaluation was conducted by utilizing the expertise of company persons representing two functions, IT and general management. As pointed out in literature review business/IT-alignment is important.

EngCo1 represents SME view as resources are more limited and awareness on PLM issues, other than PDM, is in very early stage. EngCo2 has already established PLM procedures and it has different approach to assessment. In EngCo2 current status is due to the resources of the company and higher level of understanding on the issue. It could be stated that EngCo2 represents the developmental phase of PLM. Key question is to find out what are the aims for PLM initiatives in both cases and refine maturity assessment model according to those. As maturity assessment model is rather generic, both case companies implied need for elaborating the model in order to better meet their needs.

EngCo1 has typical development challenges of small company. Use of established evaluation model needs somewhat stable environment over time. How does it function in dynamic environment when object of assessment in continuous change? Limited resources are also challenge, especially when single employee has several roles, and roles change. Also unestablished company has specific challenges, e.g. financing, project management, timetables and growth management. Those factors cause turbulence which may affect the use of assessment.

Second development need was how the customers and the customer perspective are taken in account. Informants in EngCo1 found that the issues concerning customer needs or demands or customer feedback were missing. Also closer co-operation with customers in lifecycle services should be paid attention to.

EngCo2 has more general knowledge on PLM and for them it was easier to evaluate the maturity assessment model. Main outcome here, too, was that model should take the customer viewpoint more into account. Customer perspective here is to pay more attention to customership and see the effects of it.

Expressed development needs concerning the customer perspective in EngCo2 were first, how customer can affect incidents in life cycle, i.e. need for closer co-operation or even process partnership. Second, how to attach customer to design and product development? Third, to ensure if co-operation is practical, i.e. costs do not exceed benefits. And fourth, how to communicate customers’ benefits of closer co-operation? Taking the perspective on PLM, especially the fourth point adds value to EngCo2 as efficient communication of benefits engages customers to PLM process as goal and benefit are communicated.

Case companies’ evaluation of the development needs concerning used maturity assessment framework’s individual business dimensions

Customer viewpoint

Because PLM covers not only the company itself, but the implementation of PLM has large influences towards customers, as well (the implementation of PLM should evaluate the maturity of both the company and the customer for the changes in processes and operation procedures etc.), the case companies experienced that the maturity framework and the included five business dimensions should also take the customer viewpoint somehow into consideration in the maturity assessment.

The table of Appendix 2 summarizes the case companies’ development suggestions or challenges concerning each of the five business dimensions. For instance, the companies noted that all the business dimensions included customer-related tasks or concerns to be considered when the companies are advancing in maturity in each of the business dimensions. In general, it was also noted in the interviews that PLM implementation and maturity advancement often requires new ways of operation from customers, as well, e.g. concerning the ways they provide information about their needs and business to their partners and suppliers. To enable these changes, it is critical that customers are aware of the significance of these changes and the benefits that customer (or even individual customer’s functions) will receive when implementing new ways of operation.

Company viewpoint

We asked the case companies which kinds of development needs the case companies experienced in the business dimensions of PLM maturity framework when taking the case companies’ own PLM objectives and company-based restrictions (e.g. resources) into consideration. EngCo1 emphasized the viewpoint of small project-based company towards PLM, in which e.g. IT -dedicated personnel and resources are more scarce. EngCo2 considered the development needs from a larger international company’s standpoint.

The table of Appendix 3 summarizes the case companies’ development suggestions or challenges concerning the five business dimensions.

On the basis of the interviews, both the companies felt that the maturity assessment suffered somewhat e.g. in the case of Information technology business dimension from the fact that the used IT was not a real extensive PLM solution, but consisted...
of individual IT solutions that need to be integrated in various ways. The IT dimension also affected the other dimensions, such as the roles and responsibilities in IT use etc. This brought out the systemic nature of PLM implementation: all the various individual business dimensions have close links to almost all the other dimensions, and in the course of the advancement in the maturity steps these links should be carefully taken into consideration and the maturity advancing development tasks should be intensively coordinated.

**Case companies’ viewpoints on the usefulness of PLM maturity framework and maturity evaluation**

In the general sense, the evaluation framework was experienced to provide an illustrative way to support the implementation of PLM in the studied companies. It provided a way to divide a huge entity, PLM, to more manageable pieces (EngCo1), a holistic picture of how PLM (implementation) touches and influences different company functions, all organizational levels and also customers (EngCo2), a model that enables to better take the whole product lifecycle into consideration from design to scrapping (EngCo2). It also provided a way to understand better the next steps and future tasks, as well as when and in which order of procedure to proceed, and understand why to proceed in this way (EngCo1).

Concerning collaboration and coordination of information exchange between company personnel and functions, the maturity evaluation was experienced to emphasize the importance of information and knowledge exchange (EngCo2), to give a starting point for the creation of common picture about the starting situation in the PLM implementation (EngCo1), to enable the vertical and horizontal (management, personnel and different company functions) interaction (EngCo1) and as a way to build up common motivation for the PLM facilitation (EngCo1), and it points out the most critical steps in PLM implementation and facilitation (EngCo2).

As a tool for competence management, the maturity evaluation gives a better way to understand what development actions can be done with present resources (and skills), and which resources and skills should be further developed (EngCo2). It also helped to understand whether current resources are used non-optimally or in a wrong way, and simultaneously to see whether they should be allocated differently (taking the amount of resources into consideration) in PLM implementation (EngCo2).

**Conclusions**

In general this study has pointed out that capability maturity assessment is a useful and beneficial tool in the implementation and development of product lifecycle management scheme. As pointed out in the cases it is useful through the lifecycle of PLM, i.e. in the initial phase it serves as a test for the possibility to implement a PLM scheme, and after implementation it serves as a tool to elaborate the scheme. In addition, multi-dimensional PLM maturity models, such as the model developed by Batenburg et al ([10], [11]) provide significant benefits in comparison with the more simplistic one-dimensional roadmaps, offering a more holistic and systemic perspective to PLM implementation that can significantly facilitate PLM implementation and the collaboration between different company functions, organizational levels and company stakeholders, most importantly, the customers.

Main outcome of this paper is that maturity assessment models are generic and applying those needs operationalisation of business dimensions and maturity levels, taking e.g. the target companies’ PLM objectives, company size and resource limitations into account. In addition, according to the case companies’ interviews, since PLM implementation affects closely also the customers’ operation and brings changes to customers’ processes, the advancement in the PLM maturity stages should take into consideration the evaluation and facilitation of the customers’ maturity, as well. If these are not taken into consideration properly, the assessment does not provide sufficiently useful and applicable knowledge on PLM maturity and its development.

In addition to the above, on the basis of the case studies, the maturity assessment framework was seen as a useful tool for both competence management and development, as well as a tool for supporting collaboration and information exchange coordination.

**References**


APPENDICES

Appendix 1: PLM issues used in the evaluation by each business dimension (Batenburg et al., 2005)

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<th>Strategy &amp; policy</th>
<th>Management &amp; control</th>
<th>Organization &amp; processes</th>
<th>People &amp; culture</th>
<th>Information technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLM strategy is described</td>
<td>Responsibility for in-time product delivery is defined</td>
<td>Procedures to support PLM</td>
<td>Task and job descriptions contain references to PLM processes/procedures</td>
<td>PLM software is used in the company</td>
</tr>
<tr>
<td>PLM strategy and its changes are communicated</td>
<td>Time-to-market of new products is monitored</td>
<td>PLM process descriptions are maintained</td>
<td>Employees raise suggestions to influence product lifecycle decisions</td>
<td>PLM software is integrated with other information systems</td>
</tr>
<tr>
<td>PLM strategy is aligned with the corporate strategy</td>
<td>Rules about cost allocation during product development are defined</td>
<td>PLM process descriptions are standardized</td>
<td>PLM training benefits the organization includes functionality to manage product configurations</td>
<td></td>
</tr>
<tr>
<td>PLM strategy is evaluated</td>
<td>Explicit processes for quality control are defined</td>
<td>Product lifecycle teams are organized</td>
<td>Employee reward system is related to product performance throughout its lifecycle</td>
<td>PLM processes are automated by workflow management</td>
</tr>
<tr>
<td>PLM strategy is adapted if needed</td>
<td>Metrics for product quality are defined</td>
<td>PLM procedures are formally described</td>
<td>Employees actively support the PLM strategy</td>
<td>PLM software includes functionality to manage documents</td>
</tr>
<tr>
<td>PLM strategy is translated into an action plan</td>
<td>Product quality after market introduction is monitored</td>
<td>PLM drives the product release process</td>
<td>Employees collaborate on product implementation of lifecycle issues</td>
<td>A roadmap for the new PLM software is defined</td>
</tr>
<tr>
<td>Document management is included in PLM strategy</td>
<td>Status of lifecycles of products is known</td>
<td>PLM includes a document revision process</td>
<td>Employees are actively involved in the implementation of PLM software</td>
<td>PLM software is based on compatible industry and standards</td>
</tr>
<tr>
<td>PLM strategy addresses the main PLM processes</td>
<td>Project management method for managing a product through its lifecycle is applied</td>
<td>PLM includes change management procedures</td>
<td>The concept of PLM is clearly understood</td>
<td>PLM software includes functionality to manage product changes</td>
</tr>
</tbody>
</table>

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### Appendix 2

What kinds of development needs did the case companies experience in the business dimensions of PLM maturity framework in taking the customer perspective into consideration?

<table>
<thead>
<tr>
<th>Business dimension</th>
<th>EngCo1</th>
<th>EngCo2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strategy &amp; Policy</strong></td>
<td>Customers’ requirements and feedback should be at least as important part of PLM strategy as document management.</td>
<td>Future customer needs should affect the facilitation of PLM; for example, are new resources needed (acquired/developed) for e.g. customer need acquisition in the future?</td>
</tr>
<tr>
<td><strong>Monitoring &amp; Control</strong></td>
<td>There should be added questions concerning customer requirement handling, and monitoring and controlling the level of customer service.</td>
<td>The launching of novel products should be taken into consideration in management.</td>
</tr>
<tr>
<td><strong>Organization &amp; Processes</strong></td>
<td>The processes concerning customer requirement handling and customer feedback are important. Also, the links to quality systems should be considered, since role definitions and operating procedures are part of them. “PLM-procedures” is a very generic and abstract expression in the evaluation topics.</td>
<td>Customers should be aware of the various responsibilities and roles of different actors (companies, company functions, individual persons) during the product lifecycle. E.g. if the sales is the only customer interface towards customers, the customer feedback and inquiries reaches the right persons slowly and the information changes on the way.</td>
</tr>
<tr>
<td><strong>People &amp; Culture</strong></td>
<td>The product lifecycle thinking and customer viewpoint should be jointly expressed in organizational culture and peoples’ work tasks. Are PLM, quality systems and customer viewpoint somehow possible to be integrated (in this business dimensions)?</td>
<td>The sharing of process knowledge together with customers Development cooperation in the case of new products and services</td>
</tr>
<tr>
<td><strong>Information Technology</strong></td>
<td>The customer feedback from the different stages of the whole product lifecycle should be brought to use in the organization by means of IT tools.</td>
<td>The integration of IT systems (e.g. maintenance and product data) The usefulness should be argumented to customers</td>
</tr>
</tbody>
</table>
Appendix 3

What kinds of development needs did the case companies experience in the business dimensions of PLM maturity framework in taking the case companies own PLM objectives and company-based restrictions (e.g. resources) into consideration?

<table>
<thead>
<tr>
<th>Business dimension</th>
<th>EngCo1</th>
<th>EngCo2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategy &amp; Policy</td>
<td>Additionally, the links between PLM and product/technology strategy and quality policy should be considered in the maturity assessment</td>
<td>Is document management necessary to be defined and evaluated in this business dimension? (possibly in Organization and processes)</td>
</tr>
<tr>
<td>Monitoring &amp; Control</td>
<td>The questions are right, but the emphasis in the topics is too much in product development. In the case of project business it is difficult to understand how the quality control of the launched product can be achieved.</td>
<td>It is important to ensure that management supports PLM implementation. It is also important to take into consideration how different company functions take PLM requirements into consideration, as well as how they understand the benefits of PLM (in different maturity stages)</td>
</tr>
<tr>
<td>Organization &amp; Processes</td>
<td>Document management belongs to the basic tasks that the company has to define, but the sufficient level of related procedures is determined also by PLM objectives and procedures. The management of product information and quality system should support each other and should be integrated in order not to build competing systems.</td>
<td>Important to consider how the customer is taken into consideration in company processes that change due to PLM implementation (e.g. increase in the number of customer interfaces)</td>
</tr>
<tr>
<td>People &amp; Culture</td>
<td>When PLM is still in its infancy, the task and job descriptions do not yet necessarily have references to PLM processes and procedures, even when the tasks and jobs are closely linked to the various sub-areas of PLM. In the early maturity phases of PLM the different tasks are not seen as relating to PLM.</td>
<td>Development of personnel and their competences is in a very significant role (in PLM maturity development). Also necessary changes in thinking should be considered (e.g. changing earlier product-centered thinking into more service-oriented thinking might be a big challenge in advancing the PLM maturity steps). In advancing the maturity steps, it is important to communicate to personnel and different functions the ways that present operation changes, what is sought with the changes, and what are the benefits in implementation of changes)</td>
</tr>
<tr>
<td>Information Technology</td>
<td>One challenge was the use of PLM concept instead of PDM. Also, a (small) company doing project business does not necessarily need a PDM system as such, so the IT solutions may have a different focus than in the maturity framework. The maturity assessment–related questions and topics could be applied to concern a) manual b) semiautomatic c) automatic IT solutions (concerning the processes of information acquisition and creation, transfer, dissemination, storing, re-use and change management.</td>
<td>Should be taken into consideration in this maturity dimension that commonly there is not only one PLM information system in the types of companies like EngCo2 but several ones (CRM, ERP, PDM); increased information integration in an important role in PLM maturity advancement, ensuring that responsibilities are clarified and there are no contradictory or parallel information in different systems.</td>
</tr>
</tbody>
</table>
UNDERSTANDING USERS’ CONTINUANCE INTENTION TO ANSWER QUESTIONS IN ONLINE QUESTION ANSWERING COMMUNITIES

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Abstract
This study develops a research model to investigate the antecedents of users’ continuance intention to answer questions in online question answering (Q&A) communities based on the literature of knowledge contribution and behavioral continuance. The research model is tested by using the data collected from 241 users of a famous online Q&A community in China (i.e., “Yahoo! Answers China”). The results indicate that satisfaction is the key determinant of continuance intention to answer questions. Satisfaction is, in turn, influenced by reputation enhancement, enjoyment in helping others and advancement of the online community. This study has implications for both theory and practice on the management and design of online Q&A communities.

Keywords: Knowledge Contribution, Continuance, Online Q&A Communities, Satisfaction, Outcome Performance

Introduction
Due to the rapid development of the Internet, bidirectional community-based question answering (Q&A) services have taken the place of traditional unidirectional Q&A services and have become the dominant approach of Q&A services. Distinguished from previous unidirectional Q&A platforms where consumers ask questions and the experts that are employed by the website answer the questions, bidirectional community-based Q&A services (i.e., online Q&A communities) are community-driven platforms dedicated for users to ask questions of and answer questions from fellow users without the intervention of experts or authorities in the field of interest [1].

There is growing evidence that a successful online Q&A community is beneficial to both individual users and community practitioners [2]. However, without definitive answers, online Q&A communities are of little value. Clearly, the biggest challenge in fostering an online Q&A community is the persistent supply of answers or knowledge, namely, the willingness of users to continue answering questions and help others. It is thus important to understand why individuals choose to continue answering questions in an online Q&A community.

It is undoubtedly believed that the long-term sustainability of an online Q&A community depends on the sustained voluntary contribution of answers by community members. Nevertheless, little empirical work has been carried out regarding this issue. Motivated by the practical and theoretical considerations, this study empirically investigates the factors that influence users’ intention to continue answering questions in online Q&A communities. The purpose of this study is to empirically examine the factors influencing users’ continuance intention to answer questions in online Q&A communities. Specially, we focus on a reputed online Q&A community in China—“Yahoo! Answers China” (available at http://ks.cn.yahoo.com/). Identifying the factors that drive individuals’ willingness to continue answering questions in online Q&A communities helps both academics and practitioners to gain insights into how to stimulate knowledge persistent contributions in these online communities.

The rest of the paper is organized as below. First, a review on the theories that can help to explain knowledge contribution continuance is provided. Based on the theoretical background, the research model and hypotheses are then introduced. Next, the research methodology and statistical results are described. Finally, the findings and implications for both research and practice are discussed.

Theoretical Background
With the increasing popularity of online Q&A communities, research on them has become more and more important. In order to understand the sustainability of online Q&A communities in general, and users’ continuance intention to answer questions in particular, we provide a review on the literature of knowledge contribution and behavioral continuance.

Knowledge Contribution and Perceived outcome performances (i.e., perceived benefits)
Based on the social exchange theory, the social capital theory and others, previous researchers have
largely sought to explore why people contribute their knowledge in online communities (e.g., [3] [4] [5]). This study found that knowledge contributors exchange their knowledge with knowledge seekers for some new values [6]. This indicates that perceived benefits from knowledge contribution in online communities can motivate individuals to continue doing so in the absence of personal acquaintance, similarity, or the likelihood of direct reciprocity [7]. The values received in return for knowledge contribution might be not just tangible benefits, such as gifts or money, but also intangible benefits, such as reputation or reciprocal help in the future. Based on a literature review of prior research on knowledge contribution in online communities, this study highlights several plausible outcome performance resulting from contribution in online communities, namely, extrinsic reward, reputation enhancement, reciprocity, enjoyment in helping others and advancement of the online community.

Extrinsic reward refers to the perception of tangible incentive (gift or money) provided for answering questions in online Q&A communities [3] [5]. Reputation enhancement means the perception of status and respect obtained from answering questions in online Q&A communities [4]. Reciprocity captures the perception that previous behavior of answering questions and helping others in online Q&A communities have influenced the contributor in receiving answers and helping in the future [8] [4]. Enjoyment in helping others reflects the feelings of pleasure obtained from helping others through answering questions in online Q&A communities [3]. Finally, advancement of the online community is viewed as the belief of increasing the welfare of the community as a whole by answering questions in online Q&A communities [8] [7].

**Continuance and User Satisfaction**

According to the literature of continuance such as information systems continuance and repurchase, satisfaction is considered as a key construct in predicting continuance intentions [9] [10] [11]. Empirically, the amount of continuance variance explained by satisfaction generally exceeds levels of variance explained by ex-post perceived performance (i.e., perceived benefits). We therefore expect that satisfaction will be more strongly associated with continuance intention to answer questions in online Q&A communities than perceived benefits. Further, we posit that satisfaction can be explained by ex-post perceptions of benefits. For these two reasons, in the context of knowledge contribution continuance, we expect that satisfaction will mediate the relationship between individual perceptions of benefits from knowledge contribution continuance and continuance intention of knowledge contribution.

User satisfaction has received substantial attention in the past information systems (IS) research for a variety of reasons, including the intrinsic desirability of user satisfaction and its strong relationship with IS success and continuance [12] [13] [10]. User satisfaction has been broadly defined in previous IS studies. In this study, we define satisfaction as users’ internal affective psychological responses to their behavior of answering questions in online Q&A communities.

Decades of IS research on user satisfaction has resulted in a sound understanding of how perceptions of performance (e.g., personal cognitive beliefs) affect users’ level of satisfaction (refer to [14] and [15] for a review) and how user satisfaction, in turn, influences a variety of important IS behaviors (e.g., IS continued usage). For the most part, user satisfaction is thus positioned either as a determinant of behaviors (e.g., an independent variable) or as a desirable outcome in its own right (i.e., a dependent variable). While we recognize the intrinsic value of these two perspectives, we argue in this paper that an additional important role of user satisfaction lies in its role as mediator of the relationships between various cognitive beliefs and related outcomes.

**Research Model**

Based on the theoretical background, we propose a research model to investigate why people continue answering questions in online Q&A communities (see Figure 1).

**Continuance Intention to Answer Questions**

“Continuance” answering, distinct from first-time answering, means repeated answering or answering again after initial answering. Regarding the definition of “continuance” [10] and “intention” [16] [17], users’ continuance intention to answer questions in online Q&A communities is defined as an individual’s subjective likelihood of continuing to conduct question answering actions in an online Q&A community.

**User Satisfaction**

The relationship between satisfaction and IS continuance intention has been widely demonstrated in previous studies (e.g., [10] [18] [19]). Satisfaction is the main explanation of a common situation in business organizations where IS with good attributes still fail to motivate users’ repeated use. Online consumer satisfaction has also drawn the attention of both researchers and practitioners along with the growth of the Internet due to the strong effect of satisfaction on customer or member retention and the high costs of acquiring new customers or members [20] [21]. In the context of online communities, satisfaction captures a member’s post-participation affections resulting from a cognitive appraisal of the disconfirmations of need expectations [10]. It has
been validated to be a key determinant of one’s continuance intention to participate in an online community [22]. Consistent with these studies, we infer that users’ level of satisfaction with prior behavior of answering questions in an online Q&A community has a strong and positive impact on their continuance intention to answer questions in this online community. This leads to the following hypothesis:

**H1**: User satisfaction with prior behavior of answering questions in an online Q&A community has a positive impact on users’ continuance intention to answer questions in the online Q&A community.

**Perceived Performance and Satisfaction**

As reference to [23], perceived performance is conceptualized as the perceived positive outcome from a particular behavior (e.g., answering questions in online Q&A communities). It has been found to be an essential determinant of satisfaction in different research areas. As is shown in a study of consumer behavior released by [24], satisfaction is more likely to depend on outcome performance rather than disconfirmations of prepurchase-expectations. Further, previous studies in the area of information systems research have found that, compared to initial expectations and disconfirmations of initial expectations, perceived performance of IS use is of the greatest importance to satisfaction [25] [26]. Similarly, it has been found that perceived outcome performance of knowledge sharing is the key determinant of satisfaction [27] [28]. In consequence, the emphasis that an individual places on different types of received benefits is important to predict satisfaction. The most commonly investigated perceived performance of knowledge sharing in online communities in previous studies include extrinsic reward, reputation enhancement, reciprocity, enjoyment in helping others and advancement of the online community. This leads to the following hypotheses:

**H2**: Extrinsic reward has a positive effect on user satisfaction with prior behavior of answering questions in an online Q&A community.

**H3**: Reputation enhancement has a positive effect on user satisfaction with prior behavior of answering questions in an online Q&A community.

**H4**: Reciprocity has a positive effect on user satisfaction with prior behavior of answering questions in an online Q&A community.

**H5**: Enjoyment in helping others has a positive effect on user satisfaction with prior behavior of answering questions in an online Q&A community.

**H6**: Advancement of the online community has a positive effect on user satisfaction with prior behavior of answering questions in an online Q&A community.

**Research Design**

The research model was empirically tested in “Yahoo!
“Answers China”, one of the largest Chinese-language websites devoted to questions and answers. It is browsed more than 54 billion times every week; it had more than 38 million solved questions by September 2008. Virtually any question is allowed, except ones that violate the “Yahoo! Answers China” community guidelines. Questions in “Yahoo! Answers China” are categorized according to special interests and goals. It has 13 top-level and 155 lower-level categories, ranging from health care and hospitals, to science and mathematics, or to parenting. It is the place to ask questions and get real answers from real people, that is, a service that allows users to post questions and/or answer questions asked by other members of the community. In addition, “Yahoo! Answers China” facilitates the preservation and retrieval of answered questions aimed at building an online knowledge base. People in China thus view “Yahoo! Answers China” as a human-driven search engine.

**Data collection and Responses**

The target subjects of this study were all users of “Yahoo! Answers China” who had ever answered questions. We sent a message with a link to the online survey to the users of “Yahoo! Answers China.” To encourage participation in the online survey, incentives of an “Amazon” coupon were offered as lucky draw prizes among respondents. A preventive measure was taken to avoid repetitive completion of the questionnaire from the same respondents by rejecting two pieces of data with the same IP address. The data collection was closed when there were no more new responses. A total of 241 responses were collected. As shown in Table 1, among the 241 respondents, 61.4 percent were male and 38.6 percent were female. The male female ratio was a little higher than that of the whole Internet population in China (51.5:48.5). More than half of the respondents were aged between 21 years and 30 years, and 8.3 percent were aged under 20. As for the educational level, 53.5 percent of the respondents had a bachelor degree, and 6.6 percent had a graduate or higher degree. The respondents came from diverse industries: 14.1 percent were manufacturers, 8.7 percent were business people, and 10 percent were teaching staff, etc.

**Measures**

The constructs in the research model were all measured by using multiple-item scales drawn from previous studies with minor modifications to ensure contextual consistency. Appendix shows the measures used in this study. Satisfaction was measured using the items from [10]. Items for measuring extrinsic reward were adapted from [29]. Measures for reputation enhancement were adapted from [4] [3]. Reciprocity was measured using items from [3]. Advancement of the online community was measured using the items from [8]. Continuance intention to answer questions in online Q&A communities was measured using the items adapted from [10]. The scale items used seven-point semantic differential scales anchored from “strongly disagree” to “strongly agree.”

<table>
<thead>
<tr>
<th>Demographic Variables</th>
<th>Category</th>
<th>Frequency (n=241)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td>Male</td>
<td>148</td>
<td>61.4</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>93</td>
<td>38.6</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>12-20</td>
<td>20</td>
<td>8.3</td>
</tr>
<tr>
<td></td>
<td>21-30</td>
<td>129</td>
<td>53.5</td>
</tr>
<tr>
<td></td>
<td>31-40</td>
<td>54</td>
<td>22.4</td>
</tr>
<tr>
<td></td>
<td>41-65</td>
<td>38</td>
<td>15.8</td>
</tr>
<tr>
<td><strong>Education level</strong></td>
<td>High school certificate or below</td>
<td>35</td>
<td>14.5</td>
</tr>
<tr>
<td></td>
<td>Vocational/ Technical school</td>
<td>61</td>
<td>25.3</td>
</tr>
<tr>
<td></td>
<td>Undergraduate degree</td>
<td>129</td>
<td>53.5</td>
</tr>
<tr>
<td></td>
<td>Postgraduate or higher degree</td>
<td>16</td>
<td>6.6</td>
</tr>
<tr>
<td><strong>Industry</strong></td>
<td>Manufacturing</td>
<td>34</td>
<td>14.1</td>
</tr>
<tr>
<td></td>
<td>Banking, securities and insurance</td>
<td>12</td>
<td>5.0</td>
</tr>
<tr>
<td></td>
<td>Service industry</td>
<td>16</td>
<td>6.6</td>
</tr>
<tr>
<td></td>
<td>Transportation</td>
<td>9</td>
<td>3.7</td>
</tr>
<tr>
<td></td>
<td>Business</td>
<td>21</td>
<td>8.7</td>
</tr>
<tr>
<td></td>
<td>Student</td>
<td>42</td>
<td>17.4</td>
</tr>
<tr>
<td></td>
<td>Teaching staff</td>
<td>24</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Civil service</td>
<td>17</td>
<td>7.1</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>66</td>
<td>27.4</td>
</tr>
</tbody>
</table>

**Results**
Data analysis is performed using Partial Least Squares (PLS), a structural equation modeling technique which has been widely used in IS studies in recent years. Following [30] and [31], we carried out the data analysis in two stages. First, we validated the measurement model by conducting confirmatory factor analysis; second, we examined the structural relationships by a bootstrapping procedure of PLS.

Measurement Model
Convergent validity, which indicates the extent to which the items of a scale that are theoretically related to each other relate to each other in reality, was verified by examining the composite reliability (CR) and the average variance extracted (AVE).

Table 2 Assessment of Internal Consistency and Convergent Validity

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Number of Questions</th>
<th>CR</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extrinsic reward (ER)</td>
<td>3</td>
<td>0.96</td>
<td>0.88</td>
</tr>
<tr>
<td>Reputation (REP)</td>
<td>4</td>
<td>0.92</td>
<td>0.73</td>
</tr>
<tr>
<td>Enjoyment in helping others (EHO)</td>
<td>4</td>
<td>0.94</td>
<td>0.81</td>
</tr>
<tr>
<td>Reciprocity (REC)</td>
<td>4</td>
<td>0.94</td>
<td>0.79</td>
</tr>
<tr>
<td>Advancement of the online community (ATC)</td>
<td>4</td>
<td>0.93</td>
<td>0.78</td>
</tr>
<tr>
<td>Satisfaction (SAT)</td>
<td>4</td>
<td>0.95</td>
<td>0.83</td>
</tr>
<tr>
<td>Continuance intention (CI)</td>
<td>3</td>
<td>0.89</td>
<td>0.74</td>
</tr>
</tbody>
</table>

Table 3 Correlations between Constructs

<table>
<thead>
<tr>
<th></th>
<th>ER</th>
<th>REP</th>
<th>EHO</th>
<th>REC</th>
<th>ATC</th>
<th>SAT</th>
<th>CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>ER</td>
<td>0.94</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>REP</td>
<td>0.18</td>
<td>0.85</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EHO</td>
<td>-0.19</td>
<td>0.42</td>
<td>0.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>REC</td>
<td>0.02</td>
<td>0.38</td>
<td>0.49</td>
<td>0.89</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ATC</td>
<td>0.02</td>
<td>0.36</td>
<td>0.47</td>
<td>0.53</td>
<td>0.88</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAT</td>
<td>-0.08</td>
<td>0.37</td>
<td>0.47</td>
<td>0.38</td>
<td>0.40</td>
<td>0.91</td>
<td></td>
</tr>
<tr>
<td>CI</td>
<td>-0.05</td>
<td>0.28</td>
<td>0.46</td>
<td>0.35</td>
<td>0.39</td>
<td>0.66</td>
<td>0.86</td>
</tr>
</tbody>
</table>

Structural Model
The examination of the structural model involves estimating the path coefficients and the R-square values. Path coefficients represent the strengths of the relationships between the dependent and independent variables, and R-square values stand for the amount of variance of dependent variables explained by their antecedents. Together, the R-square values and the path coefficients (i.e., loadings and significance) demonstrate how well the data validates the research model. Tests of significance of all paths were performed using the bootstrap re-sampling procedure of PLS. All statistical tests were assessed at 5 percent level of significance using one-tailed t-tests because our hypotheses and corollaries are unidirectional in nature.

As show in Figure 2, 44 percent of the variance in continuance intention was explained by satisfaction. The path between user satisfaction and continuance intention is positive and significant ($\beta=0.66$, $p<0.001$), suggesting that user satisfaction is a salient determinant of users’ intention to continue participating in “Yahoo! Answers China.” Satisfaction is, in turn influenced by reputation enhancement ($\beta=0.17$, $p<0.05$), enjoyment in helping others ($\beta=0.26$, $p<0.01$) and advancement of the online community ($\beta=0.16$, $p<0.05$). Overall, these three types of outcome performance can explain 30% of the R-squares of satisfaction.
Discussion and Conclusion
This study sought to investigate users’ continuance intention to answer questions in online Q&A communities based on the literature of knowledge contribution and continuance. In particular, this paper investigates the roles of satisfaction and question answering benefits in influencing continuance intention to answer questions. The results show that the measurement model is validated with adequate levels convergent and discriminant validities. The results also provide sufficient support to the fundamental research propositions and the proposed conceptual framework (see Figure 2).

Key Findings
The primary insights this research provides are as follows: First, satisfaction is a key determinant of users’ intention to continue answering questions in online question answering communities (e.g., “Yahoo! Answers China”). This finding is consistent with prior studies of IS continuance (e.g., [10] [18] [19] [33]). Satisfaction is thus anticipated to be an important predictor of actual continuance behavior of answering questions in online Q&A communities. Second, this study shows that the primary antecedents of satisfaction are reputation enhancement, enjoyment in helping others and advancement of the online community. Extrinsic reward and reciprocity, however, are found to be non-significantly related to either satisfaction. These findings suggest that extrinsic reward and reciprocity may be of little importance to user satisfaction with prior behavior of answering questions in an online Q&A community. In previous studies, the importance of extrinsic reward and reciprocity to knowledge contribution in online communities has been disputed. Some studies show that these two factors are vital motivations of knowledge contribution, while others have varying results. This suggests that the roles of extrinsic reward and reciprocity in online communities depend on the contexts and features of online communities.

Implications for Research
This study contributes to theory in terms of the following aspects. First, while past studies have largely focused on users’ past activities in online communities, this study moves a step forward and identifies the factors that influence users’ future intention of continued usage of online communities for knowledge contribution. Prior models of knowledge contribution have explained users’ past behavior of knowledge contribution by addressing the motivations or outcome performance for knowledge contribution. They, however, do not explain users’ further intention of knowledge contribution. In order to fill this research gap, this study integrates theories concerning knowledge contribution and continuance with the specific focus on satisfaction and five types of outcome performance. This study highlights satisfaction as mediators between motivations and continuance intention. It suggests that whether or not users want to contribute their knowledge again depends directly on their satisfaction rather than on motivations which are the key direct predictors of users’ initial or past knowledge contribution behavior. In consequence, our theoretical structure serves as an example for future attempts to integrate theories for investigating users’ further intentions after initial participation in online communities.

Second, it is surprisingly to find that
extrinsic reward and reciprocity have little impact on user satisfaction. This indicates that extrinsic motivations such as extrinsic reward and reciprocity play a small role in predicting users’ continuance intention to answer question in online Q&A communities. One of the explanations may be that it is really hard for users to get extrinsic rewards in online Q&A communities (e.g., users in Yahoo! Answers should have millions of points to exchange a gift.). Moreover, users who do not answer questions can also get answers freely from online Q&A communities. Reciprocity is, hence, insignificant in this context. Future research should play more attention on social motivations such as advancement of the online community, and intrinsic motivations such as reputation and enjoyment when studying knowledge contribution continuance in online Q&A communities.

Implications for Practice
Web 2.0-based search engines, such as Yahoo, Google and Baidu, have invested considerably in online Q&A communities. Moreover, companies and organizations have changed their way of Q&A services to community-based Q&A services where the community members, rather than their employees, are responsible for the answers. This evidence points out that online Q&A communities are becoming more and more important. The research findings in this article could have significant implications for organizations of online Q&A communities in community management and design.

User satisfaction remains as the most important factor in determining users’ intention to continue answering questions. It serves as an important measure for the sustainability of online Q&A communities, and thus, community managers should closely monitor changes in user satisfaction levels by conducting user satisfaction surveys. Users’ sense of satisfaction can be increased by the benefits that they obtain from answering questions in online Q&A communities. The community managers should thus offer some benefits or value to the answerers, such as enhancing their reputation according to the extent of contribution, increasing their feelings of enjoyment by praising their contribution in the community, and showing the users how important their contribution is to the whole community.

Limitations and Directions for Future Research
This study has several empirical and theoretical limitations which call for additional research. First, most respondents have used the focused online Q&A community for years and intend to continue using it. The responses from the continuers may be biased in contrast to discontinuers. Hence, a longitudinal study of the new users should be conducted in future research. Second, we have selected only one particular online Q&A community in China (“Yahoo! Answers”) as our research site. The research results could have been affected by the culture of China and the background of “Yahoo! Answers China.” Future research that examines different types of online Q&A communities in different countries and compares the results would enhance the generalization of our research model. Third, from the results of our study, only 44% of the variance of users’ continuance intention to answering questions in “Yahoo! Answers China” is explained by the research model. There must be other predictors of continuance intention that are unexplored in this study. Some related social factors (e.g., social capital, group norm, etc.) may be useful in explaining intention to continue answering questions in online Q&A communities. Future research should take social factors into account. Finally, our study has only examined the motivations for question answerers’ continued usage of online Q&A communities. Future research should take social factors into account. Finally, our study has only examined the motivations for question answerers’ continued usage of online Q&A communities. It is anticipated that future research studying the factors motivating information seekers to continue asking questions in online Q&A communities would help us realize another aspect of online Q&A community sustainability.

Conclusions
The goal of this study is to explore the antecedents of users’ intention to continue answering questions in online Q&A communities based on theories regarding knowledge contribution and continuance. Data collected from an online survey among “Yahoo! Answers China” users provides empirical support for the research model and the hypotheses. This study increases our understanding of the factors predicting users’ continuance intention to select an online Q&A community as a channel of knowledge contribution. Future research should continue to enrich this line of research by extending the investigation into other types of Internet-based media that support online communities in different cultures, and by examining the diverse motivations for continued usage of online communities by different kinds of users (including both information seekers and contributors).

Appendix Construct Items

<table>
<thead>
<tr>
<th>Construct</th>
<th>Items</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extrinsic rewards (ER)</td>
<td>Answering questions in “yahoo! Answers China” helps me obtain material rewards (gift or money).</td>
<td>Developed from [29]</td>
</tr>
<tr>
<td></td>
<td>I have obtained material rewards (gift or money) in return for</td>
<td></td>
</tr>
</tbody>
</table>

The 9th International Conference on Electronic Business, Macau, November 30 - December 4, 2009
<p>| | | | |</p>
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</table>
| **Reputation enhancement (RE)** | Answering questions has enhanced my status in “Yahoo! Answers China.”  
I have earned respect from others by answering questions in “Yahoo! Answers China.”  
My reputation in “Yahoo! Answers China” has increased as a result of answering questions in the community.  
Answering questions in “Yahoo! Answers China” has improved other members’ recognition of me. | Adapted from [4]  |                                                                 |
| **Enjoyment in helping others (EHO)** | I feel enjoyable after answering questions in “Yahoo! Answers China.”  
I feel good to help others by answering questions in “Yahoo! Answers.”  
Answering questions in “Yahoo! Answers China” makes me feel pleasant.  
Answering questions in “Yahoo! Answers China” gives me enjoyment. | Developed based on [3]  |                                                                 |
| **Reciprocity (REC)** | My queries for answers are responded after I answered others’ questions in “Yahoo! Answers China”.  
Answering questions in “Yahoo! Answers China” has increased the degree of reciprocity (e.g., get more answers when I am in need).  
Answering questions in “Yahoo! Answers China” makes me get more answers when I ask questions.  
When I answer questions in “Yahoo! Answers China”, I believe that my questions will be answered in future. | Developed based on [3]  |                                                                 |
| **Advancement of the online community (ATC)** | My answers are helpful to the successful functioning of “Yahoo! Answers China”.  
My answers help “Yahoo! Answers China” continue its operation in the future.  
My answers help “Yahoo! Answers China” accumulate or enrich knowledge.  
My answers help “Yahoo! Answers” grow.  
I have the expertise needed to provide valuable knowledge.  
It does not really make any difference whether I add to the knowledge others are likely to share within “Yahoo! Answers China.” | Adapted from [8]  |                                                                 |
| **Satisfaction (SAT)** | I feel very satisfied with my previous experience of answering questions in “Yahoo! Answers China”.  
I feel very pleased with my previous experience of answering questions in “Yahoo! Answers China”.  
I feel very contented with my previous experience of answering questions in “Yahoo! Answers China”.  
I feel absolutely delighted with my previous experience of answering questions in “Yahoo! Answers China”. | Adapted from [10]  |                                                                 |
| **Continuance Intention (CI)** | I intend to continue answering questions in “Yahoo! Answers China.”  
My intentions are to continue answering questions in “Yahoo! Answers China” rather than any alternative means.  
I would like to discontinue answering questions in “Yahoo! Answers China.” | Adapted from [10]  |                                                                 |
Acknowledgement. The work described in this article was partially supported by a grant from the Research Grant Council of the Hong Kong Special Administrative Region, China (Project No. CityU 145907). This work was also partially supported by a grant from the Research Grants Council of the Hong Kong Special Administrative Region, China (Project No. HKBU 240609).

References


A METHODOLOGY FOR IDENTIFYING CORE TECHNOLOGIES BASED ON TECHNOLOGICAL CROSS-IMPACT: ASSOCIATION RULE MINING AND ANP APPROACH

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Abstract
There have been attempts to examine technological structure and linkage as technological impact. Cross-impact analysis (CIA) has been mainly employed with cross-impact index to identify core technologies. Cross-impact index, however, cannot successfully capture the overall relationship based on the impacts among technologies. Furthermore, it is a time-consuming task to calculate all cross-impact index especially based on patents without developing computer program. To address this limitation, this study suggests new approach to identify core technologies in technological cross-impact interrelations. Specially, the approach applied data mining technique and multi-criteria decision making (MCDM) method to the co-classification information of registered patents. At first, technological cross-impact matrix is constructed with the confidence values by applying association rule mining (ARM) to the co-classification information of patents. Then, Analytic Hierarchical Process (ANP), one of MCDM methods, is employed to the constructed matrix for identifying core technologies from the perspectives of overall cross-impacts. A case study of telecommunication technology is conducted to illustrate the process of executing and utilizing the proposed approach. It is expected that suggested approach could help technology planners to formulate strategy and policy for technological innovation.

Keywords: Cross Impact Analysis (CIA), Association Rule Mining (ARM), Analytic Network Process (ANP), Core Technology, Patent Co-classification

Introduction
The characteristics of modern technology change can be defined as complexity and radicalness. Under this environment, the grasping of technological trend and development by analyzing overall structure of technologies and interaction among them has become more important. With this activity, firms can manage R&D portfolio efficiently thus competitive advantage can be gained and sustained [1]. Consequently, there have often been attempts to identify technological structure and relationship.

The core of the identification of technological structure and relationship is the patent analysis [2]. It is reported that patents contain about 80% of all technological knowledge [3] and they can be easily accessed and analyzed through various types of public or private database. Patents are, hence, perceived as useful information for techno-economic analysis and R&D management [4] and a lot of studies have attempted to analyze technological relationship with patent information.

The most commonly used information for analyzing technological relationship with patents is citation. The basic assumption of citation analysis is that the knowledge of cited patent is transferred to citing patent and there exists a technological linkage between them. Citation analysis is a useful index for identifying technological relationship and this can be verified with various studies. [2] [4-18]. However, there are some short comings in the citation analysis. First, the average time-lag between citing-cited patents is over 10 years [19]. Moreover, since citation analysis considers citing-cited relationship between individual patents, it is difficult to identify technological relatedness and characteristics from the perspectives of technological fields [4]. To address this limitation, there have been attempts to applying other information such as co-citation [20] [21], co-word [22], and keyword vector [4]. They also have, however, their own weakness. There is still time-lag problem in co-citation analysis. Co-word analysis and keyword vector analysis requires qualitative judgment and therefore have lack of consistency in the result of analysis. On the contrary, the patent analysis with co-classification information has some advantages compared to above mentioned methods. Co-classification analysis is to analyze technological relationship based on the fact that patents are classified to some technological classes considering their technological characteristics [23]. That is, the assumption which is made is that the frequency by which two classification codes are jointly assigned to the same patent document can be interpreted as a
sign of the strength of the knowledge relationship, in terms of knowledge links and spillovers [24]. In contrast with citation analysis, it is based on the hierarchical technological classification system so technological relationship can be analyzed not on the level of individual patents but on the various technological levels according the purpose of studies. Furthermore, error from time-lag is relatively less since patent classification is the information at the time of patent registration. Among the various techniques using the information of patent co-classification, technological cross impact analysis (CIA) has been used as a practical methodology to identify core technology and the interrelationships between technologies by analyzing cross impact between technologies quantitatively based on patent classification data [25]. In patent-based CIA, cross impact index of two technologies is calculated with the probabilities based on the patent co-classification information to analyze the impact between technologies. This is a useful and widely used approach in a patent-based CIA, but it is subject to some limitations. First, it is nearly impossible to construct cross impact matrix without developing computer program because the construction of cross impact matrix requires a huge amount of calculation with patent data. Second, in the identification of core technologies, patent-based CIA does not take into account the overall interrelationships among technologies, only considers the relationships between two technologies.

The main objective of this paper, therefore, is to suggest a new approach to identify core technologies from the perspectives of cross impact based on patent co-classification information considering overall interrelationships among technologies. Specially, the approach applies data mining technique and multi-criteria decision making (MCDM) method. At first, association rule mining (ARM) is employed to calculate technological cross impact index and derive cross impact matrix. Although ARM is one of the representative data mining techniques for exploring vast database, it has rarely been applied to the analysis of patents. Since confidence in ARM is defined as a conditional probability between two technologies and is of the same formula with cross impact index, it is adopted as the index of evaluating technological cross impact. Then, the cross impact matrix is constructed with all calculated cross impact index. Second, ANP (Analytic Network Process), one of the MCDM, is applied to the derived cross impact matrix for identifying core technologies from the perspectives of overall interrelationships among technologies. Since the ANP is capable of measuring the relative importance that captures all the indirect interactions in a network, the derived “limit centrality” indicates the importance of a technology in terms of impacts on other technologies, taking all the direct and indirect influences into account. The proposed approach is expected to allow technology planners to understand current technological trends and advances by identifying core technologies based on limit centralities. A case study on telecommunication technologies is presented to illustrate the proposed approach.

Methodological Background
Cross-impact analysis (CIA)
The changing or evolving process of a system could be regarded as a set of some events. Since they interact with each other, the occurrence of a specific event takes an effect on the probability of other events’ occurrence. Therefore, it is impractical to forecast the probability of an event’s occurrence without considering the occurrence of other events. Like social systems, technological change or progress occurs as a result of the occurrence of various events. For example, the development of mobile phone has to do with that of technologies such as mobile network, memory, and liquid crystal display. When technological events occur through the interactions with each other, an impact of each event of interest on other events is called cross impact [26-28]. Accordingly, CIA has been used as a methodology to forecast the emergence of new technologies and to identify the interrelations between technologies by defining the emergence of new technologies as event occurrences [25].

The general process of CIA is as follows: (1) Define the events to be included in the analysis. (2) Estimate the initial probability of each event. (3) Estimate the conditional probabilities for each event pair. (4) Perform a calibration run of the cross impact matrix. (5) Evaluate the results. In conventional CIA, the step (2) and (3) require the experts’ subjective judgment based on their domain knowledge and therefore inconsistent estimates may result. Further, in the step (4), the two kinds of probabilities derived from the former steps should be adjusted because of the intuitive estimation. To overcome these shortcomings of the conventional CIA, Choi et al [25] proposed a patent-based CIA that analyzed cross impact between technologies quantitatively based on patent classification data. In this study, the cross impact of technology ‘A’ on the technology ‘B’ is defined as the conditional probability \( P(B|A) = \frac{N(A \cap B)}{N(A)} \). In this equation, \( N(A) \) refers to the total number of patents classified in technology \( A \), and \( N(A \cap B) \)
indicates the number of patents classified in both technology A and B.

Association rule mining (ARM)
ARM is one of the data mining techniques to search for interesting relationships among items in large database. Association rule stands for the co-occurrence of two items and indicates that if two items occurs together frequently they have strong association relationship [29]. ARM has mainly been applied to firm activities, especially to marketing [30]. It has also been used to various areas such as bioinformatics [31] [32], medicine [33], and finance [34].

The three measures of evaluating the rule interestingness are support, confidence, lift and the details of them are described in Table 1. The typical procedure of ARM consists of two steps [35]: (1) Search for frequent itemsets – To create all item combinations over the threshold value of support (2) Generate association rules – To Select itemsets over the threshold value of confidence or lift among the frequent itemsets found in (1). The step (1) is a very time consuming job and the most representative technique for this is Apriori algorithm [36].

Table 1. Measures of interestingness

<table>
<thead>
<tr>
<th>Measure</th>
<th>Description</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support</td>
<td>The usefulness of discovered rule $A \rightarrow B$</td>
<td>$P(A \cap B)$</td>
</tr>
<tr>
<td>Confidence</td>
<td>The certainty of discovered rule $A \rightarrow B$</td>
<td>$P(B \mid A)$</td>
</tr>
<tr>
<td>Lift</td>
<td>The correlation between the occurrence of items in discovered rule $A \rightarrow B$.</td>
<td>$\frac{P(B \mid A)}{P(B)}$</td>
</tr>
</tbody>
</table>

Analytic network process (ANP)
The ANP is a generalization of the AHP which is one of the most widely used MCDM methods [37]. The ANP extends the AHP to problems with dependences and feedback. It allows for more complex interrelationships among decision elements by replacing a hierarchy in the AHP with a network [38]. Therefore, it has been used increasingly in a variety of problems such as project selection [39], product design [40] and development, and financial forecasting [41].

The process of ANP is composed of four steps [37]: (1) Network model construction (2) Pairwise comparison and priority vectors (3) Supermatrix formation and transformation (4) Final priorities.

Research Framework
The whole research procedures are as follows. First, patent data of interested technological area is collected. Second, technological cross-impact matrix is constructed with the confidence values calculated by applying ARM to the co-classification information of gathered patent data. Finally, core technologies are identified through employing ANP to the technological cross-impact matrix. Figure 1 depicts overall process of this study. Note that the rectangle denotes an individual process and the ellipse denotes the methodology for the next process. More detailed explanations are provided below.

Figure 1. Overall process of proposed approach

Technological cross-impact matrix construction
First of all, the technological area to be analyzed should be decided before constructing cross-impact matrix. For this aim, this research adopted patent classification system. Patent classification system stands for the hierarchical system to classify and manage patents considering their technological characteristics. Generally, patents are affiliated to more than two classes based on the patent classification system [42]. Class, therefore, indicates which technological areas the patents (individual technologies) are affiliated in technological classification systems.

The cross-impact index, $\text{Impact}(A,B)$ is defined to the conditional probability, $P(B\mid A)$, which is of the same formula with the confidence of the association rule $A \rightarrow B$ in ARM. Accordingly, this study applies ARM to the co-classification information of gathered patents for constructing cross-impact matrix. Figure 2 expresses the cross-impact matrix with the confidence value between two technological areas. In this figure, $T_i$ means the $i^{th}$ technological area (class), and $\text{conf}(T_i \rightarrow T_j)$, the confidence values of the association rule $T_i \rightarrow T_j$, indicates the impact of the technological area of $T_i$ on that of $T_j$. The values of the diagonal cells are 1 since the same technological areas impacts fully on each other.
Core technology identification
Previous studies on the analysis of technological cross-impact with patent classification information focus only to the identification of technology pairs with high cross-impact value. On the contrary, this study tries to grasping the most influential technologies based on the overall cross-impact that one technology impacts to all other technologies. To this aim, ANP, one of the MCDM methods, is applied to the redefined cross-impact matrix.

Figure 2. Technological cross-impact matrix

<table>
<thead>
<tr>
<th></th>
<th>T₁</th>
<th>T₂</th>
<th>…</th>
<th>Tₙ</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₁</td>
<td>1</td>
<td>Conf(T₁→T₂)</td>
<td>…</td>
<td>Conf(T₁→Tₙ)</td>
</tr>
<tr>
<td>T₂</td>
<td>Conf(T₂→T₁)</td>
<td>1</td>
<td>Conf(T₂→Tₙ)</td>
<td></td>
</tr>
<tr>
<td>…</td>
<td>…</td>
<td>1</td>
<td>…</td>
<td>…</td>
</tr>
<tr>
<td>Tₙ</td>
<td>Conf(Tₙ→T₁)</td>
<td>Conf(Tₙ→T₂)</td>
<td>…</td>
<td>1</td>
</tr>
</tbody>
</table>

Illustrative Example
Technology selection and patent data collection
The information and communication technology (ICT) industry has been at the forefront of industrial globalization [43]. ICTs can be classified into four categories: telecommunication, consumer electronics, computer and office machinery, and other ICT [44]. Among them, telecommunication technologies have been playing a critical role in economic growth and exhibiting dramatic technological progress [16]. Thus, analyzing the telecommunication technology is expected to provide valuable implication.

The primary source of patent data used in this study is the United States Patent and Trademark Office (USPTO) database. The USPTO has classified granted patents into corresponding technology classes defined by the USPC (United States Patent Classification). A class generally delineates one technology from another and serves as a unit of the analysis.

For selecting patents regarding telecommunication, the IPC (International Patent Classification) codes for ICT shown in Appendix are used. Referring to the US-to-IPC concordance provided by the USPTO website, the USPTO classes matched with the IPC codes of telecommunication technologies were chosen. The selected classes cover 13 classes in the USPC shown in Table 2.

Table 2. Telecommunication technology classes

<table>
<thead>
<tr>
<th>Class</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>329</td>
<td>Demodulators</td>
</tr>
<tr>
<td>331</td>
<td>Oscillators</td>
</tr>
<tr>
<td>332</td>
<td>Modulators</td>
</tr>
<tr>
<td>340</td>
<td>Communications: electrical</td>
</tr>
</tbody>
</table>

Technological cross-impact matrix construction
To calculate cross-impact index and construct cross-impact matrix of telecommunication technologies, ARM is applied to the co-classification information of the patents assigned to the 13 classes registered in 2005. SAS E-miner release 4.3, one of data-mining package, is used and Apriori algorithm is selected to search rules. Ultimately, as shown in Table 3, the technological cross-impact matrix of telecommunication is constructed with the derived confidence values.

Core technology identification
The next step is to identify core technology by prioritizing technologies with employing ANP to the constructed technological cross-impact matrix. First, network model is constructed. The network in the proposed approach is made on the basis of cross-impact relationships represented in the cross-impact matrix. A cluster in the ANP network corresponds to a class and each cluster has no elements. In the ANP context, then, the resulting network model only includes alternative clusters, contrary to the general network model in the ANP comprised of a goal cluster, criteria clusters, and alternative clusters. Thus, the importance of alternatives (classes) is only evaluated with respective to impacts on other alternatives.

Second, the alternatives are pair-wisely compared and priority vectors are derived. The basic form of measurement in the ANP is a pairwise comparison with a scale of 1-9. However, pairwise comparisons do not have to be done in the proposed approach. It is implicitly assumed that the cross-impact index between two classes is a proxy of intensity of influence. Then, the importance of classes can be directly measured from the cross-impact matrix. Furthermore, since the alternatives have no elements, the cross-impact matrix itself is a priority vector and a supermatrix.

Third, supermatrix is constructed and transformed. As mentioned above, the supermatrix is the cross-impact matrix and need to be transformed into the weighted supermatrix and the
A Methodology for Identifying Core Technologies Based on Technological Cross-Impact

The weighted supermatrix shown in Table 4 is constructed by manipulating the sum of columns elements of the supermatrix to be zero. Then, the limit supermatrix was derived by raising the weighted supermatrix to powers. Table 5 shows the limit supermatrix.

Finally, the priority is finalized and core technologies are identified. The columns of the limit supermatrix represent final priorities. This indicates importance of technologies in terms of impacts on other technologies, taking all the direct and indirect influences into consideration. The technology with the highest column value is 329 (Demodulators), and the next is 332 (Modulators). It is obvious that these technologies have significant impacts on other technologies, and therefore they are considered as the core technologies of the telecommunication technology network. The class whose column value is the lowest is 370 (Multiplex communications).

The weighted supermatrix shown in Table 4 is constructed by manipulating the sum of columns elements of the supermatrix to be zero. Then, the limit supermatrix was derived by raising the weighted supermatrix to powers. Table 5 shows the limit supermatrix.

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Conclusions

This study suggests a systemic approach to identify core technology from the perspectives of the technological cross-impact. For this purpose, ARM is applied to the patent co-classification data and technological cross-impact matrix is constructed with the derived confidence value of each technology. Then, ANP, one of the MCDM methods, is employed to prioritize technologies. To illustrate the process of executing and utilizing the proposed approach, an example of telecommunication is presented.

The main contribution of this study is as follows. First, ARM is applied to the analysis of patents. ARM is one of the representative data mining techniques for exploring information of large database, but the study that applied it to the analysis of patents is hardly seen. In this study, ARM is employed to calculate the cross-impact index which has the same
formula with the confidence. Second, this study applies the ANP to a technology network. The importance of technologies in terms of impacts on other technologies in the technology network could be measured with ANP. Finally, the suggested approach could help technology planners to formulate strategy and policy for technological innovation.

This study, however, is still subject to some limitations and these limitations are issues for further research. First, the proposed approach is illustrated with analyzing patents on the class level and so applying ANP is restricted to only clusters with no elements. Extending the analysis to the sub-class level of patents could make use of the full potential of ANP. Second, the cross-sectional analysis of the telecommunication patents registered in 2005 is conducted. A dynamic analysis on the telecommunication is expected to provide useful information on the change of technological trend. An extension of analysis to all technologies in ICT could be considered as future research issues. Finally, the selected 13 patent classes as telecommunication technologies are by no means exhaustive. A more systematic procedure is required to select the target classes.

Acknowledgement. This research is partially supported by Research Fund of Induk University.

Appendix. ICT classification and corresponding IPC codes

<table>
<thead>
<tr>
<th>ICT</th>
<th>IPC Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telecommunication</td>
<td>G01S, G08C, G09C, H01P, H01Q, H01S3(025, 043, 063, 067, 085, 0933, 0941, 103, 133, 18, 19, 25), H11S5, H03B, H03C, H03D, H03H, H03M, H04B, H04J, H04K, H04L, H04M, H04Q</td>
</tr>
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</table>

Table 5. Limit supermatrix

<table>
<thead>
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<th>340</th>
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A Methodology for Identifying Core Technologies Based on Technological Cross-Impact

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KNOWLEDGE CREATION AND ORGANIZATIONAL PERFORMANCE: AN ORGANIZATIONAL AGILITY PERSPECTIVE

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Abstract
This paper is an extended summary of a research that examines the role of organizational agility as a mediator between knowledge creation processes and organizational performance. The moderating role of two knowledge characteristics, tacitness and institutionalization, in the mediation processes are also analyzed. Our results indicate that organizational agility significantly mediated the effect of knowledge creation on organizational creativity, which, in turn, affects organizational performance.

Introduction
The strategic value of knowledge management has been demonstrated in a number of empirical studies on knowledge creation, organizational creativity and organizational performance. For instance, Lee and Choi [47] theorize that Nonaka’s knowledge creation processes have positive impact on organizational performance through creativity enhancement, and report empirical findings that support this theoretical position. The emphasis on the role of organizational creativity in knowledge creation raises a few interesting research questions: Can an organization foster continuous creativity through knowledge creation processes and what is the underlying mechanism for knowledge creation processes to enhance organizational creativity?

A purpose of this research is to build a model that extends the growing stream of work on organizational creativity [1, 28, 32, 82] by incorporating the role of organizational agility and empirically evaluating the extended model. Our theoretical exposition that organizational agility plays a pivotal role in the relationship between knowledge creation and creativity is firmly based on existing theories. New knowledge develops better routines that make operations more efficient and effective. Other literatures also indicate that, as organizations learn from newly generated knowledge, not only do they improve existing processes, dynamic capabilities also develop to integrate knowledge into creative ideas, novel solutions, and new products and services [30, 42].

Another goal of this research is to examine whether the effect of knowledge creation processes on organizational creativity exists in all organizations or is contingent upon the nature of the organization’s knowledge. Based on the common understanding that tacit and explicit knowledge differ substantially in their codifiability and transferability, our goal is to examine the moderating role of knowledge characteristics in the process of using knowledge management to foster organizational creativity.

Moderating Role of Organizational Agility
Knowledge creation processes not only promote a higher level of organizational creativity, they also create competitive advantage by enhancing the organization’s agility. Following Sambamurthy, Bharadwaj, and Grover [70], we define organizational agility as “the ability to detect opportunities for innovation and seize those competitive market opportunities by assembling requisite assets, knowledge, and relationships with speed and surprise” (p. 245). In this section, we elaborate on the mechanism through which knowledge creation processes enhance organizational agility. At the same time, we specify how agility promotes organizational creativity. More specifically, we argue that the relationship between knowledge creation and organizational creativity is predicated on organizational agility. Additionally, we would like to demonstrate that the effect of different knowledge creation processes may differ in different organizations. A contingency model is proposed to predict boundary conditions within which knowledge creation processes are most effective. Specifically, we argue that two knowledge characteristics, namely, tacitness and institutionalization, play important moderating roles in knowledge creation processes. These arguments are elaborated below.
As modern organizations adapt to hypercompetitive environments, organizational agility, or their ability to sense environmental changes and respond to them appropriately with speed and intensity [62], becomes increasingly crucial for firm survival [19, 70]. Our analysis of the literature reveals that the relationship between knowledge creation processes and organizational creativity, as Lee and Choi [47] have reported, may be understood as a consequence of increased organizational agility.

While Sambamurthy and colleagues [70] argue that strategic IT provides a platform for agility, we would like to argue that knowledge creation processes similarly supply a solid basis for agility. Knowledge creation processes increase organizational agility because they enhance the organization’s knowledge reach and richness. The level of knowledge reach and richness significantly determines an organization’s agility, as current and substantive knowledge stock allows firms to make quick decisions with a high degree of certainty, notwithstanding change and uncertainty in the environment [70]. People and information are key differentiators in the presence of agile competition [35], and knowledge creation processes allow firms to maximally mobilize these intellectual resources.

New knowledge generated as a result of knowledge creation processes contributes to the firm’s digital knowledge capital, “the IT-enabled repository of knowledge and the systems of iteration among organizational members to generate knowledge sharing of expertise and perspectives” [70, p. 247]. Knowledge codified through the externalization process, for example, can be digitally transmitted to a broader set of functional units and organizational members across geographical boundaries, reaching a more diverse audience that can benefit from such knowledge. For example, semiconductor design companies implement eCatalogs and design repositories to support communication and collaboration efforts during the new product development process across the organization [27]. ECatalogs and design repositories are information technology applications that inventory existing design products in the semiconductor community. They provide a common platform to support various knowledge creation processes. As such, these tools create greater knowledge reach by facilitating awareness of designs that are available for reuse and visibility of internal design products in the marketplace outside the organization. Greater accessibility of the industry’s knowledge base is vital to the organization’s ability to quickly translate design concepts into marketable products, and to “move quickly from one temporary advantage to another” in an industry with a fast clockspeed [27, p.266].

At the same time, insights derived from knowledge creation processes enrich the quality of the firm’s digital knowledge capital. Socialization, for instance, enables organizational members to share and develop tacit knowledge that forms a rich basis for intellectual capital. Combination, on the other hand, engages organizational members in idea exchanges that inspire them to take new perspectives, again enhancing the richness of the firm’s knowledge [70]. In new product development, peer reviews are an important part of knowledge creation processes for ensuring the quality of knowledge products and justifying design decisions [27, 60].

Greater knowledge reach and richness fostered by knowledge creation processes enable stronger organizational agility [70]. Externally, enriched knowledge allows the organization to more accurately detect a relevant change in the environment (e.g., market opportunities, or evolving customer needs), and to more quickly comprehend the meaning of such events. This enhanced speed in perception and comprehension is a key element in organizational agility. Internally, greater knowledge reach and richness promote tighter integration and coordination across functional units. This higher level of rapid coordination allows the organization to respond quickly as soon as it senses significant changes or critical events in the environment [70]. Moreover, a constant supply of new knowledge from well-established knowledge creation processes helps the firm build a solid knowledge base for continuously creating small and short-term advantages. The know-how advantages from having a strong knowledge base enable firms to quickly outmaneuver competitors and to gain timing advantages [19].

Organizational agility, in turn, stimulates organizational creativity that welcomes new ideas and encourages risk taking and experimentation. “Innovation is intendedly adaptive, and it is undertaken typically in response to unfamiliar, unexpected, or nonroutine problems” [33, p.1095]. An agile organization is nimble in both sensing problems and unexpected changes arising in the environment, and developing an ad hoc response plan and executing it in a speedy manner. The agile organization’s response is often an innovation with varying degrees of proven track records. The ability to sense problems quickly and identify proper solutions accurately gives the organization higher degree of certainty in adopting and implementing innovative ideas. In other words, the agile organization is more capable of dealing with the risks associated with creativity not because they have
strong tolerance for risks, but because their solid operating capabilities enable them to commit the right resources and to act with maximal speed and confidence [62, 70].

To summarize, we have developed a theoretical model to illustrate the mechanism underlying the impact of knowledge creation processes on firm performance. Specifically, we argue that knowledge creation processes promote organizational creativity that enhances firm performance. Moreover, this relationship can be mediated through organizational agility. With these ideas linked together, the mechanism through which knowledge creation processes stimulate organizational creativity becomes clear. When an organization develops stronger agility through knowledge creation processes, it also becomes more receptive to creative solutions. In this process, organizational agility plays a critical role between knowledge creation processes and the resulting innovative culture.

**Data Collection**

An empirical study was conducted to test the proposed research model. Survey instruments were distributed to 414 representatives in the top 1000 enterprises in Taiwan ranked by the CommonWealth Magazine [17], when they participated in an extended education program sponsored by their companies. The ranking of top 1000 enterprises by the CommonWealth Magazine was based on firm revenue; the ranking system was regarded as highly prominent and representative of the profile of Taiwanese businesses. All participants were selected for the education program based on their substantive amount of work experience with their organizations; as such they were able to provide useful information regarding the survey questions.

Of those surveyed, 147 filled out and returned the questionnaire, which resulted in 134 unique cases that completed forms without missing or invalid data. This represented an effective response rate of 32.4%. The sample organizations were well represented in the service sector (N=63, 47.01%), manufacturing (N=41, 30.60%), finance (N=9, 6.72%) and the other (N=21, 15.67%). More than a third of the organizations had established formal positions or units for knowledge management activities (N=50, 37.31%). All organizations had implemented knowledge management systems in some ways.

The majority of the respondents had worked for their organizations for 3-5 years (N=58, 43.28%), 30.60% had worked for 6-10 years, 17.16% had worked for 11-15 years, and 8.96% had more than 15 years of work experience in their organizations. The extensive work experience of the study informants in their respective organizations suggests that their assessments of their organizations should be reasonably valid and representative of their respective organizations.

**Data Analysis and Findings**

After validating the data collected from the survey, we can further evaluate the structural relationships in the research model. We first use our data to test the benchmark model of Lee and Choi’s [47], that has been empirically established. This analysis allows us to verify the integrity of our measurements as compared with existing research. Then, we continue to test the extended organizational agility model. These analyses were conducted using PLS. Figure 1 in the next page shows the major findings with the solid lines indicate significant results.

**Concluding Remarks**

Even though organizational creativity has received much attention in the management literature over the last decade, only limited research has established its antecedents and consequences empirically. Motivated by a critical synthesis of literatures on organizational creativity, knowledge creation, and organizational agility, this study thoroughly investigates the effect of knowledge creation processes on organizational creativity and the mediating role of organizational agility in the process. Consistent with prior research, our study shows that knowledge creation processes improve organizational creativity, which subsequently results in superior organizational performance.

Drawing upon an organizational agility perspective allows us to further demonstrate that availability of new knowledge leads to a creative organization by building agility. This agility perspective complements the more prominent approach to organizational creativity, which focuses more heavily on psychological antecedents to creativity [2, 3, 82]. Existing theories tend to emphasize the significance of factors such as leadership, organizational structure, and resources in promoting creativity. The present research, in contrast, shows that in order for the organization to be creative, it may be just as important, if not more so, to maintain an environment that fosters knowledge creation among employees. Particularly, our data suggest that knowledge creation processes such as socialization, combination and internalization improve organizational creativity because they allow the organization to be more agile. When knowledge creation processes afford the organization the freedom to experiment with new ideas and take risks, the enriched knowledge environment can
significantly facilitate the organization to be more creative. References are available upon request.

### References

![Diagram](Figure 1. Resulting Model from the PLS Analysis)
FACTORS INFLUENCING CONSUMPTION EXPERIENCE OF MOBILE DEVICE: A STUDY FROM EXPERIENTIAL VIEW

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Abstract
Among the large number of studies on adoption of mobile commerce, the major research perspective is the utilitarian factors. In this study, we interpreted consumers' consumption experience of handphones from an experiential view of the intervening response system which focuses on hedonic factors of customers. We studied the following research questions. First, whether hedonic factors (e.g. subjective norms) and utilitarian factors (e.g. convenience), are positively related to emotional factors. Second, whether emotional factors are positively related to customers’ consumption experience of mobile device. A survey study was conducted to collect data from 293 mobile phone users. The results of this research implied that hedonic factors performed a positive effect on the consumption experience, while the utilitarian factors had a negative effect on the consumption experience of consumers.

Keywords: Hedonic, Intervening Response System, Consumption Experience, Experiential View, Mobile Device

Introduction
Mobile phones provide us not only an easier way of communication but also make our lives more colorful. More and more people start using mobile devices. It is estimated that the mobile phone sales will reach at least 300,000,000 U.S. dollars in 2009. After researched among the customers, Authen Tec found that, 58% of the respondents have purchased the mobile phones with the functions of m-bank and other m-services. 74% of the respondents were planning to receive the m-services by mobile phones. The results of this research implied that hedonic factors performed a positive effect on the consumption experience, while the utilitarian factors had a negative effect on the consumption experience of consumers.

Key literature Review
Among the large number of studies on adoption of mobile commerce, the major research perspective is the utilitarian factors which caused the application of m-commerce. Davis’ Technology Acceptance Model (TAM) [9] has been widely cited as a framework for explaining users’ IT adoption and usage in multiple contexts, say that researches on m-commerce application and environmental factors [29]. Previous IT adoption literatures have focused on general technology perceptions, the direct adoption drivers, namely perceived usefulness (PU) and perceived ease of use (PEU), and its antecedent variables, or external variables, the indirect adoption drivers.

New factors were added to enhance the explanatory power of the variance in users’ behavioral intention related to IT adoption. In a research concerning financial problems of mobile application, Luarn and Lin extended the TAM by...
new factors of trust, self-efficacy and transaction cost, which involved individual differences into the classification of external variables [22]. Dickinger, Arami, and Meyer added perceived enjoyment and social norm, the two important antecedents for the adoption of technology with network externalities, into TAM [10]. The model extension provides us a wider sets of adoption drivers, including general technology perceptions [15], individual differences (self-efficacy) [21] [22] [24], user psychographics (e.g. perceived enjoyment) [15], social influence (e.g. social norm) [10] [15] [21] and demographics (e.g. gender and age) [16]. In addition, system quality is also established to have a causal relationship with adoption of m-commerce [18].

Nevertheless, most of the aforementioned studies are conducted under the context of workplace system. In contrast, mobile devices and some mobile services are closely related to customers’ personal life. Mahatanankoon found that motivational, situational, and psychological factors could influence personal services such as mobile SMS use experience [24]. The mobile device using behavior cannot be fully determined by utilitarian values.

Therefore, a number of researchers studied IT adoption in settings other than the workplace in recent years. Two new factors, visual orientation and fun, are added into TAM by Bruner and Kumar [4], which can help the researchers to forecast the willingness of the customers whether they are interested in participating in m-commerce. Lu, Yu, Liu, and Yao added technology complexity, trust, individual differences, social influences and facilitating conditions into TAM to explain the consumer willingness of mobile Internet users [21]. Nyssven, Pedersen, and Thorbjørnsen have conducted a study on the determinants of consumer adoption willingness of mobile phone text message, mobile contact, mobile payment, mobile games and other mobile applications [26]. The established factors are perceived enjoyment, perceived usefulness and perceived expressiveness [26]. From a non-TAM perspective, Mahatanankoon examined the effects of personality traits (individual playfulness, personal innovativeness) and optimum stimulation level (OSL) on text-messaging activities and m-commerce intention [24]. The findings implied that personality traits mediated by OSL can be applied to study IT-based adoption behaviors [24].

Prior literatures have examined the contribution of motivational, situational, and psychological factors towards IT adoption in non-work settings, where IT was not been regarded as a tool to improve task performance. A generally accepted view is that, in order to get an understanding of consumer willingness of m-commerce adoption, researchers need to start with the emotional and cognitive perspective related to the social and cultural background of individuals [28]. For example, as “cool” feature becomes one of the vital considerations when using mobile device, many people prefer iPod to other mp4 players, which are more powerful, long lasting, and having larger capacity. As it were, iPod is successful for its concise design and its culture, which symbolizes innovation and rebellion.

Although most studies were conducted from the utilitarian perspective and not free from the conventional performance conception of IT use, in m-commerce, consumption experience is more vital than product itself. Internal imagery and emotions can be aroused by external multiple sensory modalities including sounds, tactile impressions and visual images [13]. From a hedonic perspective, Holbrook and Hirschman have introduced, defined and linked constructs of multisensory experience, fantasy imagery and emotive response to various consumption processes [14]. Therefore, aside from the benefits of utilitarian response, such as perceived usefulness and perceived ease of use, other hedonic factors, such as subjective and perceived experience, could determine consumers’ usage patterns [24].

In the context of shopping, Park, Kim and Forney explored the causal relationships among fashion involvement, positive emotion, hedonic consumption tendency and fashion-oriented impulse buying [27]. The study showed that Fashion involvement and positive emotion have positive effects on consumers’ fashion-oriented impulse buying behavior with Hedonic consumption tendency being an important mediator. More hedonic consumers (typically younger people with lower income or lower education level) tend to seek excitement experiences during leisure time, in the context of internet bank service, and personality is emphasized when consumers concern more about playful and entertaining service features [23].

In conclusion, in the context of m-commerce, where wonderful consumption experience is demanded and network externality exists, hedonic factors could be vital antecedents for the IT usage. Having examined previous literatures, we focus on four sets of usage drivers: individual differences (self-efficacy), user psychographics (e.g. emotion), social influence (e.g. subjective norm) and system quality (e.g. media richness and convenience). The objectives of this study are to understand the factors affecting users’ consumption experience of mobile device and to analyze the relationships among these factors.

**Intervening Response System**
The need of understanding consumers’ consumption experience from emotional perspectives leads us to the intervening response system. Within the field of consumer behavior study, intervening response system was widely used, which defines individual’s services or products usage as a process involving individual’s cognition, affect, and behaviors. Individual mobile device usage can be defined as an individual’s cognition, affect, and behavior [5]. The intervening response system is understood from two perspectives: information process view and experiential view. The former is more about rational choice and the latter is more about irrational buying needs [14]. Information processing model regards consumers as a goal-oriented logical thinker and emphasize the utilitarian value of consumption [14]. Recent studies on information system have shown the information processing model neglects several important consumption phenomena, including enjoyment, playfulness, excitement etc. [23] [24] [27]. Laukkanen and Lauronen regarded consumers’ utility as subjective consumption that tried to seek “satisfying experiences instead of pure products” [19]. Since mobile device may be used both functionally and hedonically, we explore user behavior in relation to hedonic consumption. Therefore, it is necessary to understand the intervening response system from the perspective of experiential view which puts more emphasis on hedonic factors when we want to study customers’ mobile device usage.

From an experiential perspective, Holbrook and Hirschman involve the fantasies, feelings, and fun into intervening response system [14]. The contrast between information processing and experiential view on intervening response system is shown in Figure 1.

The experiential view emphasizes the recognition of symbolic meanings, hedonic responses, and esthetic criteria when explaining consumer behaviors [14]. Cognition refers to “the mental functions, or mental processes” (e.g. comprehension, inference, decision-making, planning and learning), such as level of attention. The experiential view focuses on cognitive process at a more subconscious and private level [14].

Affect is defined as “the experience of feeling or emotion” [15] (e.g. level of anxiety) and thought to be based on a prior cognitive process [20]. An affective reaction, such as liking, disliking, or the experience of pleasure or displeasure, is elicited after a certain amount of cognitive processing of information has been accomplished [3]. Apart from the attitude (like or dislike of a particular brand) and the preference (the rank relative to other brands), which are emphasized in the information processing perspective, diverse emotions like love, hate, fear, joy, boredom, anxiety, pride, anger, disgust, sadness, sympathy, lust etc. also play an important role as aspect of affect [14]. Consumers’ affective states (e.g. pleasure) can influence the intention to use product or the experience on using. People tend to do repeat behaviors from their past positive experience, thus, if they gains positive affect from mobile service, users will intend to use the service continuously and more frequently.

In the area of behavior, the experiential view emphasizes the mental events surrounding the act of consumption, that is, experience. Behavior is defined as “the users’ observable actions” [5], such as the activities they participate. The entertaining-, arts-, and leisure- related offerings of mobile service call attention to the experiences when actually consuming it [14].

**Research Model and Hypotheses**

Using mobile device is often determined by situational and psychological factors, which stimulates emotion and then raises the satisfaction of
mobile device usage or motivates the intention to use. The intervening response system suggests that consumers’ behaviors are influenced by both their experience with the environmental factors and their inputs to the environments [14]. The environmental factors can be studied from two aspects: system quality and social influence [10] [18] [21]. On the other hand, consumers’ inputs are factors that determine one’s consumption view that influences their intervening response system [14]. It has five dimensions: (1) Resource (e.g. time); (2) Task definition (e.g. hedonic response); (3) Type of involvement (e.g. orientation reaction); (4) Search activity (e.g. exploratory); (5) Individual differences (e.g. personality, religion) [14]. Among those dimensions, previous investigation on individual differences has shown its essential contribution to explain or predict consumer behavior [21] [22] [24]. Therefore we focus on individual differences to study the effect of consumers’ inputs.

In the context of m-commerce, system quality can be understood from the angle of how well handphones can facilitate consumers to do what they want. It was discovered that factors such as perceived convenience has significant effect on customers’ decision calculus in on-line repurchases, being moderated by transaction experience [12]. Greater convenience means user could spend less time and effort to gain more utility during usage [12]. Convenience can be defined as consumers’ perceptions of the time and effort involved in using the mobile device [2]. It is reasonable to assume that for the same service, customers would prefer whichever mobile device offers the greater convenience. Using mobile device costs users’ mental and physical energy, such as operating keypad, and surfing a mobile website. If the keypad is insensitive or the website is very slow, users may feel impatient or even annoyed. Emotions, like pleasure, will increase when time and effort are saved. Therefore, in this study, we include convenience in our model, which is expected to bring great positive effect on feeling and emotion towards mobile device. H1. Convenience has a positive effect on emotion during mobile device usage.

One advantage of mobile phone is that it enables people to communicate over long distance in various ways (e.g. voice call, E-mail, text message). Users can freely choose communication way in desired degree of media richness, which may have different impacts on the users’ perception, appreciation, or level of satisfaction [25]. In situations that messages containing equivocality, it is important to use richer communications media [7], such as video call. While leaner media types can sometimes offer more efficiency than richer ones, in situations that messages were unequivocal [7], such as text message. Therefore, one should choose the media type that offers the greatest efficiency and the greatest opportunity for the intended message to be conveyed accurately [6]. Thus, users could well transmit their information, including feelings and emotions, via mobile phone and get appropriate feedback mutually.

When studying consumers’ consumption experience of mobile phone, we cannot ignore that unique feature of mobile phones. Therefore, we included media richness as another factor examining system quality. Media richness is defined as the ability of a medium to carry information [30]. According to Daft and Lengel’s theory, media richness is the ability of the media to, (1) relay immediate feedback, (2) provide feedback cues such as body language, (3) allow the message to be created or altered specifically for an intended recipient, and (4) transmit the feelings or emotions of the communicators [7]. From the definition, it can be observed that media richness is different from convenience in that the latter is from a utilitarian perspective while the former reflects more feelings and emotions of consumers. New technology on mobility brings impacts on the quality or nature of communications between people, which enriches their mobile life and increase pleasure and excitement during usage. In this study, media richness is expected to be one of the hedonic factors preceding the emotion. H2. Media richness has a positive effect on emotion during mobile device usage.

As to the aspect of social influence, according to the Theory of Planned Behavior (TPB), subjective norm is included as a determinant of behavioral intention, as well as attitude, and perceived behavioral control when examining user acceptance of WAP services, and the actual use of WAP services was determined mainly by attitude and subjective norm rather than perceived behavioral control when applying TPB [17].
Previous studies usually regard subjective norm as a utilitarian factor, which affects people’s attitude, thus affects their behavioral intention. However, with highly interactive services like m-commerce, subjective norm is an essential determinant of perceived enjoyment due to network effects [10]. From an experiential view, this study desires subjective norm to be a hedonic factor, which could affect their consumption experience after through actual use. It is more enjoyable to use mobile phone if most of one’s friends are also available via mobile phone.

**H3. Subjective norms have a positive effect on emotion during mobile device usage.**

In terms of individual difference, one of the variables received researchers’ attention is self-efficacy. Luarn and Lin studied the relationship between self-efficacy and individual response to information technology [22]. According to Bandura’s Social Cognitive Theory, self-efficacy is defined as the belief that one is capable of succeeding in attaining certain goals [1]. Self-efficacy is believed to affect one’s thought patterns and emotional reactions, especially to regulate emotional states when experiencing in threatening or difficult situations [1]. Users with higher self-efficacy tend to experience more kinds of communication media and function, while users with lower self-efficacy may be confined in few operations. The more mobile service users experience, the more fun and sense of satisfaction they’re likely to have. Empirical evidence of a causal link between self-efficacy and behavioral intention, which is mediated by perceived ease of use and perceived usefulness, has shown in context of wireless finance [22] and WAP services [17]. Therefore, self-efficacy is involved into our study to explain the usage of technology or intention to use.

**H4. Self-efficacy has a positive effect on emotion during mobile device usage.**

Consumption emotion refers to “a set of emotional response elicited specially during product usage or consumption experience” [12]. Evidence shows emotion has an important role in the adoption and usage of technology. With network externalities, perceived enjoyment is an important antecedent for the adoption of technology [10]. Individual playfulness has a positive effect on the individual’s OSL and exploratory usages of mobile devices [24]. Wakefield R. L. and Whitten D. found that playfulness will generate positive feelings that drive usage behavior [32]. Consequently, previous literature has provided the theoretical and empirical support for relationship between emotion and consumption experience.

**H5. Emotion has a positive effect on consumption experience.**

Applying the intervening response system from the perspective of experiential view shown in the Figure 1, the research model depicted in Figure 2 is developed to examine several utilitarian and hedonic factors toward consumption experience. It illustrates the relationships among six variables (Convenience, media richness, subjective norms, self-efficacy, emotion, and consumption experience) in a mobile commerce context.

In this model, emotion is assumed to be influenced by convenience (H1), media richness (H2), subjective norms (H3), self-efficacy (H4). In addition, emotion is assumed to influence consumption experience (H5). Estimates for the structural model for consumption experience were based on five hypotheses.

![Figure 2. Research model](image-url)

**Methodology**

**Measurements**

The self-administered questionnaire included six...
variables. The survey instrument was developed by adopting existing validated questions wherever possible. Some items were self-developed for more accurate fit between the instrument and the context of the research. Five items for convenience were adopted from Gupta and Kim [12]. Three items for media richness were adopted from Daft and Lengel [8]. Four items for subjective norms were adopted from Hung and Chang [17]. Three items for self-efficacy were adopted from Luarn and Lin [22] and from Hung and Chang [17]. Five items for emotion were adopted from Voss, Spangenberg, and Grohmann [31]. According to Holbrook and Hirschman, consumption experience consisted of three aspects: intention to use, activities involved in consumption, and mental events surrounding the act of consumption [14], thus four items was developed, such as “I want use this cell phone more frequently”. The variables were measured on a five-point Likert scale (1 = strongly disagree, 5 = strongly agree).

Sampling and Data Collection
The sample was 90% college students at one university in a southeast city in China and 10 percent people-at-work aged 25 to 35. The questionnaire was administered in study classrooms, library or via e-mail. Usable data were obtained from 293 respondents who represented 51 percent female and 49 percent male people.

Data Analysis
The measurement model and structural model was examined by LISREL 8.7. The measurement model assessed how the latent variables (Convenience, media richness, subjective norms, self-efficacy, emotion, and consumption experience) were measured for the observed indicators (e.g. CVN, MDR, SN, SFE, EM, and BH). The structural model applied the relationships among these latent variables to test the hypothesis (See Figure 2). The overall fit of the model was assessed by root mean square error of approximation (RMSEA), goodness-of-fit index (GFI), adjusted goodness-of-fit index (AGFI), comparative fit index (CFI), normed fit index (NFI), incremental fit index (IFI), and the non-normed fit index (NNFI).

Results

Measurement Model
In the structural model presented in Figure 2, there are one exogenous variable – consumption experience (BH) – and five endogenous variables – convenience (CVN), media richness (MDR), subjective norms (SN), self-efficacy (SFE), and emotion (EM).

The estimated measurement model presented in Table 1 consisted of five observed variables (EM1, EM2, EM3, EM4, EM5) for emotion, four observed variables (BH1, BH2, BH3, BH4) for consumption experience, five observed variables (CVN1, CVN2, CVN3, CVN4, CVN5) for convenience, three observed variables (MDR1, MDR2, MDR3) for media richness, three observed variables (SFE1, SFE2, SFE3) for self-efficacy, and four observed variables (SCN1, SCN2, SCN3, SCN4) for subjective norms. Overall, the coefficients of factor loading on the latent constructs ranged from 0.44 to 0.76 and all paths were significant. Besides, error variances of all constructs were positive, suggesting a good preliminary fit of the measurement (See Table 1).

<table>
<thead>
<tr>
<th>Item</th>
<th>Emotion</th>
<th>Consumption experience</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EM1</td>
<td>EM2</td>
</tr>
<tr>
<td>Loading</td>
<td>0.58</td>
<td>0.64</td>
</tr>
<tr>
<td>Error Variance</td>
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<td>0.19</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item</th>
<th>Convenience</th>
<th>Media richness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CVN1</td>
<td>CVN2</td>
</tr>
<tr>
<td>Loading</td>
<td>0.48</td>
<td>0.44</td>
</tr>
<tr>
<td>Error Variance</td>
<td>0.43</td>
<td>0.56</td>
</tr>
</tbody>
</table>
Table 1. Items Loading and Error Variance

<table>
<thead>
<tr>
<th>Item</th>
<th>Self-efficacy</th>
<th>Subjective norm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SFE1</td>
<td>SFE 2</td>
</tr>
<tr>
<td>Loading</td>
<td>0.65</td>
<td>0.76</td>
</tr>
<tr>
<td>Error Variance</td>
<td>0.28</td>
<td>0.07</td>
</tr>
</tbody>
</table>

The reliabilities of each latent variable and overall measurement were measured by Cronbach’s Alpha. The Cronbach’s Alpha of the latent variables ranged from 0.808 to 0.911 with an overall Alpha being 0.959 and exceed the suggested minimum cut-off of 0.7. Confirmatory factor shows good fit between the data and the construct of scale. The composite reliability (CR) from all the constructs ranged from 0.808 to 0.898, exceeding the recommended 0.8 criterion. The average variance extracted (AVE) of each latent factor ranged from 0.535 to 0.747, more than the recommended value of 0.5, suggesting that the constructs are distinct. Besides, the \( \chi^2/df \) was 1.37 and the RMSEA was 0.034, being below the desired maximum cut-off of 2 and 0.08 respectively (See Table 2). Accordingly, the measurement model was valid and reliable.

Table 2. Reliability and Validity

<table>
<thead>
<tr>
<th>Item</th>
<th>Emotion</th>
<th>Consumption experience</th>
<th>Convenience</th>
<th>Media richness</th>
<th>Self-efficacy</th>
<th>Subjective norm</th>
<th>Whole measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cronbach’s Alpha</td>
<td>0.911</td>
<td>0.808</td>
<td>0.887</td>
<td>0.821</td>
<td>0.916</td>
<td>0.885</td>
<td>0.959</td>
</tr>
<tr>
<td>CR</td>
<td>0.898</td>
<td>0.819</td>
<td>0.852</td>
<td>0.808</td>
<td>0.898</td>
<td>0.858</td>
<td>( \chi^2/df = 1.37 )</td>
</tr>
<tr>
<td>AVE</td>
<td>0.641</td>
<td>0.535</td>
<td>0.543</td>
<td>0.587</td>
<td>0.747</td>
<td>0.603</td>
<td></td>
</tr>
</tbody>
</table>

The results confirmed the interrelationship among the six variables. This study found that the utilitarian factors, that is, convenience (H1), and self-efficacy (H4) had negative effects on emotion, while the hedonic factors, subjective norms (H3), and media richness (H2) had significant positive effects on emotion, which explains 52 percent of the variance. Emotion (H5) had significant positive effects on consumption experience explaining 47 percent of the variance. In addition, convenience, media richness, subjective norms, and self-efficacy had significant effects on consumption experience, explaining 24 percent of the variance (See Figure 3).

**Discussion**

H1 was not supported. Convenience had a negative effect on emotion during mobile device usage and the effect is not significant. The result did not support a notion that mobile device user with high perception of convenience will generate more positive emotion. The reason may be that people will spend more effort and time in mobile commerce for the purpose of leisure or communication, and people appeal to personal space. Although mobile device enables people to contact others at will, people could be disturbed or bothered in any place or time. However, the negative effect of convenience on consumption experience is not significant, suggesting users are
likely to develop a perception of convenience and are used to these situations. Therefore, user’s perception of convenience is not important in affecting their hedonic experience.

![Structural Model for consumption experience](image)

**Figure 3. Structural Model for consumption experience**

Notes: RMSEA = 0.043, GFI = 0.91, AGFI = 0.88, NFI = 0.95, NNFI = 0.98, CFI = 0.98, IFI = 0.98, ns = not significant, * p < 0.01.

H2 was supported. The results showed media richness had a significant positive effect on consumption experience directly. Daft and Lengel reported that performance improves when team members choose proper media in different situations [7]. As the 3G era, people are able to have face to face talking in different areas and choose from communication media with desired degree of information richness. Therefore, feelings and emotions can be conveyed passing the space, as well as information. Not only the adoption of new media, but also the rich kinds of communication tools can generate excitement and joy during usage. This implied that media richness is a hedonic factor that influences consumers’ behavior.

H3 was supported. Subjective norms had a significant positive effect on emotion during mobile device usage. Due to the network effect, mobile service can be successful when a mass of people using it and become more enjoyable to individuals [10]. Mobile device users who received more recognition and support on using mobile device were more likely to gain positive emotion and willingness to use mobile device more frequently. When choosing the mobile devices, the customers are supposed to prefer the devices with high reputation and social acceptance. And the existing users may abandon the certain mobile devices if they find it is out of endorsement. Therefore, this finding implied that mobile device as an experiential product plays an important role in fulfilling people’s hedonic needs.

H4 was not supported. Self-efficacy had a significant negative effect on emotion during mobile device usage. It may be that users with higher self-efficacy felt less excited if there was inadequate challenge for them. Furthermore, self-efficacy was more likely to increase users’ positive emotional states if mobile device could put their curiosity and mind to good use. This supports the significant effect of self-efficacy on user’s hedonic response and the finding suggested involving more challenging functions into design.

H5 was supported. Emotion had a significant positive effect on consumption experience during mobile device usage. Users with positive emotion, such as being satisfied and excited, were more likely to use mobile device and increased the activities on mobile device using and mobile commerce. Therefore, the finding suggested that emotion played an important role in experiencing mobile device usage. Consumers were more willing to adopt mobile commerce when hedonic needs were satisfied.

In conclusion, this study has three major implications, that is, regarding the mobile device usage as a hedonic experience, examining the effect of media richness, and confirming the impact of user’s psychographics. To begin with, the results suggest the behavioral factor (e.g. consumption experience) is strongly determined by the affective factor (e.g. emotion) during mobile device usage; whereas the cognitive factors (e.g. subjective norm, self-efficacy, and media richness) have significant partial effect, respectively. In this study, the high model fitness indicated our model based on the intervening response system from an experiential view for explanation of consumers’ behavior is valid and meaningful. It was interesting to find that, among cognitive factors, the hedonic factors are positive related to emotion, thus to effect consumption experience, whereas the utilitarian factors are
negative related. In other words, traditional utilitarian factors may not apply in the context of personal mobile devices and researchers should pay more attention to the influence of hedonic factors on consumers’ behavior.

Furthermore, advancing technologies enable people to convey message from text message to video call, which makes media richness an important antecedent in explanation for mobile phone use. Finally, users’ psychographics, which reflect subjective experience and personal value, plays a strong role on affecting consumption experience. Similar results have been found in a recent IT adoption study from hedonic perspective [10]. The main driver of intention to use is perceived enjoyment, whereas perceived enjoyment and usefulness have significant effect on attitude.

Besides the implications on research, the study yields a number of important practical managerial implications, which both in service and product design and customer relationship management (CRM). First, the factors which are the antecedents of emotion and consumption experience can help the companies offering mobile device or service to find the proper and effective design avenue. When doing a survey before product design, researches should be taken within the target market, since the advices from customers’ social network are taken significantly. A wide variety of media and more challenging functions should be concluded in the mobile device and service.

The second implication for this study in mobile commerce industry is the emphasis of CRM. As the network effect plays a significant role in mobile service, companies should develop a popularization plan to encourage customers to use continuously and convince their peers to use the same services. Increase in peer-to-peer interaction, such as chat room, may win a positive word of mouth to help acquire more customers and retain current ones. Third, mobile device is about saving time, varying location, and convenience. Basic call function or means of communication are good enough to satisfy customers thus it is advisable to add rich information (e.g. interesting expression and picture) or convenient input method in the text editing and improve the infrastructure construction (e.g. wireless terminal equipment).

Conclusion
The study has validated the relationship between the cognitive factors, affective factors and consumption experience of mobile devices. Mediating by emotion, media richness, and subjective norms have the significant positive effects on consumption experience, while the convenience and self-efficacy have the negative effects. This research has shown the factors which performed an effect on the consumption experience, especially on a hedonic dimension.

The limitations of this research are mainly on the sample and research method. First, the use of a sample with a majority of university students and mobile phone present constraints in that the findings may not be reproducible with other populations or with other mobile devices. Second, we study mobile commerce as a whole, regardless of classification between hedonic services and utilitarian functions. Third, we conducted the survey focused on users’ perception rather than their actual behavior, regardless of the subjectivity of data.

For future study, comparative study among different respondents’ categories is expected. For example, it would be interesting to survey between younger and educated users and older and less-educated ones. Besides, demographic factors like gender and age, which may bias the result, can be involved into study. Last but not least, additional variables, which can improve the explanatory ability to usage experience, should be added into the model. It would also be interesting to study more hedonic factors, such as appearance of mobile device, upon theories in marketing, consumer behavior and psychology.

References


SECURE AND TRANSFERABLE MOBILE TICKETING USING DIGITAL RIGHTS MANagements

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Abstract
The increasingly matured mobile commerce enriches our daily lives. Mobile ticketing, a process that allows consumers to order, make payment, acquire, and authenticate tickets using their mobile phones, will become popular since it can be conducted from anywhere and at anytime. In addition to the convenience of use, the fabrication and distribution costs of traditional paper-tickets can be greatly reduced with mobile tickets. Many applications, such as traffic tickets, concert tickets, movie tickets, and so on, may take the advantages of mobile ticketing. Such tickets, in their paper-forms, can be transferred to anyone before use since no specific identity is recorded in these tickets. Nevertheless, current schemes restrict mobile tickets to be non-transferable because the transferring will result in the tickets being invalidated. To overcome the non-transferability problem, we use the idea of digital rights managements to separate the content and the usage-rules of mobile tickets, and propose a transferrable mobile ticketing scheme. The usage-rule, i.e. the rights object of the ticket, registers the ticket identification and a hashed number comprising an issuer’s random number and the International Mobile Equipment Identity (IMEI) of the ticket owner. The rights object is independently issued by a trusted third party. When a ticket is transferred, the issuer will be notified and he will modify the rights object with a new hash value, computed from a new random number and the IMEI of the new owner who receives the transferred ticket. Therefore, mobile tickets are secured and transferrable in our proposed mobile ticketing scheme.

Keywords: Mobile Commerce, Mobile Ticket, Information Security, Digital Rights Management

Introduction
Ticket ordering today is evolving from direct sales from physical stores to online ordering via Internet [1]. Consumers may easily inquire the related information of tickets and order tickets using the Internet. Ticket issuers, viewing this trend, have made possible online ordering of their products through Internet. Example applications such as traffic tickets, concert tickets, movie tickets, and so on [2] [3], all take the advantages of ticketing online.

E-tickets transactions have to provide many application services that allow consumers to order tickets. The E-ticket enables consumers to efficiently collect ticket information and to reduce the time cost of lining up. Nevertheless, E-tickets are restricted to be acquired in fixed locations, thereby inducing the poor portability and low usage rate. Benefiting from the mature development of the mobile environment, mobile users may connect to Internet with the handheld devices wirelessly and obtain information real time [4]. Moreover, mobile ticket services provide not only convenient but also flexible transactions to the mobile users. In addition to order and acquire tickets, mobile users are flexible to transfer tickets in case of traffic accidents [5] [6], potential lateness or absence. The loss of the consumer can be minimized since the ownerships of tickets can now be transferred anytime before the expiration of the tickets.

A mobile ticket is a valuable digital product so that it should be protected against tampering, forging, and other security issues in the mobile phone. Therefore, this paper aims to design a mobile ticket transaction protocol of necessary security, emphasizing the transferability of mobile tickets. A mobile user obtains a ticket, accompanied with a hash value computed with the IMEI and a random number from the ticket issuer. Thus, the security of the ticket could be protected while the user may effectively own the rights of the ticket. To protect the legitimacy of ownership and un-forge-ability of the mobile ticket, the Right Object (RO) that used in the digital rights management is independently issued by the trusted right issuer. Hence, trading can be performed so that the owner’s right is protected. Therefore, mobile users may have the confidence of using mobile ticketing in the secure mobile environment.

Related Work
From some of the information security issues that deliver mobile tickets to the mobile user through the handheld device, such as information has been intercepted, tampered and forged. Hence, we use the
encryption technology or the RO of way to protect the rights of mobile users. There have two technologies were used to protect mobile tickets.

First, Moni Naor et al. used the Visual Secret Sharing (VSS) method [7]. The third party will generate a pair of ticket, X-part and Y-part, and the user own X-part, the issuer own Y-part. When the users want to acquire the ticket, the issuer generates a password that combine X-part and Y-part. In this paper, we use the X, Y-part of concept. The mobile user delivers a portion of ticket information and the IMEI to the exchange server, and the exchange server can be verifies the part of own of ticket issuer. If the all part were correct, the mobile user will be obtain a mobile ticket.

Another, Kazuo Matsuyama et al. proposed the architecture of ownership [8]. Users have to transfer the owner to others from the website of third party. The third party transfer the ownership to the others account. But the third part do not guaranteed or recognized the validity of tickets.

In this paper, we proposed the RO concept in the DRM, it protect the security of tickets. The RO records the ownership of ticket and issuers, and open-card that writes the valid period by RO issuer. Therefore, the RO can be prevents a malicious user to do anything, such as tamper and forgery of tickets. We use the main technologies to protect ticket, namely asymmetric encryption and hash function.

**Mobile Ticket**

The method use mobile devices as a communication platform for mobile users. The mobile ticket allows consumer to order, acquire, or transmission of the tickets using their mobile phones, will enhance the portability and convenience. Combination of the International Mobile Equipment Identity (IMEI) as the mobile user’s identification, can be to prevent the malicious forgery and tampering with the ticket. Not only use of one-time password to ensure the mobile user’s identification, but also protect the ticket content using the security technology, can be to achieve the data integrity. We protect the owner using the Right Object (RO) in the mobile ticket. When you want to transfer the mobile ticket to others, the RO will be verified that re-create a new RO, it prevent amount of the mobile ticket be transferred. In this session, we introduce the system architecture, the process that allows consumers to order, acquire, and transfer tickets. Separately illustrate order, acquire, transfer phases (Figure 1) and transfer phases (Figure 2) of the process of functional and security.

**System Architecture**

The architecture consists of Mobile User, Ticket Issuer, Right Object (RO) Issuer and Exchange Server, and the main of a process that allows the order, acquire, and transfer tickets. First phase, the way that mobile users use through the wireless by the

![Figure 1: Mobile ticket system architecture](image1)

When the mobile user A want to send to the mobile user B, the mobile user B must be change the own IMEI into the authentication code. Separately deliver the IMEI and the authentication code to the mobile ticket and the mobile user A. When the user A receives the authentication code, it combines the mobile ticket and deliver to the ticket issuer. The ticket issuer confirms the identity of the mobile user B. When the identity is correct, the RO issuer generates a new RO that updated the owner and date and delivered to the exchange server. The exchange server generates a new mobile ticket that
combines the ticket and the new RO, and delivers to the mobile user B.

Table 1: Notations

<table>
<thead>
<tr>
<th>Notation</th>
<th>Statement</th>
<th>Notation</th>
<th>Statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>$z_i$</td>
<td>Ticket i-1, i,..., n</td>
<td>$\text{proof}$</td>
<td>Purchase proof</td>
</tr>
<tr>
<td>OI</td>
<td>Order information</td>
<td>PID</td>
<td>Proocessor</td>
</tr>
<tr>
<td>data</td>
<td>Purchase item</td>
<td>$R_i$</td>
<td>Random number $i=0,1,..., n$</td>
</tr>
<tr>
<td>$K_{ES}$</td>
<td>Between the TI and ES symmetric encryption key</td>
<td>$K_{ES}$</td>
<td>Between the TI and ES symmetric encryption key</td>
</tr>
<tr>
<td>$K_{ES}$</td>
<td>Between the RI and ES symmetric encryption key</td>
<td>valid period</td>
<td>Proof of purchase of the valid period</td>
</tr>
<tr>
<td>UID</td>
<td>User number</td>
<td>$pw_0$</td>
<td>One time password $i=0,1,..., n$</td>
</tr>
<tr>
<td>check</td>
<td>Confirm the mobile ticket</td>
<td>TC</td>
<td>Transferable certificate</td>
</tr>
<tr>
<td>MAC</td>
<td>Message Authentication Code</td>
<td>CID</td>
<td>Certificate number</td>
</tr>
<tr>
<td>session</td>
<td>Session message</td>
<td>content</td>
<td>Purchase items</td>
</tr>
<tr>
<td>now</td>
<td>Now of time</td>
<td>Req</td>
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</tr>
<tr>
<td>Record</td>
<td>Record in the database</td>
<td>Response</td>
<td>Response message</td>
</tr>
</tbody>
</table>

Order Phase

Following order of the steps (Figure 3):

**Step1:** The mobile user selected conditions of the ticket before order a mobile ticket. The conditions contain ticket type, date, and transferable, will be formed by order information (OI).

**Step2:** After the ticket issuer receives the OI, the ticket issuer generates a ticket number (TID) and contains within the confirm message (Req).

**Step3:** When the content is confirmed, the ticket issuer will be generated a responsive message (Response) that combined the IMEI and TID.

**Step4:** When the responsive message is received, the ticket issuer will be modified the IMEI with a hash value as the user ID (UID) and recorded in the database. The ticket issuer generates a purchase proof that combines the OI and UID. To overcome the security problem, we use the idea of symmetric encryption to protect the purchase proof and the one time password.

Acquire Phase

Following transfer of the steps (Figure 4, 5):

**Step1:** Mobile users want to acquire the mobile ticket that deliver the purchase proof to the exchange server.

**Step2:** When the purchase proof is confirmed, the exchange server delivers the proof information to the ticket issuer.

**Step3:** The ticket issuer takes out the conditions from the database using the TID, and delivered to configure conditions by RO issuer.

**Step4:** When the message is confirmed, the RO issuer submits the success message that notified the ticket issuer will be delivered the ticket information to the exchange server.

**Step5:** The ticket issuer delivers the ticket information and this one time password that protects message at each time, and next password using the public key of the mobile user (E_\text{User}_{pk}).

**Step6:** The RO issuer generates a RO that configured conditions and valid period, and delivered to the exchange server.

**Step7:** The exchange server request to the mobile user.

**Step8:** The mobile user sends the password ($pw_0$) to the exchange server, and verified the password.

**Step9:** The exchange server generates a mobile ticket (T_0) that combined the ticket information and the RO and delivers the next one time password to the mobile user. The mobile user will be verify the mobile ticket, computed the IMEI and next one time ($pw_{i+1}$) with a hash value.

Figure 3: Order phase

Figure 4: Acquire phase (a)

Figure 5: Acquire phase (b)
Transfer Phase
When the mobile user A does not want to useable and effective of the mobile ticket, will be transferred the mobile ticket and changed owner to the mobile user B. Following transfer of the steps (Figure 6, 7):

Step1: The mobile user B computes the IMEI with a hash value, it can as a proof of the validation.

Step2: The mobile user A delivers the mobile ticket ($T_0$, $H$(IMEI)_B), and one time password ($pw_{i+1}$) to the ticket issuer and changes the owner. And the ticket issuer can be verified one time password.

Step3: The mobile user B delivers the IMEI to the ticket issuer and the ticket issuer can be checked the IMEI.

Step4: The ticket issuer generates a transferable certificate ($TC$) that will be redeemed a new ticket.

Step5: The mobile user A delivers the check value in the transferable certificate to the mobile user B.

Step6: The ticket issuer takes out the RO and delivered to the RO issuer, and verified the RO and created a new RO.

Step7: To Verify confirmed and return message to the ticket issuer.

Step8: The ticket issuer delivers the new ticket information and one time password ($R_{i+2}$) to the exchange server.

Step9: The RO issuer delivers the RO after he updates it.

Step10: The exchange server receives and verified the check value.

Step11: When the check value is confirmed, the exchange server generates a new mobile ticket that combines the ticket information and the new RO. The mobile user B will be verify the mobile ticket, computed the IMEI and next one time ($pw_{i+2}$) with a hash value.

Analysis and Discussion
In the purchase and acquire phase, we can achieve the integrity of the contents of the mobile ticket. Because the ticket issuer sends the random number to the mobile user and used the password for next transmission. When the mobile user receives the mobile ticket, he will be computed random number as a MAC value, to confirm that this mobile ticket is unmistakable.

In the transfer phase, we add a fair RO issuer that issues the RO and configures the conditions, i.e. valid period, times of usage, and will be finished of open-card, achieves the authentication of the mobile ticket. In addition, the RO cannot allow a malicious mobile user who sent mobile tickets to others, because the RO records the owner. Therefore, the mobile tickets can be prevent malicious destruction of others and secured of usage.

Security Analysis
This research method can reach the following security:

(1) Confidentiality: In the transmission process, mobile users and the ticket issuer use the public key to encrypt, $E_{UserPK}$ and $E_{ISPK}$. If he wants to decrypt, must have the corresponding private key. Another, the symmetric keys were used between the issuers and servers. So we use encryption methods according to the different targets to ensure confidentiality of information.

(2) Verifiability: When the mobile users acquire mobile ticket at each time, we verify the password that computed the random number with a hash value, because the ticket issuer creates different password at each time. Another, he will be use the random number to verify, when mobile users get the mobile ticket.

(3) Authentication: In the purchase and transfer phase, the ticket issuer generates a user ID (UID) that used the IMEI of mobile user, and it can be used the...
verification or RO. Specially, the RO issuer will be verify the identity of owner in the RO.

(4) Non-repudiation: The ticket issuer generates the mobile ticket and password using the IMEI, so the mobile users can achieves the object of Non-repudiation. Another, the RO issuer needs to write the identity of himself, when he creates a RO.

(5) Integrity: In the transmission process, the mobile user and ticket issuer use the asymmetric key to encrypt. If the data has been tampered in the transfer process, mobile users and the ticket issuer will be unable to correctly decrypt, so it can be protects the integrity of data. In the acquire process, the ticket issuer generates the MAC value that used a hash function to create, and it can be judge this message were correct.

(6) Forgery: When the tickets were created, the RO protects the user’s rights in the tickets. Because recorded the owner and transferable conditions of mobile user in the RO, so can not be used this mobile ticket by malicious mobile users. Therefore, the mobile tickets aren’t forged.

Conclusion
In this paper, we propose a protocol that allows mobile users to order, acquire, and transfer e-tickets using the mobile phones without comprising the security. The RO is used to prevent illegal usage of the mobile ticket and the rights of the ticket owner. Thus, a fair third party (the RO issuer) is important. Whenever a mobile user acquires a mobile ticket, we verify the password generated from a computation of a random number with a hash value. In this way, we may not only authenticate the identity of the mobile user, but also verify the mobile ticket whether it is tampered. Therefore, mobile users may have the confidence of using mobile ticketing in the secure mobile environment.

References

SECURING MOBILE ACCESS OF CONFIDENTIAL DOCUMENTS BY INTEGRATING TRUSTED COMPUTING PLATFORMS WITH DIGITAL RIGHTS MANAGEMENTS

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Abstract
The mature mobile network today empowers mobile employees to access Intranet documents via mobile devices and increases the productivity of company workers. Internal documents transmitted without encryption through the open mobile networks undoubtedly creates security holes for eavesdroppers. A common way to provide preliminary protections for an important document to be accessed outside the Intranet is to transmit the document after encryption. Such mechanisms, however, cannot assure the security of documents because the documents can be decrypted and then forwarded without protections once the ciphering keys were known. Therefore, we propose an approach to enhance the security of transmitted mobile documents, using the idea from digital rights managements. A confidential document is encrypted so that, except the targeted mobile user, none can read the confidential document without proper rights. The proposed approach utilizes the trusted computing platforms (TPM) technology to protect the rights object of a confidential document. A rights object can be as simple as a ciphering key of the document or as complicated as the usage-rules of the document. We use the public key in TPM to encrypt the rights object so that only the dedicated mobile device, i.e. the mobile user, may decrypt the rights object using the private key of the device. A malicious user can never decrypt the rights to access the transmitted document, which is encrypted. Moreover, the usage-rules in the rights object may specify whether the document can be further forwarded or be read more than once, and so on. Therefore, the proposed scheme provides maximum flexibilities for mobile employees to access confidential documents without compromising the security, in addition to the mobility and timeliness of mobile environments.

Keywords: Mobile enterprise, digital rights management, trusted computing platforms, information security

Introduction
To avoid the disclosures of confidential information in a company, the employees only accessed to the paper documents in a company. In the mobile Internet era, it will be allowed to access digitalized documents at any time and any place through mobile added-valued services using the mobile phones.

Whenever necessary, an employee uses handheld devices to connect to Internet so that he can instantly access documents for efficiency. Currently, digital content protection method is protected by digital rights management mechanisms [3]. Digital content will be divided into the content part and the rights part to prevent illegal use of a malicious user. Previous methods can only protect the security of digital content during transmission but the security issue of digital content transmission to other devices is ignored. Therefore, this research will combine the security services delivery mechanism of the mobile device, proposed by Adrian Leung [1], with DRM to protect the forgery, modification and transmission problems of the digital content.

Relate work
According to the security service delivery mechanism proposed by Adrian Leung [1], three kinds of security technologies including TPM, MAC (Message Authentication Code) and hash function are used in the design of our proposed security mechanism. First, TPM is used to generate a non-migratable key to encrypt a message. Thus, even if a malicious user has the content, he has no key to decrypt the message. The message needs the key owned by the mobile device to decrypt the message. Aspects of the one-way hashing, using the hash function to compute the three parameter then use the output value as the key to encrypt message and MAC, the malicious users cannot know the parameter so it is not possible to obtain key to decrypt the message. Aspects of the timestamp, it is used to verify whether the both sides time of the
send the message within the specified time and it is used to detect whether the messages is being tampered.

According to the Chin-Ling Chen scholar proposed E-DRM system [4], it use the PKI to design security mechanism, the author create the contents of the package into a DRM format. When a user access to content, it must through the certificate server to register, the user must send the IMEI and certificate of mobile devices to the certificate server register, after successful registration will return a random number to the user and then the user send the message and certificate to the certification center, the certification center re-transmission of a message to the certificate server for authentication. The certificate server received and confirmation message, it will a key of decrypt the message to passed to the user, after the user received can use the key to decrypt the message. It is can prevent though malicious user to get the message is also unable to obtain key through use hash function to compute the random numbers and personal certificate information, therefore, it can prevent forgery and alternation of message.

According to Yin-Ling Liong and Sudhir Dixit proposed digital rights management for the mobile internet [5], introduction of DRM and DRM components and OMA (Open Mobile Alliance) organization [7] and REL (Rights Expression Language). OMA will be DRM delivery models divided into three kinds, forward-lock, combined delivery and separate delivery. In the forward-lock mode, the digital content is packaged into a DRM format, does not include right object, users are free to use the digital content, is suitable for low-value content. In the combined delivery mode, the digital content is divided into content and right packaged into a message, through the right object to regulate the condition of use digital content, such as: frequency of use and use of time. In the previous two methods, when the mobile phone users to download content, you cannot send the content to other users. In the separate delivery mode, the message is divided into content and right is separated from each other with no packaging, when a user downloads digital content and to use it, you must to obtain the right to use, in this mode, digital content can be passed to other users, right will have to get through the issuer.

In this paper, we will apply symmetric encryption, DRM and TPM as the main security mechanisms.

A Company document transmission Mechanism

This study combines TPM technology with DRM technology, using mobile devices as the platform, for manipulating company documents remotely. We ensure that the classified documents will not be tampered and forged by malicious users during transmissions. It will encrypt the documents using a secret key, concatenating International Mobile Equipment Identity number (IMEI), documents ID (CID) and a random number (RN), to prevent the intercept of the confidential documents. We use a pair of keys by the TPM mechanism (PKTP, SKTP) for the document to be delivered to other equipment, so that non-recipients cannot access the encrypted document having no private key. Section 3.1 first introduces the system structure of a company document transmission mechanism. The process of obtaining company documents obtained, comprising the content and the right, is described. The two stages of our design, content acquisition and rights acquisition will be illustrated and the functions and security will be discussed.

System Architecture

The proposed architecture, as shown in Figure 1, is composed of user, content provider and rights provider. The main process of obtaining content and rights is also outlined. The architecture bases on the TPM approach, proposed by Adrian Leung, and extends the DRM mechanism to enhance the security of transmissions of the documents in the company.

When users want access to company documents must be send a request to content provider, when the content provider receives a request then the company document and to open the parts of key of the document to transmission to users. When the user wants to use company documents must be sent as identity information to content providers. If the validation is successful, the content providers will transmission the parts of key to rights issuer. Rights issuer receives the part of the key and confirm legal then the key to re-package will be delivered to users. Users receive two sets of keys will be merged with the keys to unlock the encrypted company documents to obtain the content.

Acquire Content Phase

At the beginning users, content provider and rights issuer has a mutual key to encrypt the messages. The user uses $K_{UC}$ to encrypt the $CID$ and IMEI, and we uses $K_{UD}$ to encrypt the $PKTP$ and $UID$ delivered the two ciphertext to content provider, expression: $K_{UC}(CID, IMEI) \cdot K_{UD}(PKTP, UID)$. The content provider receive the ciphertext from user and then it decrypts $K_{UC}(CID, IMEI)$ using $K_{UC}$ to
obtain $C_{ID}$ and $IMEI$. Using the hash function to hashing the $CID||IMEI||RN$, expression: $SEK=H(C_{ID}||IMEI||RN)$, the generated value by the hash function is defined as $SEK$, the purpose is enable users use RN to unlock the company documents in the obtain right phase, because RN is generated by the content providers and user to get content at the beginning did not know, therefore it is not possible to calculate $SEK$. Content provider using $SEK$ to encrypt the content and sent to the user, expression: $E_{SEK}(Content)$. Content provider cannot be solved the ciphertext by $K_{CR}$ to encrypt the content at this phase, the purpose is the content promoter doesn't know a content, so cannot counterfeit or distort a content (Figure 2).

Figure 2: Acquire content phase

**Acquire Right Phase**

When the employee wants to use the document of the company, then encrypt the $C_{ID}$ using $K_{IC}$ to deliver to the content provider. Because the $SEK$ is composed of $C_{ID}$, $IMEI$ and $RN$ in phase of obtained content then it can be through the $C_{ID}$ to find $RN$. The content provider receipt the message and unlock, it through the $C_{ID}$ to find the corresponding $RN$ then uses the $K_{CR}$ to encrypt the $RN$. The $K_{CR}(RN)$ together with $K_{CR}(PK_{TP}, U_{ID})$ delivered to the right issuer.

The rights issuer receive the message and unlock to obtain the $RN \cdot PK_{TP} \cdot U_{ID}$. It uses the $PK_{TP}$ to encrypt the RN and $U_{ID}$ to delivered to the user, expression: $PK_{TP}(RN, U_{ID})$. Using $PK_{TP}$ is to ensure that only holds $SK_{TP}$ equipment can match with the $PK_{TP}$ to unlock the ciphertext. The user receipts the message and unlock, it using the hash function to compute the $RN|C_{ID}|IMEI$ to obtain the $SEK$, then it use the $SEK$ to decrypt company document (Figure 3).

Figure 3: Acquire right phase

**Security Analysis**

The proposed method satisfies the following security requirement.

1. Confidentiality

In content acquiring phase, the user will deliver the information using the $K_{IC}$ and $K_{CR}$ to encrypt to content provider, expression: $K_{IC}(C_{ID}, IMEI) \cdot K_{CR}(PK_{TP}, U_{ID})$. The content provider use the hash function computing the value to encrypt the company document, expression: $E_{SEK}(Content)$. In acquire right phase, the content generated using $K_{CR}$ to encrypt RN, expression: $K_{CR}(RN)$, it using the public key of the TPM produce to encrypt the $RN$ and $U_{ID}$, expression: $PK_{TP}(RN, U_{ID})$, the ciphertext must using the public key and privacy key of the TPM generated to match...
then unlock the company document, therefore reach confidentiality of information.

(2) Verifiability
The company document contains the $C_{ID}$, $IMEI$ and $RN$, the equipment must provide the information to enable the composition of $SEK$, the malicious users cannot provide such information, and therefore it cannot know the content.

(3) Non-repudiation
The user provide the message of include $IMEI$ to content provider. The user provide the message of include $PK_{TP}$ to right issuer. These are two information can be proving the message by the user to send.

(4) Integritly
The message through the sharing of the key($K_{U_C}$, $K_{U_R}$, $K_{C_R}$) to encrypt, therefore only the both sides of own sharing key can unlock the message. In the acquire right phase, the right issuer delivered the $RN$ have been tampered by malicious users will not be able to compute the $SEK$, to cause the company document cannot be unlock, therefore can protect the integrity of the company documents.

(5) Integritly
In the acquire content phase, when the content provider using the $SEK$ to encrypt the company document, the malicious user cannot acquire the $RN$, only the content provider known, therefore it can achieve the integrity.

(6) Alternation
In the acquire right phase, the right issuer using the $PK_{TP}$ to encrypt $RN$ and $UID$, if a malicious user intercept the message and tampering with the message, but only hold the mobile equipment of the $SK_{TP}$ can be unlock and to acquire the content.

**Conclusion**

In this research, we integrate TPM and DRM mechanisms to deliver the documents of a company for preventing malicious users to tampering or forgery of the documents. The content is protected by the TPM mechanism so that malicious users cannot decrypt the content in the non-bound mobile device. Therefore, we can prevent invalid delivery of the content. Using the DRM mechanism further binds content with rights so that decrypting the content is impossible unless proper rights are acquired. A malicious user may get the content but he may not be able to decrypt the contents for readable information. In the future, the TPM can be combined with DRM for applications such as e-books so as to resolve current security issues. E-books then can be flexibly used and consumers might be encouraged to use e-books.

**References**


AN EXTENDED UTAUT MODEL FOR THE STUDY OF NEGATIVE USER ADOPTION BEHAVIOURS OF MOBILE COMMERCE

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Abstract
An extended Unified Theory of Acceptance and Use of Technology (UTAUT) for mobile commerce (m-commerce) was empirically tested using data collected from a web survey distributed to and through the Hong Kong undergraduates and postgraduates. The partial least squares (PLS) technique of the structural equation modeling (SEM) was used to evaluate the causal model and the confirmatory factor analysis (CFA) was performed to examine the reliability and validity of the measurement model. Findings indicated that the new construct of Disturbance Concerns (DC) is a significant factor affecting users’ behavioural intention. This study aims to understand both the positive and negative factors that can significantly explain user acceptance intention and use behaviour so that service providers can adjust their strategies for providing successful m-commerce services. It also provides a base for further research on the user acceptance models of new information systems.

Keywords: e-commerce, m-commerce, partial least square, structural equation modeling, user acceptance models, PLS, SEM, TAM, UTAUT

Introduction
Mobile commerce (m-commerce) extends electronic commerce (e-commerce) by allowing people to conduct business transactions through mobile devices. Nowadays, the computing power and the communication capability of contemporary mobile devices are significantly improved and sophisticated enough for surfing internet and conducting e-commerce as on the desktop computers, there is significant opportunities and growth of m-commerce business in the coming years. Hong Kong, with the highest mobile phone penetration in Asia, had 11.66 million mobile phone subscribers at the end of April 2009 as reported by OFTA [1], significantly outnumbering the total population. However, the user acceptance of m-commerce is below expectation [2]. Researches of the user acceptance of m-commerce have proven the positive user adoption determinants based on the user acceptance models of new Information Systems (IS), but only few explore the negative adoption factors.

With the popularity of internet-enabled mobile phones, it is necessary for m-commerce service providers to have better understanding of user behaviours towards the acceptance of new m-commerce service. This study is going to perform the preliminary analysis of an empirical study of the user acceptance of m-commerce conducted in Hong Kong. A proposed model extended from the Unified Theory of Acceptance and Use of Technology (UTAUT) model [3] is employed for the study of behavioural intention towards adopting m-commerce. The proposed model consists of five constructs. They are performance expectancy, effort expectancy, social influence, and a new construct of “disturbance concerns”. In order to validate this model and to ensure significant effect of the new construct, this research is designed with two sets of instruments with two significant levels of survey questions for the study of the negative user acceptance factor of m-commerce. One hundred and forty eight responses were collected through a web survey. The statistical method of partial least squares (PLS) is applied to study and explain the proposed user acceptance model of m-commerce. Results of analysis proved that both levels have significant impacts on the user acceptance of m-commerce.

Basic Concepts, Research Model and Hypotheses
Announced in March 2009, Apple Inc. reported the sales of above 13.7 million iPhones in 80 countries by the end of 2008 since the introduction of iPhone in 2007. The powerful iPhone 3G represents an important push on mobile development that mobile phones are getting more computing power for fast web surfing and m-commerce service. In early 2000, Wireless Application Protocol (WAP) technology [4] was used to perform m-commerce. The WAP technology was designed to work in a mobile device with limited computing power, low bandwidth and little screen size. The user experience of conducting m-commerce with the restricted hardware and the WAP-based service are significantly different from the e-commerce with desktop computers. Nowadays, mobile devices are equipped with excellent
computing power, which generally have hundreds of megahertz CPU speed (e.g., 500mhz.), several gigabytes RAM storage, screen resolution in full-color HVGA (320x480 pixels) or up to WVGA (480x800 pixels), and with a big 2.6 to 4 inches screen size. M-commerce no longer depends on the simple and primitive WAP technology. The computing power of mobiles is good enough for naturally surfing the internet and conducting m-commerce by using the mobile versions of the desktop-based internet browsers, such as pocket internet explorer (from Microsoft) or Safari (from Apple). The mobile software applications are as mature and efficient as the desktop applications. Besides that, new mobile applications are finger friendly. The innovative touch-based and multi-touch interface have provided the unique user interface of mobile devices since the introduction of iPhone. The touch technology and interface introduced new friendly experience to users and radically improved the perceived ease of use [5] of the mobile applications, which is a construct of the technology acceptance models. Moreover, the wireless communication capability of mobile devices is actually more sophisticated than the desktop computers. Modern mobile devices are generally equipped with 3G mobile connection, 3.5G plus Wi-Fi data communication, and the GPS or A-GPS feature for location detection. The sophisticated and ubiquitous communication capabilities facilitate users to conduct m-commerce transactions anywhere and anytime.

As the result, m-commerce with modern mobile devices can provide equivalent or better services and user experience as e-commerce with desktop computers. Many studies have conducted about the user acceptance behaviour of m-commerce and mobile service, but the dramatic hardware and software advancement of mobile devices causes those studies inadequate to explain the changed situation. Moreover, it is uncertain that those rapid mobile advancements have not stimulated the user adoption of m-commerce similar to the boom of e-commerce. The growth rate of m-commerce is actually slow. Previous studies have analyzed and explained the adoption of m-commerce and mobile service, but they only explained the positive factors of user adoption based on the user acceptance models of new IS. There are some undiscovered factors may explain the slow adoption of m-commerce, which could have negative impact of user acceptance of new IS.

Issues of m-commerce
Tarasewich et al. [5] defined m-commerce as all activities related to a (potential) commercial transaction conducted through communication networks that interface with mobile (or wireless) devices. A consumer transaction is the conduct or carrying on of trade, business or a financial matter to a conclusion or settlement including the activities of marketing, promotion, sales and customer services related to the transaction. Mobile devices include mobile phones, smart phones (with user installable applications and plug-ins), PDAs (personal digital assistance), MIPCs (mobile internet personal computer), UMPCs (ultra-mobile personal computer), and those handheld devices that can connect to the mobile services.

Though new mobile devices are powerful enough for comfortably surfing the internet and conducting m-commerce and, thus, it is difficult to identify the difference between m-commerce and e-commerce, some researchers have identified and explained the significant uniqueness of m-commerce. Okazaki [7] described the rapidly achieved worldwide penetration of the internet-enabled mobile device is due to its very personal nature and the sophisticated communication technologies. The personal mobile devices carry much private information of the owners, such as the phone number, personal data, contact addresses, and business appointments. The sophisticated wireless communication technologies enable users to conduct m-commerce transactions anywhere and anytime.

The personal nature and ubiquitous communication uniquely differentiate m-commerce with personal mobile devices from e-commerce with desktop or public computers. M-commerce with personal mobile devices can capture, process and record the personal data and user location with the transactions. Owners of the mobile device can access internet and conduct transactions anywhere and anytime. The personal nature and ubiquitous communication of m-commerce cultivated new type of services offered to consumers that may enhance customer convenience and satisfaction, and subsequently increase the potential of commercial transactions. However, new challenges are aroused, especially the security and privacy risks [9]. Tarasewich [10] identified several challenges of m-commerce, such as dynamic environment, security, safety, and social concerns. These concerns of m-commerce could be the hurdles of user adoption, which are the user rejection factors in alignment with the user acceptance factors. These factors are categorized as “Disturbance Concerns”. Mobile users worry about SMS or email spam, privacy, data leaks, security, and any potential or unexpected interrupts or disturbances.

User acceptance research of m-commerce
Mobile applications can automatically capture the privacy data through the personal mobile devices and the mobile network, and transmit the information to the m-commerce service providers. Users assume the service providers primarily use the privacy information for customizing intimate service to them.
only, but the users cannot ensure if the service providers can protect the collected privacy information. Users gain user convenience and satisfaction, but taking the risk of security and privacy.

The efficiency and effectiveness of m-commerce with well internet-enabled mobile devices should have better user adoption. The researches about the user adoption of mobile service and m-commerce in different contexts have been very popular since this century. Some studies were trying to explore the cultural difference of the user adoption behaviour conducted by country. For example, Lee et al. [11] studied the cross-cultural comparison between Korea and Japan. Hung et al. [4] adopted Davis’s Technology Acceptance Model (TAM) [5] to conduct one of the most comprehensive studies of mobile internet adoption in Taiwan. Nysveen et al. [12] carried out similar research in Norway. They also formulated a causal model base on the TAM [5], Theory of Reasoned Action (TRA) [13] and Theory of Planned Behaviour (TPB) [1], to examine the cross-service comparisons via multi-group structural equation modelling. Some researchers have examined the specific nature of mobile internet services [7], such as the user adoption of mobile banking and finance, and location-based services with GPS.

Although there were many studies of the user acceptance of m-commerce and the related areas, only few of them considered the significance of the advanced internet-enabled mobile devices and the unique market of Hong Kong. Furthermore, the researches, through the widely adopted TAM, TRA and TPB models, focused more on understanding the positive factors could influence acceptance of m-commerce. Because of the actual slow growth rate of m-commerce adoption, it is essential to identify additional factors that may affect the negative adoption behaviour (user rejection) apart from the ones defined by the employed models. This study aims to contribute additional knowledge in the existing pool of knowledge by identifying additional factors influencing the adoption of m-commerce with the support of the modern internet-enabled mobile devices. Thereby, further research can be conducted to obtain additional insight to the service providers for them to formulate appropriate business strategies, stimulate the usage of m-commerce service, and increase business transactions through better customer convenience and satisfaction by taking the advantages of those internet-enabled mobiles. It further believes that the right strategy will bring competitive advantage to the service providers of m-commerce.

**Research Model and Hypotheses**

Many competing theoretical models have been proposed and adopted in the research of user acceptance and adoption of information technology innovation, each with different focus and tested in different contexts and countries. Many of the previous empirically researched models were drawn from the theories of social psychology and the sociology, such as TRA [13], Motivational Model (MM) [14], and TPB [1] from the social psychology, others such as Social Cognitive Theory (SCT) [16] and Innovation Diffusion Theory (IDT) [17] from sociology. With hundreds of studies, researchers adopted these models to explain the innovation acceptance and adoption behaviour of the end-users. In the domain of IS research, TAM is the most widely adopted model followed by TRA and TPB. Davis derived TAM from the TRA. Two main factors namely, perceived ease of use and perceived usefulness, were identified as the main behavioural factors that influence the user intentions towards the use of a new system.

Although, TAM was considered to be well established and robust [17], Venkatesh and Davis [19] further enhanced the TAM to include subjective norm construct as a new component and named the enhanced model as TAM2. The acceptance theories are important to the technology investors and service providers, because the theories can help them to improve user adoption of their new products.

As various models and different thoughts of schools were out there and no consensus on which model should be the best one to be applicable to study technology adoption, researchers were facing a dilemma of choosing a suitable model to conduct a technology acceptance research. In 2003, Venkatesh et al. [3] compared the similarities and differences among various models. Eventually, they combined the eight important user acceptance models, including those above-mentioned models, identified the critical constructs of user acceptance, and constructed a unified model named as Unified Theory of Acceptance and Use of Technology (UTAUT).

UTAUT integrated constructs across eight models and provided a refined view of how the determinants of intention and behaviour evolved over time and identifies that there are three direct determinants of behavioural intention (performance expectancy, effort expectancy and social influence) and two direct determinants of usage behaviour (facilitating conditions and behavioural intention). Venkatesh et al. [3] empirically validated UTAUT with six longitudinal field studies of six different departments of six large firms in six different industries. UTAUT accounted for 70 percent of the variance (adjusted R2) in usage intention, better than any of the eight models alone did. Subsequent researches tested UTAUT and accepted it as a definitive model that synthesizes the known factors.
and provides a foundation to guide future research in the area of technology adoption.

In this study, the UTAUT model will be employed as the base model to study user acceptance of m-commerce with modern mobile devices in order to further validate the model and enhance our understanding of the user adoption behaviour. However, UTAUT mainly focuses on the positive user acceptance behaviour. Several researches have identified several missing factors of the user adoption behaviour that can negatively affect the user acceptance of new technology. As described, security and privacy risk [9] are some of the key negative factors that cause the slow growth rate of user acceptance. Jarvenpaa et al. [20] conducted a cross-cultural research study involving 32 focus groups with nearly 200 active urban mobile device users in Finland, Japan, Hong Kong, and the U.S. in 2001 to explore both positive and negative user concerns of the adoption of mobile services. Although mobile communications and information services, that enable continuous connectedness, have increased users’ freedoms psychologically, socially, and physically, users are experienced disorders of freedom that significantly deflect from their value. Those disorders include new pressures, anxiety, disturbance, privacy and inter-dependency. In summary, the mobile users worry about potential disturbance and subsequent loss that may arouse from the use of mobile services. In this study, the UTAUT model is extended by including a new construct of “Disturbance Concerns” as the factor to explain the negative adoption behaviour. The research will explore, analyze, and critically assess the extended UTAUT model and the relationship between the constructs of Disturbance Concerns and Behavioural Intention as depicted in Figure 1.

The conceptual framework depicts the interrelationships of the constructs. Constructs on the left are the independent variables that have influence on either Behavioural Intention of m-commerce or Use Behaviour of m-commerce. The first three independent variables (Performance Expectancy, Effort Expectancy, and Social Influence) are the concluded determinants of Behavioural Intention of the UTAUT model. The fourth independent variable of Facilitating Conditions and the Behavioural Intention are the determinants of Use Behaviour. The dotted lines are used to present the dependency relationships. The final independent variable of Disturbance Concerns is added to explore and analyze the potential influence on Behavioural Intention of m-commerce. The solid lines are used to present the mainly examined relationship between disturbance concerns and behavioural intention. Several hypotheses are defined for the proposed model.

Performance expectancy (PE) is the degree to which an individual believes that using the system will gain benefits or enhance job performance [3]. It is similar to the concept of perceived usefulness in TAM, extrinsic motivation in MM, job-fit in MPCU, relative advantage in IDT, and outcome expectations in SCT. The performance expectancy construct should have influence on the behavioural intention of an individual on using a new technology. In this proposed framework, the first hypothesis (H1) states that Performance Expectancy has a positive influence on the behavioural intention towards adopting m-commerce.

Effort Expectancy (EE) is the degree of ease to which an individual believes in the association with the use of the system [3]. Again, effort expectancy bears a similar concept of other existing technology adoption models such as perceived ease of use in TAM, complexity in MPCU, and ease of use in IDT. It generally believes that people would use a new technology if they find it easy to use. For the proposed model, the second hypothesis (H2) states that Effort Expectancy has a positive influence on the behavioural intention towards adopting m-commerce.

Social influence (SI) is equivalent to subjective norm TRA, TAM2, and TPB/DTPB in which an individual perceives that important others believe the person should use the new technology [3]. It is equivalent to social factors in MPCU, and image in IDT. For the proposed model, the third hypothesis (H3) states that Social Influence has a positive influence on the behavioural intention towards adopting m-commerce.

Facilitating Conditions (FC) is defined as the degree of believing in the existence of the technical and organizational infrastructure to support the usage of a new technology [3]. Similarly, it embodied by three constructs of user acceptance models: perceived behavioural control of TPB/DTPB, facilitating conditions of MPCU, and the compatibility of IDT. Unlike other constructs, facilitating conditions should have a direct influence on the actual usage of the new technology. The UTAUT model stated that facilitating conditions have a positive influence on the actual usage instead.
of the behavioural intention. For this research about m-commerce adoption, it is difficult to examine the actual usage of m-commerce of the studied subjects because we cannot provide them with modern mobile phones and cannot record their actual usage of m-commerce applications. Thus, FC is excluded from this analysis.

Disturbance Concerns (DC) is the degree to which an individual believes and worries about the potential disturbance and subsequent loss aroused from the use of the system. The construct extends the original UTAUT model to explore, analyze and critically assess the negative influence factors on the adoption model of m-commerce. Disturbance is an activity that is a malfunction, intrusion, or interruption as defined in the dictionary of WordNet 3.0 of the Princeton University. Disturbance can be security or privacy [9], customer trust, pressures, stress, anxiety, inter-dependency [20], mobile spam [21], hidden transaction cost [22], and any unanticipated (potential) loss aroused from the use of the system. The proposed model of this study is going to explore the impact of Disturbance Concerns; hence, the fourth hypothesis (H4) is defined as Disturbance Concerns has a negative influence on the behavioural intention towards adopting m-commerce.

To conclude the research model and hypotheses, the first three hypotheses are designed to verify and validate the proposed model. If results of the study match with the original UTAUT model, the structure of the proposed model can be considered as the valid extension of the UTAUT model. As explained, there is a limitation of this research to measure and understand the actual use behaviour of the studied subjects. The research has excluded the study of facilitating conditions and use behaviour. However, it will not affect the validity of the proposed model.

Research Methodology
This is a survey research. The research questions were designed with reference to the published questions for the survey research of the UTAUT model [3]. A web site was constructed to facilitate the collection of user responses. Respondents can freely forward the site address of the survey to others so that the survey can liberally collect responses from people. The survey includes the collection of the required user profile but not the identity of the respondent in order to ensure the unbiased analysis of the data. A pilot of the questionnaires was conducted in late 2008 by a group of 20 undergraduates. In early 2009, one hundred and forty-eight responses were collected via the web survey of the constructed web site with the majority are the undergraduates and postgraduates of the City University of Hong Kong.

The questionnaire of the survey includes the collection of the required data of user profile that are useful for further analysis of the user behaviour by different user profiles. For the original constructs of Performance Expectancy (PE), Efficiency Expectancy (EE), Social Influence (SI), and Behavioural Intention (BI) of the UTAUT model, three to four questions are set for each of them. Since this research is to extend the well-established UTAUT model, there are ten questions related to the new construct of Distributed Concerns (DC). In order to test if different levels of distributed concerns have different impact on the behavioural intention, the ten questions are basically divided into two sets of five equal questions for two different situations.

The two situations stated in the questionnaire are as follows:
1) “If your mobile device (such as your phone) can use an internet browser to surf the Internet”
2) “If your mobile device (such as your phone) can install some applications for taking online transactions and those applications can access your privacy information (such as phone number and contacts) and your current location (such as by means of GPS or A-GPS)”

The five questions applicable for the above two situations are:
1) I worry about being spammed when using the mobile device to conduct online transactions.
2) I worry about losing privacy data (such as my location, my phone number) when using the mobile device to conduct online transactions.
3) I worry about my personal information (such as address, bank account, etc) being stolen or leaked if I use the mobile device for online transactions.
4) The mobile transaction is not as secure as the traditional electronic commerce.
5) I worry that using the mobile device for online transactions may result unexpected interrupts or disturbances.

In situation 1, users understand that their mobile devices are equivalent to desktop computers equipped with the internet browser for surfing the Internet. Their personal data are protected similar to the protection in the desktop computers. In the situation 2, users are reminded that their personal data can be captured by someone during the conduction of m-commerce. The five questions covers the disturbance concerns of spam, privacy, information leaks, security, unexpected interrupts, or any potential disturbances. In data analysis, both situations were tested individually and in a combined model. The purpose of this approach is to test the disturbance concerns of the different levels of data protection on those two typical situations of
m-commerce and study the validity of the extension of disturbance concerns scrupulously applicable to both situations.

**Data Analysis and Results**

Structural Equation Modelling (SEM) is a family of statistical technique for testing and estimating causal relationships using a combination of statistical data and qualitative causal assumptions. SEM encourages confirmatory modeling that is suited to theory testing of the researched model. Partial Least Squares (PLS) [23] is a second generation technique of SEM that enables researchers to answer a set of interrelated research questions by modeling the relationships among multiple independent and dependent constructs simultaneously [24]. PLS is widely used in IS research to test the statistical quality and standard of the research result. Thus, the data analysis of this research was conducted with PLS, using SmartPLS 2.0 software [25].

**Demographic characteristics**

The demographic characteristic of the 148 responses are summarized in the Table 1.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>16-25</td>
<td>26-35</td>
</tr>
<tr>
<td></td>
<td>67.36%</td>
<td>32.64%</td>
</tr>
<tr>
<td>Education Level</td>
<td>Doctorate</td>
<td>Post-Grad</td>
</tr>
<tr>
<td></td>
<td>81.25%</td>
<td>13.19%</td>
</tr>
<tr>
<td>Mobile with WiFi</td>
<td>Support</td>
<td>Not Support</td>
</tr>
<tr>
<td></td>
<td>47.22%</td>
<td>52.78%</td>
</tr>
<tr>
<td>Internet Access</td>
<td>Support</td>
<td>Not Support</td>
</tr>
<tr>
<td></td>
<td>73.61%</td>
<td>26.39%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>m-Commerce Experience</th>
<th>Never</th>
<th>One-time</th>
<th>Occasional</th>
<th>Frequent</th>
</tr>
</thead>
<tbody>
<tr>
<td>m-Banking</td>
<td>81.94%</td>
<td>4.17%</td>
<td>9.72%</td>
<td>4.17%</td>
</tr>
<tr>
<td>m-Bidding</td>
<td>90.28%</td>
<td>3.47%</td>
<td>4.17%</td>
<td>2.08%</td>
</tr>
<tr>
<td>m-Booking</td>
<td>65.97%</td>
<td>9.72%</td>
<td>18.75%</td>
<td>5.56%</td>
</tr>
<tr>
<td>m-Shopping</td>
<td>82.64%</td>
<td>5.56%</td>
<td>11.11%</td>
<td>0.69%</td>
</tr>
<tr>
<td>m-Trading</td>
<td>88.89%</td>
<td>4.86%</td>
<td>5.56%</td>
<td>0.69%</td>
</tr>
<tr>
<td>m-Ticketing</td>
<td>70.14%</td>
<td>9.03%</td>
<td>18.75%</td>
<td>2.08%</td>
</tr>
<tr>
<td>Other transactions</td>
<td>76.39%</td>
<td>6.94%</td>
<td>15.28%</td>
<td>1.39%</td>
</tr>
<tr>
<td>Purpose of M-Commerce</td>
<td>Job-required</td>
<td>Voluntary</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>20.83%</td>
<td>79.17%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Demographic Summary

Two-third is male. Four-fifth respondents are in the age of 16-25. All are educated at least in the high-school level. Around four-fifth respondents are undergraduates. Over 73% respondents have Internet-enabled mobile phones although only 47.22% mobiles are equipped with WiFi. As shown in the section of m-commerce experience, it is obvious that majority of them have never conducted any type of m-commerce transactions. Surprisingly, there are 20.83% respondents are required to conduct m-commerce due to their work/study requirement. The percentage is almost equivalent to the percentage of those occasional and frequent m-commerce users. It can reflect that the m-commerce acceptance rate of the respondents is really low for the voluntary users.

**Data Reliability and Validity**

The internal consistency is used to assess the tolerable reliability of the related measures. The heuristics of SEM to measure the internal consistency is by means of Cronbach’s alpha correlations and SEM reliability coefficients [26]. Cronbach’s alpha should be above 0.7 for confirmatory analysis and in PLS. In this study, both the calculated Cronbach’s alpha correlations and composite reliability coefficients are all above 0.8 as shown in the corresponding columns of the Table 2, which indicates the statistical reliability of the internal consistency of the measures. For the measures of the studied distributed concerns, the figures are higher than the other measures and all above 0.9, which indicates the higher reliability of the extended construct.

Construct validity can be determined by the convergent and discriminant validities among the measures of constructs. In PLS, two indicators are considered: (1) the own-loadings are higher than the cross-loading; (2) the square root of each construct’s Average Variance Extracted (AVE) is larger than its correlations with other constructs [19]. The table 2 shows the Cross-loadings between the constructs and the measures. The bolded figures are own-loadings of the constructs. They are all above 0.75 and higher than the cross-loading with other measures. On the left of Table 2, the grids of latent variable correlations and SEM reliability coefficients are all above 0.8 as shown in the corresponding columns of the table 2, which indicates the statistical reliability of the related measures of constructs indicate that the square root of each construct’s AVE (shown in the grey diagonals) are all above 0.8 and larger than their correlations with other constructs [19]. The table 2 shows the Cross-loadings between the constructs and the measures. The bolded figures are own-loadings of the constructs. They are all above 0.75 and higher than the cross-loading with other measures. On the left of Table 2, the grids of latent variable correlations and SEM reliability coefficients are all above 0.8 as shown in the corresponding columns of the table 2, which indicates the statistical reliability of the related measures of constructs indicate that the square root of each construct’s AVE (shown in the grey diagonals) are all above 0.8 and larger than their correlations with other constructs [19]. The table 2 shows the Cross-loadings between the constructs and the measures. The bolded figures are own-loadings of the constructs. They are all above 0.75 and higher than the cross-loading with other measures. On the left of Table 2, the grids of latent variable correlations and SEM reliability coefficients are all above 0.8 as shown in the corresponding columns of the table 2, which indicates the statistical reliability of the related measures of constructs indicate that the square root of each construct’s AVE (shown in the grey diagonals) are all above 0.8 and larger than their correlations with other constructs [19]. The table 2 shows the Cross-loadings between the constructs and the measures. The bolded figures are own-loadings of the constructs. They are all above 0.75 and higher than the cross-loading with other measures. On the left of Table 2, the grids of latent variable correlations and SEM reliability coefficients are all above 0.8 as shown in the corresponding columns of the table 2, which indicates the statistical reliability of the related measures of constructs indicate that the square root of each construct’s AVE (shown in the grey diagonals) are all above 0.8 and larger than their correlations with other constructs [19]. The table 2 shows the Cross-loadings between the constructs and the measures. The bolded figures are own-loadings of the constructs. They are all above 0.75 and higher than the cross-loading with other measures.
The PLS Results for the proposed research model

Table 2: PLS Analysis Report

Figure 2: PLS Paths of the Proposed Model
by someone during the conduction of m-commerce. The final section (3) combines all measures of (1) and (2) to analyze the overall impact of disturbance concerns. The results as indicated by the R-squared values and the path coefficients shown the last column are similar and satisfactory, although the R-squared value (0.4856) of situation 1 is a bit lower than the R-squared value (0.5057) of situation 2. The redundancies of all tested models are small and satisfactory. The model with combined measures gave the R-squared value of 0.5003. It implied that respondents showed the similar behaviour of disturbance concerns to behaviour intention in both typical situations. Therefore, the combined measures were adopted as the concluded model.

Figure 2 summarises the analysis of this preliminary study. It shows the PLS path coefficients model of the proposed research model in which the disturbance concerns (DC) combines all 10 measures of both situation 1 and 2. The path coefficients are shown alone the arrow lines between the constructs, and all are significant at least at the .05 level. The R-squared value of the extended model which includes the extension of disturbance concerns is 0.5. According to the path coefficients, performance expectancy (PE), efficient expectancy (EE), and social influence (SI) have significant and near positive effects on behavioural intention (BI) since the coefficients are 0.286, 0.334, and 0.264. They match with the original UTAUT model. The new construct of disturbance concerns (DC) has significant negative effect on the behavioural intention of m-commerce acceptance because of the negative value (-0.230) of the coefficient. Since the weights of the path coefficients are near, it statistically indicates that the proposed model is a valid extension of the UTAUT model and the disturbance concerns (DC) represents a negative factor of the model for the measurement of m-commerce acceptance.

Discussion and Conclusion

The structural model of the proposed model was analyzed by the PLS method with the help of the SmartPLS software. The general applicability of a structural model depends on the reliability and validity of the modeling results. The required minimal sample size of PLS is at least 10 times the number of constructs for IS research [24]. The preliminary study of 148 responses is good for PLS analysis. Reliability and validity of the proposed model was assessed by internal consistency (reliability), convergent validity and discriminant validity. All test results are found to be satisfactory. The primary objective of PLS is the maximization of variance explained in all dependent constructs, which can be measured by R2 values of structural models. The R2 value for behaviour intention is 0.5. All the relationships between the latent constructs in the structural model are significant (p<0.001). This result satisfies the crucial requirement for reliability and validity of structural model.

The proposed model is extended from UTAUT which consists of well-established theories and approaches of user acceptance of new IS. The original UTAUT model includes the positive factors that can significantly explain user acceptance intention and use behaviour of new IS. The proposed model with extension of the new construct of disturbance concerns (DC) introduced the negative factor that significantly explains the negative user acceptance (or user rejection) intention of m-commerce acceptance. A major design of the measurement model is the use of two sets of questions to study the user’s concerns of disturbance in the two typical situations, which sufficiently tested the validity of user behaviour in these two typical situations. The analysis result indicated little difference among the situations. Thus, the final measurement model ignored the situations and combined all questions of disturbance concerns. The concluded model indicated that the new construct of disturbance concerns is an important factor of m-commerce acceptance.

The proposed research model represents a substantial and original contribution to understand the user acceptance of m-commerce, which will combine both positive and negative constructs that may influence the behavioural intention and use behaviour of the users. Further study and analysis will carry out in order to ensure the validity of the results and enhance the rigorousness of the enhanced acceptance model. Although the study was conducted in Hong Kong, the data are useful for comparing with the studies of other countries in order to validate the acceptance model. Furthermore, this study reveals additional factors that may influence technology acceptance. The factors are believed to be applicable to the user acceptance of general IS, because privacy, security, spam, information leak, unexpected interrupts, or any potential disturbances are general issues of information systems and they are obstacles of user acceptance. The applicability of disturbance concerns warrants further exploration and research.

References


MOBILE SERVICES IN HUBEI: ADOPTION MODEL AND EMPIRICAL ANALYSIS

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Abstract
Mobile Commerce has developed rapidly in China with the characters of ubiquity, location relevance, convenience and personalization. The researches on technology, value chain, business models, user adoption have become a hot topic among academics.

Based on the classical Davis’ TAM theory and the expansions of it, and the predecessors' research on perceived enjoyment and perceived cost, this study builds an adoption model of Mobile value-added services in Hubei Province. In the variety of individual mobile value-added business, four most commonly used services are extracted in this study, including Mobile Instant Message, Multimedia Messaging Service, WAP Web browse and Multi-media Downloads to represent the overall situation.

According to the result of empirical analysis based on valid data of questionnaires, perceived enjoyment and perceived cost are the most influential factors. Six of the seven hypotheses in this study are verified.

Keywords: Mobile value-added services, User adoption, Mobile Commerce

Introduction
The research on user adoption has been a hot topic in the field of information systems and e-commerce. Similarly, in the research on mobile services, building an adoption model can extract the mainly influencing factors of users’ acceptance, help to improve the degree and speed of acceptance of mobile services. This study, combines with the specific level of Hubei Province, builds an adoption model and makes an empirical analysis.

Mobile value-added services can be divided into four main categories [1]. There are mobile trades, mobile real-time communication, mobile entertainment and mobile information. Mobile trades include mobile payments, phone booking and so on; Real-time communication are the services that like mobile MSN, phone mail, etc.; Entertainment services contain ringtones, pictures, multimedia downloads; Information services provide kinds of information, including weather forecasts, mobile stock markets and so on.

Based on the survey on mobile services acceptance level in Hubei Province, some of the services has been deeply penetrated into the daily lives of consumers, such as MMS; but some new services are still in the introduction period, such as mobile business street. So, in this study, four most commonly used services are extracted to represent the overall situation. The four mobile applications are mobile instant message, multimedia messaging service, WAP web browse and multi-media downloads.

Research model and hypotheses
TAM: In the research on user acceptance of information systems, Davis[2] put forward his technology acceptance model. Two main determining factors of user acceptance in TAM are perceived usefulness and perceived ease of use[2][3]. When customers use value-added services, if the users feel that the business will help improve their own efficiency, the actual frequency of use will be greater. In the other hand, if the service is easy to use for customers, the actual use will be more. Another view of TAM is that users’ perceiving ease of use has an effect on the perceived usefulness. So, this study gets following 3 hypotheses based on TAM.

H1a: Perceived ease of use is significantly related to adoption intention.
H1b: Perceived usefulness is significantly related to adoption intention.
H1c: Perceived ease of use significantly has an effect on perceived usefulness.

Perceived Enjoyment: Moon and Kim introduce perceived enjoyment use in TAM[4]. The result discovered that, added this variable the model had the higher explanation degree compared to the original model[4][5]. It explained that the perceived enjoyment also is an important influence factor of user acceptance. In this study, perceived enjoyment is defined as the degree that the mobile service can bring joyful to the user. It is similar with the TAM in a conclusion that perceived ease of use significantly affects perceived usefulness, perceived ease of use also has the influence to perceived enjoyment[1]. If the service operation is complex, the user possibly loses the interest to it, namely reduced user's perceived enjoyment. This article proposes following hypotheses based on the definition of perceived enjoyment.

H2a: Perceived enjoyment is significantly related to adoption intention.
H2b: Perceived ease of use significantly affects perceived enjoyment.

Perceived Cost: In predecessor’s research, the negative price brought by using service usually is divided into the cost and the risk[1][6]. In this study, the cost and risk are combined into a general perceived cost which is another important influence factor of user acceptance. Then, on the other hand, if the user thought some service to oneself extremely useful, he/she may accept a higher cost. It is said that the perceived usefulness affects the customer’s perception of price. Following hypotheses are proposed based on the definition of perceived cost.

H3a: Perceived cost is significantly related to adoption intention.

H3b: Perceived usefulness significantly affects perceived cost.

Based on the discussions above, an adoption model of Mobile value-added services in Hubei Province is proposed in Figure 1. In this model, which contains 7 hypotheses, there are four possible determinants of intended use of mobile value-added services: perceived usefulness, perceived ease of use, perceived enjoyment, and perceived cost.

Data analysis and results

This study is a questionnaire-based empirical study. According to the research model, a questionnaire was designed, which contained the statements using a five-point Likert-scale with 1 as “disagree” and 5 as “agree”. In the survey of EMBA, MBA, PhD, Masters of management school of HUST and other social personnel, 334 questionnaires were received. Excluding incomplete and inconsistent questionnaires, we had 188 final useful samples. Out of the 188 useful samples, 83% was male and 17% was female. With respect to age groups, the highest percentage of the respondents was 20-25 and 36 - 40 age groups. The background of respondents is summarized in Table 1.

Table 1  Background of research samples

<table>
<thead>
<tr>
<th>Variable Classification</th>
<th>Number of samples</th>
<th>Percentage (%)</th>
<th>Cumulative (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>156</td>
<td>83</td>
<td>83</td>
</tr>
<tr>
<td>Female</td>
<td>32</td>
<td>17</td>
<td>100</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;=25</td>
<td>40</td>
<td>21.3</td>
<td>21.3</td>
</tr>
<tr>
<td>26-30</td>
<td>27</td>
<td>14.3</td>
<td>35.6</td>
</tr>
<tr>
<td>31-35</td>
<td>34</td>
<td>18.1</td>
<td>53.7</td>
</tr>
<tr>
<td>36-40</td>
<td>47</td>
<td>25</td>
<td>78.7</td>
</tr>
<tr>
<td>&gt;=41</td>
<td>40</td>
<td>21.3</td>
<td>100</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Associate degree</td>
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<td>48.4</td>
<td>48.4</td>
</tr>
<tr>
<td>Bachelor</td>
<td>39</td>
<td>20.7</td>
<td>69.1</td>
</tr>
<tr>
<td>Master or greater</td>
<td>31</td>
<td>16.5</td>
<td>85.6</td>
</tr>
<tr>
<td>Other</td>
<td>27</td>
<td>14.4</td>
<td>100</td>
</tr>
<tr>
<td>Monthly Income</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RMB&lt;2000</td>
<td>35</td>
<td>18.6</td>
<td>18.6</td>
</tr>
<tr>
<td>RMB2000-4000</td>
<td>51</td>
<td>27.1</td>
<td>45.7</td>
</tr>
<tr>
<td>RMB4000-6000</td>
<td>31</td>
<td>16.5</td>
<td>62.2</td>
</tr>
<tr>
<td>RMB6000-8000</td>
<td>27</td>
<td>14.4</td>
<td>76.6</td>
</tr>
<tr>
<td>RMB&gt;=8000</td>
<td>44</td>
<td>23.4</td>
<td>100</td>
</tr>
<tr>
<td>Monthly Phone charge</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RMB&lt;50</td>
<td>16</td>
<td>8.5</td>
<td>8.5</td>
</tr>
<tr>
<td>RMB50-100</td>
<td>37</td>
<td>19.7</td>
<td>28.2</td>
</tr>
<tr>
<td>RMB100-300</td>
<td>49</td>
<td>26.1</td>
<td>54.3</td>
</tr>
<tr>
<td>RMB300-1000</td>
<td>69</td>
<td>36.7</td>
<td>91</td>
</tr>
<tr>
<td>RMB&gt;=1000</td>
<td>17</td>
<td>9</td>
<td>100</td>
</tr>
</tbody>
</table>

Put the useful data into computer, we conducted principal component factor analysis on the five independent latent variables with VARIMAX rotation as in table 2[7].

Table 2  Rotated Factor Loading Matrix

<table>
<thead>
<tr>
<th>Component</th>
<th>Factor 1</th>
<th>Factor 2</th>
<th>Factor 3</th>
<th>Factor 4</th>
<th>Factor 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>au1</td>
<td>0.89</td>
<td>0.11</td>
<td>0.10</td>
<td>0.15</td>
<td>0.10</td>
</tr>
<tr>
<td>au2</td>
<td>0.87</td>
<td>0.26</td>
<td>0.07</td>
<td>0.10</td>
<td>0.11</td>
</tr>
<tr>
<td>au3</td>
<td>0.89</td>
<td>0.25</td>
<td>0.01</td>
<td>0.14</td>
<td>0.06</td>
</tr>
<tr>
<td>au4</td>
<td>0.88</td>
<td>0.06</td>
<td>0.01</td>
<td>0.06</td>
<td>0.11</td>
</tr>
<tr>
<td>pc1</td>
<td>0.06</td>
<td>-0.04</td>
<td>0.84</td>
<td>0.03</td>
<td>-0.08</td>
</tr>
<tr>
<td>pc2</td>
<td>0.05</td>
<td>0.03</td>
<td>0.80</td>
<td>-0.12</td>
<td>-0.11</td>
</tr>
<tr>
<td>pc3</td>
<td>0.04</td>
<td>-0.19</td>
<td>0.77</td>
<td>-0.11</td>
<td>0.12</td>
</tr>
<tr>
<td>pc4</td>
<td>0.27</td>
<td>0.46</td>
<td>-0.20</td>
<td>0.62</td>
<td>0.10</td>
</tr>
<tr>
<td>pe1</td>
<td>0.19</td>
<td>0.25</td>
<td>-0.12</td>
<td>0.79</td>
<td>-0.04</td>
</tr>
<tr>
<td>pe2</td>
<td>0.03</td>
<td>-0.16</td>
<td>0.00</td>
<td>0.73</td>
<td>0.05</td>
</tr>
<tr>
<td>peu1</td>
<td>0.24</td>
<td>0.31</td>
<td>-0.22</td>
<td>0.11</td>
<td>0.73</td>
</tr>
<tr>
<td>peu2</td>
<td>0.09</td>
<td>-0.04</td>
<td>0.06</td>
<td>-0.01</td>
<td>0.91</td>
</tr>
<tr>
<td>pu1</td>
<td>0.28</td>
<td>0.81</td>
<td>-0.19</td>
<td>0.09</td>
<td>-0.02</td>
</tr>
<tr>
<td>pu2</td>
<td>0.14</td>
<td>0.90</td>
<td>0.00</td>
<td>0.07</td>
<td>0.06</td>
</tr>
<tr>
<td>pu3</td>
<td>0.14</td>
<td>0.89</td>
<td>-0.03</td>
<td>0.01</td>
<td>0.12</td>
</tr>
<tr>
<td>eigenvalue</td>
<td>3.43</td>
<td>2.84</td>
<td>2.10</td>
<td>1.64</td>
<td>1.46</td>
</tr>
<tr>
<td>% of Variance</td>
<td>23%</td>
<td>19%</td>
<td>14%</td>
<td>11%</td>
<td>10%</td>
</tr>
<tr>
<td>Cumulative %</td>
<td>23%</td>
<td>42%</td>
<td>56%</td>
<td>67%</td>
<td>76%</td>
</tr>
<tr>
<td>Cronbach’s α</td>
<td>0.92</td>
<td>0.885</td>
<td>0.735</td>
<td>0.633</td>
<td>0.617</td>
</tr>
</tbody>
</table>

The results showed that a total of five factors with eigenvalue greater than 1.0 were identified. All items of the variables loaded on each distinct
factor and explained 76% of the total variance. All variables showed convergent validity with factor loadings above 0.6. It shows that the sample has a good validity.

We use Cronbach’s α to measure the reliability of our research instrument. It has been recommended that “the internal consistency, as measured by the Cronbach’s α, should be at least 0.60 for a self-report instrument to be reliable and at least 0.8 when used as a screening instrument.”[8][9] As shown in table 2 the Cronbach’s α of our instrument ranges from 0.617 to 0.920, indicating a medium high to high reliability.

The Structural Equation of this study is:

$$
\begin{align*}
\eta_1 &= \beta_{11}\eta_1 + \beta_{12}\eta_2 + \beta_{13}\eta_3 + \beta_{14}\eta_4 + \zeta_1 \\
\eta_2 &= \beta_{21}\eta_1 + \zeta_2 \\
\eta_3 &= \beta_{31}\eta_1 + \zeta_3 \\
\eta_4 &= \beta_{41}\eta_1 + \zeta_4 
\end{align*}
$$

(1)

In this equation, η1, η2, η3, η4 represent the four endogenous variables Actual Use, Perceived Enjoyment, Perceived Usefulness and Perceived Cost; ξ1 represents the exogenous variable Perceived Ease of Use; γ, β is the path coefficient, ζ is the errors.

Further analysis then will be made in path analysis software LISREL8.7 to determine the every coefficient. Put the code into computer, we got following result:

Table 3: Hypothesis testing results.

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Coefficient</th>
<th>Supported</th>
</tr>
</thead>
<tbody>
<tr>
<td>H2a: Perceived enjoyment is significantly related to adoption intention.</td>
<td>.38 √</td>
<td></td>
</tr>
<tr>
<td>H2b: Perceived ease of use significantly affects perceived enjoyment.</td>
<td>.38 √</td>
<td></td>
</tr>
<tr>
<td>H1c: Perceived ease of use significantly have an effect on perceived usefulness.</td>
<td>.36 √</td>
<td></td>
</tr>
<tr>
<td>H3a: Perceived cost is significantly related to adoption intention.</td>
<td>.24 √</td>
<td></td>
</tr>
<tr>
<td>H1b: Perceived usefulness is significantly related to adoption intention.</td>
<td>.20 √</td>
<td></td>
</tr>
<tr>
<td>H1a: Perceived ease of use is significantly related to adoption intention.</td>
<td>.20 √</td>
<td></td>
</tr>
<tr>
<td>H3b: Perceived usefulness significantly affects perceived cost.</td>
<td>&lt;.20</td>
<td></td>
</tr>
</tbody>
</table>

Conclusions
In this paper, the empirical research results show that Perceived enjoyment, Perceived cost, perceived ease of use and Perceived usefulness are all significantly related to the adoption Of mobile value-added services, while Perceived enjoyment and Perceived cost are the two most important factors.

This is because, First, general mobile value-added services are closer to entertainment systems rather than practical systems. Perceived enjoyment has a more significant impact on users’ adoption than perceived usefulness. Second, to college students as the main consumer groups, cost and safety must be important considerations.

In previous studies, perceived cost and perceived risk (or perceived security) are the two factors which are negatively related to adoption. In this study, the cost and risk are combined into a general perceived cost. In this way, users do not have to identify the negative impact is from the price or security. This point still needs a number of examples and theory to support, it calls for future research on exploring more accurate classification of the influence factors.

This study extracts four most commonly used services, which are mobile instant message, multimedia messaging service, WAP web browse and multi-media downloads, to represent the overall situation of mobile services. Future research could also find a more accurate representation of the actual use.

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References


INFLUENCING FACTORS FOR THE INTRODUCTION OF MOBILE-INTEGRATED BUSINESS PROCESSES

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Abstract
Although mobile information technology is introduced in business processes of enterprises for many years, many projects for integrating mobile workforces still fail to generate a business value for the company. However, reasons for a successful introduction of mobile IT have not been investigated so far. In this paper, we present the findings of a grounded theory study that focused on influencing factors for the introduction of mobile-integrated business processes. The outcome of the paper is a theoretical framework describing the decision process and the intervening conditions on the intention to introduce mobile-integrated business processes. The framework should be extended by the effects resulting from the introduction of mobile IT to get a picture as complete as possible.

Keywords: Mobile-integrated business processes, grounded theory, mobile information technology, theoretical framework

Introduction
Mobile information technology (IT) is introduced in business processes of enterprises for more than 10 years now. However, many companies fail or do not even start projects for the integration of mobile workforce. The integration of mobile workforces will become more and more crucial for companies due to the rising number of mobile workers which was predicted to be 61 million only in the United States by 2009 [1]. However, many companies have lagged to support their mobile workers with mobile IT [2] so that these business processes are still not integrated into the electronically mapped value chain. In the context of this paper, we refer to mobile business processes (MBP) as any business process which is partly or completely executed mobile and thus cannot be fully supported by the use of stationary IT [3]. The term mobile-integrated business processes (MIBP) refers then to any MBP that is fully supported by mobile or ubiquitous IT [4].

Reasons for project failure or success of the introduction of mobile-integrated business processes have not been analyzed. The focus has yet been on the analysis of single companies or industries. Examples are [5; 6] in the maintenance industry, or [7] focusing on sales force automation. A framework covering all industries and operation areas within each company is still missing. Thus, little research has been done to analyze critical success factors or intervening factors for the introduction of mobile IT.

Therefore, the research objective of this paper is to contribute to the understanding of the decision process of companies to use mobile IT. We used a grounded theory approach to derive categories as influencing factors for the introduction of mobile-integrated business processes. These findings were compared with the existing literature to validate them initially. The outcome of the paper is a theoretical framework about the intention to introduce mobile-integrated business processes.

The paper is structured as follows. Firstly, the grounded theory methodology is presented. Then, we present and discuss our results and provide afterwards implications for practice and offer suggestions for future research. In the last section, we conclude our results.

Methodology
For this paper we apply the grounded theory approach [8]. Grounded Theory is a qualitative and empirical research method to develop a new theory. This theory is derived through systematical data collection and analysis and can therefore be preliminarily validated [9]. A grounded theory has to fit to the collected data and be relevant and able to explain the behavior [8].

The grounded theory approach is suitable for our research topic because little research has yet been done on the influencing factors for the introduction of mobile IT. The decisive strength is the empirical and explorative approach that enables the researcher to develop a model close to reality. „Generating a theory from data means that most hypotheses and concepts not only come from the data, but are systematically worked out in relation to the data during the course of the research.“ [8, p.6] A purposeful theory development is achieved due to the iterative approach and the continued generation of knowledge about the research area under study. The developed theory consists on the
one hand of conceptual categories and their characteristics and on the other hand of hypotheses describing the relationships between the categories [8].

Data collection and data analysis are intertwined and done in several iterations. ’Theoretical sampling is the process of data collection for generating theory whereby the analyst jointly collects, codes, and analyzes his data and decides what data to collect next and where to find them, in order to develop his theory as it emerges.” [10, p.36] Firstly, for the development of the model, respondents who are considered to fit to the research question had to be identified. For this reason, interviews with strategy consultants have been conducted in Germany, because they have a lot of insights into various industries and businesses and can therefore offer a wide range of information. The selection of these respondents favored the choice of guideline-interviews, because the group of respondents is relatively specific and rare [11]. During a period of four weeks in May and June 2008 data was collected in seven in-depth interviews. All interviews were audio-taped, and, as suggested by [9], transcribed verbatim as well.

The data was collected through telephone interviews. The guidelines used ensured to address all developed constructs, relationships and ideas, without establishing a rigid order. The knowledge gained from the interviews was used to update the guidelines for the next interview. At the beginning of each interview, it was important to clarify the understanding of the term “strategic” because of the innovative field of research. Subsequently, the data collection started with an open question about the assessments and observations of the respondent about the use of mobile IT in enterprises to gain as much new knowledge as possible. Finally, constructs and relationships already identified were checked for strengthening or adjusting them further. Each interview lasted on average between 30 and 60 minutes.

After the sixth interview only factors were mentioned, that were already covered by existing categories, so that, according to [8], the theoretical saturation was reached and the interviews were terminated.

Theory Building

Theoretical Framework

Based on the data, we developed a basic model depicting a typical decision making process for the implementation of mobile IT within the company. Figure 1 outlines this process and influencing conditions developed during the grounded theory study.

![Fig. 1 Theoretical framework](image)

The first step to start the process is the question about the degree of mobility within the company. If there is mobility the intention to use mobile IT is originated to support these parts of the company. Four different kinds of conditions have an effect on the intention to introduce mobile-integrated business processes which influence the actual behavior to implement or not to implement them.

In the following sections we will use this basic model to describe the motivations and conditions for this decision making process.

Core category

Since the intention to use mobile IT was seen as the primary issue, this category was chosen as core category. According to [12], a behavioral intention can best be interpreted as the strength of intention to try performing a certain behavior. In accordance with the theory of reasoned action [13], we propose that the intention has a direct effect on actual behavior.

Causal condition

The causal condition is the degree of mobility within the company. The consideration whether mobile IT may be useful for the company is only relevant if the company’s work is in some way conducted mobiley [14; 15]. The degree of mobility within companies can be analyzed regarding whether employees or products and machines are mobile. Pousstchi and Thurnher [2] use the following categorization: firstly the mobility of employees, secondly the mobility of equipment for example machines and specialized tools, and thirdly the mobility of goods like products, parts or materials. Mobile employees are further distinguished by [16] into four groups according to their responsibilities. These are skilled personnel being mobile on the premises, the other ones being mobile outside the premises, skilled personnel with management functions working in a company with a mobile core business, and the top...
management. Due to the interviews we know that the support of the top management with mobile IT has no strategic aspect for the company. One reason given in the interviews is that the top management is not bound to rigid processes so that no process optimization or redesign with strategic impacts can be done. The three attributes for describing the degree of mobility will be described in the following.

Companies whose core business is conducted mobile render services at different places so that the value adding tasks could not be supported by stationary IT. In this case, all three categories mentioned by [2] are typically applicable, like for example in logistics or construction industry [17].

The second degree of mobility covers companies whose core business is not mobile but an important functional area. Based on the interviews, there are two approaches for claiming a functional area is important. The first one focuses on the importance for rendering the service or the product. An example for this approach is maintenance and emergency interference suppression for a machine manufacturer [2]. The other approach focuses on the number of employees working in the functional area like for example the field service or sales force. An interviewee stated this fact as follows: "It's important if a major part of the workforce is mobile."

The third degree of mobility focuses on the mobility of goods and equipment as described in [16]. One of the interviewees said about it: “Mobile IT is important if goods need to be tracked or monitored”.

It can be stated that mobility in companies differs in the degree of mobility. All companies with some degree of mobility may generate a strategic impact by using mobile IT. Due to that, the degree of mobility is the causal condition for the intention to use mobile IT.

Corporate conditions
Corporate conditions describe the company-related aspects about the interaction with the market and include the response time and the information intensity of the company.

In respect of a better interaction with the market a shorter response time may offer new strategic options. This could for example be a better service level agreement due to process optimization with a faster response time. Therefore, the response time is crucial in some industries, because cost reductions and sales increases can be achieved [18; 19]. If no strategic option can be achieved, the process changes have no further effect on the company. An interviewee explained it: “If there is no difference between a response time of 17 or 9 minutes, a process optimization has been achieved, but no strategic competitive advantage”.

If considering a time critical industry mobile IT offers the opportunity to increase these positive effects due to a shorter response time than with stationary IT [17].

The aspect of information intensity relates to the volume of information and the availability of information at the time it is needed to provide services or products. Porter and Millar [20] distinguish the information intensity between the information intensity of the value chain and of the product which could each be low or high. With this matrix industries could be described according to the necessity of information processing and therefore IT support. [21, p.43] defines information intensity according to [22] as “the degree to which a firm’s products and operations are based on the information collected and processed as part of the exchanges along the value chain”. Mobile IT further enables companies to collect and to process information faster or to even collect new information. One of the interviewees described it like follows: “It is important for knowledge worker who need real-time information while being mobile”. It can be stated that the impact may be higher in information intense industries than in industries with low information intensity of the value chain or of the product and for companies for whom a short response time is crucial.

Attitudinal conditions
Attitudinal conditions describe the attitude of the project participants and describe the business process focus of the company and the top management support.

Project participants have often focused on technical aspects rather than business aspects for the introduction of IT. This leads to a lack of understanding of the business processes by the CIO [23]. The customer does not notice the concrete IT implementation and therefore, a business process focus is necessary to fulfill the customers’ expectations [24]. An interviewee said about this aspect: “Technology is an enabler for business value and can change the business processes to gain competitive advantage.”

Another aspect is the top management support for the introduction of mobile IT. Sohal and Ng [25] analyzed IT projects and identified typical reasons for project failure. One main reason is the missing understanding of the potential of IT by senior management. This top-down approach is most appropriate for IT projects due to necessary changes in the business processes [24]. Pousstchi and Thurnher [26] discovered a relationship between decision making done directly by the top
management and the likelihood of the introduction of mobile IT. This relationship was mentioned during the interviews as well: “To successfully introduce mobile IT, the project has to be initiated by the top management”. Brodt and Verburg [27] support these findings within their case studies as well.

Due to the literature these attitudinal conditions are often critical success factors for the introduction of IT so that they have an influence on the intention to use mobile IT.

**Technical conditions**
The technical conditions cover two aspects: the maturity of the mobile market and the appropriateness of the mobile solution for mobile-integrated business processes.

The first aspect that could be identified describes the maturity of the mobile market. The more mature the market is, the more opportunities exist for the implementation of mobile solutions. For that purpose the available bandwidth and the available applications have to be taken into account [28]. The bandwidth is important if great volumes of data shall be transmitted via the mobile network. These characteristics describe the mobile market and the aspects that have an influence on the intention to use mobile IT [4].

The other aspect describes the mobile application. Jain [17, p.1984] emphasizes on the fit between the application and the chosen mobile device in terms of the functionality and design. The interface characteristic is important within the literature as seen for example in [28]. A reason for that was given in the interviews: “If the application is easy to understand and to use and it really helps conducting his or her work, than it will be adopted really fast.” The aim is a mobile application that is easy to use with a high usability and that helps doing the job.

It can be stated that the maturity of the mobile market and the implementation of the mobile application are important factors for the intention to use mobile IT.

**Resource-based conditions**
The resource-based conditions of the implementation of mobile IT consists of the profitability for such a project and the anticipated competitive advantages. This construct has an influence on the intention to use mobile IT and, in addition, a direct influence on the action/interaction strategies.

Profitability is defined as: “the difference between economic returns resulting from adoption of an innovation and the innovation’s economic costs” [29, p.136]. The profitability here includes on the one hand project planning and implementation costs of the solution as well as the organizational and process-related changes that are necessary for the introduction of mobile-integrated business processes in the enterprise. On the other hand, the introduction of mobile IT typically causes not only costs but also leads to monetary value and indirectly assessable monetary benefits. An interviewee said about it: “It all comes down to the question how strong the business case is.” Gumpp and Pousttchi [3] have, for example, developed the Mobility-M framework which provides an analysis and evaluation of projects that include the introduction of mobile technology. Direct monetary benefits may include here any cost savings that can be calculated, such as shorter trips and less overtime work.

A company has a competitive advantage “when it is implementing a value creating strategy not simultaneously being implemented by any current or potential competitors” [30, p.102]. This definition is used according to the resource-based view of the firm. The degree of competitive advantage is often expressed in monetary terms, but it can be measured in other ways, too [29]. Indirect monetary value describes a value that can not be expressed in monetary units, because it is not measurable, such as customer satisfaction. These may represent specific competitive advantages for the company. Due to the lack of measurability of these factors, we consider here the anticipated competitive advantages, regardless of whether they can be realized in the end.

This benefit from the introduction of mobile-integrated business processes has a positive effect on the intention and also affects the actual behavior. The cost of implementation and the resulting benefits can thus be offset against each other which leads to the profitability of the project.

**Actual Behavior**
In terms of [9] actual behavior can be interpreted as action/interaction strategy. Therefore, the actual behavior could be to use or not to use mobile IT to support mobile business processes. “As a general rule, the stronger the intention to engage in a behavior, the more likely should be its performance.” [31, p.181]

**Implications**
The findings of our study have implications for both practitioners and researchers. By providing practitioners with some insight into the influencing factors on the decision process to introduce mobile-integrated business processes. This framework serves as a basis for the decision about the introduction of mobile IT what is typically a complex situation that has been tried to solve unsystematically up to now. Based on this
framework, practitioners could estimate the project success and, if necessary, try to influence important factors like the support of top management.

From a theoretical viewpoint, this paper contributes to the existing literature in some ways. First, it provides insights about the influencing factors on the intention to introduce mobile IT in the business environment. Moreover, the results show that existing theories like the resource-based view of the firm and the diffusion of innovation theory can be applied to and are suitable for the analysis of mobile-integrated business processes.

Further research is necessary at some points of contact with these findings. Firstly, the resulting consequences deriving from the introduction of mobile-integrated business processes should be evaluated. This enables the development of a complete framework describing influencing factors on and effects of the introduction of mobile IT. Secondly, the theoretical framework should be proved by quantitative research.

Conclusions
Starting point for our consideration was the fact that understanding the influencing factors is necessary to successfully introduce mobile-integrated business processes. For that purpose a theoretical framework is developed by following the grounded theory methodology. The contribution of this paper is twofold. Firstly, the grounded theory was used to investigate an almost unexplored research field like the one of mobile-integrated business processes. Due to that fact, the grounded theory methodology is the only appropriate approach. Secondly, a general framework for mobile-integrated business processes was developed. This general framework is not bound to any industry or operational area. In further research the framework should be extended with the effects resulting from the introduction of mobile integrated business processes to gain a picture as complete as possible.

References


A PROCESS VIRTUALIZATION THEORY APPROACH TO UNDERSTANDING THE USAGE CONTINUANCE OF CROSS-CHANNEL INSTANT MESSAGING

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Abstract
Increasingly, we are witnessing the advent of IM software on mobile devices for users to communicate with other users who are using either the desktop or mobile channel. The emergence of such cross-channel instant messaging (CCIM) demands a renewed understanding of users’ continuance behaviours. In this research-in-progress paper, we draw upon the process virtualization theory perspective to extend the expectation-confirmation model for IT (ECM-IT). According to PVT, we propose that users’ confirmation of using the virtualized CCIM is determined by the communication process’s dimensions of sensory, synchronism, relationship, and identification & control. In addition, we propose that the extent to which the communication dyads make mutual adaptation to one another will moderate the relationship between confirmation and perceived usefulness of CCIM. We expect our findings to make theoretical contributions to the domain of research on IT usage post-adoption behaviours as well as managerial implications to CCIM application developers and other stakeholders in the mobile industry.

Keywords: Cross-channel Instant Messaging, Process Virtualization Theory, Mutual Adaptation, ECM-IT, Personal-tie Building

Introduction
The adoption of instant messaging (IM) has witnessed phenomenal growth during the last decade. The number of IM accounts has increased from 590 million in 2003 to 1060 million in 2007. It was estimated that the number of IM accounts will rise to 1700 million by 2011 [1]. This projection is largely expected because as more people begin to use IM to communicate with their friends and colleagues. Instant messaging is fast becoming a social tool for people to establish and facilitate their personal ties with others. In 2007, Gartner group published a global survey report on the mobile messaging indicating that mobile messaging would eventually become the primary solution for P2P communications in the future [2]. With the development of mobile technology, cross-channel instant messaging (CCIM) has emerged to allow users to chat with others regardless of whether they are using desktop-based IM or mobile-based IM. Figure 1 provides an illustration of CCIM in use. Users who are using either the desktop or mobile version of the CCIM would be presented with the information as to whether the other party is using desktop or mobile terminal (represented by different avatar).

Figure 1. Screenshots of CCIM (Both from mobile device and desktop device)

Figure 2. The Category of the Instant Messaging Communication
As depicted in Figure 2, there can be four possible instant messaging communication scenarios. When users use IM, they can choose the
desktop or the mobile IM to send messages; the receiver can also choose to receive the message either through the desktop or mobile terminal. In Scenario I, the sender uses the mobile terminal to send message and the receiver uses the desktop terminal to receive the message; In Scenario II, both the sender and receiver use the mobile terminal to send and receive the message; In Scenario III, both the sender and receiver use the desktop terminal to send and receive the message; In Scenario IV, the sender uses the desktop terminal to send message and the receiver uses the mobile terminal to receive the message. In the present study, our scope of CCIM is limited to Scenarios I and IV. Accordingly, we define CCIM as follows:

Cross-Channel Instant Messaging (CCIM) refers to the use of instant messaging software where the source and receiving party are on different channels and includes communications with another party from the mobile to desktop channel or from the desktop to the mobile channel.

In the extant research, instant messaging communication has been studied in a single channel context on the desktop computer. Studies were conducted to validate the established technology adoption models such as TAM model, TPB theory, Flow theory in this application context [3] [4] [5] [6] [7] [8]. It has been found that perceived usefulness, perceived enjoyment and concentration have positive effects on the intention to adopt IM [6] [9] [10] [11]. Prior to the availability of IM on mobile terminals, users communicated with each other on the same channel - there are no differences between the sender’s device and the receiver’s device (e.g. screen size, processor capability, keyboard, IM software interface). However, in the case of CCIM, the communication partners use different methods to chat with each other (e.g. one uses desktop-based CCIM while the other uses the mobile-based CCIM). They have to deal with the differences in the desktop and the mobile devices. Consequently, their communication behaviours may be influenced both by the hardware constraints and by the CCIM communication process characteristics.

To the best of our knowledge, no studies have been conducted in the cross-channel IM context, especially in the case of post adoption [10] [12]. In this paper, we extend the ECM-IT model by process virtualization theory (PVT) perspective to predict the usage continuance of CCIM. PVT [13] aims to explain the virtualization mechanism of a process from the four essential facets: sensory, relationship, synchronism, and identification and control. Since CCIM is purely a communication process, it is appropriate to use the process characteristics outlined in PVT to assess confirmation and continuance of its usage. It has been pointed out that there is a lack of research on the post adoption of mobile services [14], our study attempts to fill this gap by adopting a new theoretical perspective to investigate an emerging mobile service. We also expect the findings from this study to provide new insights to inform managerial practices in the mobile services industry.

Conceptual Developments

Figure 3 shows the proposed research model.

![Figure 3. The Research Model](image)

Expectation-Confirmation Model for IT (ECM-IT)

Drawing attention to the substantial differences between initial adoption and continued usage behavior in the IT context, Bhattacharjee (2001) developed and empirically tested an expectation-confirmation model of continued IT usage. ECM-IT had its roots in the expectancy-confirmation paradigm. The model predicts users' intentions to continue using IT with three antecedent constructs: (1) user satisfaction with the IT; (2) extent of user confirmation; and (3) post-adoption expectations, represented by perceived usefulness. In the ECM-IT model, perceived performance was not included as the assumptions has been made that the effects of perceived performance is already captured by the confirmation construct. Based on the logic of ECM-IT, confirmation is the congruence of the expectation and the actual performance [15] [16]. If the actual performance cannot meet the expectation, users will feel disconfirm. If the actual performance is better than expectation, users will feel satisfied and regarded it as a bonus. In order to assess the users’ perceived performance/confirmation of the communication process in using CCIM, we draw upon the process characteristics outlined in the process virtualization
theory.

Process Virtualization Theory

Prior research has investigated shopping and commercial exchange processes and provided findings as to which products are best suited for trading in virtual environments [17] [18]. Other research has also looked at relationship development processes and how they might be conducted via virtual mechanisms such as email, online dating sites, and virtual worlds [19]. The process virtualization theory [13] was developed to provide a framework to answer the question: “What factors affect the ‘virtualizability’ of a process?”

In PVT, process is broadly defined as a set of steps to achieve an objective. We adopt this perspective to investigate the CCIM process thoroughly. Consider the process of friendship development. The steps in this process include meeting, identifying mutual interests, creating shared experiences, etc. This could be done online through exchanging e-mails and sharing experiences in the same online role playing game. The objective is to develop a mutually beneficial relationship. PVT proposes that sensory, relationship, synchronism, and identification and control are the four dimensions that can be used to characterize a process. Communicating using CCIM is a process that involves all of these four aspects and hence users’ perceived confirmation of its performance can be appropriately evaluated using these PVT process characteristics.

Sensory Perceptions

Sensory perceptions refer to the overall sensation that users feel when engaging in the CCIM communication (e.g. excitement, sadness) [13]. It determines whether users are able to perceive a full sensory experience of the communication via CCIM. When users feel happy in using the CCIM, they would like to use the CCIM and enjoy the process of chatting. This will enhance the communication performance.

Much research has been done on the users’ sensory perceptions of IT. In the context of IM adoption, Kang et al. (2009) found that enjoyment has positive effect on IT actual usage and performance[20]. Other scholars also found that the perceived sensory aspects, such as perceived concentration, are positively associated with IT performance [5] [10]. Therefore, we hypothesize that:

Hypothesis 1 (H1): The users’ perceptions of CCIM sensory aspects are positively associated with their confirmation of the use of CCIM.

Relationship Perceptions

Relationship perceptions refer to the quality of personal tie-building in the CCIM communication context. Such interactions often lead to knowledge acquisition, trust, and friendship development [13].

Relationships have a direct impact on cooperative communication performance. Some scholars found that personal ties are special in that they create an emotional intimacy and social and/or cultural sense of belonging [21] [22] [23]. Fulfillment of the needs of participants’ interpersonal interaction is thus linked to a willingness to cooperate. Users may characterize their relationship in various terms such as “friends”, “classmates”, or “professional associates”. Users will tend to seek help from and provide help to people with whom they have close relationships rather than people they do not know or whom they dislike. Hence, relationship perceptions will likely to positively influence the communication performance. Therefore, we hypothesize that:

Hypothesis 2 (H2): The users’ perceptions of CCIM relationship aspects are positively associated with their confirmation of the use of CCIM.

Synchronism Perceptions

Synchronism perceptions refer to the degree to which the activities that make up the CCIM communication need to occur quickly with minimal delay [13].

The partners should respond as soon as possible in order to improve mutual understanding [24]. This is so because replying synchronously makes the communication process more seamless. The communication partners would like to chat with each other synchronously in order to enhance the performance of communication [25] [26]. This is particularly important because of the users’ need to always remain contactable and to communicate with those on their CCIM contact list. Therefore, we would expect that synchronism is likely to have an influence in computer-mediated communication process such as CCIM. Therefore, we hypothesize that:

Hypothesis 3 (H3): The users’ perceptions of CCIM synchronism aspects are positively associated with their confirmation of the use of CCIM.

Identification and Control Perceptions

Identification and control perceptions refer to the degree to which users can identify other communication participants and the ability to exert control over/influence their behavior in the CCIM communication [13]. We note that the conceptual definition of control in the PVT is similar to the notion of perceived behavior control in TPB.

In the context of CCIM, the ability to recognize friends when they logon, ability to logon anonymously and the ability to execute service functions are examples of such perceptions. The ability to exert control may have positive influences on the communication performance [27] [28] [29] [30]. The provision of identification by
CCIM can allow users to choose an appropriate manner to chat with the other party (e.g., chatting with trusted friends more casually, and chatting with anonymous parties more prudently) [31]. Therefore, we hypothesize that:

Hypothesis 4 (H4): The users’ perceptions of CCIM identification and control aspects are positively associated with their confirmation of the use of CCIM.

**Mutual Adaptation**

Mutual adaptation is arguably on of the most essential characteristics of every interpersonal interaction. It refers to the magnitude and type of influence that one person’s overt behavior has on the partner [32]. Mutual adaptation is similar with the concept “reciprocity” in interpersonal communication [33]. Reciprocity involves responding to a positive action with another positive action, and responding to a negative action with another negative one. A point of difference is that mutual adaptation focuses only on the positive reciprocal activities. In the distributed learning context, mutual adaptation plays an important role in the teaching experience and self-learning [34] [35]. When parties communicate remotely using computer-mediated communications (CMC), the ability to make mutual adaptations based on hardware, software and bandwidth constraints and variations are important. In the context of CCIM, we consider mutual adaptations as the users’ self-regulation behavior to adapt to the partner’s real-time situation in the CCIM communication.

Mutual adaptation is likely to moderate the relationship between confirmation and perceived usefulness. In the ECM-IT model, confirmation tends to elevate users’ perceived usefulness and disconfirmation will reduce such perceptions. Mutual adaptation will strengthen this positive effect. When using CCIM, users would like to adjust to their communication partner in order to improve overall communication performance (e.g. change the typing speed, use some abbreviation if their partner is using mobile terminal). These self-regulation behaviors may enhance the communication performance and in turn make the users feel that the CCIM is useful (see Figure 1). This is because on the basis of reciprocity, people know what they can expect from cooperating parties, and are more likely to commit themselves to the formal and informal obligations associated with the cooperative relationship [21] [22] [24]. Mutual adaptation thus has a harmonious and stabilizing effect on the relations between the parties. The result will be greater continuity in communications with minimum delays. Thus, with the moderating effect of mutual adaptation, confirmation may have a greater influence on the perceived usefulness of CCIM. Therefore, we hypothesize that:

Hypothesis 5 (H5): Mutual adaptation positively moderates the relationship between users’ confirmation and perceived usefulness of CCIM.

**Perceived Usefulness, Confirmation, Satisfaction, CCIM continuance intention**

The remaining hypotheses in our proposed model have been previously investigated in numerous ECM-IT studies [15], and have now become well established in the literature of ECM-IT [20] [36]. We expect these relationships to hold in the context of CCIM. First, a user's satisfaction has positive influence on his/her intention to continue using CCIM. Second, a user's extent of confirmation and perceived usefulness are two key determinants of satisfaction. Third, perceived usefulness is the most important factor in determining users' adoption intentions. Finally, the extent of confirmation resulting from the usage experiences is hypothesized to positively affect perceived usefulness. Hence:

Hypothesis 6 (H6): Users’ perceived usefulness of CCIM use is positively associated with their satisfaction with CCIM use.

Hypothesis 7 (H7): Users’ extent of confirmation is positively associated with their satisfaction with CCIM use.

Hypothesis 8 (H8): Users’ level of satisfaction with initial CCIM use is positively associated with their CCIM continuance intention.

Hypothesis 9 (H9): Users’ CCIM continuance intention is positively associated with their perceived usefulness of CCIM use.

Hypothesis 10 (H10): Users’ extent of confirmation is positively associated with their perceived usefulness of CCIM use.

**Research Method**

A survey using a communication-dyad approach will be conducted to test the research model. Data will be collected from existing users of the CCIM. Only users who had experiences in using IM to communicate across desktop and mobile channels (i.e., Scenario I and IV) will be used as respondents. It will be performed in three stages. First, a mailing list of current users will be obtained from a major CCIM firm. Next, we will randomly select several respondents and send them invitation letters to participate in our study. Upon completion of the survey, users will be asked to provide the contact information of another friend/colleague whom they communicate using CCIM frequently. The dyad assessment approach would allow us to assess the mutual adaptation aspect.

We plan to examine two major Chinese
CCIMs: QQ (pc.qq.com) and Fetion (www.fetion.com.cn). QQ is the primary product of Tencent Company, which is the largest Internet service provider in China. QQ started off with a desktop version and has introduced a mobile version in recent years, users can chat via both versions of QQ. Fetion is the IM product of China Mobile, which is the largest mobile network carrier in China. Fetion began as a mobile service and recently provided a desktop version. These two CCIMs have their unique aspects and are suitable for our research. For QQ, it is the dominant desktop IM in China, and is now extending its usage into the mobile domain; for Fetion, it has an edge in the mobile network domain, and is now moving into desktop domain. By studying two competing CCIMs with different focused markets, we expect to uncover some interesting insights when doing comparative analysis.

Constructs from the ECM-IT in the research model are operationalized using established scales and adapted to suit the CCIM context. The items to assess the four process characteristics are developed based on the theoretical conceptualizations of Overby (2008) and other related research in the CMC literature. We expect to have approximately 200 respondents for each CCIM. Data will be analyzed using partial least squares (PLS) technique.

**Status of Research & Expected Contributions to Theory and Practice**

**Status of Research**

We have completed the conceptual developments and validation process and have developed a preliminary version of the questionnaire. Data collection is targeted during summer 2009. We expect to complete the preliminary data analysis by fall 2009.

**Expected Contributions to Theory and Practice**

The main theoretical contribution of this research is that it provides a new perspective to understand users’ post adoption behavior with the introduction of the process virtualization perspective. Our proposed research model provides a more holistic assessment of users’ confirmation of IT by considering them from the four aspects of sensory, synchronism, relationship, and identification and control. Next, our unique research context of cross-channel IM allows us to examine the effects of mutual adaptation. The findings would provide new insights to study other cross-channel information services. We expect the revised model to further enhance the explanatory ability of the ECM-IT model. Third, further development and test of ECM-IT could advance research into users’ interpersonal interaction. From a managerial point of view, empirical findings from our study would identify the aspects that are important to cross-channel information service users. The results regarding the importance of mutual adaptation would inform cross-channel services designers and providers about offering users the ability to identify and make mutual adjustments to other users in order to improve usage continuance.

**Acknowledgement.** This research is supported by the national natural science foundation of China (70890081)

**References**


The Usage Continuance of Cross-Channel Instant Messaging


ANTECEDENTS AND CONSEQUENCES OF MOBILE ADVERTISING INTRUSIVENESS

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Abstract
Consumers’ negative perceptions toward mobile advertising have been a major impediment to its wider acceptance. This study examines the effects of perceived value of the mobile advertising and consumer privacy violation would have on consumers’ perceived mobile advertising intrusiveness, as well as the relationships of intrusiveness with perceived ad irritation and ad avoidance behavior. Results from a survey of 103 Chinese mobile consumers suggest that informativeness of mobile advertising reduces perceived intrusiveness, consumer privacy concern positively affects intrusiveness, while a higher level of perceived intrusiveness positively impacts ad irritation and ad avoidance behavior.

Keywords: mobile advertising, perceived intrusiveness, information value, privacy concerns, ad avoidance, perceived irritation

Introduction
The rapid deployment of third-generation (3G) high-speed mobile communication systems and the proliferation of smart phones have renewed the interests in mobile commerce. These recent developments in mobile technologies and the distinct features of mobile devices - mobility, personalization and location-awareness have rekindled the hopes of merchants to perform marketing activities using the mobile medium [1, 2]. Touted as one of the most promising application of mobile marketing, mobile advertising has been utilized by both marketers who already have existing relationships with consumers and those who want to reach out to potential customers [3].

In the early stages of mobile marketing, mobile operators and marketers were largely driven by the hype effect and rushed onto the bandwagon hoping to obtain a leading position without appropriate strategies [4]. Recent research has identified that different delivery modes (push or pull) [5] and schedules (deliver time and frequency) [6] can cause consumers to form different perceptions toward mobile advertising. Negative perceptions from consumers are the prime reasons why the potential advantages of mobile advertising could not live up to the industry's expectations [4]. To ensure mobile advertising success, consumers’ negative perceptions toward mobile advertising warrant a thorough investigation, especially in the context of evolving mobile communication environment.

The intrusion of mobile advertising is regarded as the strongest stumbling block for mobile advertising development. Consumers’ perceived intrusiveness, irritation towards advertising, and ad avoidance had been investigated in traditional media [7, 8] as well as in the context of Internet [9]. In the domain of mobile advertising, there is some research into the primary antecedents of the user’s negative perceptions [10] or actual avoidance behavior in the mobile marketing context [11]. However, to the best of our knowledge, there is no research that has attempted to examine both the antecedents and consequences of mobile advertising intrusiveness.

This paper intends to contribute to the domain of mobile advertising by exploring the antecedents and consequences of perceived mobile advertising intrusiveness. Our research context is the use of push mode mobile advertising with no government regulation (e.g., mobile SPAM control). Our objective is to gain a comprehensive understanding of the determinants of mobile advertising intrusiveness as well as the outcomes arising from it. In section 2, we first introduce the concept of ad intrusiveness and the consequences of consumer perceived intrusiveness; then we discuss the effects of perceived value of the mobile advertising and the impact of consumer privacy violation would have on consumer’s perception of mobile ad intrusiveness; we will introduce the research method in section 3; results and implications will be presented and discussed in section 4 and 5.

Conceptual Model Development
Over the past decade, widespread interest in mobile marketing has led to a considerable amount of research focusing on the attitudes toward mobile marketing [12-16], determinants of user acceptance [17-22] and mobile medium effectiveness assessment [5, 23, 24]. Although the previous works in mobile commerce have provided some understanding to the problems of mobile advertising, there is generally a lack of an overarching theoretical framework that could be adopted to help understand the intrusiveness and irritation felt by mobile users and their avoidance...
behavior toward mobile advertisements. Hence, we combine cognitive psychological models with prior research from advertising and information systems to develop the research model since perceived intrusiveness is a kind of psychological perception.

**Consequences of perceived mobile advertising intrusiveness**

Perceived advertising intrusiveness is a construct that could influence consumers’ attitude [25], and has been examined in research on consumers’ negative reactions when faced with unwanted advertisements [26]. It is claimed to be an individual perception of advertisement, not a feature of advertisement, and is entirely different from the emotional (irritation) and behavior (avoidance) outcomes of advertising exposure [9]. The distinct features of mobile devices make marketing via mobile devices to be a new revenue stream that is attractive to marketers [2, 17, 20] and consequently, the consumers exposure to mobile advertising has become more prevalent [26]. Moreover, the fact that mobile devices are personal and are intimately carried by people has made mobile advertising potentially more intrusive than advertising channels [13].

Ad intrusiveness is considered to be a leading cause of advertising irritation [7] and advertising avoidance [8]. Advertising irritation is an emotional response to advertisement and is reflected as the negative, impatient and displeased feeling caused by ad content, execution and placement [7, 25, 26]. It is a state of response that is less negative than offensive but stronger than dislike. Advertising avoidance is a behavioral outcome of exposure to advertising [10], undermining the effect of advertising for the loss of consumer’s attention [8]. In push-based mobile advertising context, we expect that perceived ad intrusiveness would result in ad irritation and ad avoidance. Hence, we hypothesize that:

**Hypothesis 1 (H1):** The perceived level of mobile advertising intrusiveness will have a positive influence on mobile advertising irritation.

**Hypothesis 2 (H2):** The perceived level of mobile advertising intrusiveness will have a positive influence on mobile advertising avoidance.

Consumer attention is a scarce resource. Therefore, consumers incur costs to read the messages [27]. The frequency the same advertisement is being delivered to consumer has been found to be negatively affecting the advertising effectiveness [28]. In addition, excessive advertisements would often elicit negative reactions [29-31]. According to the psychology reaction theory, when external sources create pressure on consumers, they would react against threats by acting in the opposite way [25]. Hence, if consumers perceive mobile advertising as an intrusion, the delivery frequency of this intrusive mobile advertisement would reinforce the ad avoid behavior. Therefore, we hypothesize that:

**Hypothesis 3 (H3):** The frequency of that mobile advertising positively moderates the relationship between the perceived level of mobile advertising intrusiveness and mobile advertising avoidance.

**Privacy concern due to mobile advertising**

Privacy can be understood as "the ability of an individual to control the terms under which their personal information is acquired and used." [32] Privacy is a key concern of consumers [33], especially in the use of mobile devices where they can be potentially tracked ubiquitously. Privacy stresses consumer’s control over personal information and how companies process and use their personal information, which has been found to be an issue in the context of Internet sites [34]. Likewise, similar concerns have been found to exist in the context of mobile marketing since obtaining and using personal data is the necessary condition that a mobile advertising campaign could be carried out [13, 19, 35]. And this initiative seeking for personal information is the most striking difference of advertising via mobile devices than advertising via other medium. Misgivings would be raised when consumers received unsolicited mobile advertisements, such as, how could they know the information, where do they get the information, why would they send this kind of advertising to me at this time, and so on. Receiving unsolicited advertisement is regarded as a direct consequence of the disclosure of personal information involuntary [36, 37]. Intrusiveness would be perceived by consumers when receiving unsolicited mobile advertising due to the loss of control over privacy information [10]. Consequently, consumers’ concern about the privacy information would affect their perception toward mobile advertising intrusiveness. Therefore, we hypothesized that:

**Hypothesis 4 (H4):** Consumers’ concern over private information will have a positive influence on perceived mobile advertising intrusiveness.

**Perceived value of mobile advertising**

Perceived value is closely related to the ad effectiveness and consumer behavior [20]. As a kind of positive social influence, perceived value of mobile advertising would possibly affect the perceived intrusiveness [9, 38]. In other words, if mobile advertising is regarded as high value, the perceived intrusiveness would be lessened [9]. The quality of the information advertisements delivered to the consumers has a direct influence on
consumer’s perception and attitude toward advertising and the brand [15], and turned out to be strongly related to the value of advertising in traditional media [28]. Also, the level of enjoyment consumers derives from the advertisements determines the overall attitude towards them [39], and this entertainment value also proved to be related to advertising value of traditional advertising [28]. Furthermore, previous studies on mobile advertising have suggested that informativeness and entertainment are two most important predictors to the value of mobile advertising [13, 17, 24]. Therefore, we hypothesized that:

Hypothesis 5 (H5): The informativeness of mobile advertising will have a negative influence on perceived level of mobile advertising intrusiveness.

Hypothesis 6 (H6): The entertainment of mobile advertising will have a negative influence on perceived mobile advertising intrusiveness.

Figure 1 shows the research model.

![Research Model](image)

**Research Method**

An online survey on SMS advertising was conducted to empirically test the hypotheses. SMS advertising was chosen as the research context as it is the most popular form of mobile advertising in China [16]. We collected data from 107 graduate students from a large university in Northwestern China. As the purpose of this paper is to explore consumers’ reaction to mobile advertising, the prior experience in receiving mobile advertising was required. Hence, we included a manipulation check question asking “have you ever received mobile advertising?”. Four respondents did not receive mobile advertisements before. Thus, our final dataset comprise of 103 respondents who have received mobile advertisements. The use of student respondents is appropriate for our research as students have been reported to form the largest group of mobile phone users in China [40]. Our dataset comprises of 54.9% male and 45.1% female participants, with 84.3% aged between 23 to 25 years, and the rest aged between 26 to 30 years.

The conceptualizations and development of the questionnaire was based on extant literature and most constructs were measured using a 7-point Likert scales ranging from (1)” strongly disagree” to (7) “strongly agree”, while the frequency of mobile advertising was measured using a 5-point Likert scales from (1) “almost none” to (5) “ several per day”. The items used to measure ad avoidance were self-developed based on group discussion with graduate students, taking into consideration the characteristics of mobile advertising.

**Data Analysis and Results**

**Measurement model**

We use the Smart-PLS software version 2.03 [41] to analyze the empirical data. Partial Least Squares (PLS) employs a component-based approach for estimation purpose, and can handle formative constructs. PLS has been widely used in recent IS studies. PLS was chosen over co-variance-based methods, and it's appropriate for testing theories in early stages of development, as it supports both exploratory and confirmatory research. In general, PLS is better suited for explaining complex relationships as it avoids two serious problems: inadmissible solutions and factor indeterminacy.

As shown in Table 1 and 2, all of the reliability coefficients were above 0.7 and AVE of each construct was above 0.5. This indicated that the measurements are reliable and the latent construct can account for at least 50 percent of the variance in the items. The square root of the AVE is greater than all of the inter-construct correlations, showing evidence of sufficient discriminate validity [42]. In order to further assess validity of our measurement instruments, we used the cross-loading matrix to ensure that each item loading is much higher on its assigned construct than on the other constructs. This provided further assurance that our measurement instruments have adequate convergent and
discriminate validity. Construct validity assesses the extent to which a construct measures the variable of interest. Results of the item loadings are given in Table 1. All loadings are greater than 0.5, as recommended by Hair et al. [43] (convergent validity). There are no high cross-loadings of items in one construct with items in other constructs (discriminate validity). As shown in Table 2, this criterion is met. Internal consistency (construct reliability) of the eight factors was examined using Cronbach $\alpha$ value. As shown, Cronbach $\alpha$ values ranged from 0.72 to 1, which is well past the threshold recommended by Rivard and Huff [44] and Nunnally [45]. Therefore, our instrument encompassed satisfactory content, convergent validity, and discriminate validity.

### Table 1  Factor loadings and Reliability

<table>
<thead>
<tr>
<th>Variable</th>
<th>Item</th>
<th>Loading</th>
<th>Cronbach $\alpha$ (Composite Reliability)</th>
<th>Variable</th>
<th>Item</th>
<th>Loading</th>
<th>Cronbach $\alpha$ (Composite Reliability)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ent</td>
<td>ENT1</td>
<td>0.93</td>
<td>0.92</td>
<td>Inf</td>
<td>IFO1</td>
<td>0.78</td>
<td>0.72</td>
</tr>
<tr>
<td></td>
<td>ENT2</td>
<td>0.92</td>
<td>(0.95)</td>
<td></td>
<td>IFO2</td>
<td>0.92</td>
<td>(0.83)</td>
</tr>
<tr>
<td></td>
<td>ENT3</td>
<td>0.93</td>
<td></td>
<td></td>
<td>IFO3</td>
<td>0.65</td>
<td></td>
</tr>
<tr>
<td>PC</td>
<td>PC1</td>
<td>0.58</td>
<td>0.81</td>
<td>Fre</td>
<td>FRE</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>PC2</td>
<td>0.86</td>
<td>(0.88)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PC3</td>
<td>0.88</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PC4</td>
<td>0.87</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P Intr</td>
<td>INTRU1</td>
<td>0.79</td>
<td>0.89</td>
<td>P Irr</td>
<td>IRR1</td>
<td>0.92</td>
<td>0.80</td>
</tr>
<tr>
<td></td>
<td>INTRU2</td>
<td>0.86</td>
<td>(0.90)</td>
<td></td>
<td>IRR2</td>
<td>0.67</td>
<td>(0.88)</td>
</tr>
<tr>
<td></td>
<td>INTRU3</td>
<td>0.78</td>
<td></td>
<td></td>
<td>IRR3</td>
<td>0.91</td>
<td></td>
</tr>
<tr>
<td></td>
<td>INTRU4</td>
<td>0.70</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>INTRU5</td>
<td>0.86</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>INTRU6</td>
<td>0.83</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

AB=avoidance behavior, Ent=entertainment, Fre=frequency, Inf=informativeness, P Intr=perceived intrusiveness, P Irr=perceived irritation, PC=privacy concern

### Table 2  Discriminant Validity of Constructs

<table>
<thead>
<tr>
<th>PC</th>
<th>AB</th>
<th>Ent</th>
<th>Fre</th>
<th>Inf</th>
<th>P Intr</th>
<th>P Irr</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PC</td>
<td>0.81</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avoidance Behavior (AB)</td>
<td>0.26</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Entertainment (Ent)</td>
<td>-0.37</td>
<td>-0.42</td>
<td>0.93</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency (Fre)</td>
<td>-0.06</td>
<td>0.15</td>
<td>-0.08</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Informativeness (Inf)</td>
<td>-0.36</td>
<td>-0.34</td>
<td>0.5</td>
<td>-0.04</td>
<td>0.79</td>
<td></td>
</tr>
<tr>
<td>Perceived Intrusiveness (P Intr)</td>
<td>0.48</td>
<td>0.45</td>
<td>-0.46</td>
<td>0.07</td>
<td>-0.48</td>
<td>0.81</td>
</tr>
<tr>
<td>Perceived Irritation (P Irr)</td>
<td>0.37</td>
<td>0.28</td>
<td>-0.38</td>
<td>0.09</td>
<td>-0.49</td>
<td>0.82</td>
</tr>
<tr>
<td>Average Variance Extracted (AVE)</td>
<td>0.65</td>
<td>1</td>
<td>0.86</td>
<td>1</td>
<td>0.62</td>
<td>0.70</td>
</tr>
</tbody>
</table>

**Hypothesis testing**

Figure 2 shows the results of the analysis. As recommended by Chin [46], bootstrapping was performed to test the statistical significance of each path coefficient. As shown in Table 3 all of the structural model paths’ t-values were significant at p<0.05 except H6.

Results suggest that users’ perceived intrusiveness has an impact on both of the users’ behavioral consequences of ad avoidance and perceived irritation. Next, informativeness of mobile ads has been found to reduce perceived intrusiveness while privacy concerns are positively related to perceived intrusiveness. The entertainment value of mobile ads did not significant reduce perceived intrusiveness. Our findings in a mobile advertising context are consistent with those by Edwards [9] examining pop-up ads. Approximately 68% of the variance of perceived irritation towards mobile SMS advertising and almost 31% of the variance for avoidance behavior towards mobile SMS advertising, and 37% of variance in perceived intrusiveness can
be explained by the variables in the model.

![Diagram](image)

**Figure 2  PLS Results of Structural Model**

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Casual Path</th>
<th>Path Coefficient</th>
<th>T-Values</th>
<th>Supported*</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td>Perceived Intrusiveness -&gt; Perceived Irritation</td>
<td>0.83</td>
<td>24.77***</td>
<td>Yes</td>
</tr>
<tr>
<td>H2</td>
<td>Perceived Intrusiveness -&gt; Avoidance Behavior</td>
<td>0.44</td>
<td>5.49***</td>
<td>Yes</td>
</tr>
<tr>
<td>H3</td>
<td>Perceived Intrusiveness * Freq -&gt; Avoidance Behavior</td>
<td>0.33</td>
<td>3.81***</td>
<td>Yes</td>
</tr>
<tr>
<td>H4</td>
<td>PC -&gt; Perceived Intrusiveness</td>
<td>0.39</td>
<td>3.12***</td>
<td>Yes</td>
</tr>
<tr>
<td>H5</td>
<td>Informativeness -&gt; Perceived Intrusiveness</td>
<td>-0.26</td>
<td>2.07*</td>
<td>Yes</td>
</tr>
<tr>
<td>H6</td>
<td>Entertainment -&gt; Perceived Intrusiveness</td>
<td>-0.21</td>
<td>1.7ns</td>
<td>No</td>
</tr>
</tbody>
</table>

ns p > 0.05  * p<0.05  ** p<0.01  *** p<0.001  Hypotheses were tested at 5% level of significance.

**Discussion**

Overall, results provide insights to understand the impacts of both the consumers’ concern of their control over private information and the perceived value of push mobile advertising on perceived ad intrusiveness, as well as the impacts of perceived mobile ad intrusiveness on ad irritation and ad avoidance behavior. In line with prior research reporting consequences of perceived ad intrusiveness in other advertising medium, perceived ad intrusiveness is also the cause of ad irritation and ad avoidance in mobile advertising context. In addition, our findings reveal that the frequency of consumers’ exposure to advertising would significantly and positively reinforce the influence of perceived ad intrusiveness on ad avoidance behavior. Consumer's attention span is limited. Hence, an overwhelming amount of push advertisements would be perceived as spam and therefore result in consumers wanting to avoid the mobile ads.

Interestingly, we found that perceived entertainment value of mobile advertising would not significantly relieve the negative perception of mobile advertisement, but informativeness value could. This finding is different from prior studies and we attribute this probably to the characteristic of mobile devices because its primary function is for communication but not for recreation. Therefore, the perceived informative value of mobile advertising has a greater impact than entertainment in reducing perceived intrusiveness. Nevertheless, we need to acknowledge the possibility that since our research context is based on SMS advertising, the text-only medium might limit the entertainment value compared to perhaps multimedia messaging system (MMS) advertising.

Another significant finding is that consumers' privacy concern significantly influences their perception of mobile ad intrusiveness. Though permission has been emphasized to be a hygiene factors for push mobile advertising, this just take into account one dimension of consumer privacy, the more important part of consumer privacy is the control over the private information, as the unwanted advertisements are the direct consequences of...
This exploratory study has examined Chinese consumers’ perceptions of the determinants and outcomes of mobile advertising intrusiveness. Results highlight the importance of consumer privacy, information value, and frequency of campaign schedule as critical success factors of mobile advertising. With the ongoing technical developments in mobile communication technologies, further research into the topic of mobile advertising intrusiveness would certainly be a promising pursuit to gain deeper sites for more effective mobile advertising.

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References


IMPROVING THE ADOPTABILITY OF A MOBILE SERVICE: A CASE STUDY

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Abstract
Mobile technologies are penetrating into everyday lives of people and are providing miscellaneous services on the mobile device for users. Most of researches in this area have been done after the introduction of the service to the market. In this tough market, service providers need to know exactly which elements of their services or technologies can be improved before final stage of development and surely before launching the application or service. This article studies intentions to use a service, through a mobile application, for possible improvements in adoptability of the service. The Nysveen et al’s integrated model (2005) has been utilized for conducting the research and data was collected over a survey study. Such insights allow mobile service providers and mobile marketers to create more customized services. This paper concludes with both theoretical and practical implications and limitations of the study results.

Keywords: Service adoption, adoption model, mobile services, mobile application, mobile service usage, mobile service optimization, attitude towards the use, intention towards the use

Introduction
Wireless communication enables users and businesses to transcend time and place, and it has resulted in increased accessibility and expanded both social and business networks (Palen, 2002). Wireless communication also promises to provide a convenience, localization, and personalization of services (Clarke, 2001). Advances in mobile technology have changed the business environment significantly. Devices and technological mobile applications have become a common place in our everyday lives (Balasubramanian et al., 2002), increasing the accessibility, frequency and the speed of communication. As a result, mobile technologies have the potential to create new markets, change the competitive landscape of business, create new opportunities, and change existing community and market structures (Stewart and Pavlou, 2002). The concept of mobile services has been defined as something for which the provider can charge the mobile user for taking part in (Nordman and Liljander, 2003). The original concept of mobile service was voicing communications with mobility. Understanding market needs, users’ adoptions and knowing what services to be offered and where are the crucial dimensions to success of new service development’s success. Hence, it becomes evident to mobile service providers that they have to identify their users’ needs and tastes in order to develop the right service to the right market.

Traditional marketing methodologies are not sufficient when it comes to non existing products. Investigations in the sociology of technology are essential to evaluate if new applications are good responses to market needs and user taste or not. For widespread adoption of mobile services, a set of requirements including technological, business strategic and behavioral are to be considered (Pedersen, 2002). For researchers, an important issue is to learn how mobile services differ from stationary services in regard to users’ adoption (Pedersen et al., 2005). Considerable developments in mobile technologies and related services create new motives for users and also strong need for studies in the area of service adoption to maximize service penetration and user engagement in different markets (Balasubramanian et al., 2002, Nysveen et al., 2005).

This article investigates intention to use a new service in development stage to improve and optimize the service before delivering to the market. The service was targeted to provide free content and generate revenue through advertising. Understanding users’ attitude toward a service, using the Nysveen et al’s integrated adoption model (2005), allows us to understand user’s expectations and experiences on the tested service to optimize and customize the service to achieve the highest adoption rate. This paper is composed as follows: In the next section, there is a review of previous studies related to technology adoption models, specially the integrated model by Nysveen et al. (2005) and its application to mobile Internet usage. Then, a description of the research procedures employed and eventually a final data analyzing the data. Authors conclude that the paper by acknowledging limitations of studies, discussing the implications of the findings, and possible future research in this area.

Literature Review
There are many different models for technology adoption that were developed during the recent years. The development of these models resulted in better understanding and prediction of mobile technologies and services adoption. Applying these models to analyze the adoption of a service is very useful as it gives the chance to the service
providers to improve the service in the areas that have the highest impact on the adoption.

The first studies on this topic, were carried out by Schultz and Slevin (1975). Their analysis resulted to seven explanatory dimensions, of which the performance dimension, “perceived effect of the model on the manager’s job performance”, was found to be the most highly correlated with the self-predicted use of a decision model. Further studies revealed that several specific user attitudes or perceptions are highly related to system use (Robey, 1979). According to Robey’s model, “user perceptions or attitudes are formed concerning the value of rewards received from performance, the likelihood that rewards result from performance, and the likelihood that performance results from the use”. Fishbein’s multi-attribute model (Ajzen and Fishbein, 1980) is supported by behavioral learning theory (Kassarjian and Robertson, 1991) which says “an attitude toward an object is more or less automatically learned as one learns about a new product, and that learning occurs in the form of beliefs about product attributes”.

Theory of reasoned action, TRA, (Fishbein and Ajzen, 1975) was proposed to clarify the relationship between attitudes and behavior. In other words, it is used to predict user’s behavior with the assumption that the customer controls his own behavior. According to TRA, the “intention to perform a behavior” is the most significant determinant of user actual behavior. It is a function of “attitude towards behavior” and “subjective norms”. To include the impact of external sources of influence on “intention” and “attitude” the theory of planned behavior (TPB) was proposed by Ajzen (1991). This model has been proven to be useful for conditions where individuals do not have complete control over their behavior (Taylor and Todd, 1995). A third determinant of “behavioral intention”, “perceived behavioral control” was included in TPB.

Technology Acceptance Model, TAM, (Davis 1989) was designed to predict user’s acceptance of information technology. In TAM, Davis (1989) defined perceived usefulness as the degree to which a person believes that using a particular system would be advantageous in performing his or her task. TAM is applied for predicting user acceptance (Venkatesh and Davis, 2000), and it has become the most applicable model of user acceptance and usage (Ma and Liu, 2004). This model illustrates that, users, who find mobile technology useful and easy to use, are users with more positive attitudes towards mobile services. In addition to the researches that have been conducted on the subject of technology adoption, there have been some studies that have focused specifically on the concept of mobile services and mobile technologies adoption (Vatanparast 2009).

Based on domestication studies, “expressiveness” is another effective driver for intention to use mobile technology and services. The definition of Nysveen et al (2005) for expressiveness is: “the degree to which users of mobile services perceives the services as suitable for expressing their emotions and social and or personal identity”. Finally, Nysveen et al (2005) proposed an integrated model based on information system theories, gratification and domestic theories that can be utilized to explain user intentions to use mobile services (Figure 1). Nysveen et al. (2005) claimed that; perceived expressiveness and perceived enjoyment show the most promising and considerable effect; perceived usefulness, perceived ease of use and attitude toward the use are direct or indirect determinants of mobile service’s usage and finally subjective norms and perceived control are important antecedents of users’ intentions to use mobile services as it has been proven. The technological development along with high penetration of mobile phones has created a whole research area of adoption around mobile services and mobile marketing (Vatanparast 2009). Nysveen et al (2005) could explain user intentions to use mobile services, by constructing the integrated model. Pedersen (2002 and 2005) found that the intention to use is influenced by perceived expressiveness, enjoyment, subjective norm and behavioral control. Nysveen et al (2005) confirmed that perceived usefulness and attitude toward the use are direct or indirect determinants of mobile services’ usage. Li et al. (2005) suggested that enjoyment shows a significant effect on intention to use instant messaging and will increase when the multimedia communication and entertainment are getting richer e.g. moving from SMS to MMS (Hsu et al., 2007). Nysveen’s integrated model has been designed around mobile services, and it has been tested successfully in many research studies, as mentioned above. Based on literature review, we decided to use Nysveen’s integrated model in our research study to understand the user’s attitude toward use and intention to use of our application based mobile service to optimize the service before launch of service.
Research Method

As it was discussed in the literature review, the Nysveen et al.’s integrated model is a very suitable model for the case study, as it provides better a prediction of users’ attitudes towards usage of mobile services. Therefore, the integrated model was utilized in this research study to comprehend the attitudes toward uses and intentions to use of a mobile service which was under development by a telecommunication company. It was initially intended to have a larger number of participants in public, but due to confidentiality of the service, legal and liability issues, there was no permission to run the trial version in public. As the result, it was limited to the company’s internal participants to run this trial of service and to do this research. The participants in this study did not have any experience or knowledge about this service and its focus prior to their usages. User recruiting was done through an Email marketing campaign which was targeted to approximately three hundred employees. It was asked from voluntary participants to go to a particular website to register and download a client application, and start using the service during a trial period of four weeks. Hundred thirty five users registered to download the application and among those seventy seven successfully downloaded the application and activated their service. Eighty six percent of users were recruited by the end of the first week. After the period of trial, they were asked to fill in the research questionnaire which was designed around the integrated model. The questionnaire was in English and was sent to the participants via email. In order to measure the real sense of the consumers in each user in the integrated model, the five point Likert System scale in which the data were in an ordinal format was used. Ordinal format indicates the data of each category with a specific quantity as an index of that category.

The Kendal Tau correlation was found more suitable as it represents a probability for a non-interval scaled ordinal format (Bolboaca and Jantschi, 2006). It should be noted that there were a couple of questions for each construct. Kendal Tau method is utilized to do a correlation analysis in our case, as the data were in a non-interval scaled format. By applying Kendal Tau method, the coefficients of the correlations became less and the differences became more sensible. Before applying Kendal Tau method, we have applied rank based approach in which we transferred the data into ranks, which are invariant and the mathematical operations on them are construable (Madden, 2004). Kendal Tau correlation was applied on the averages of the ranks of each construct according to the integrated model. This approach is much more suitable for studies with a limited number of data, rather than using Spearman or Pearson approach. Since our research model is greatly based on the Nysveen et al.’s (2005) model, we used the same measures as they used in their study for measuring perceived usefulness, ease of use, expressiveness, enjoyment, subjective norms, behavioral control and intention to use. We adapted the measures for the particular mobile service relevant for our own study.

Data analysis

A data reduction factor analysis was conducted to determine the existence of subcategories among the questions included in each of the constructs. The results of each factor analysis conducted on the
data are gathered for each construct in the Table 1. Factor analysis determines whether there is any sub-categories in any set of questions under one category or not. All questions loaded strongly together except question 23 for behavioral control and question 21 for attitude toward the use. The Eigen values are computed and all values were over 1, which is the significance in the model (Hair et al., 1998). The results revealed that in all the constructs, we have only one component. This means that all the questions were in the same category in all the constructs. Therefore, we could calculate the average of ranks in every construct for each person. The results helped us to provide one set of data for each construct that could be easily correlated with other constructs based on the integrated model. Table 1 shows the result of data reduction analysis.

<table>
<thead>
<tr>
<th>Questions</th>
<th>Usefulness</th>
<th>Ease of Use</th>
<th>Expressiveness</th>
<th>Enjoyment</th>
<th>Subjective Norms</th>
<th>Behavioral Control</th>
<th>Attitude</th>
<th>Intention</th>
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<td>2.6</td>
<td>5.3</td>
<td>4.1</td>
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</table>

Table 2 shows some descriptive data for the variables used in this study. The table shows the minimum, maximum and the median for all variables. Minimum and maximum values show that all the variables are consistently within the points on the scale. Correlation analysis was conducted based on the integrated model, in order to determine the most effective construct on the users’ attitudes and intention to use the service. Having transferred the data into rank orders, the Kendal Tau correlation was applied (Table 3). According to Hair et al (1998), when a single independent variable is highly correlated with the set of other independent variables, multicollinearity occurs. Multicollinearity represents the degree to which one variable can be predicted by the other variables in the analysis. Hair et al (1998) suggest that calculating tolerance and VIF values are good measures for testing multicollinearity. Table 4 shows collinearity statistics for the dataset. Either tolerance or VIF values in our data are within the accepted values according to Hair et al (1998). Tolerance value should lay somewhere between 0 to 1 and, VIF values should vary between 1 to 10 but should not exceed 10, and the closer to 1 the better. High multicollinearity contributes negatively to the interpretation of the result as it makes it difficult to ascertain the effects of a single variable. This indicates that the data do not suffer any collinearity problems.

<table>
<thead>
<tr>
<th>Questions</th>
<th>Minimum</th>
<th>Median</th>
<th>Maximum</th>
</tr>
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<td>Usefulness</td>
<td>6.2</td>
<td>13.8</td>
<td>34.8</td>
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<tr>
<td>Ease of Use</td>
<td>8.43</td>
<td>14.29</td>
<td>29</td>
</tr>
</tbody>
</table>
Expressiveness | 7.75 | 15.5 | 25.25
Enjoyment | 6 | 14.8 | 34.8
Subjective Norms | 6 | 13.5 | 32.5
Behavioral Control | 6.67 | 12.67 | 32.67
Attitude | 6 | 15.67 | 35.67
intention | 6 | 15.33 | 34

Table 3- Kendal tau correlation coefficients

<table>
<thead>
<tr>
<th></th>
<th>Attitude</th>
<th>Intention</th>
</tr>
</thead>
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<tr>
<td>Perceived Usefulness</td>
<td>.673*</td>
<td>.667*</td>
</tr>
<tr>
<td>Perceived Ease of use</td>
<td>.622*</td>
<td>.573*</td>
</tr>
<tr>
<td>Perceived Expressiveness</td>
<td>.628*</td>
<td>.615*</td>
</tr>
<tr>
<td>Perceived Enjoyment</td>
<td>.634*</td>
<td>.656*</td>
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<tr>
<td>Subjective norms</td>
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<td>.505*</td>
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<tr>
<td>Behavioral control</td>
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<td>.579*</td>
</tr>
<tr>
<td>Attitude</td>
<td></td>
<td>.779*</td>
</tr>
</tbody>
</table>

* Correlation is significant at the 0.01 level (2-tailed).

Table 4 – Measures testing the impact of multicollinearity, Tolerance and VIF values for the dataset

<table>
<thead>
<tr>
<th>Model</th>
<th>Collinearity Statistics for the dataset</th>
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</thead>
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<tr>
<td>Ease of use</td>
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<td>Expressiveness</td>
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<tr>
<td>Enjoyment</td>
<td>.192</td>
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<tr>
<td>Usefulness</td>
<td>.221</td>
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<tr>
<td>Ease of use</td>
<td>.213</td>
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<tr>
<td>Expressiveness</td>
<td>.233</td>
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<tr>
<td>Enjoyment</td>
<td>.152</td>
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<tr>
<td>Subjective norms</td>
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<tr>
<td>Behavioral control</td>
<td>.375</td>
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<tr>
<td>Attitude</td>
<td>.242</td>
</tr>
</tbody>
</table>

Results

The summary of the results of correlation analysis is schematically shown in Figure 2. The result shows that the service is high in perceived usefulness and then in perceived enjoyment, which means that users believe in the existence of a positive use-performance relationship. Davis (1989) supports that; the perceived usefulness is a direct determinant of the users’ intentions to use a technology. The justification behind is that if the service will improve a person’s daily life performance, then it will be considered as useful. Thus a person will have a higher incentive to use the service. Doll et al. (1998) define that; systems will be useful in general if they “contribute to accomplish the end-user’s purpose”. The result shows that, the information intensive service, which was provided during the trial, led to a positive usage intention. The service helped users to accomplish certain tasks, get useful information and gain positive value and satisfaction.

The result shows that, perceived expressiveness was unexpectedly considerable for the tested mobile service which is information intensive. It is uncharacteristic, to see this significance, since it was predicted that expressiveness would not have strong effect on the adoption of mobile services. As a result, expressive services are experiential services. We can assume that since the service is experiential and expressive services are also experiential, there is a connection between the service and expressiveness. This reasoning could explain the significant effect on the relationship between perceived expressiveness and intention to use the mobile services. Other studies highlighted that; the use of mobile services can serve as a way of expressing personality, status and image in a public context (Nysveen et al., 2005; Leung and Wei, 2000; and Höflich and Rossler, 2001). In other hands, higher perceived expressiveness may contribute to higher probability of using the mobile service. This confirms the direct link between expressiveness and intention to use of mobile service, which was also supported by a fair amount of domestication researches done by other scholars (e.g. Ling, 2001; Skog, 2002).
When it comes to perceived enjoyment, it is understandable that this variable is significant with low information intensive services. The original intention of the service was built around delivering free content and information. High information intensive services are meant to collect or to process big amount of information and content, not for fun and relaxation originally. However, it seems that users, value enjoy-ability and looking for fun and relaxing time while consuming information and content. In other words, from user’s view, the service is used not only for receiving information but also for enjoyment. In their gratification studies, Höflich and Rössler (2001) indicate, that among others, enjoyment is a significant factor influencing intention to use mobile services. As we delivered a set of quizzes with prizes during the trial period, promoting usage of the service, the mobile service led to an intrinsic reward, which enhanced enjoyment. This surely brings a higher probability for users to use this service. Perceived enjoyment was proven to be an important antecedent of usage intentions and had a significant effect on all services that had been studied regardless of being information intensive or not, such as SMS, contact services, payment services and gaming services (Nysveen et al., 2003).

The perceived behavioral control was not that significant in this study in comparison to other ascendances, but it shows a positive direct effect due to high information intensive characteristics of the service. Nysveen et al. (2005) and Sendecka (2006) explain that the positive effect of behavioral control on intention to use mobile services will be stronger for services with a high degree of information intensity comparing other services with a low degree of information intensity. The more information one has, the more confident he or she becomes about the behavior. This in turn, increases the intention to use the mobile service. The user interface design of a service can affect information access, collection and processing of a user. This means that even though, the service is information intensive, but the user interface can facilitate handling of the information and make it easy to consume content. As a result we can see that, some services could be information intensive but having a positive effect on intention to use, due to easy to use user interface. Since manipulation of a goal oriented services requires high levels of behavior control, we expect that managing of highly information intensive services will also require high levels of behavioral control.

To summarize, the results of correlation analysis reveal that, there exists a high positive relation between the constructs of the model and also all the correlations were significant (at 0.01 level). There is a high positive correlation between attitude and intention to use. Attitude has the highest impact on the intention of the users towards the use comparing to other constructs. Usefulness and enjoyment have higher coefficients of correlation with attitude. Usefulness has a higher positive correlation with the intention to use comparing to the other three constructs. Ease of use, on the other hand, has the least impact on the attitude of the users towards the use.

**Conclusion and Discussions**

The scale to measure the variables in this study was highly reliable, based on the results of factor analysis. All factors analysed in this paper showed that, every variable or concept was measured properly. It was shown that, measure for each variable fitted properly, as each of them loaded strongly and well to the respective factors proves
Hair et al. (1998) explain that a successful target of delivering free content to mobile users. This paper introduces a new approach to utilize adoption models in the future studies. The results from this paper offer several managerial implications when developing services and increasing users to use mobile services. The result of the overall regression shows the importance and the advantages of adoption study of mobile services during the period of development to impact final design of a mobile service. The finding implies that industry players must be aware of drivers’ effects on attitude toward use and intention to use when developing services. It will be important for mobile service developers to pay attention to fun, excitement and expressiveness, especially when developing high information intensive services. High information intensive services also have to be designed to enable their users to express their social and personal identities. It can surely be challenging for service producers to combine information, usefulness, enjoyment and expressiveness factors in one service. However, it shows that mobile service industry is willing to take on any challenges to enable mass adoption. There are some factors that could have led to some weaknesses in this paper. Small quantity of the data does affect the integrity of data analysis. On the other hand, the sample was not representative of the population, due to confidentiality and legal issues. Basically, the sample used in this study, only consisted of people who were working for the same company which was developing the service, consisting highly educated and technology savvy respondents. This had its advantage in the fact that participants have enough experience and knowledge of using different mobile services, no need to educate participants and collect the result very quickly. At the end, authors conclude importance of utilizing adoption models to determine the constructs that have the highest impact on the user’s attitude and intention towards usage of mobile service in an early stage of service development. This kind of knowledge in the development stages of the service preparation allows additional optimization to maximize adoption. By utilizing this approach the service providers will be able to tune the elements of a particular service and improve and utilize the areas that have the highest impact on the adoption of the service.

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Improving The Adoptability Of A Mobile Service: a Case Study


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http://shop.informatmm.com/marin/300000001001/MARKT_EFFORT/marketingid/200014444760?process=trueanDMarEntityId=1167456884244andentHa sh=1002311bd757andUType=trueAccessJan2007,


[38] Sendecka (2006). Adoption of mobile services Moderating effects of service’s information intensity, MBA program thesis at Norges Handelshøyskole university


The rapid transformation of the wireless industry, the factors driving user behavior and satisfaction are changing. This paper presents MobiTrack, a framework to measure user experience at the point of convergence – devices. The paper compares the MobiTrack framework to alternative methods to measure user experience, and shows the unique advantages of on-device measurements in building a comprehensive view on user experience. Along with data collection, the paper addresses the approaches for analytics, in showing how the presented framework provides value to device vendors and carriers through holistic user research, utilizing adoption models, and stickiness analysis, to complement the data collected from the introduced mobile audience measurement platform.

Introduction

The mobile industry is amidst a transformation, as new players like Apple and Google are expanding to the wireless space, with old giants like Nokia and RIM fiercely defending themselves through new releases of devices, platforms and services, and a number of other players, including carriers, advertisers, application developers and content providers, are assessing their future role in the wireless industry. The competition is shifting towards applications, services, and usability, instead of mere hardware (networks and devices), and the players successful in these dimensions are likely to be strong in the battle for user attention and face time. Smartphone sales are ramping up quickly, with estimated 300 million smartphones device to be sold annually by 2013 [1]. Smartphones not only enable new applications and services, but they are also in the heart of customers’ digital lives, being ubiquitous, personal mini computers.

In this transformation, the key players of the industry are likely put more focus on user data and insights. Who are likely to adopt my application? How do user interfaces and keypad affect stickiness to value-added applications? When and where should location-based advertisements be delivered, and to whom? How are the investments in networks actually correlating with perceived use, and satisfaction, among users? Are users satisfied with my services, and if not, why? Who are customers likely to change for a competing device or subscription in the short-term future, and how to prevent this from happening? How is pricing affecting the use of the mobile Internet? Who are the people interested in using, and willing to pay for my new application offering? How to increase adoption of services through the elimination of bottlenecks? These are some exemplary questions that are of importance to mobile businesses across the globe today. One thing is for sure, new kinds of data on user behavior is needed in solving these problems.

The research on the use of mobile services and applications has been a growing business since the 90s. The typical ways to understand customer behavior include different kinds of interviews and surveys, laboratory tests, and analysis of operator CRM databases or charging records (CDRs). Different kinds of traffic measurements [9] and header data analyses represent as more technical measurements of specifically mobile Internet usage [6]. However, these methods and data points do not provide a complete, real view on the details of customer behavior, and are not typically collected from real environments, with also context being tracked. Neither do these research methods always include both subjective (questionnaire) and objective (behavioral) data collected simultaneously. The research problem of this paper is: “How to collect comprehensive data on the usage of mobile devices and applications, and use advanced analytics in measuring user experience and extracting actionable insights for the purposes of carrier and device vendor revenue improvement?”

The paper introduces and evaluates MobiTrack, a new framework to conduct user experience research in the wireless industry. This approach, and related technologies, is developed by MobiTrack Innovations Ltd., which is working closely with leading carriers and device vendors in modeling user behavior in real-life environments. The MobiTrack approach is based on the utilization of different types of data collected from real lives of people, using on-device meters in customer
panels, and deploying advanced analytics in converting data into actionable insights. There is some earlier research on the use of device-based behavioral data in the mobile industry, in academia [12], [13], [14], [15], [5], but no complete end-to-end approaches, including data collection, mining and reporting, have been introduced so far commercially. Terminals have been used earlier in collecting behavioral data, for example, on TV or Internet usage. The research is typically conducted with specialized technologies or software applications that are embedded into terminals. For example Nielsen and ComScore have been monitoring TV [10] and web [17] usage for years in coordinated panel studies. This paper evaluates the power of on-device meters in helping the mobile industry to better understand its massive audience, reaching to billions of potential users globally in the future.

In the empirical part of the paper, exemplary ways to use customized analytics in converting the collected MobiTrack data into actionable and valuable insights for the key players of the wireless industry are introduced. The dataset is collected during 2009 in MobiTrack Global Smartphone Study, involving users of Windows Mobile, Android, Symbian S60, Blackberry devices all around the world.

Background

Traditional research methods

Questionnaire surveys are one of the most widely used ways of studying service usage. Different kinds of questionnaires are applied, from single answer to multiple answer ones, and from fixed answer to open-ended answer ones. In the past, questionnaires were printed on paper and distributed via mail or presented on special occasions (such as in events where many members of the target group were present at the same time, for example academic conferences or class-room events). Nowadays electronic means of deploying questionnaire studies are increasingly used. Particularly Internet technologies provide new ways of implementing questionnaire studies. Web-based questionnaires provide a possibility to quickly reach a wide selection of end-users, and through electronic means the analysis of questionnaire results is quick. Questionnaires are a flexible method to end-users, who fill in the questionnaire when they have the best occasion to do so. Questionnaires can include many kinds of questions. Open-ended questions allow respondents to express their real opinions on the topic. Fixed pre-specified answers on the other hand are quicker to fill in. The cost per respondent is low in questionnaires. On the other hand, questionnaires are highly subjective. End-users do not always know the answer, and they might give false answers either intentionally or unintentionally. The interpretations of both questions and answers pose challenges, too [8]. Questionnaire structures are typically fixed beforehand, providing less flexibility in study deployment. On the other hand, questionnaires are cheap to deploy.

Interviews are an interactive method of end-user research, where an interviewer asks questions directly from respondents. The interviewers can guide the discussion based on their own research interests. This is both a challenge and an advantage. The discussion should not be guided too much, because that would spoil true interactivity. On the other hand, if the discussion goes off in a wrong direction, the time is running out or if the answers are incomplete (more details are needed to interpret them correctly), then the interviewer has a possibility to control the discussion and get it back on track. By using communication skills in capturing emotional hints, interviewees can also capture spontaneous feedback, as experimented in the interviews of this study. Interviews are in several cases valuable because of the interaction involved. Complicated research problems can be solved by asking both structured and unstructured questions from end-users. The setback of interviews is the expense in carrying them out. Doing interviews is slow, and the interviewer has to invest time in both preparing and executing the interviews. No economies of scale exist and extensive interview studies are either expensive or logistically impossible to carry out. Interviews, just as questionnaires, also face the problem of subjectivity (after all, the collected data represent people’s perceptions, it is not hard data). Traditional interviews are at their best in studies which require detailed and open-ended answers to a specific set of questions.

Laboratory and road tests refer to pre-planned tests taking place in a fixed context (such as in a laboratory). Road tests are different from laboratory tests in that they take place in more natural contexts, in places where also actual use cases happen. Both laboratory and road tests follow the same principles. Services are provided to end-users in controlled environments, and during the experiment observations are made regarding end-user Behaviour. In some tests questions are also asked from end-users to complement usage-level observations. Laboratory and road tests...
require effort in setting up the test environment. A context for testing has to be arranged, services and devices have to be prepared for testing, observation processes have to be planned and end-users have to be recruited. Laboratory tests best suit for specific research needs in which both actual usage-level observations and end-user opinions are needed. Usability designers typically use laboratory tests.

**Traffic measurements** take place at network gateways. Examples from the academic community include among others [9], [16] and [4]. Typically packet data traces are collected at network gateways. A point of convergence should be found, because at these points a maximum coverage (e.g. maximum number of data flows) can be metered. In traffic trace measurements individual packets (their header information) are studied and classification schemes are used in modeling data flows (e.g. distinguishing between different protocols, source devices or operating systems). Sometimes the analysis is easy (e.g. based on TCP port numbers), but in many cases different kinds of “TCP finger printing” methods are used in categorizing the traffic by operating systems [4]. Traffic trace measurements provide a scalable and computerized method for studying packet data service usage. This restricts the method only to packet data studies (mobile Internet), but, on the other hand, the amount of data to be studied is often extensive. At best traffic trace measurements provide an extensive amount of data on many interesting factors, and particularly the scalability and potential for automation is high.

By doing **measurements at servers**, specific data points can be collected that reflect the server’s functionality in the network. For example, from web-servers the specific types of documents and sub-sites that users retrieve can be observed. As with traffic measurements, server-side measurement processes can be computerized, and given that a server is heavily loaded, lots of accurate data can be captured. The setback is that an access to the server should be first achieved, and additionally potential legal problems (with regards to user privacy, for example) should be solved in advance. At best server-side measurements provide complete data on specific applications. Examples of what server-side measurements include can be found in [2] and [3].

**Charging records (CDRs).** to the extent collected by carriers, provide a centralized database on user behavior. Services that utilize the operator’s infrastructure can be charged for by the operator. These services include such things as voice calls, SMS messaging, packet data traffic, MMS messages, downloadable ring tones and wallpapers. If charging records are available for research purposes, they can be utilized in analyzing service usage in several dimensions. Also the analysis of charging records can be computerized (see e.g. [11]).

**MobiTrack Innovations**

The research methods presented above have their own strengths, but also weaknesses. Some of the methods are based on subjective data, like interviews and surveys, and they provide little details on actual usage. On the other hand, most computerized methods rely on CDRs or Internet traffic measurements, which provide a restricted view (only at a certain gateway point, and with limited details e.g. on protocols and applications) on mobile consumption at best, given that the measurements can be done at all due to technical challenges. The ultimate way to measure actual user behavior on a very detailed level, and in collecting contextual feedback from real lives of people, is to use device-based tools in audience measurements.

Devices have been used also earlier in collecting behavioral data, for example, on TV consumption. The research is typically conducted with specialized technologies or software applications that are embedded into terminals. For example Nielsen and ComScore have been monitoring TV [10] and web [17] usage for years in coordinated panel studies. According to [7], panel studies of this kind, also called audience measurements, have certain challenges, mainly attrition bias (loss of panel participants over time), panel selection bias (people in the panel are different from the population to be studied), and conditioning effects (the implementation of the panel affects the behavior of panel participants). Audience measurements in TV, web and radio domains provide insights about real-life consumption, and these panel studies can be of either dynamic (new panelists replace old ones gradually) or static (the panelists stay the same) nature. Audience measurements in mobile phones are still an unexplored territory in the research world, and the research process defined below proposes an approach to do audience measurements with smartphones.

MobiTrack Innovations Ltd. has been developing technologies and analytics approaches since 2002 in the field of mobile audience measurements. The group has submitted several patent applications regarding the optimal way of collecting data from...
smartphone devices, and applying customized analytics in processing the collected data. MobiTrack Innovations Ltd. is working closely with global leaders of the telecom industry throughout the world, including device vendors, carriers, service and content providers, Internet companies, and advertisers, in modeling user experience with panels involving on-device meters. The company also runs its own global smartphone study, some of the results of which are published in this paper.

MobiTrack framework

Figure 1 illustrates the MobiTrack approach. The framework is structured around three kinds of data:

1. **Behavioral measurements**, consisting of on-device measurements on communication (voice, SMS, MMS, email, instant messaging), application (personal information management, productivity, maps and navigation, games etc.), mobile Internet (web browsing, streaming, downloads), device feature (camera, calendar, USB, Bluetooth, WiFi), and multimedia usage (music, imaging, video), complemented with technical measurements such as location and time of usage, battery status, and network parameters, among others.

2. **Contextual surveys**, involving on-device questionnaires on user perceptions and satisfaction, that can be triggered by location, time, activities (e.g. application usage) or transactions (e.g. an incoming SMS).

3. **Web surveys**, that are deployed online, and used typically to collect comprehensive subjective data on user needs, demographics, and other relevant background factors.

The research is typically conducted in the form of audience measurement panels (see Figure 2 for an exemplary study timeline), meaning that people from the target population are invited to the study, with incentives like an annual compensation plan (cash), free vouchers, or participation in a lottery of smartphones, attracting people to sign up. People register for the study on a web site, on which the generic guidelines of the study are presented, including statements on the motivation and objectives for the whole study, lists of collected data points, and terms for the collection and handling of data. When people sign up for the study, they agree on the terms, and opt in. After filling in their demographics and other important information, panelists download and install the MobiTrack research application into their smartphones.

The on-device meters are included in a MobiTrack research application that can be installed to all of the leading smartphone platforms of today. The application, after being installed to the device, works automatically on the background of the phone. It does not significantly affect battery lifetime, neither does it affect other use of the smartphone (it does not slow down the device, or intervene with the use of other applications). The meters are collecting all kinds of relevant information on device and service usage, together with contextual data and technical measurements. Some of the data points collected include:

- Communication usage (voice, SMS, MMS, instant messaging, email, VoIP)
- Multimedia consumption (camera, music, gallery, video, mobile TV, streaming)
- App store and add-on application usage (installations and use)
- Mobile Internet traffic (web browsing usage, data service usage)
- Mobile advertising and use of carrier-specific services
- Device features (downloads, file storage, calendar, phonebook, profiles)
- Maps and navigation (applications, GPS)
- Location and time of activities
- Network parameters (used protocols, signal strengths, throughput rates etc.)
- Network access methods (including e.g. WiFi, 3G, GRPS)

The collected data is first locally stored into the devices, and periodically synchronized to servers. When terminating a panel study, participants are simply asked to remove the research application. All the collected data is anonymous, and survey...
and behavioral data are only linked together for the purposes of correlations and cross-tabulations. During the panel studies, several on-device contextual or online questionnaires can be implemented, in dynamically obtaining more information from users. For example, based on behavioral measurements it can be identified that there is a group of people who have indicated they are interested in mobile email, but in practice they however do not use mobile email at all. A customized survey can be sent to these people’s mobile phones about possible reasons of not using mobile email.

Figure 2 – Mobile audience measurement panel

After data collection, it is being processed and analyzed. Due to the special nature of collected data points, customized approaches to pre-process them are needed. The analysis itself consists of various processes, and there are various approaches to visualize and correlate the data, effectively combining both behavioral (on-device meters) and subjective (surveys) data. Some exemplary analysis approaches are presented below. Typically the key findings of the study are published as research reports, with benchmarking to reference datasets being combined to put the obtained results into a perspective. There is also a web-based dashboard tool available to access and plot the key data points, to conduct correlations, and to export the data into spreadsheets or PowerPoint figures (see Figure 3) through a SaaS (software-as-a-service) concept.

Figure 3 – MobiTrack process

MobiTrack analytics

In addition to data collection, the analysis of the collected data is one of the key parts of the solution provided by MobiTrack Innovations. The analytics approaches answer specific problems posed by industry players, each approach deep-diving into a certain dimension. In holistic views of device usage, for example, universal activity metrics on application usage are cross-tabulated over device types or subscriber segments, to gain insights on the actual use of devices. On the other hand, for example adoption models deep-dive into the balance between potential and actual usage, comparing user needs with actual usage as measured with on-device meters. The purpose of analytics is to transform the collected raw data into information (concrete KPIs), and further into insights (that have relevance to industry players) and advice (actionable recommendations that suggest how to improve revenues based on the insights).

Figure 4 – From raw data to insights

This section provides some examples of the different analytics as provided in the MobiTrack framework.

Research context

The data for this paper is collected from MobiTrack’s Global Smartphone Study during 2008-2009. This study is an initiative to collect important benchmarking data, and to analyze emerging trends in mobile consumption. The panel is being operated and maintained by MobiTrack Innovations Ltd., and reaches across the globe including panelists from North-America, Europe, and selected markets of Asia (China, Japan, Hong Kong, Singapore).

The panelists are using all kinds of smartphones, including Symbian S60, Windows Mobile, Google Android and Blackberry devices. The panelists are compensated with free participation in lotteries (e.g. vouchers and smartphones), panelists additionally gain a restricted access to their own usage data, an online, rich phone bill. 67% of participants are
male, and 33% female, with 56% of participants being younger than 30 years. 86% of participants pay their phone bills themselves, being therefore consumer subscribers. This dataset is not completely representative in the sense of demographic distributions or level of advancement in smartphone usage, mainly due to the used recruitment methods and incentives. Nevertheless, the results showcase the unique value of the approach.

For this study, selected panelists from this panel population are included in the analysis, demonstrating the capabilities of the approach.

**Analysis**

**Holistic view on smartphone usage**

MobiTrack provides a holistic view on usage, facilitating several usage activity measures that can be calculated for particular features or applications, and averaged for any user, or groups of users:

- Average number of usage sessions per unit of time (e.g. sessions/week)
- Average number of transactions per unit of time (e.g. messages/month)
- Average number of face time minutes per unit of time (e.g. minutes/day)
- Average frequency of usage (e.g. distinct usage days per month)

In understanding the overall usage of today’s smartphones, average application specific face time measures for each users are aggregated together in Figure 5, giving a high-level view on the ways people spend time with devices. In general, messaging (21% of all direct face time spent with smartphones) and voice (34%), only represent together a total of 55% of all smartphone usage. Internet browsing (14%) and multimedia (15%) are clearly emerging as competing categories of applications to voice and messaging, both communication functions. In categorizing browsers, the de-facto device browsers (S60 browser, Blackberry browser, Internet Explorer, Android browser) represent 75% of browsing face time, the rest divided between Opera (12%) and Opera Mini (13%). This can be partially explained by the fact that certain Windows Mobile and S60 devices include Opera browsers preinstalled. In messaging, SMS (short messaging service) and email represent a total of 96% of messaging usage, MMS (multimedia messaging services) and IM (instant messaging) being used very little. Music, camera and gallery (viewing of photos) are the key multimedia functions.

![Figure 5 – Aggregate face time over smartphone applications](image)

In Figure 6 the most important application categories are plotted over the number of weekly users (x-axis) and average usage frequency (average distinct usage days per month, y-axis). No surprise, voice and SMS are used by almost everybody, and average usage frequency is very high – these services are in daily use. Also Internet browsing and calendar are in fairly frequent usage among those who use them. However, Internet browsing attracts about 30% more users than calendar. Multimedia functions and map applications face rather low usage frequencies; they are not used on a daily basis. App stores are on average not accessed very frequently, but music stores and email services on average are used every second day, though their penetration is lower than 35%.

Application stores are interesting, as most global players have taken steps to launch their own stores during 2009. At the time of this research, only RIM, Google and Nokia had their app store up and running, and 22%, 72%, 35% of users, respectively, accessed them on a weekly basis. The top installed applications through app stores are:

1. Adobe Reader
2. Navicore
3. Anti-Virus
4. Quickoffice
5. Opera Mini
6. Opera
7. Google Mail
8. Google Maps
9. Google Latitude
10. Nokia WidSets
Figure 6 – Ranking of device functionalities

In Figure 7, adoption of key smartphone functions are compared across device platforms. All in all, 65% of Nokia S60 users used Internet browsers on a weekly basis, whereas only 55% of Windows Mobile users, and 34% of Blackberry users did the same. The same patterns (S60 devices being used more actively than Windows Mobile and Blackberry) hold for music and video playback, MMS, and map applications, too. Interestingly, in instant messaging and MMS the differences are not that significant, and expectedly in email usage Blackberry tops the rankings with 56% of Blackberry users using mobile email on a weekly basis. In general, Nokia S60 devices still outperform in the use of many advanced functions, when comparing the older, established device platforms.

Figure 7 – Comparison of device platforms vs. application adoption

In Figure 8, all the device platforms are compared against each other in overall face time distribution. It is evident that while Symbian S60 is strong in multimedia, Google Android is pushing the usage of the mobile Internet (25% of Google Android face time goes on mobile browsing), and Blackberry users spend more time on messaging (SMS, email) than on voice calls. These statistics not only reflect the characteristics of different devices, but they also tell about the users of devices to some extent. For example, many Blackberry users are still from the domain of corporate users.

Figure 8 – Distribution of face time across device platforms

Based on the holistic analysis of smartphone usage, many kinds of topics can be assessed, including ranking of device functions and applications in usage activity (e.g. face time) or reach (e.g. penetration), contextual analysis of usage (see Appendix A), correlation between different services, high vs. low vs. non-user analysis, data service analysis (studying the average amount of data generated), trend analysis, user segmentation etc. Because of the vast amount of data that can be collected from the point of convergence, the possible dimensions for analytics are numerous, and the view on user behavior is complete, instead of partial.

Adoption analysis

In addition to providing high-level views on device usage, the MobiTrack research methodology allows for all kinds of deeper, more specific analysis angles. In this paper, three more specific types of analytics approaches are demonstrated. In particular, adoption, stickiness and satisfaction measurements are discussed.

First, adoption analysis dives deeper into the differences between potential usage (intentions and interest to use applications) and actual usage (as measured with on-device meters). High-level analyses, as presented above, certainly give insights on the overall user base of different applications and device functions, but a more actionable metric are adoption rates, that effectively compare the real user base to the potential one (that could be achieved).
In Figure 9 the key findings of the adoption analysis are presented. The x-axis reflects the level of interest, in other words the proportion of panelists who indicated (in surveys) that they are interested in using the specific applications. The y-axis reflects the proportion of panelists who actually used the applications on a weekly (recurring) basis. By reading the matrix over the x-axis, out of the included newer mobile services, Internet browsing, email, map applications, music and video, have reasonable interest from the user base. In contrast, few users are interested in gaming, instant messaging, MMS or Internet calls at this point of time.

The value of the adoption analysis is in correlating interest with actual usage. By including the y-axis in the analysis, the adoption barriers are easy to identify. In the figure above, for example, it is easy to see that email and Internet browsing have almost an equal base of participants interested in using, and therefore a valid hypothesis could be that they have an approximately same number of users. However, based on this analysis it is evident that only 31% use mobile email actively, whereas 77% are using Internet browsing on a weekly basis. Therefore mobile email significantly fails in terms of relative adoption, when comparing to Internet browsing. From the matrix it can also be identified that video playback and map applications have relatively low adoption rates.

Adoption analysis gives insights on the biggest opportunities to improve usage activity and revenues, by identifying application categories with high interest from users, but low current usage. MobiTrack tools, including a set of contextual questionnaires (in mobile phones) or web surveys, also help in finding out the key bottlenecks that are the cause of adoption problems.

**Stickiness analysis**

Whereas adoption analysis compares actual usage with potential usage, stickiness analysis gives insights on the gaps between trial and active usage. That is, even though many people might give a try to different applications, the stickiness analysis measures on a relative basis how many of these users continue using the application in a sustainable manner, in a recurring fashion.

Figure 10 below plots different applications and device functions in user rate (proportion of panelists who used the application; x-axis) and stickiness rate (y-axis). The stickiness rate measures the relative difference between trial and active user domains. If the stickiness rate is high, it means that most people, who try out the application, also keep on using it actively. If the stickiness is low, it means that a relatively low number of people who have tried the application, continue using it.

In the exemplary analysis below it is evident that map applications, calculator, MMS, music, gallery and camera have very low stickiness, whereas voice and SMS, web browsing, calendar, phonebook and call register have high stickiness. The matrix also visualizes that MMS, music, camera and gallery are anyways tried by a relatively high number of people, meaning that the low stickiness of these applications is a bigger value destroyer in absolute terms than that of less widely used applications. Certain applications, like Poker, VoIP and friend finder applications (picked here for exemplary purposes), can have a relatively small user domain, but still high stickiness (indicating that people who install these applications, typically use them very actively).

**Figure 10 – Penetration vs. stickiness rates**

1.1.1. **User satisfaction**

As a final demonstrating on the MobiTrack analytics, some insights from user satisfaction research are provided here. Instead of doing traditional paper or online surveys, not to talk about
interviews, in the MobiTrack framework user perceptions and satisfaction are measured with on-device, contextual questionnaires. This means that when actual users of individual applications terminate the session, or have completed a task (e.g. reading or writing SMS messages), there is a pop-up questionnaire, right after the experience, asking feedback regarding the completed task, application session, or other transaction.

In Figure 11 the results of contextual questionnaires (user satisfaction as measured in a real environment, x-axis) and average monthly face time (in number of minutes, y-axis) are plotted, revealing that most basic services receive high satisfaction and usage activity, with the exception of email. Email users spend an average of 410 minutes per month with mobile email (almost as much as people spend talking on the phone), but still the average user satisfaction is very low. Based on another contextual survey, the main causes of dissatisfaction for email are poor keypads (most of the devices in the study did not include QWERTY keypads), small screens, and lack of push functionality. Continuing the analysis, it is also evident that web browsing, MMS and map applications receive relatively high satisfaction rates, though actual usage is not that high. As found also earlier, games, video, instant messaging and VoIP are applications that receive low usage activity, the measured user satisfaction being also low.

In Figure 12, average satisfaction rates across a set of exemplary services are plotted against stickiness, showing that on average perceived satisfaction has very high correlation with measures stickiness rates (see the previous section).

**Conclusion and discussion**

This paper has presented MobiTrack, which answers to the demand for more reliable and precise user experience research in the world of rapidly changing wireless business. The key advantages of MobiTrack are the capabilities to collect a comprehensive set of data from real environments of users, measuring at the point of convergence not only behavioral, but also technical and subjective dimensions of user experience, and providing of actionable insights through advanced analytics approaches. MobiTrack brings the advantages of audience measurement panels, earlier used only in measuring TV, radio and Internet usage, to smartphones. The shortcomings of the method include a certain degree of effort needed in launching bigger panel studies, challenges in motivating people to join the panel (incentives), and the selection bias due to the fact that only smartphone users can be studied.

In general, the amount of data collected is vast, and possible degrees of freedom in analytics approaches are numerous. Carriers and device vendors, in particular the ones who build and deploy own services and can affect usability-related factors, are the key customers of the presented tools. In the future, also service providers, application developers, content houses and advertisers alike are increasingly interested in understanding the mobile medium, making them potential customers. In addition to valuable descriptive statistics of user behavior and satisfaction, the following two important research problems can be assessed in providing actionable insights: 1. What are the user needs? How to improve adoption of mobile applications? 2. How to improve usage activity and user satisfaction, and contribute to revenue growth?
Exemplary topics of MobiTrack research include:

- Mobile Internet (social networking, web)
- Use of applications and device features
- Adoption and stickiness bottlenecks
- Service and device testing, lead-user studies
- Usability evaluations
- App stores and add-on application usage
- Benchmarking against references
- Trend analysis
- Customer segmentation
- Churn and up-selling modeling
- Perceived quality of user experience
- Correlation of technical drivers (e.g. network quality) and user behavior
- Contextual analysis (roaming, home vs. office)

MobiTrack provides an innovative approach of research for both commercial players and academics, in going closer to users’ real life experiences than any other research method.

Appendix A – Additional visualizations

Figure 13 – Roaming vs. home usage

Figure 14 – Distribution of face time over the hours of working days

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E-SERVICES AND TOURISM: A CASE STUDY OF UAE HOTEL INDUSTRY

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Abstract
This proposed study seeks to develop specific e-service (electronic service) strategies that could help enhance competitiveness of Abu Dhabi’s tourism in the global market in general and in the Gulf region in particular. As e-commerce (electronic commerce) increasingly transformed business operations in the contemporary networked economy, services provided by these emerging information and communication technologies (ICTs) became essential for global competition in tourism as well. With high growing number of luxury hotels, Abu Dhabi is in critical need of e-service framework that could help attract international tourists and better position itself in today’s competitive global market. The proposed study could thus benefit the local hospitality industry in the following ways. It could first call for critical attention to e-service strategies that play a significant role in hospitality competition in many advanced economies but are seemingly overlooked by the local industry. Secondly, the framework that the proposed study intends to develop would systematically outline strategic guidelines that are tailored to the specific social and cultural needs of the local hotel industry and in turn help utilize these emerging ICTs for competitiveness enhancement. Consequently, an advanced tourism image that differentiates Abu Dhabi from other major cities in the region or in the world could be established.

Keywords: e-service, tourism, UAE, case study

Research Proposal
As information technology in general and the Internet and e-commerce in particular were increasingly advocated by researchers and practitioners in tourism [1-3], many believe that their positive effects could be rather promising for hospitality services [4]. Examples that study specific nations and advocate those positive effects have been found in Greek tourism industry [5], rural South Africa [6], northeast India [7] etc. In a rapidly developing country such as UAE (United Arab Emirates), those positive effects could be even more promising because UAE’s economy has attracted growing attention in the global market [8-11] and inspired considerable tourist interests around the globe [12].

More specifically, tourism has been reported to contribute over 18% of Dubai’s economy [12]; many online sources and consulting agency such as Deloitte & Touche LLP have confirmed that Dubai, the largest city in UAE, achieved the highest hotel occupancy rate in the world [13-15]. The number of luxury hotels in UAE, particularly in Dubai and Abu Dhabi, has outgrown that of any country or city in the world, even that of Las Vegas; an astounding growing rate is even expected in other Emirates such as Ras Al-Khaimah and Fujairah [12]. These reports clearly confirmed the promising future of tourism in UAE, which in turn inspires this research investigation.

Nevertheless, the notion of e-services has seemingly maintained at a relatively basic level in the hotel industry of UAE. Although most hotel businesses provide online booking and e-services, options are mostly descriptive and lacking interactive dynamics that are normally expected among international travelers. For instance, Le Royal Méridien Abu Dhabi1, one of five star hotels in Abu Dhabi, merely provides plain toolbar menus and basic descriptions and photo displays for most e-services chosen. While its physical infrastructure and settings well fit the image of a five star hotel, the online appearance seemingly fails to do so. Similarly, the Armed Forces Officers Club and Hotel2 (or locally known as the Officers Club) presents another example of a five star hotel with unfitting e-services. Despite its intriguing architecture and substantial endeavor to attract international tourists, its online system is also mostly descriptive and exhibititve without even a basic reservation option.

This proposed study thus seeks to accomplish the following objectives.
1. To understand strategic vision of e-service in Abu Dhabi’s hotel industry: this objective could help the local hotel industry to articulate the organizational structure and the social and cultural contexts that shape individual hotels’ perception of e-service provision. The local hotel industry could then better understand its strategic position in the global marketplace.

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1 http://www.starwoodhotels.com/lemeridien/property/overview/index.html?propertyID=1900
2 http://www.afoc.mil.ae/afoc/home.htm
2. To analyze obstacles and issues that hinder the development of e-service in Abu Dhabi’s hotel industry: obstacles and issues derived from the completion of this objective allow specific social and cultural needs of the local industry to emerge. The local hotel industry could thus follow systematic guidelines that help overcome those issues and integrate social and cultural needs into its e-service strategy.

3. To raise awareness of and call for attention to the significance of e-service for the hotel industry’s global competition: built upon objectives 1 and 2, this objective could help lead the local hotel industry to appreciate e-service strategies and integrate them into its regional and global competitiveness.

4. To develop e-service framework that help strategize the local hotel industry’s market positioning and enhance the global competitiveness of tourism: the framework developed will help the local hotel industry to maximize the potential of emerging information and communication technology (ICT) and in turn renovate Abu Dhabi’s tourism image and elevate its competitiveness in the global market.

Potentially, major impacts of this proposed study might include: (1) enhance understanding of ICT significance in the contemporary networked economy, (2) address issues and concerns that have been largely overlooked in the local hotel industry’s e-service models, and (3) develop a strategic framework that could help the local hotel industry to renovate its market positioning and lead the growing competition in the region and in the global market.

Proposed Methodology
A mixed research methodology will be deployed for the entire project with the first phase focusing on qualitative method and the second phase emphasizing survey method. During the first (current) phase, a case study will be conducted to compare and contrast different hotels in Abu Dhabi that demonstrate contrasting strategic vision of e-service. Case study is commonly recognized for its in-depth analysis of ‘why’ and ‘how’ questions [16]. It is considered a suitable methodology here because its research orientation is in line with the exploratory nature of this proposed study. Moreover, in addition to common factors that many hotels in UAE face, individual hotels might have different consideration for its e-service strategy. A case study research methodology will thus allow more contrasting issues among individual hotels to surface.

More specifically, I plan to visit those hotels on a weekly basis and conduct interviews with business and IT managers of those hotels to gain insights of their perspectives of and plans for e-services. Documents gathered from their websites and public sources will also provide fundamental background information. Interviews conducted will be digitally recorded and transcribed. Data analysis will thus primarily reply on transcripts and documents gathered. When available, qualitative analytical software such as NVivo might be used to help analyze necessary textual information.

As the proposed study is still under development, the second phase (survey study) will depend on the understanding derived from the first phase. Nonetheless, upon completion of the project, it is expected that practical relevance to hotel management in the region will be demonstrated, particularly in relation to strategizing e-services. Its potential contribution will in turn help UAE better face growing competition in the hotel industry from neighboring countries such as Oman, Qatar, Bahrain and others [17].

References


STRATEGY FORMATION FRAMEWORK FOR TECHNOLOGY ADOPTION IN SUPPLY CHAIN MANAGEMENT

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Abstract
Firms have been seeking the strategies for technologies adoption to improve the internal performance and to streamline the processes with both partners. Emerging IT and manufacturing technology are the main driving forces. To form competitive strategies, the companies need to know the current situation, the projected position, and the technology to adopt to achieve the goal. A framework of strategy position map is presented to locate, set and move company’s strategy position based on IT adoption and corporate focus. Case studies on the firms from different parts in the supply chain for various industrial sectors demonstrate the applications of the proposed framework. The paper provides a discussion on the issues of observations, guidelines, components selection, and implications. The paper concludes strategy position map can help companies to form the strategy for supply chain management and highlights the challenging coordination for intra-firm and inter-firm strategy formation.

Introduction
Globalization has come to the new era on the reformation in business. Companies have been seeking the strategies to improve the operation efficiency and collaboration with supply chain partners. In order to form a competitive strategy, the company should take into account technology adoption and deployment in long term basis. The company not only needs to identify its current situation (or position) but also need to decide the expected situation (or position). In addition, the companies have to decide how to move to the expected position by adopting technology, systems, or initiatives.

A framework of strategy position map is presented to locate, set and migrate company’s strategy position based on IT adoption and corporate focus. Case studies on the firms from different parts in the supply chain for various industrial sectors demonstrate the applications of the proposed framework. The paper provides a discussion on observations that companies need to take into account both temporal and scope aspects in adoption of technology, systems or strategies. The cases studies further highlight some guideline about balanced, economic, progressive, dynamic, and streamlined issues. Several contemporary commercial systems, such as ERP and RFID, are discussed as the exemplary technology for strategy formation to illustrate the importance of both based-on and paired-with components in IT adoption. The paper also gives an explanation that IT adoption has become the pressing issue for the transformation in logistics industry because of both direct and indirect driving forces. The paper concludes strategy position map can help companies to form the strategy for supply chain management and highlights the challenging coordination for intra-firm and inter-firm strategy formation.

The Section 2 focuses on the framework of strategy formation for technology adoption. The strategy formation map is used to denote the company current status and expected position of the technology capability. The measures of technology capability is based on both information technology and manufacturing technology. Various case studies based on industrial classification are conducted. Section 4 discusses the implication of the study. The paper concludes the summary and future directions.

Preliminary Framework
Firms have been seeking the strategies for supply chain management by taking initiatives, adopting technology, and forming alliances. In order to form a competitive strategy, the company needs to know the current position, the projected target, and the technology to adopt to achieve the goal. A framework of strategy position map is presented to locate, set and move company’s strategy position based on the adoption for both information technology and product technology.

Strategy map
The strategic move of company mainly can be classified into three stages – internal stage, external stage, and integrated stage. The internal stage mainly focuses on the company internal coordination on the operations; the external stage then concentrates on the synchronization with the immediate upstream and downstream partners; and the integrated stages brings together the various parties on the same chain to consolidate the activities and processes.

The improvement for supply chain management can be made in two aspects – information aspect and product aspect. The
information aspect includes informative, interactive, and integrated stages. The informative stages is about the intra-company information availability; the interactive stage focuses on the inter-company information exchange; and the integrated stage is mainly concerned the coordination of information processing on the chains. On the other hand, the product aspect includes product, process, and personalization stages. The product stage is about the product related issues (e.g., design and storage); the process stage is to streamline the processes to ship, distribute, or forward the product; the personalization stage is concerned the adaptiveness, responsiveness and customization. The product stage mainly focuses inventory management and personalization stage is more into the service management.

The information aspect and the product aspect denote the status of a company in the supply chain as shown in Figure 1. The information technology is the drive to improve the information aspects as moving upward. Similarly, the production and logistics technology function as the drive to improve the product aspect as moving rightward.

To evaluate and improve the supply chain performance, we can locate the current status of the company, decide the desired status, and select the appropriate approaches or technology to move there. In summary, there are three main issues in this framework – how to locate the current company position, decide the desired position, and form the strategy to move to the target position.

Firm position in SCM
The types of supply chain can be classified as follows [1].

1. Traditional Supply Chain Relationship. A traditional supply chain is asset-based, relatively customer insensitive and slow in adapting to new business conditions. Some firms focus on upstream activities (e.g. sourcing, manufacturing and inbound logistics) and others manage downstream activities (e.g. outbound logistics, branding and sales). The sequential activities force each party to focus on its own business. The interactions with partners are based on minimal exchange of information and decision-making is based on past information. It results in reactive solutions to market conditions since their business processes operate in silos, making it difficult to achieve supply chain efficiency.

2. Building Efficient Supply Chains. In addition to optimizing the internal business functions to deliver products and services in a timely and efficient manner, firms take the initiative to exchange product and logistics information through information technology. Streamlining of individual supply chain processes leads to efficiencies but the gains were internal and the supply chain still did not maximize the efficiency throughout the chain of activities.

3. Collaborative Supply Chain Integration. Firms design their supply chain to manage one collaborative process rather than multiple processes and this integration is important to ensure uniformity amongst the partners in their supply chain network. Information is the key factor which could ensure such uniformity at all levels but it needs to be accessible to all key parties.

While the partners has established all the essential relationship levers (e.g. trust, long-term business partnership and mutual dependency), the final implementation would need to involve deeper organizational collaboration on both ends. In addition, the supply-chain focus needs to shift from developing mutual cost savings to developing a value chain of allies working toward the same strategic objectives. The benefits are not necessarily focused on functional efficiency but on factors (e.g. entire supply chain reliability and performance) which would have a strategic impact such as the flexibility of partners to respond to market changes with minimal disruption, the ability to penetrate new markets or speedy new product introductions. The partners would want to achieve maximum supply chain efficiency by developing an agile supply chain, which in turn would lead to shorter lead times. The main driver for this would be the transparent flow of information: by substituting information for the product, the need for inventory is eliminated as the chain becomes demand-driven rather than forecast driven. Figure 2 shows the types of supply chains.

Strategy types and strategy formation
There are several issues for the firm to consider the strategy formation:

- What is the firm’s original position on the strategy map?
- What is the firm’s desired or expected position on the strategy map?
- How does the firm move to the desired position?
- What about the upstream, downstream or other partners in the supply chain?

There are two levels of strategies that the firms should consider: macro level and micro level. The macro level strategy is from the supply chain perspective and micro level strategy is from the individual firm perspective. In the Figure 2, in general, the firm’s supply chain can be one of the supply chain types discussed above. The move of supply chain can be very straightforward and eventually most supply chains ideally evolve to collaborative supply chain. There are three possible
moving paths as shown in the Figure 2. The path selection is dependent on industrial characteristics and firm conditions. The first path is IT oriented approach that firms firstly focus on IT adoption to streamline the information flow to improve the internal operational efficiency, then gradually to coordinate and consolidate the business processes. On the other hand, the third path is to prioritize the changes on collaboration and service-centered issues before adopting IT to gradually improve the cooperation. The second path is a balanced approach to take into accounts both information flow and product flow.

Similarly, each firm may also take steps to enhance its strategic position in the supply chain. The firm could focus on IT adoption to enhance the information processing, exchange, and consolidation to move up in the Figure 2. On the other hand, the firm might focus on the synchronization and coordination of product flow to move right in the Figure 2. Of course, the firm might also take into account both concurrently.

In summary, the strategy of supply chain management can be viewed from two aspects: level and orientation. The level aspect includes macro (chain) view or micro (firm) view; the orientation aspect includes technology direction and operation direction. There are many initiatives, technology, strategies that have been applied to supply chain management in the last two decades as shown in Figure. For example, third-party logistics (3PL) has played the role to enable the management of product flow and Radio-frequency identification (RFID) tags are expected to enhance streamline and consolidation of information flow.

Case study
The study covers more than two hundred companies in various industry sectors both in Hong Kong, China, and overseas. The summary of selected case studies is listed in Table 1. The exemplary case study of HMV (Figure 3) is to illustrate the technology adoption and process coordination to enhance the strategic position in supply chain.

Company and business background
HMV defines itself as a specialist retailer of music and movies. It targets the market’s more serious buyers and collectors of CDs and DVDs by providing a broad range of items for selection. Some 60% of HMV’s sales come from back-catalog and the remainder from best-selling items. Although the market for CD sales has stagnated, DVD sales have picked up because of the fast penetration of affordable DVD players. Capitalizing on its brand image and store management expertise, HMV’s sales have been growing at the expense of weaker competitors. It continues to expand its store network, as the brick-and-mortar model still generates attractive returns in many markets, such as smaller towns in the U.K.

Although sales of CDs through large supermarket chains and online stores have emerged as new forms of competition, downloading of music via the Internet is HMV’s greatest long-term threat. Many online downloading sites (e.g., Apple’s iTune) are entering the market. Unlike HMV, these new players have no existing market to protect. Longer term, even movie could be downloaded from the Internet after bandwidth limitation is resolved. Although the threat of the Internet is at an early stage, the pace of uptake is difficult to estimate. Given healthy operating performance of its current business model, HMV appears to have ample time and financial resources to chart its future digital strategy. HMV should prepare itself to meet the Internet challenge and grasp emerging opportunities by leveraging its retail presence, huge customer base and a strong brand in music.

Projected position of HMV
On the information dimension, HMV is located on the interactive stage. HMV places great emphasis on managing its CD/DVD inventory and promoting items of both best-selling and backlist stock. To this end, it maintains close communication with disk distributors as well as the record labels. On the product dimension, HMV is most appropriately placed on the intersection of the product and process stages. The company is most concerned about selecting its store locations, store design, employee training, items and quantities to carry. The primary customer value proposition is a broad selection of titles, a comfortable setting, helpful and knowledgeable employees who can make good recommendations. These are mostly product-related issues and are the most critical factors driving success. As for supply-chain process, HMV focuses on streamlining distribution and logistics, aiming at reducing lead time and reducing inventory. In addition, managing reverse logistics is important in the dynamic marketplace. HMV has set up five online stores in the U.K., Canada (joint venture with Amazon.com), Japan and Australia. This alternative mode of distribution, by taking advantage of the company’s physical facilities and brand value, involves many process-related issues such as fulfillment and online payment.

Original position of HMV
On the information dimension, HMV is located on the interactive stage. HMV places great emphasis on managing its CD/DVD inventory and promoting items of both best-selling and backlist stock. To this end, it maintains close communication with disk distributors as well as the record labels. On the product dimension, HMV is most appropriately placed on the intersection of the product and process stages. The company is most concerned about selecting its store locations, store design, employee training, items and quantities to carry. The primary customer value proposition is a broad selection of titles, a comfortable setting, helpful and knowledgeable employees who can make good recommendations. These are mostly product-related issues and are the most critical factors driving success. As for supply-chain process, HMV focuses on streamlining distribution and logistics, aiming at reducing lead time and reducing inventory. In addition, managing reverse logistics is important in the dynamic marketplace. HMV has set up five online stores in the U.K., Canada (joint venture with Amazon.com), Japan and Australia. This alternative mode of distribution, by taking advantage of the company’s physical facilities and brand value, involves many process-related issues such as fulfillment and online payment.
dimension, HMV will need to integrate with the information systems of the record labels and movie studios, which hold the rights to digital content. The online downloading model is likely to result in the disintermediation of distributors, since there is no need for production and distribution of disks. On the product dimension, the virtual business model excels over the physical model by giving customers great flexibility and convenience to buy digital content. For example, customers are no longer forced to buy a complete album, which may contain titles they do not like. They can choose to download song titles from a wide variety of artists, mix and play them in whatever order they desire. In short, Internet distribution of music and movies is a perfect example of personalization, empowering customers and ensuring no stock-outs.

How can HMV move there?
The first and foremost strategic requirement is to develop strong relationships and mutual trust with the major record labels and movie studios. To become a popular downloading site and consistent with HMV’s traditional image, it should continue to carry a broad selection of titles. HMV needs to demonstrate to the copyright holders that it is a trustworthy partner and has the required technologies for distributing and protecting digital content. Obviously, HMV still lacks many of the capabilities. Some of the key technologies HMV will need to migrate towards an integrated / personalization supply-chain model for digital content are listed below.

- Development of an online storefront for customers to download music and movies. The website should be user-friendly, informative, secure, CRM-enabled and come with payment functionalities. It should make it easy for customers to locate and identify music by genre, artist, album, title, version and record company. It should also build in personalization features and offer suggestions to customers based on indicated preferences and historical browsing and buying patterns.
- Development of server technologies jointly with the major record companies and movie studios. The servers should be able to deliver different formats (e.g. MP3, WMA, WAV, HDCD, DSD for music, and MPEG4 for movies) to customers.
- HMV can consider entering into strategic alliances with hardware makers (e.g. Creative) and technology companies to develop improved devices and formats for downloading music and movie. Of course, the new devices and formats have to offer superior features and value over current devices (e.g. iPod and its proprietary AAC format). Another area of emerging opportunity in the video space is portable-display device that features massive storage for movies in a highly compressed format (e.g. MPEG4).
- Development of technologies to prevent or limit the copying of downloaded content to disks or other storage media. Working jointly with the record companies, a flexible pricing scheme should be devised for different kinds of copying rights. For example, pricing could vary from free-of-charge for streaming for pre-purchase listening, to a moderate rate for lower-quality formats, to higher rates for better-quality formats. Higher rates could be charged to allow for a limited number of duplicated copies.

Discussion
The discussion is mainly based on the case study above and other selected industrial examples summarized in Table 1.

Observation – temporal / spatial aspects
Form the case study and summary of the cases, it is shown there are two aspects of observation on the strategy adoption - spatial aspect to reflect the importance of upstream and downstream partnership in strategic adoption, and temporal aspect describes the impact of time factor on the process of strategy formation. The strategy formation and adoption usually is not only based on company needs but also on the situation or requirements from the business partners, especially immediate upstream and downstream partners. Many companies outsource IT adoption or logistics operations to the correspondent service (i.e. IT and logistics) providers that enable adoption and coordination in the scope of both intra-organization and inter-organization.

The strategy formation and adoption is also an evolutionary process. Normally the strategy formation is a continuous process. Companies need to take into account the time issues in the strategy formation and revisit/revise the strategy on regular or ad hoc basis. In addition, the definition of stages of IT adoption and industry focus might evolve with time, so the strategy map is dynamic rather than static.

Suggestion - SCM implication / guideline
The general findings are described as follows.

- Balanced. The companies should keep and move toward the balanced position between the information dimension and production dimension.
- Economic. It would be cost-effective for the companies move along the diagonal line than the X-axis or Y-axis.
- Progressive. The strategic move should be progressed one stage by step on the strategic
positioning map.

- Dynamic. The company should keep on revisiting and revising the strategic move to adapt to the changes in the dynamic environment.
- Streamlined. The strategic move should be aligned with that for partners, especially immediate upstream and downstream partners as shown in Figure 4.

We discuss the supply chain types (i.e. traditional, efficient, and collaborative supply chains) and strategy types of moving paths. Taking into account the guidelines above, we can further conclude that the adjustment of focus scope needs to comply with the evolution of supply chain strategy. The firms start with the traditional supply chain by only focusing on internal linkage and integration. At this stage, the companies independently adopt and implement the strategy, for example, database installation and development of inventory control mechanism. Later, the firms convert to efficient supply chain by further enhancing the IT capability for interacting with other players and calibrating the business concentration on streamlining process and cooperation. At this stage, the companies need to work with their immediate upstream and downstream neighbors to decide the suitable strategy. Sometimes, they also get the help from the service providers to augment the linkages with their business partners. Finally the companies transform to a collaborative supply chain by moving to a more competitive position. The focus at this stage is to further deepen the relationships with partners for service oriented solution and joint decision. The collaboration scope evolves from firm to the whole chain as shown in Figure 5.

Selection - technology component

We have witnessed many technologies, systems, and strategies emerge along with initiatives proposed for supply chain management in the last two decades (please refer to Figure 6). For example, database management systems have been used to convert the enterprise data to digital and organized format. The concept of mass customization is proposed to manage the product variety and service-oriented solution.

The adoption of these system, technologies, or strategies can be seen as managing projects. To effectively improve project management efficiency to lessen the failure rate, it is crucial for the management to judge what, when and how to structure and allocate resources to the relevant projects. Weill and Broadbent [2] develop an IT Portfolio Management Model to help match IT investments to strategic objectives. The model identifies four broad classifications of IT investment: Transactional, Informational, Strategic and Infrastructure. By realizing the four broad classifications, it can assist management to identify the project type, resources required, projected returns and potential risk level. The examples in Figure 6 can be further elaborated to denote the applicability scope and dependency relationships. To adopt and implement the system, technologies, or strategies in the Figure 6 would not guarantee the success for company’s transformation. The firms should also take into account two critical issues - based-on components and paired-with components. The based-on components ensure the readiness for adoption. For example, some IT components serve as infrastructure to other IT systems. The paired-with components complement to the components to be adopted for mutual support and full benefits.

We use two examples to summarize the discussion in this subsection. The examples are two extremes from two aspects – high or low level and macro or micro view. ERP system focuses on high-level adoption (integration) and micro-view (intra-organization) whereas RFID focuses on low-level (standardization) and macro-view (inter-organization). The ERP adoption normally assumes the readiness of IT infrastructure; otherwise, the adopting companies may suffer either the dramatic changes or under-usage result. The RFID adoption should be used with other system, such as middleware, databases, logistics systems, or ERP in order to get the full benefits.

Implication - service provider position

Logistics development is one of the indicators for industry advance and economy growth. In the last few decades, many large corporations have been moving part of the supply chains, especially manufacturing, offshore to take advantage of the cheap resources and low wage resources. China became the world-manufacturing powerhouse. In addition, the WTO, opening up the gate to China, has further sped up the process of logistics development to keep up with continuing and sustainable growth. A study about logistics development was conducted and examined through the latest transportation infrastructure and the cargo handling throughput with different means of transportation, railway, trucking, river shipping, ocean shipping, airway and multi-model transportation provided in greater China. Three case studies on logistics service provider for Proctor & Gamble (P&G) in China, Hong Kong and Taiwan respectively summarize the evolution of technology adoption, alliance strategy, and service packaging for logistics service providers in greater China [3-5].

IT brings the competitiveness and is treated as a kind of valuable logistics resources. The sole and joint use of IT brings many benefits to the companies and makes them more competitive in the...
strategic planning. The logistics information system can be categorized as logistics operating system (e.g., transactional application for sales, warehouse, transportation) and logistics planning system (e.g., co-ordinate applications for forecasting, planning, management) [6].

Three major driving forces in third party logistics (3PL) transformation are supply chain trend, development of logistics infrastructure, and advancement of information technology (IT) –

• **Supply Chain Trend.** The trend includes internal integration, external coordination with upstream and downstream parties, partnership with other supply chain parties or service (e.g., logistics, IT, and financial) providers, outsourcing non-core business, etc. The progression pattern and pace varies in different industries. The requirement of agility, adaptability, and alignment [7] for contemporary supply chain practice highlights the great demand and high expectation for logistics support.

• **Development of Logistics Infrastructure.** The transportation and logistics has been changed in the last two decades due to the technology improvement (e.g., faster vehicle) and infrastructure expansion. On the one hand, logistics service providers would facilitate the new infrastructure development to provide broader and better services; on the other hand, high cost, high expectation from the clients, and high competition from the peers further accelerate the movement.

• **Advancement of Information Technology.** The adoption of off-the-shelf IT is pervasive in all business sectors. One trend is to integrate the subsystem (e.g. ERP) to enhance intra-organizational synchronization and inter-organizational coordination. Another trend is to utilize the wireless support and standardize the components (e.g. RFID) to convert the IT system from physical form with constraints to virtual platform for further consolidation. IT not only enhances the organization competitiveness but also improve the services to the clients. IT also plays as the service and communication infrastructure between suppliers and clients.

There are several commonalities and discrepancies among these three case studies [3-5]. Some noteworthy issues clearly point out that though they may differ in geographical location and length of history, they all evolve from the shipping-oriented operation to logistics service companies. In addition, coincidently, they all have invested heavily on IT adoption in the last few years. On the one hand, IT adoption help the transformation for logistics companies through streamline of information and operation, enhancement customer satisfaction, and differentiation in strategic move. On the other hand, IT adoption is also necessity for logistics companies to serve or even enable the client companies to move to a more competitive position as shown in the Figure 1. Through both direct and indirect driving forces, logistics industry needs to double the efforts on IT adoption and deployment in the transformation.

**Conclusions**

In the last two decades, firms have been seeking the strategies for technology adoption to improve internal operational performance and streamline processes with partners. IT and manufacturing technology are the main driving forces. In order to form a competitive strategy, the companies need to know the current position, the desired position, and the technology to adopt to achieve the goal. The paper proposes a framework of strategy position map to identify and to plan the strategic position in the context of supply chain. The information dimension includes informative, interactive, and integrated stages; the company focus includes product, process, and personalization stages. Case studies on the firms in different parts of supply chain for various industrial sectors demonstrate the applications of the proposed framework.

The paper provides a discussion on observations that companies need to take into account both temporal and scope aspects in the adoption of technology, systems or strategies. The cases studies further highlight some guideline about balanced, economic, progressive, dynamic, and streamlined issues. Several contemporary commercial systems, such as ERP and RFID, are also discussed as the exemplary technology for strategy formation to illustrate the importance of both based-on and paired-with components in IT adoption. The paper also gives an explanation that IT adoption becomes the pressing issue for the transformation of logistics industry due to both direct and indirect driving forces. The paper concludes strategy position map can help companies to form the strategy for supply chain management, and highlights the challenging coordination for intra-firm and inter-firm strategy formation.

The future research can be in several possible directions as follows.

• **Investigate the relationship between the IT adoption and firm focus.** These two aspects are independent. Firm focuses may drive the needs of IT adoption and IT adoption may help or enable the focus shift.

• **Incorporate more factors in addition to the IT adoption and firm focuses.** The possible
choices are industry types, corporate size, supply chain roles, etc.

- **Industry specific patterns.** The study can focuses on a specific industry (e.g. textile industry) to investigate the industry characteristics.

**Acknowledgment**

Some exemplary case studies are based on the discussion in the courses of supply chain management. We would like to thank those students, especially Mr. Daniel Leung for his case study on HMV. Thanks to Ms. Debbie Chu for the summary of several case studies. The research is partially sponsored by The University of Hong Kong under Seed Funding for Basic Research 08-10.

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**Table 1, Summary of Selected Case Studies**

<table>
<thead>
<tr>
<th>Industry</th>
<th>Company Name</th>
<th>Current Position ¹</th>
<th>Expected Position ¹</th>
<th>Adoption of Exemplary System, Technology, and Strategy ¹</th>
<th>Upstream/Downstream Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logistics</td>
<td>PGL Logistics Group [4]</td>
<td>(I2, P2)</td>
<td>(I3, P2)</td>
<td>• VPN-based XDI (eXchange Data interface) and XML technology (I2, P2/P3)</td>
<td>P&amp;G</td>
</tr>
<tr>
<td>Apparel</td>
<td>Luen Thai [1]</td>
<td>(I1, P1)</td>
<td>(I3, P2)</td>
<td>• Re-position their business from an OEM to a design-to-store (D2S) provider in the value chain (I2, P2)</td>
<td></td>
</tr>
<tr>
<td>Toys</td>
<td>Lego [8, 9]</td>
<td>(I2, P2)</td>
<td>(I2, P3)</td>
<td>• Mobile Operations Terminals allows access to the item information in the store (I2, P2)</td>
<td>Anheuser-Busch, Kraft Foods, Pepsi Co.</td>
</tr>
<tr>
<td>Retailer</td>
<td>7-Eleven (Japan) [10]</td>
<td>(I2, P2)</td>
<td>(I3, P3)</td>
<td>• Mobile Operations Terminals allows access to the item information in the store (I2, P2)</td>
<td></td>
</tr>
</tbody>
</table>

²: (I, P): Informative (I1), Interactive (I2), and Integrated (I3); and Product (P1), Process (P2), and Personalization (P3)
<table>
<thead>
<tr>
<th>Category</th>
<th>Company/Platform</th>
<th>Reference</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Books</td>
<td>Gordon and Gotch (Magazine Distributor in Australia)</td>
<td>(I2,P2)</td>
<td>• Adopt RFID for contactless payment acceptance at 7-Eleven stores. (I3,P2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(I3,P3)</td>
<td>• PDA technology across its merchandise network (I1,P1) • Technical solutions to its publisher clients for data analysis. (e.g. XchangeIT, Powerplay, Impromptu, Website) (I2,P2) • Provide online services to facilitate the organization of different advertising / promotion (I2,P3) • Information sharing with its parent group (PMP) (I3,P2)</td>
</tr>
<tr>
<td>Logistics</td>
<td>Highly Confident Transportation (HCT) [5]</td>
<td>(I2,P2)</td>
<td>• Real-time tracking system • Digital signature and image authentication system for tracking the consignment status of shipments (I2,P2) • GPRS tracking goods (I3,P3)</td>
</tr>
<tr>
<td>Apparel</td>
<td>TAL [11]</td>
<td>(I1,P1)</td>
<td>• EDI standard for trade document (I2,P1) • VMI offers backward replenishment tool (I1/2, P2) • ERP (I3, P2/P3) • Made-to-measure(MTM) (I2, P2)</td>
</tr>
<tr>
<td>Health Care</td>
<td>Shun Sang (HK) Co.[3]</td>
<td>(I1,P1)</td>
<td>• Web-based system (I1,P2) • PDAs and mobile phones (I1,P2) • Barcode system (I1,P2)</td>
</tr>
<tr>
<td>Food and Beverage</td>
<td>Circle K (Supermarket)</td>
<td>(I1,P1)</td>
<td>• IT system connection and inventory control system with its main suppliers, close communication with its main suppliers (I2,P2)</td>
</tr>
<tr>
<td>Food and Beverage</td>
<td>Carrefour (Supermarket)</td>
<td>(I1, P1)</td>
<td>• Central procurement system (I3,P2) • EDI (I2,P1)</td>
</tr>
<tr>
<td>Logistics</td>
<td>Wonderful Transportation Ltd [15-16]</td>
<td>(I1,P2)</td>
<td>• Just-in-Time distribution center (I1,P2) • Vendor Compliance System (I2,P2) • Purchase Order Monitoring (I1,P2) • Web portal for customers to track the delivery status (I3,P2)</td>
</tr>
<tr>
<td>IT and Electronics</td>
<td>Leitax [17-18]</td>
<td>(I1,P1)</td>
<td>• DMO (Demand Management Organization) synthesizes the data, manages the planning process, and resolves the conflicts. (I1/2,P2) • BAP function as a strategic plan (I1/2,P2)</td>
</tr>
<tr>
<td>Food and Beverage</td>
<td>Lotus Supercenter (Supermarket)</td>
<td>(I1,P1)</td>
<td>• Electronic process (I1,P1) • WMS system (I1,P2) • EDI and electronic workflows (I2,P2/P3)</td>
</tr>
<tr>
<td>Logistics</td>
<td>IDS (Member of Li &amp; Fung Group) [21-22]</td>
<td>(I1,P1)</td>
<td>• Transportation Management Systems for vehicle routing and scheduling (I2,P2) • ViTAL supports the aggressive growth of International business (I3,P2/P3) • Trigantic - an online reporting system (I1,P2) • Road Warrior - remote order taking (I2,P2/P3) • TradEx - extends visibility of clients on transaction data (I3,P2/P3)</td>
</tr>
<tr>
<td>Telecommunications</td>
<td>Bell Canada [23]</td>
<td>(I2,P2)</td>
<td>• Reliance on IT systems to provide automated business processes (I1,P1) • Single terminal, a customer service agent (I3,P2) (2002)</td>
</tr>
<tr>
<td>Food and Beverage</td>
<td>Macrofood (healthy food provider)</td>
<td>(I2,P2)</td>
<td>• Database, provide product database for stock tracking and keeping service level (I1,P1) • Barcode System (I1/2,P2)</td>
</tr>
<tr>
<td>Music</td>
<td>Sunrise Records [25]</td>
<td>(I1,P1)</td>
<td>• Online Music Store, partnered with mymusic.ca to launch an online music stores (I2/3,P2/P3)</td>
</tr>
</tbody>
</table>

*G&G, Parent Group

J.C. Penny, Brooks Brothers.

British American Tobacco (BAT)

Global suppliers such as Nestle Taiwan

Futureshop, Bestbuy, HMV,
<table>
<thead>
<tr>
<th>Household Appliance Manufacturer</th>
<th>Haier (household appliance manufacturer) [26]</th>
<th>(I1,P1) and (I3, P3)</th>
<th>Wal-mart</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model “manufacture-store-sale” as the company operation model (I2,P2)</td>
<td>Logistics department (I2,P2)</td>
<td>Barcode System (I2,P2)</td>
</tr>
<tr>
<td></td>
<td>CRM system (I2,P2/P3)</td>
<td>Standard platform for data sharing (I2,P2/P3)</td>
<td></td>
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<tr>
<td></td>
<td>Retail Link allows Wal-Mart and its suppliers to manage the inventory efficiently (I3,P2/P3)</td>
<td>Customers can obtain first-hand information on new products through web (I2, P3)</td>
<td>Allow customer create their own “wish list” linked up to their customer account (I3, P3)</td>
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<tr>
<th>Food and Beverage</th>
<th>Wal-Mart (Supermarket) [27-28]</th>
<th>(I1,P1) and (I3,P2/P3)</th>
<th>Wal-mart</th>
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<td></td>
<td>Retail Link allows Wal-Mart and its suppliers to manage the inventory efficiently (I3,P2/P3)</td>
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</tr>
</tbody>
</table>
Figure 1. Framework of Strategy Position Map

Figure 2. Types of Supply Chains

Figure 3. Strategy Position Map of HMV

Figure 4. Strategy Coordination on Supply Chain

Figure 5. The Scope of Supply Chain Types

Figure 6. Examples of Technology Adoption
The current economic crisis has been widely viewed as yet further proof of the inadequacy of managerial Decision Support Systems. In spite of a half century of research into business decision making many still question whether information technology has actually improved how management addresses their business challenges. New technologies, rather than facilitate innovative approaches to managerial decision making have more often than not simply reinforced traditional managerial orthodoxies. This paper explores this relationship, and proposes the concept of corporate ecology as a means of enlarging managerial choices while focusing technology initiatives where they can provide measure value to organizations.

Keywords: Managerial decision-making, decision support systems, enterprise technologies, corporate ecology

Introduction
Palladium CEO David Friend [1], like many industry observers, has recently underlined the responsibility of poor decision making in the current economic crisis. This critique is nothing new, for the perceived failures of managerial decision making, as well as the support of the underlying organizational processes, have been under close study for most of the last fifty years. If managers are made and broken by the quality of their decisions, why haven’t enterprise technologies substantially improved the process?

Enterprise technologies enrich the quality of managerial decision making to the extent that they foster a significant change in how management views their business challenges. In our opinion, the current introduction of peer based and social networking applications, like that of functional and process centric applications in the past, will have little impact on how managers take decisions. The following paper introduces the metaphor of corporate ecology to help organizations leverage technology to improve the decision making process. The resulting framework encourages managers to survey their organizations as territories that have been staked out from particular experiences and then to design contextual strategies for sustainable future growth.

In the contribution we begin by examining historical development of research on decision-making and Decision Support Systems (DSS). Building upon this analysis we will then focus on the concept of bounded awareness, and specifically on the role that enterprise technologies have played in shaping managerial expectations and behavior. We will introduce the concept of corporate ecology as an operational framework to capture the importance of context in shaping pertinent management options. The paper will conclude with a discussion of how these considerations are being addressed as we apply this framework in our research for the Leading Edge Forum (LEF)

Managerial decision making
According to Keen [2] the roots of contemporary research on organizational decision making can be traced back to the early 1960s to the conceptual work at the Carnegie Institute of Technology while those of Decision Support Systems can be found in the projects on interactive computer systems undertaken by the Massachusetts Institute of Technology.

Hackathorn and Keen [3] have suggested that subsequent research has focused on three types of managerial decision making. Independent (or “high noon”) decision making occurs when an individual alone assumes responsibility for gathering the necessary information and making decisions. Sequential interdependent decision making involves a workflow in which an individual makes a decision to address part of a larger problem, and then passes it on to another. Finally, the authors define pooled interdependent decision making in which all the participants work together throughout the decision making process.

Kahnemann [4] noted, when accepting the Nobel prize for economics, that the distinction between intuition and reasoning has been a topic of constant discussion and debate over the last three decades (see Sloman [5]; Stanovich [6]; Stanovich & West [7]). A general consensus has emerged of the general characteristics of these two concepts which Stanovich and West have labeled System 1 and System 2. The managerial skills generally associated with intuition (System 1) are automation, associativity, and perception. The mental characteristics associated with reasoning (System 2) tend to focus on deliberation, replicability, and control.
Dawes [8], based on his case study of the graduate application process, was one of the first to demonstrate that linear models produce predictions that are superior to those of experts across an impressive array of domains. Bazeman and Chugh [9] have suggested that System 2 thinking can be leveraged to reduce System 1 errors by explicitly addressing managerial attempts to simplify organizational complexity.

Rather than trying to modify a decision maker’s thinking from System 1 to System 2, recent research on behavioral economics has suggested that changing the organizational environment to facilitate intuitive thinking (System 1) can improve the process. These recommendations provide the principal focus of Thaler and Sunstein’s [10] propositions in their work Nudge.

This theme of enhancing the managerial view of the organizational environment has been a principal tenet of Decision Support Systems. According to Klein and Methlie [11] the original DSS papers were published by Ph.D. students or professors in business schools who had access to the first time-sharing computer systems: Project MAC at the Sloan School, the Dartmouth Time Sharing Systems at the Tuck School and in France at HEC.

Doctoral research by Scott Morton [12] demonstrated that managers benefited from using a computer-based management decision system. Keen [12] later defined a decision support as “a problem-solving aid that either lowers the cost of carrying out an existing mode of analysis or encourages the individual to increase his or her level of reaction from routine to adaptive or adaptive to fundamental.”

Sol [13] has suggested that the definition and scope of DSS has in fact evolved in response to both the evolution of business challenges over the years. In the 1970s DSS was described as “a computer based system to aid decision making”. In the late 1970s the DSS movement started focusing on “interactive computer-based systems which help decision-makers utilize data bases and models to solve ill-structured problems”. In the 1980s the focus on DSS shifted to providing systems “using suitable and available technology to improve effectiveness of managerial and professional activities”.

By the 1990’s DSS faced a new challenge in the design of intelligent workstations. Today the intention and the scope of Decision Support Systems are commonly classified using Power’s five tiered typology [14] [15]: communications-driven, data-driven, document driven, knowledge-driven and model-driven decision support systems. Decision Support Systems seem to mirror the objectives of the larger information architectures around them.

Bounded Awareness

The implementation of Decision Support Systems are to a large degree based on the assumption that managers are both capable and willing to use information to make rational decisions based on best case scenarios. The validity of this basic assumption has long been contested by a number of sociologists who argue that human perception is inherently bound by organizational context. Herbert Simon [16], among others, has argued that in fact, “human rationality is very limited, very much bounded by the situation and by human computational powers”. Schkade and Kahneinan [17] categorized human proclivity to willingly make judgments based on imperfect information as a “focusing illusion”. Chugh and Bazerman [18] have suggested that this bounded awareness is a phenomenon in which individuals do not “see” accessible and perceivable information during the decision-making process. They suggest that this “focusing failure” results from a discrepancy between the information needed for a good decision and the information commonly used in managerial decision making.

Enterprise technologies, rather than enhancing a manager’s ability to locate, leverage, and share critical information, have often hampered managerial insight by imposing a number of stringent boundaries on the decision-making process. One such boundary can found in the successive generations of enterprise technologies that have privileged certain types of information over others in describing organizational realities. Enterprise technologies can be best understood as the implementation of information technologies to capture the information necessary to achieve an organization’s operational goals. These technologies define the role of information technology inside the organization, the supports used to capture and process the targeted information, and the transactional processes needed to implement new technologies in response to changing organizational needs.

Four distinct generations of enterprise technologies have been deployed in business over the last thirty years to improve management’s understanding of the organization and its market [19]. Functional architectures have provided management with conceptual models describing enterprise roles, interactions and expected results based on industry norms. Process-centric applications enlarge the notion of best practice to propose standard methodologies for shaping organizations across functions and divisional units to optimize the flow of information, goods, and investments. Extended Enterprise architectures are attempts to capture the exchanges of loosely coupled networks of firms to deliver a cohesive set of products and services offerings to a given market. Finally, social media
based applications use Internet- and mobile-based tools to capture unstructured data through and user interaction to focus on opinions, insights, experiences, and perspectives.

Each of these enterprise technologies has introduced a specific set of technical and organizational considerations that challenge how managers do and should take decisions. To begin with, their design blurs to various degrees the distinctions that separate the organization from its eco-system, not to mention that between employees and customers. These applications encourage collaboration, but provide few clear rules of engagement for influencing effective managerial participation in the business. The key performance indicators produced by these applications gauge the weight of culture and informal organization differently in explaining why certain organizations outperform others. Finally, their use tests the foundations of managerialism: What role should command and control play in organizations held together essentially by perceptions of common interest?

A second perceptual boundary can be found in the models that decision makers have used over the years to frame organizational realities. Management as a science, as F. Taylor demonstrated, assumes that business is essentially about “simple” challenges in which the problems are well understood, and for each problem there is “one best way” to move the organization forward. The role of information technology has been traditionally to structure organizational activities into standard processes, and to record progress towards the mean. A customers, organizations, and markets mature, the nature of the problems managers face has evolved substantially. As management has turned its attention to new products, services and markets, managers face the less empirical, less linear challenges of optimizing organizational resources. The role of information technology in supporting the decision making process has shifted accordingly to address supply chain issues around enriching physical, financial and/or human resources.

Stacey [20] and Snowdon [21], among others, have argued managers are increasingly confronted with complex challenges that defy the very principles of scientific management. They argue that the nature of the challenges differ from those addressed previously: even if there exists a broad consensus concerning today’s business challenges: launching new products, improving market share, enhancing organization productivity, the “best” answers to these challenges have eluded the experts. In complex markets, traditional IT architectures seem unable to effectively support managerial decision making. In fact, systems prescribing best practices of process control, cost cutting, standardization often create more problems than they solve. These situations seem to require complex adaptive systems that focus managerial attention on the degree of certainty and level of agreement concerning each issue.

For many managers, the very idea of straying from the beaten track of global best practices seems both counterproductive and counter intuitive. After all, if the introduction of process centric support systems has worked in the past, why shouldn’t it work in the future? Yet, if many managers introduce technologies that simply reinforce existing managerial orthodoxies, the meager results are often gained at the expense of personal engagement, creating a vicious circle of bottlenecks, disengagement, and disillusionment.

A third conceptual boundary can be found in the very categorizations that decision makers perpetuate to deal with organizational challenges. Commonly referred to as the company culture, employees and organizations are greatly influenced by previous experience. Proponents of social network analysis suggest several reasons behind this organizational reality. To begin with, in business everything is connected: managers and employees alike are influenced by the successes and failures of their colleagues. Although managers deploy methods, technology and directives to enhance authority, knowledge, and energy, the results depend less on each initiative than on the relationships that characterize each organization. Company culture is often judged as an obstacle to organizational change, often rightly so when initiatives contest the nature of the existing relationships.

Potentially, the practice of management offers a much wider range of possibilities than traditional management theory suggests. For the purposes of our own research, we have defined management as a series of decisions taken to enhance the impact of organizational knowledge, influence and engagement [22]. Knowledge can be enhanced either for the individual or for the organization; it can be seen to either codified or embedded. Influence can similarly be concentrated or diffuse, strategic or opportunistic. Engagement can be either be fostered extrinsically or intrinsically, instrumentalized or based on ethical considerations. Why do decision support systems always seem to favor only one set of remedies?

If a manager’s job is to add value to his organization, which paths lay open to move the organization forward? Choosing a pertinent path requires understanding how company culture has impacted organizational performance in the past. Managers need to explore how the interplay between managerial choices, technological initiatives and personal engagement has marked their organization. Organizations need to look past traditional decision support systems to the types of business challenges
that their managers are facing, and to implement technological solutions that directly address the problems at hand. Finally, the solutions, rather than reinforcing the current managerial paradigms, need to be sufficiently dissonant to permit the organization to grow. If creativity, engagement and energy are the cornerstones of innovation, the very the foundations of managerial decision making need to be periodically reset.

The Framework of Corporate Ecology

Behind the concept of Corporate ecology lies a three dimensional framework designed to help managers refocus attention on the contextual factors that explain the success and failure of decision support systems in enhancing organizational performance. The accompanying toolbox can be used both as a descriptive model for understanding how organizational experience has bounded current performance and as a prescriptive framework for successfully leveraging information technologies in the future. Let’s first explore the context and the dimensions of the model, then explore why similar information architectures produce quite different results, and finally examine how this methodology can improve managerial decision making.

The potential of organizational performance is determined as much by the past as by the future. Organizational performance can be visualized as two concentric circles: one representing where the organization is today given current constraints and the other defining where the organization could be if its resources were used to their full potential. Management involves taking decisions of how to best close the gap between the two.

Corporate Ecology: moving “forward” to fulfilling organizational potential

Rather than reducing business decision making to an organizational chart of well defined functions or as a set of processes that need to be optimized, the objective here is to deepen management’s understanding of how experience, context, and vision have molded their territories over time.

In the framework of corporate ecology, three dimensions provide potential paths between where organizations are and where they could be. In understanding how the context, experience and vision of each organization have mutually shaped the reality of these roadmaps, the framework encourages managers to develop a realistic view of the expanse and the complexity of the organization in which they work:

- The application of management principles draws attention to which practices have produced measurable results in the past.
- The implementation of technology projects helps capture, examine, and automate common administrative tasks.
- Interactions with people – customers, employees, colleagues and shareholders – provide the passion and innovation needed to give meaning to work.

As important as each of the dimensions may be, managers that focus too narrowly on any one to the exclusion of the others draws managers inevitably off the track of success. The introduction of new decision support systems in an organization inevitably influences, and is influenced by existing management practices and levels of personal engagement. As might be expected, the implementation of global best practices that neglect the organization’s past experience are likely either to be ignored or worse produce negative results.

More surprisingly, technological choices that simply reinforce existing business practices or cultural norms are more likely to rigidify the existing boundaries than stimulate profitable growth. Economists have called this phenomenon the law of diminishing returns: as investments in any one area increases productivity growth proportionality decreases. Rather than provide a road forward to help an organization grow, new technologies can sometimes hinder productivity through a vicious circle of bottlenecks, disengagement, and disillusionment.

When we speak of improving managerial decision making, we are focusing on the manager’s role in designing and implementing targeted strategies to enrich organizational performance.
Although there is panoply of potential options available to foster growth, very few will make sense in the context of a particular organization. Understanding the distinctive contours of each territory will be fundamental in charting a road forward in today’s economic climate of depleting resources and diminishing returns.

For many managers, the idea of not doing more of the same can seem both counterproductive and counter intuitive. That said, in the right conditions the introduction of new technologies can provide the dissonance necessary to encourage employees and their managers to reach for a new equilibrium closer to the organization’s potential.

Although corporate ecology can be compared in many ways to environmental science, its focus on managerial choice justifies its use in business. The goal of corporate ecology is not to take people out of the equation through the progressive adoption of technology and management, but to use information technology to anchor the human resource in the heart of the enterprise. Decision making is inherently a human exercise: the value of individual input is critical in difficult economic conditions when time tested recipes no longer produce the desired results. People purchase technology, people input the data, and people interpret the results. Since human interaction also shapes stakeholder behavior, improving the depth and breadth of managerial perception can go a long way in reinforcing the value proposition of Decision Support Systems.

How does corporate ecology differ from traditional management approaches?

Before turning our attention to how this framework can be used to guide future managerial choices, it is important to explain how “corporate ecology” differs concretely from existing management frameworks. Our research attempt to goes beyond simple catalogue of managerial practices or proposing a normative model of future technological options, we have attempted to provide the contours of a cohesive roadmap to improve managerial decision making. Four guiding principles: singularity, path dependency, bandwidth and the value of dissonance set corporate ecology apart from traditional and “scientific” approaches to management.

The principle of singularity suggests that successful business practice is a lot “messier” than the principles of best practices and “one best way” would suggest. Management, especially in times of economic difficulty, is primarily a question of focusing on what is essential in moving an organization forward. Corporate ecology proposes that it is essential to take a hard look at how your employees, your sponsors, and your customers behave in reality rather than playing lip service to idealised models of how business should be run. In reality, business is about dealing with problems that defy simple answers, accepting that work is a lot more complex than we would like it to be, and that neither our customers nor our colleagues are wholly rational decision makers. In such contexts there is no universal one best way of moving forward, just better ways than others to foster pertinent decision making.

As managers realize each time they are faced with implementing global best practices, businesses can rarely start from scratch. Their history, culture and experience opens some doors while closing others. Technology options may be sound in theory, but their impact will be inevitably influenced by the dominant management practices. Social scientists suggest that in an increasingly interconnected economy the growth of teams, organizations and markets is inherently dependent on initial conditions. Corporate ecology takes on board this principle of “path dependency” to explain why even the best designed technology projects can go wrong.

The principle of “bandwidth” suggests that managerial discretion is much broader that most managers think. This gap between conceptual models and actual practice opens up a larger pool of initiatives than theories of “global best practice” suggest. A wide variety of value propositions can be formulated around new management practices, technology implementations or personal engagement. Managers need to recognize that global best practices aren’t the only rational option, let alone the best option available. The choices that make sense will fit more easily into the organizational context than into a consultant’s handbook.

Finally, the principle of dissonance suggests that management solutions are rarely found in models. They are more likely to emerge from inquiry into why managers have problems with applying their principles consistently. If controlling risk and deviance were the only goals of management, the current economic crisis would be yet another proof that managers are doing a very poor job. Managerial innovation and risk go together: innovation is all about appreciating that improving performance requires accounting for the risk of moving forward. On the one hand, forcing employees to “toe the line” can be both illusive and useless in adding value to the organization. On the other hand, behavior that deviates from the norm can be a real source of innovation if we understand how it reflects individual perceptions of organizational practice and experience. Experimentation involving new approaches to management decision making is inherently risky, yet fundamental in helping an organization move from where it is to where it could be if it used all available resources to their full potential.
*Putting the framework into practice*

In dealing effectively with the organizational issues that challenge the business today, we are suggesting that management would be wise to refocus its attention on the larger implications of how Decision Support Systems have influenced and are influenced by persistent managerial orthodoxies.

In our current research project on “Rethinking Management and Employee Engagement” at the Leading Edge Forum [23], we have proposed a mindset around the concept of corporate ecology to focus managerial attention on a roadmap for growing their business towards their organization’s full potential. As part of our project team’s research, we are currently producing a workbook that synthesizes the operational activities and tasks that can help organizations put our recommendations into practice. The implementation of the framework involves three processes: 1) surveying organizational resources, 2) projecting the growth of the eco-system and 3) personalizing the return on investment for the organizational stakeholders. Let us quickly look at each in terms of their major themes, objectives, and likely outcomes.

LEF’s project team is putting together a number of simulation games, visioning exercises, and group worksheets to explore managerial perceptions of the nature of the gap between current organizational realities and organizational potential. These activities are designed to identify the coherence of existing technological architecture, the degree of organizational fitness of existing Decision Support Systems, as well as the managerial perceptions of the strengths and weaknesses of the current deployments. The desired outputs of this process are a general consensus around the nature of the contextual challenges in leveraging information technologies more effectively.

The results can then be mapped back to the three dimensional model of corporate ecology to uncover the realistic paths for improving the decision making process. A second set of activities involves projecting future scenarios for exploiting organizational data in enhancing organizational performance. Project exercises here include focus sessions and group work with subject experts, peers and/or customers depending on the nature of the challenges to be addressed. The overriding goal is to provide an operational roadmap that recognizes the unique position of the organization and the actionable steps that will enrich performance. Deliverables here include the specific knowledge, actions, and metrics needed to deal successfully with the targeted challenges.

A third set of activities involves contextualizing the return on investment for organizational stakeholders. Here the group’s work focuses on encouraging managers to appropriate the roadmap in the form of personal visions that reveal individual action points, expectations, metrics and payback. The implementation activities here are monitored and then mapped back to the organizational challenges to help management visualize the impact of the ongoing projects on organizational performance. The goal here is to manage expectations and to produce a structure of testimony and feedback that can demonstrate the personal value of each investment.

**References**


Management Review, Automne 1971, pp.55-70)


RFID AS GREEN IT: LESSONS LEARNED FROM CASE STUDIES

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Abstract
RFID can play an important role as a green ICT solution to environmental sustainability. The traditional perception about ICT is that whatever ICT did came at a cost to the environment (Aronson 2008). This negative view is supported by computer societies which mandate the reduction of carbon footprint for IT industry and active lobbyist groups which call on reduced use of IT. Being part of ICT, RFID has faced similar negative reputation since today’s RFID tags are by and large neither biodegradable nor recyclable, causing the recycling of the tags difficult (Thomas 2008). Nevertheless, there is an emerging trend of new IT that is eco-friendly to our globe. The concept and practice of Green IT emphasises minimal impact on the environment, economic viability, and improved system performance and use (Murugesan 2008). It is further suggested that the greening of IT industry itself is barely enough but IT’s role in improving the environmental sustainability in other industries has greater impact (Ruth 2009). In the context of Green IT, RFID’s proliferated applications have unlimited potential in certain areas such as e-waste control (Krikke 2008). Yet the application of “green RFID” is challenging. Increased complexities in operational processes and possible sacrifice on economic benefits have both deterred the diffusion of RFID as green technologies. However, investors and consumers are demanding more of carbon footprint disclosures from companies, increasing the public pressure for green practice adoption (Murugesan 2008). Tightening regulatory restrictions, rising energy costs, and strong need for realizing social responsibility(Ruth 2009), green technology has become a favored solution in which RFID is an important component. In this research, several cases of successful implementations of RFID for green use will be studied. Different areas of applications have been identified including, but not limited to, material waste cut, increased operational efficiency, reduced energy consumption, recycling boost, tracking of hazardous materials, and collection of item-level information. The companies under investigation span from well-known multi-national corporations to small localized business, from public service organizations to private profit maximizing enterprises. The analysis of the cases will be based on a few important criteria including environmental sustainability, economic viability, and social value, with a view to see their overall impact since there is a necessary trade-off between the multiple criteria. Both the positive and negative consequences resulting from the use of RFID will be reviewed. Mature and practical applications of green RFID will be highlighted. Promising and potential use of RFID will be discussed with hope and care. Less impressive consequences resulting from use of Green RFID will be considered for further improvement as well as re-consideration.

Keywords: Case studies, Green IT, RFID.

References
A SUGGESTION ON THE ROADMAPPING PROCESS TO MAKE AN
INTEGRATION ROADMAP BETWEEN SERVICE-DEVICE-TECHNOLOGY
- WITH A FOCUS ON THE CASE OF U-CITY

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Abstract
The Technology Roadmap (TRM) is a technical strategic decision support framework in order for the anticipation and projection of the changes of technologies in the future, which has higher uncertainty in general. While the importance of technology management is receiving more attention these days, the research works on the TRMs have been limited to project future technology trends yet diversely studied in different sector such as the service industry. The aim of research is therefore to explored and proposed a integrated roadmapping process based on the service oriented business model which based on technology. Proposed methodology has been applied into smart city development project to validate its usefulness and benefits.

Keywords: TRM, u-City, Service, Device, Technology

1. Introduction
In the current circumstances where the technical changes are dynamically evolving, the decisions on the choice of technology are a critical for many companies to sustain their competitive advantages. As the future technology lies obscure and uncertain, it becomes more critical to make a proper strategy in response and prepare to advance as far as possible to whatever strategic goals we have. In this case, if it is possible to make an accurate anticipation on the future technology agreed upon by a reliable number of experts, a very important value in strategic planning of technology can be provided [7] [61]. As a decision support tool for the technology strategy support for the anticipation and proper response for future technical development [32] [50], which throws at us a very high amount of uncertainty, a TRM is receiving more and more attention lately. But, even though the weight the service industry carries in terms of the economic structure is even heavier [43], previous literatures so far have been studied with focuses on specific industrial technologies and product development, while the researches of the TRM reflecting the views from the service area have not been relatively explored [65]. In an industrial structure weighing over the service department, the role of technology is as a vehicle to deliver the invaluable service to the customers, and the value creation occurs not by the products themselves but by the uses the customers make [68].

Therefore, in this research, our aim is to make a projection on the development of ubiquitous devices and technologies in the future in respect of the services and propose an integrated ubiquitous city (u-City) technology roadmapping process that is systematic, standardized, and capable of supporting the making of development strategy.

2. Literature Review
2.1. TRM
2.1.1. TRM Definitions
Galvin, who was a former CEO of Motorola and came up with the concept of TRM earlier, defined as follows. His definition has been cited by many scientists since then [5] [10] [32] [56]: ‘An extended view of the future in a field created by the accumulated knowledge and imagination of experts in that field.’ In addition, in another research with Motorola as the research subject, he defined it as ‘determining the necessary actions to be taken by an enterprise in order to secure the experience, components and processes for the demands in products and services in the future.’ [55] Since then TRM definitions have been proposed by many scholars with different perspectives as shown Table 2-1.

<table>
<thead>
<tr>
<th>Sources</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Garcia &amp; Bray (1997)</td>
<td>A document created as a result of technology roadmapping process</td>
</tr>
<tr>
<td>Kostoff &amp; Shcaller(2001)</td>
<td>An auxiliary tool to concretize the links between the research program, development program, objective capacity and requirements thereof</td>
</tr>
<tr>
<td>Kappel(2001)</td>
<td>A document that helps the viewer recognize the critical definitive factors in the market, product, and technology, which form a part of the business</td>
</tr>
<tr>
<td>Probert &amp;</td>
<td>Participants’ views to envision the</td>
</tr>
</tbody>
</table>
2.1.2. TRM Types
Phaal (2001) broadly divided the types of TRM in two ways, by their objectives and forms [52]. He studied 40 TRMs and categorized them in 8 forms according to their objectives. They illustrated different types of TRM including product planning, service/capability planning, strategic planning, long-range planning, knowledge asset planning, program planning, process planning and integration planning [32]. Among these, Service/Capability Planning is used in making expectations on the impacts of the technical development on services, and Long-range Planning is for making expectations of technology on a national scale by expanding the planning time horizontally [52].

Phaal also have categorized different formats of a TRM which including: multiple layers, bars, graphs, tables, pictorial representation, flow charts [52]. Among these, the Multiple Layer type of roadmap is the most generic format to use when TRM is developing. A multiple number of layers (technology, products, market, etc.) components this type of TRM and what it does is that it connects the technology with the products, services, and business system while manifesting the hierarchies between the layers and showing the evolutions/improvement that happens within each layer. The Bar-shaped roadmap is a simplified version, which has its own merits when one tries to understand the TRM the easy way [52]. Currently all national-level TRMs concerning the ICT technologies use the Multiple Layers type or Bar type[45] [46].

2.1.3. A Research Study On The Technology roadmapping Process
A roadmapping defines as an activity to create a roadmap and communicate for it [21]. Groenveld (1997) defined roadmapping as 'a process that contributes to the integration between business and technology, as well as to the definition of technical strategies by illustrating the interactions between the technology and products over time in consideration of long term and short term view from the product and technology. '[17] Meanwhile, Garcia and Bray (1997) also defined as 'a technical process based on the necessity to help the process of identifying, choosing, and developing technologies to satisfy the needs over the products.' [15]

Of all different studies on technology roadmapping, researches on the national level the processes have been proposed respectively by Industry Canada, U.S. DOE, and Lee et al.(2007) [37]. Firstly, Industry Canada has been so far drafting the TRMs for respective industries – all 8 of them, including aviation, electricity, and medical- , and in this process has been actively engaged in the research of technology roadmapping. In the preliminary activity stage of this research, it emphasized the importance of the establishment of Steering Committee for the development of the TRMs in order to clarify the roles and responsibilities of the organizations involved in the roadmapping process, with a comment that, for the head of this committee, an expert on the process itself rather than an expert on the technology would be more suitable[20]. The processes of US Department of Energy generally resemble those of Industry Canada. However, it differs from them in a sense that it induced the technical issues by the assessments of technical needs and developed the TRM based upon the priority order between these [66]. Lastly, Lee et al. (2007) proposed a six stage roadmapping process for the national level R&D roadmap development and applied the demand analysis, environment analysis, technical assessment, portfolio and priority analysis to develop a more detailed and systematic TRM [37]

2.2. u-City Development
2.2.1. Definitions of u-City
There are various definitions of u-City in previous studies as shown in Table 2-2. Reviewing different definitions proposed by different government agency, u-City provides its citizens with services via its infrastructure based on ICT infra technologies. That is, as the u-City industry grows, the identification and projection of the ICT technology that can meet the future demands of the city is critical, since the ICT technology is the very fundamental infrastructure of u-City’s services in recent years.

<table>
<thead>
<tr>
<th>Sources</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Korea Land Corporation (2005)</td>
<td>A city that provides combined services via the integration of domestic IT industry and construction industry</td>
</tr>
<tr>
<td>Ministry of Information &amp; Communication (2006)</td>
<td>A highly advanced future city that applies IT infrastructure, its technologies and services to multiple components of itself</td>
</tr>
</tbody>
</table>
3. Proposing The Integrated Technology Roadmapping Processes & Case Studies

3.1. Integrated Technology Roadmapping Process
In this case, three major directions of strategies have been proposed for the development of TRM driven by the government that can be implemented in the u-City project.
- The establishment of a systematic classification of service-device-technology applied in u-City
- Development of proper TRM formats
- Accumulating a database of u-City service / device / technology

The deduction of the classification system of the subjects in drafting a roadmap is referred to as a critical step in creating a roadmap document [10] [37] [40] [58]. A government driven TRM tends to need a systematic policy in planning of the technical assignment and development [23]. Therefore, an identification process of the various services generally applicable of the entire scope of u-City development

3.2. A blueprint of Technology Roadmapping
In this research paper, an integrated technology roadmapping process is consists of 8 different processes including: “planning”, “demand identification”, “service identification”, “device identification”, “technology identification”, “roadmap drafting”, “roadmap adjustment”, and “follow-up stage.” (Table 3-1)

3.2.1. Planning phase
In the planning phase the vision and objectives about mid-long term strategy are to be set and the characteristics need to support this are identified. Also, the CSF(Critical Success Factors), which should be considered in the process of roadmapping and the ultimate outcome thereof, should be drawn up. And the task force that is ultimately responsible for the creation of the roadmap and the work group that provide help in the drafting stage are organized.

Table 3-1 A Technology Roadmapping Process For u-City Development

<table>
<thead>
<tr>
<th>Phase1. Planning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step1. u-City Mid-long term vision and goals identified</td>
</tr>
<tr>
<td>Step2. Definition of Roadmap</td>
</tr>
<tr>
<td>Activity1. Individual objectives of the roadmap</td>
</tr>
<tr>
<td>Activity2. Setting boundaries and limits</td>
</tr>
<tr>
<td>Activity3. Defining individual time table</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase2. Demand Identification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step1. Identify urban problems</td>
</tr>
<tr>
<td>Step2. Infer the solutions and demands</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase3. Service Identification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step1. U-City Services classification</td>
</tr>
<tr>
<td>Activity1. Classification standard to be set</td>
</tr>
<tr>
<td>Activity2. Service List-up</td>
</tr>
<tr>
<td>Activity3. Making the service classification system and verifying it</td>
</tr>
<tr>
<td>Step2. Service tendencies analyzed (Delphi)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase4. Device Identification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step1. U-City Device classification</td>
</tr>
<tr>
<td>Activity1. Classification standard to be set</td>
</tr>
<tr>
<td>Activity2. Device List-up</td>
</tr>
<tr>
<td>Activity3. Making the device classification system and verifying it</td>
</tr>
<tr>
<td>Step2. Device tendencies analyzed (Delphi)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase5. Technology Identification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step1. U-City technologies identified</td>
</tr>
<tr>
<td>Activity1. Classification standard to be set</td>
</tr>
<tr>
<td>Activity2. Technology List-up</td>
</tr>
<tr>
<td>Activity3. Classification system established and verified</td>
</tr>
<tr>
<td>Step2. Technical tendencies analyzed (Delphi)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase6. Roadmap Drafting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step1. Roadmap formats developed</td>
</tr>
<tr>
<td>Step2. The analysis of the interdependencies between service/device/technology</td>
</tr>
<tr>
<td>Step3. Integrated Roadmap developed</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase7. Roadmap Adjustment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step1. Roadmap adjustment</td>
</tr>
<tr>
<td>Step2. Roadmap verification</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase8. Follow-up Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step1. Execution Plan developed</td>
</tr>
<tr>
<td>Step2. Execution of plan</td>
</tr>
</tbody>
</table>

Step1: Setting the Vision and Goals for the
Development of Mid-long Term Strategies

In order to draw the mid-long term strategies for u-City, the future shapes of the city need to be anticipated with the philosophical discussion of the city also in consideration, and the principal direction and goals of developing the u-City have to be set. For this purpose, we conducted literature review studies on exiting city – relevant literatures and interviews with experts in the related fields. As a result, we identified six different visions of u-City, which are respectively ‘a convenient city’, ‘a safe city’, ‘a comfortable city’, ‘a cultural city’, ‘a productive city’, and ‘a city open for participation.’ In addition, since these visions can be accomplished by the improvement of the efficiency and effectiveness of the existing services and by providing and developing new services that the citizens require [42], we decided to establish a mid-long term strategy based not on Technology Push initiated by the production side but Market Demand driven by the requirements of the consumers[35].

Step 2: Defining Roadmap

In this step, the objectives of developing the roadmap are clarified and the limits and scopes of the roadmap are determined. And theses should lead to the setting of the development time table for all aspects and preparation of a systematic preliminary processing. In this case study, we have defined three objectives of developing the roadmap. The first objective is to identify and verify the R&D subjects that can be presented to the ‘national level of u-City development strategy’ which is in turn to realize a high-end city in response to the ever-changing technical and service environment. The second one is provide a strategic direction and goals of developing the u-City project members who participate in u-City R&D projects. Therefore, the necessary project group was formed out of the forming a project team and its cooperating entities, as well as experts of academic, industrial and government agencies. The fixed expert group included urban experts such as those from the main task research planning organization or other participating bodies for u-City project, public officers from the related local governments, university professors, engineers, GIS experts, and also ICT technical experts, experts from IT service providers and communication service companies were involved as well.

Step 3: Identifying CSFs for the Roadmap Development

In this stage, we derived the CSFs as shown in Table 3-2 after doing interviews with experts who have experiences in the development of roadmaps and senior researchers who participated in u-City project team and its tasks. Particularly, connectivity with the objectives of the research, continued improvements and adjustments have already been verified as important factors in the existing empirical researches [28].

Table 3-2 The vision, objective, and

<table>
<thead>
<tr>
<th>CSFs in u-City roadmap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vision</td>
</tr>
<tr>
<td>- u-City Characterization</td>
</tr>
<tr>
<td>- Enhanced Research</td>
</tr>
<tr>
<td>- Competitiveness</td>
</tr>
<tr>
<td>- Enhanced Research Efficiency</td>
</tr>
<tr>
<td>- Exhibition of Technical Feasibility</td>
</tr>
<tr>
<td>- Presentation of Technical Direction</td>
</tr>
<tr>
<td>- Suggestion of Optimal Combination of the Services</td>
</tr>
<tr>
<td>- Strategic Instructions for Service development</td>
</tr>
<tr>
<td>Objectives</td>
</tr>
<tr>
<td>- Organization Level Support</td>
</tr>
<tr>
<td>- Effective Roadmapping Process</td>
</tr>
<tr>
<td>- Link with proper roadmap objective</td>
</tr>
<tr>
<td>- Reflection of the demands from the customers</td>
</tr>
<tr>
<td>- Utilization of Specialized Research resources</td>
</tr>
<tr>
<td>- Recognition of the Need of Utilization</td>
</tr>
<tr>
<td>- Continued Improvement and adjustment</td>
</tr>
</tbody>
</table>

Step 4: Organizing the Project Team

In this stage, the TRM team for the roadmap development is identified and the preliminary works before the Working Group is formed will be established. As for the forming of the project team, with the characteristics of u-City which has a very strong tendency toward combination and integration, we decided that it has the most importance to build a cooperating body between the project team members who participate in u-City R&D projects. Therefore, the necessary project group was formed out of the forming a project team and its cooperating entities, as well as experts of academic, industrial and government agencies. The fixed expert group included urban experts such as those from the main task research planning organization or other participating bodies for u-City project, public officers from the related local governments, university professors, engineers, GIS experts, and also ICT technical experts, experts from IT service providers and communication service companies were involved as well.

3.2.2. Demand Identification

The wide variety of demands from urban citizens came from the problems of modern cities. In this phase, therefore, the problems that are given by the modern cities will be identified and solutions for them will be proposed by establishing u-City to discover the demands from the citizens. This will in turn serve as the basis for the ordering the services, devices, and technology in u-City in the future.

Step 1: Identification of Urban Problems

Urban Problems means the social obstacles and...
nuisances caused by the structural imbalances that the city has. Gwon (2007) classified the urban problems into housing/land, transportation, environment/energy, parks and greens, social development/pathology, disaster control, leisure/tourism development/rehabilitation, government/taxation, rural outskirts development, metropolitan area/population intensity, local development/mercantile location, new town development and measured the intensity of each class[42]. In addition, Choi (2005) attributed the urban problems to reasons such as the shortage of public services, heavy traffics, inequality, over-developing, land shortage, and crimes. In Step 1, we identified 7 urban problems such as housing/land, transportation, disaster control/safety, environment/energy, parks and greens, landscapes of the city area, and civil participation[42].

**Step 2: Solutions for Urban Problems and Deducement of The Demand for u-City**
The urban problems introduced above can mostly be solved by developing u-City, and the solutions here are connected to the demand for u-City by the citizens [42]. Therefore, we conducted interviews with 15 experts from the fields such as the city, service, and technologies[42]. As a result, it was concluded that out of 17 urban problems 14 can be resolved. This demand is then again further narrowed down to 8 urban demands. (Table 3-3)

<table>
<thead>
<tr>
<th>Urban Problem</th>
<th>Solution</th>
<th>u-City Demands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Housing/Land</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inefficient use of Land</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Over Developing</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Housing Price Rise</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Low Quality Housing</td>
<td>Enhancement of the quality inside the housing by adopting ubiquitous services and technology</td>
<td>Automated Residential environment</td>
</tr>
<tr>
<td>Transportation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clogging &amp; Heavy Traffics</td>
<td>Promotion of public transportations and restraints on private vehicles</td>
<td>Efficient Management of public transportation</td>
</tr>
<tr>
<td>Pollution</td>
<td>Regulating cargo vehicles and diesel vehicles for minimize pollution</td>
<td>Systematic management of environment pollution</td>
</tr>
<tr>
<td>Traffic Accidents</td>
<td>Providing real-time information on the accidents' occurrences and establishing a systematic response system</td>
<td>Swift and accurate management of disasters</td>
</tr>
<tr>
<td>Disaster control/safety</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural Disasters</td>
<td>Providing accurate information on the weather and related facilities</td>
<td>Swift and accurate management of disasters</td>
</tr>
<tr>
<td>Man-made hazards</td>
<td>Detection of the incidents and establishment of response systems</td>
<td>Swift and accurate management of disasters</td>
</tr>
<tr>
<td>Environment/Energy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air/Water/Soil pollution</td>
<td>Real-time detection of the contaminating source and establishment of response systems</td>
<td>Systematic management of environment pollution</td>
</tr>
<tr>
<td>Installation, perating &amp; Managing Environmentally Hazardous Facilities</td>
<td>Computerized Information Systems of Environmentally Hazardous Facilities</td>
<td>Systematic Control of Environmental Pollution</td>
</tr>
<tr>
<td>Deflection of Fossil Energy</td>
<td>Monitoring energy consumption and building facilities that are environment friendly s</td>
<td>Efficient management of energy</td>
</tr>
<tr>
<td>Insufficient user information</td>
<td>Enhanced accessibility toward information on parks’ location, status, and facilities thereof</td>
<td>Convenient park facilities</td>
</tr>
<tr>
<td>Lack of Convenience &amp; Comfort</td>
<td>User-oriented facilities and providing such information to users</td>
<td>Convenient park facilities</td>
</tr>
<tr>
<td>Urban Landscapes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bad Pedestrian Environment</td>
<td>Provide information on pedestrian walks</td>
<td>Comfortable urban environment</td>
</tr>
<tr>
<td>Insufficient support facilities for minorities</td>
<td>Establishment of minority-oriented facilities and provision of information thereof</td>
<td>Comfortable urban environment</td>
</tr>
<tr>
<td>Civil Participation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conflicts among individuals, areas, classes</td>
<td>Securing a participation route for the citizens in the urban planning process and interactive accessibility for the information</td>
<td>Open environment for participations by the citizens</td>
</tr>
</tbody>
</table>

3.2.3. Service Identification
In Service identification stage, the services of u-City get identified and the information is collected in a more systematic manner by establishing a service classification system. In addition, by monitoring the tendencies in these, a
preliminary work before making the service layers of the roadmap for later stages is done.

**Step1: U-City Service Classification**

The services herein need to be classified properly, in order to promote a shared understating on u-City services, efficiencies in the project’s execution, and help the local governments develop services that fit into their own unique requirements. For a u-City developer, this classification can be used and an indicator that helps him/her to check the current status of u-City services and to anticipate potential services which could be adopted later on. Also, a new unit of service can be developed by identifying the connections between the pre-developed services. In this regard, our intention is to establish a classification system in order to minimize the differences in understandings on the development of service models among the developers and allow systematic R&D projects.

Details of such activities include making the standards for the service classification, listing the services up, developing the service classification system and verification thereof. With a strategic goal to develop the classification standard, we performed nine multi-dimensional analyses on 228 detail units of services [42]. That is, Legal/Regulatory View, Space Factors, Human, and Functional Factors (Table 3-4). With the classification standard created as above, we made the service lists and had an expert group (of ten experts) verify them.

**Step2. Service Trend Analysis**

To identify the current and future trends of the u-City services we identified above, we conducted a two-stage Delphi survey (from Nov. 2008 to Feb. 2009) [42]. The reason why this kind of survey was necessary came from the very characteristics of u-City services. Since u-City services are very futuristic and cover a very wide scope, there is only limited effectiveness in gathering information from the ordinary citizens who never came across such things or from the scarce experts who are also limited to very narrow fields in their knowledge. That is where the Delphi survey method has selected, which is capable of gathering information from a relatively larger number of subjects, accumulating it, and finally allowing to make a decision with objectivity[36](Table 3-5).

<table>
<thead>
<tr>
<th>Standard</th>
<th>Classification</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Legal</td>
<td>Laws Administration, Transportation, Sanitary/Medicine/Welfare, Environment,</td>
<td>[41]</td>
</tr>
<tr>
<td></td>
<td>Crime/Disaster Control, Facility Management, Logistics, Labor / Employment,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Education, Misc.</td>
<td></td>
</tr>
<tr>
<td>Space Factor</td>
<td>Space unit Buildings, Sidewalks, Districts, Facilities, City, Metropolitan</td>
<td>[42]</td>
</tr>
<tr>
<td>Space Facility</td>
<td>Space Facility Information Media Facility, Unit Space Control Facility, Combined</td>
<td>[22]</td>
</tr>
<tr>
<td></td>
<td>Community Facility, Integrated Control Facility</td>
<td></td>
</tr>
<tr>
<td>Human</td>
<td>Provider Public Services, Private Services, Joint Services</td>
<td>[29]</td>
</tr>
<tr>
<td>Beneficiary</td>
<td>Public Sector, Citizens, Enterprises</td>
<td>[29]</td>
</tr>
<tr>
<td>Functional</td>
<td>Purpose of Development Resident Support, Commercial Support, Industrial Support</td>
<td>[42]</td>
</tr>
<tr>
<td>Factors</td>
<td>Urban Activities Health, Security/Safety, Community, Education, Economy,</td>
<td>[42]</td>
</tr>
<tr>
<td></td>
<td>Leisure/Culture</td>
<td></td>
</tr>
<tr>
<td>Human Behavior</td>
<td>Living, Working, Moving, Playing, Cybering</td>
<td>[1], [63]</td>
</tr>
<tr>
<td>Methods</td>
<td>General Service, Specialized Service, Potential Service</td>
<td>[42]</td>
</tr>
</tbody>
</table>

**Table 3-5 u-City Service Assessment Indexes and Definitions**

<table>
<thead>
<tr>
<th>Category</th>
<th>Sub Category</th>
<th>Operational Definition</th>
<th>Evaluation Scales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development Adequacy</td>
<td>Feasibility</td>
<td>The market volume and expected profit of the service</td>
<td>5 level scale</td>
</tr>
<tr>
<td></td>
<td>Demand</td>
<td>Forecast on the service demand</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Importance</td>
<td>The existence of benefits to be enjoyed by the public as a result of the service, regardless of the feasibility or demand</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Influence</td>
<td>Consequential influence of the service over the related industries</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Urgency</td>
<td>How urgent the service is needed</td>
<td></td>
</tr>
<tr>
<td>Implicational Capacity</td>
<td>Time of Availability</td>
<td>The possible timeline when the service becomes available in consideration of technical development and regulatory modifications</td>
<td>Year</td>
</tr>
<tr>
<td></td>
<td>Time of Application</td>
<td>Actual time when the service actually gets applied to the city</td>
<td></td>
</tr>
</tbody>
</table>

For device and technology as well, we conducted similar Delphi surveys for the same reason. The subjects of the surveys consisted of 140 service experts from u-City related private corporations,
110 civil servants from the local government picked up according to 11 laws and regulations, and 70 urban service experts from the academic sector. In total, we have collected 147 survey answer sheets from them.

From the collected answer sheet, a database on the future prediction and current status of the u-City services has been built. This would be of an asset when updating the u-City roadmap once it is developed or drafting a new roadmap for some other city[42].

3.2.3. Device Identification
In Device identification stage, a classification of device has been made to collect the related information and monitor the necessary progresses in a more systematic way which eventually stacks up as a preliminary work for the device layer within the roadmap.

Step1: u-City Device Classification
In the u-City environment, multiple devices perform various functions that can be recognized by the users in physical or virtual connections via the network. Therefore, in this study, if a function is performed by a multiple number of devices grouped together, they have been recognized as a single unit. In addition, when using the networks, it is possible that the newly recognized device (which is actually a group of devices connected together) spread over a wide range of physical locations, we have set up a space-oriented classification standard for a more clear identification of these. Such a classification system will serve as a preliminary work for the collection of device-related information and monitoring the current progress, which eventually support a better understanding on the various devices used in u-City and systematic acquisition of information.

The first step of the detailed activities is to set up the classification standard of the devices, which we did in space type, infrastructure components, and formal types. The definitions of these three standards are given in Table 3-6 below. The space type (node, landmark, path, edge, district, metropolitan) and infrastructure components (ceiling, walls, floors, combined, network) are, as mentioned above, space-oriented standards for the classification of the devices, while the formal type is separate independent, single devices (standalone) and grouped/combined devices that work as a group. After setting up the classification standards, we identified the devices that already exist in/out of the country or that are likely to be developed in the future to classify them in the classification standards we selected 10 experts from the related fields verified the completed device classification system.

<table>
<thead>
<tr>
<th>Standards</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space Type</td>
<td>The location where the device lies, or the range in which the devices can communicate with each other</td>
</tr>
<tr>
<td>Infrastructure Components</td>
<td>The location where the devices are installed when the device is connected with the existing infrastructure</td>
</tr>
<tr>
<td>Formal Type</td>
<td>The number of the devices needed to perform their functions or whether the devices are connected with other devices.</td>
</tr>
</tbody>
</table>

Table 3-6 u-City Device Classification Standard

<table>
<thead>
<tr>
<th>Category</th>
<th>Sub Category</th>
<th>Operational Definition</th>
<th>Evaluation Scales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device Importance</td>
<td>Marketability</td>
<td>Overall assessment of the current market competitiveness of the device, as well as the future growth potential thereof</td>
<td>5 level scale</td>
</tr>
<tr>
<td>Device Importance</td>
<td>Consequential Influence</td>
<td>Overall assessment of the technical influence of the device toward other devices and industry and economic consequences thereof</td>
<td></td>
</tr>
<tr>
<td>Device Importance</td>
<td>Feasibility</td>
<td>Expected economic profits there from</td>
<td></td>
</tr>
<tr>
<td>Device Importance</td>
<td>Economic Soundness</td>
<td>The soundness of the device application in the city in consideration of the economic costs is assessed.</td>
<td></td>
</tr>
<tr>
<td>Device Importance</td>
<td>Utilization</td>
<td>The extent of the utilization of the device</td>
<td></td>
</tr>
<tr>
<td>Device Level</td>
<td>Device Maturity</td>
<td>Assess which stage of development the device is currently at</td>
<td>Introduction/Growth/ Maturity/ Fade out</td>
</tr>
<tr>
<td>Device Level</td>
<td>Device Productivity</td>
<td>The availability of existing production facilities for the device and likelihood of mass production</td>
<td>(0~100)%</td>
</tr>
</tbody>
</table>
### Step2. Device Trend Analysis

Like the services, we conducted Delphi surveys (from Nov. 2008 to Feb. 18, 2009) for the analysis of the progresses with the devices. 108 technical experts who worked in u-City related departments of private corporations, 30 experts from the academic sector who are specialized in the u-City field have been surveyed and we got 97 responses back from them in total.

In previous literatures, the marketability, feasibility, capability of development, and possibility were assess in order to find out the tendency with the devices. [27] [71] [62].

In this study, we reorganized the detailed they presented to suit the requirements of our tasks (Table 3-7), and added Time of Availability, Time of Application, and the intensity of plausibility of these items to anticipate the likely time of actual application of the device in u-City.

### 3.2.4. Technology Identification

In stage of technology identification, a classification system is made in order for a systematic acquisition of technology-related information and check out the connected progresses as a preliminary work before making technical layers of the roadmap later.

#### Step1: u-City Technology Classification

Due to the nature of the case we have at hand, we firstly had to make an overall classification system for the ICT technologies applicable to u-City and identify the technology in accordance with this classification. In addition, in this study, we assumed a daily life environment where the information flows into the user via ubiquitous infrastructure.

Baek(2004) divided the process where the service user gets the information and give the response thereof into three stages, Awareness, Decision, and Action.[4] Under this conceptual classification, five major categories, Sensing, Networks, Processing, Interface, and Security were again conceived in terms of the technical functions and roles, as shown in Table 3-8 [3] [11] [48] [59]. Also, we identified the individual technologies that belonged to each category from industrial data and existing literature.

The u-City related technologies collected were again divided into 12 sub categories and 27 detail categories, resulting in 114 technology factors. And we had an expert group that consisted of 10 experts interviewed for the validation of the adequacy of the technical classification, accuracy of the classification standard, technologies to be left out or to be considered as overlapping.

#### Step2: Technology Trend Analysis

For the technical tendency analysis, we conducted a Delphi survey with ICT technical experts from industrial, academic, R&D background (from Nov. 2008 to Feb. 2009)

The targets of the survey consisted of 126 technical developers from private information or communication service providers, 100 experts from the academic sector, and 50 researchers from the technical research institutes run by the government, from whom we collected 226 answer sheets. In addition, the answers we had were heavily concentrated on the network and sensing part, which turned out to be 65% of the total answers.

In the anticipatory survey over the mid-long term development of technology, the subjects of the technical assessment were mainly focused on the importance, current technical level, and future anticipations on further development of such technology [49] [45] [12]. Therefore, we organized the technical assessment indexes in Importance, Current Level, and Future Expectations as shown in Table 3-9. In addition, similar to service and device tendency analysis, we separated the expected time of availability and application to the city so that the actual possibility of the technology’s application to u-City could be figured out [8] [9] [45] [12].
Table 3-8 u-City Technology Classification Standard

<table>
<thead>
<tr>
<th>Category</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensing</td>
<td>Monitor any external changes of status and transmit the collected data to process and respond to the signals from the sensors</td>
</tr>
<tr>
<td>Processing</td>
<td>Process the data from the sensors with proper analysis and decisions</td>
</tr>
<tr>
<td>Network</td>
<td>Connecting each device and user for the support of efficient communication</td>
</tr>
<tr>
<td>Interface</td>
<td>Convert the information that flows between the devices or between the users and devices into a more intellectual form (Graphical, Textural)</td>
</tr>
<tr>
<td>Security</td>
<td>Control illegal accesses to the information from the users or facilities over the entire ubiquitous environment and protect personal privacies</td>
</tr>
</tbody>
</table>

Table 3-9 u-City Technology Assessment Indexes

<table>
<thead>
<tr>
<th>Category</th>
<th>Sub Category</th>
<th>Operational Definition</th>
<th>Evaluation Scales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology Importance</td>
<td>Marketability</td>
<td>Overall assessment of the technology’s current market competitiveness and the potential for future growth</td>
<td>5 level scale</td>
</tr>
<tr>
<td></td>
<td>Consequential Influence</td>
<td>Assessment of the technology’s potential influence in other technologies and the industry, as well as the economic consequential influences</td>
<td>- Very high</td>
</tr>
<tr>
<td></td>
<td>Feasibility</td>
<td>Expected economic profits</td>
<td>- High</td>
</tr>
<tr>
<td></td>
<td>Economic Soundness</td>
<td>Financial cost of the actual application of the technology to u-City</td>
<td>- Intermediate</td>
</tr>
<tr>
<td></td>
<td>Application</td>
<td>The extent of the utilization of the technology</td>
<td>- Low</td>
</tr>
<tr>
<td></td>
<td>Potential of future evolution</td>
<td>Whether a continued research and development of the technology has the potential of bring forth a next generation of the current one</td>
<td>- Very low</td>
</tr>
<tr>
<td>Technology Level</td>
<td>Technical Maturity</td>
<td>Evaluate at which point of the development stages the technology is</td>
<td>Introduction/Growth/Maturity/Fade out</td>
</tr>
<tr>
<td></td>
<td>Domestic Level against the global status</td>
<td>Assume the technical proficiency of the country with the most advance technology in that field as 100, and evaluate the domestic technical proficiency against it</td>
<td>(0~100)%</td>
</tr>
<tr>
<td></td>
<td>Most Advanced Nation</td>
<td>Pick the country which has the most advanced technology in that field</td>
<td>Choose from Korea /USA /Japan /EU/ETC</td>
</tr>
<tr>
<td></td>
<td>Existence of a substitute or resembling technology</td>
<td>Existence of a substitute / resembling technology that could be used in similar purpose</td>
<td>YES / NO</td>
</tr>
<tr>
<td>Technology Anticipation</td>
<td>Time of Availability</td>
<td>The time when the technology is expected to become available or commercialized in the market for first-hand uses</td>
<td>Year</td>
</tr>
<tr>
<td></td>
<td>Time of Application</td>
<td>The time when the technology can possibly be applied to u-City, in consideration of legal or regulatory adjustments as well</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Positiveness of the Anticipation on the Times</td>
<td>Evaluate the positiveness of the surveyee’s assumption on the time of application for the technology in u-City</td>
<td>5 level scale</td>
</tr>
</tbody>
</table>
3.2.5. Roadmap Development

In roadmap drafting stage, a format for the roadmap is developed and drafted by using the collected data from the definition steps of service, devices, and technology.

**Step 1: Developing a Roadmap Format**

In this step, a simple and easy-to-understand roadmap format is developed. The parallel axis of the u-City roadmap is divided into three terms, ‘near future (up to 2013)’, ‘possible future (2014 to 2020)’, and ‘far future (2021 and beyond)’. ‘Near future’ means a relatively closer point of time in the future where it is possible to predict the changes with the infrastructures and related technologies. ‘Possible future’ means the kind of future that is close to the current time and it is still possible to make predictions without too much trouble. The end of the ‘possible future’, that is 2020, is also a time schedule most of the national development projects are pointing to, and it is necessary that our plan for the u-City development remains linked to this. ‘Far future’ is an assumed point of time where all of the services and values the u-City is meant for can be realized without any technical restraints.

The vertical axis of the roadmap stands for, respectively, each individual service in case of a service roadmap, and individual technology in case of a TRM. As for the form of the roadmap, we have chosen the ‘Bar’ type from the list of the roadmap forms suggest by Phaal [52], as we thought this could best descript the direction of the development of each service and technology.

The meaning of the diagrams in the u-City roadmap format in Table 3-10 is as below. The beginning point on the Bar shaped arrows means the time when the development of the service, device, or technology starts. In addition to that, the time of availability and the time of application are respectively marked with a triangular icon. The time of availability means the time in which the subject becomes commercialized in the market. However, even after the commercialization, there still can remain the legal, regulatory issues as well as the matter of standardization, there might be a gap between the time of availability and the time of actual application to u-City. Hence they are marked separately with different markings. Other than these, the current maturity of the service, device, and technology is marked in five colours, and the production capability of the device and current domestic technical proficiency are marked with a shaped-diagram for better readability.

**Step 2: Interdependency Analysis**

In the previous phases, the information from the service, device, and technology sectors has been gathered separately. However, with separated information, it is difficult to understand what kind of device u-City requires, or the service than can be provided via such a device. It is not easy to decide what kind of technology is necessary to make it come true, either.

<table>
<thead>
<tr>
<th>Service</th>
<th>Diagram</th>
<th>Device</th>
<th>Diagram</th>
<th>Technology</th>
<th>Diagram</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>![Unit Service Name]</td>
<td>Name</td>
<td>![Device Name]</td>
<td>Name</td>
<td>![Technology Name]</td>
</tr>
<tr>
<td>Time of Availability</td>
<td>![Availability]</td>
<td>Time of Availability</td>
<td>![Availability]</td>
<td>Time of Availability</td>
<td>![Availability]</td>
</tr>
<tr>
<td>Time of Application</td>
<td>![Application]</td>
<td>Time of Application</td>
<td>![Application]</td>
<td>Time of Application</td>
<td>![Application]</td>
</tr>
<tr>
<td>Importance</td>
<td>![Importance]</td>
<td>Importance</td>
<td>![Importance]</td>
<td>Importance</td>
<td>![Importance]</td>
</tr>
<tr>
<td>Maturity</td>
<td>![Maturity]</td>
<td>Maturity</td>
<td>![Maturity]</td>
<td>Maturity</td>
<td>![Maturity]</td>
</tr>
</tbody>
</table>

*The 9th International Conference on Electronic Business, Macau, November 30 - December 4, 2009*
A Suggestion on the Roadmapping Process to Make an Integration Roadmap

The 9th International Conference on Electronic Business, Macau, November 30 - December 4, 2009

To solve this problem in the existing studies, QFD method has been incorporated in this research. The characteristics of this method are [51] [25] [2] [17]:

1. Market Oriented Approach
2. Convenient in figuring out the interdependencies between the layers in a Roadmap
3. Applied in the planning phase of the Roadmapping process

The above characteristics suited our purpose of this step, which is to systematically identify the service/device/technology that can satisfy the citizens’ needs (1) and understand the interdependencies among these (2). However, unlike the existing studies which did a QFD analysis in the planning phase of the roadmap and conducted roadmapping with this on the bottom-line (3), we remembered that there are countless services/devices/technology in different time and location for the implication of u-City and the importance of these factors do change over time. Hence, we will first establish a database with collected data, and apply QFD in accordance with the situation we face to figure out the interdependencies.

Also, in the existing studies that applied QFD in roadmapping[51] [25] [17], the distinction between the product and service is rather vague. So, they could not present a methodology for QFD that is capable of analyzing the customer demands, products and services simultaneously. However, Lee et al. (2008) proposed that the product and services existed in the same level, and suggested a modified method of QFD that is capable of identifying the first-hand relationships between the customer demands, products, and services [2].

In this study, we adopted the QFD method proposed by Lee et al. (2008)[2] to clearly separate the services and products that could be realized in u-City and at the same time understand the customer demands and their relationships with theses.

To begin with, we performed a preliminary QFD analysis to figure out the interdependencies between the urban demands, services, and devices as shown in Figure 3-1. As a result, we could pick up the most importance services and devices to satisfy the urban needs and figure out how these are linked up with the technology.

**Step 3: Integrated Development of the Roadmap**

In this step, the roadmap format developed in Step 1 and the interdependencies between service/device/technology picked up from Step 2 are put together as a basis to visualize the collected data. Figure 3-2 shows an example roadmap for the integrated environmental pollution control service, universal resident card service and public transportation information service. The 3 services with the most weigh as the result of QFD analysis were identified along with the related devices and technology as well. Then the information on these items are conceptualized in the roadmap’s format.

![Figure 3-1. Analysis of the interdependencies between service/device/technology](image-url)
3.2.6 Roadmap Adjustment
In this stage of ‘roadmap adjustment’, we will adjust and verify the projections in the previously made roadmap to make it better in terms of reliability and objectivity.

**Step1: Roadmap Adjustment**
Usually, since a roadmap contains information gathered from a number of different categories, the predictions from the expert in individual fields are not enough to make proper anticipations for the future. Therefore, a process of repeated adjustment of the roadmap once it is preliminarily completed is necessary[5] In particular, roadmapping process that resemble our own in this study, there can be errors amount the collected information when putting together the roadmap, since the surveys on the future prediction regarding service/device/technology are given by expert group from different fields. In this step, we will identify the troubles discovered on the roadmap and modify them though internal discussions and using secondary data in order to enhance the credibility and accuracy of the roadmap.

An example of such an adjustment process is shown in Figure 3-3. The time of application for the integrated pollution management service, intellectual traffic signals, and intellectual bus stops were found to be 2012, meanwhile the time of application for the OLED technology necessary for these services turned out to be after 2014. To solve this problem, experts from service, device, and technical fields have been interviewed and the existing data have been reviewed against the secondary data. As a result, it was concluded that OLED technology for the service will only be applicable to the city in 2014, and the roadmap was modified accordingly.

**Step2: Verification of the Integrated Roadmap**
According to Kostoff & Schaller(2001), it is not possible to completely figure out the roadmap before the completion of it, even for the experts who drafted it, and it is required to get help from other experts to secure the credibility of the roadmap[32]. Hence, in this study, we added the verification processes into the methodology to have the validity and credibility of the roadmap, and had internal researchers and external experts in the field of u-City services and technical backgrounds involved in it.

3.2.7. Follow-up Stage
In this stage, the roadmap from the roadmap – development stage will be evaluated and an execution plan will be set up. The feasibility study and establishment of a sustained updating system will happen, too. In our case, we will perform continued adjustments and enhancement for the TRM though surveys and interviews with the
experts and using secondary data from the other research institutes and the media. This will serve our purpose in drawing a consensus on the completed roadmap as it contributes to the accuracy of the data. And, an integrated execution plan will be provided, which is based on the priority assessment via QFD analysis. This plan is to assist the decision making process for the selection of technology and development.

Furthermore, the information gathers since the definition stage of each territory will be accumulated as a DB for a more systematic sharing and management within the project team. This can be translated in line with the study by Kim [28] which pointed out ‘the establishment of adequate software system’ as the key factor in the utilization of the roadmap.

Figure 3-3 u-City TRM (after Adjustment)

4. Conclusion

4.1 Conclusion and Implication
In our study, we have carried out our research with emphasis on the classification system, development of roadmap formats, DB accumulation of the related information. Firstly, a literary study on the characteristics of u-City and the TRMs thereof has been done, and with this on the foundation, a study on the u-City TRM was performed.

As a result, a formalized and systematic technology roadmapping process that supports the projection and strategy making on services/devices/technology needed in a development project of u-City has been proposed. In particular QFD methodology in roadmap’s developing phase and the accumulated DB are unique characteristics in this technology roadmapping.

As using modified QFD, we could clearly distinguish the services and devices, as well as to identify the interdependencies between them. This is a step further from the existing studies that only suggested a modified QFD as it not only suggested but also applied in an actual case [2].

Also, Based on DB which is developed to collect and store various information, we will be able to support roadmap developments for other cities in the future or update the roadmap currently existing.

In this research, proposed roadmapping process is expected to be useful in TRM developments for not only u-City but also other technology based industries that involves a dramatic scale and continued needs for updating.

Acknowledgement
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A Suggestion on the Roadmapping Process to Make an Integration Roadmap

Science press, 2001


The 9th International Conference on Electronic Business, Macau, November 30 - December 4, 2009


Abstract
This article briefly summarizes a case study that investigates how wireless networks renovate a community hospital’s competitive operations. Due to limited resources, this small community hospital failed to follow specific implementation patterns that most large or more advanced hospitals experienced. Consequently, older versions of wireless networks have never been implemented in this hospital. Interestingly, as technology capabilities of wireless networks continued to emerge in the industry, certain leapfrog effects of these emerging wireless technologies helped this hospital to surpass many of its larger competitors who continued to operate on older versions of wireless networks and relevant technologies. This community hospital’s experiences thus provided insightful lessons for other SMEs that are facing constant technological changes in their respective fields.

Keywords: wireless network, leapfrog, SMEs, case study, hospital

Executive Summary
Wireless network and relevant mobile technologies have rapidly changed the business world and society [1-3]. Research community has also paid growing attention to this rapidly moving technology [4-6]. A variety of issues such as security [7, 8], network service provision [6], campus deployment of wireless LAN [7], and strategic positioning [9] have been widely discussed as well. Nevertheless, little attention is paid to some specific aspect—leapfrog effects—of wireless networks that might be of SMEs’ (small and medium enterprises) particular interests.

The leapfrog effects derive its analogy from a game “in which one player bends down and is vaulted over by another player” (Merriam-Webster Dictionary). It implies that one organization leaps forward and surpasses the other without following certain orders or procedures that are normally expected. In the emerging technology environment, leapfrog effects have been known to provide evolutionary results to organizations or individuals [10, 11]. For instance, the lack of technology infrastructure allows some poor nations to implement advanced technologies without carrying out previous infrastructural or technological requirements [12]. This situation often occurs when the development of emerging technologies creates rapidly changing features all the time and thus imposes substantial pressure on decision makers and organizations, particularly those that lack of resources.

Facing the exponential growth of wireless networks and relevant technologies in recent years, SMEs, lacking resources in comparison to larger organizations, inevitably experience such situation. Since 1999, wireless networks have quickly evolved into several standards including 802.11b, 802.11a, 802.11g, and the emerging 802.11n (standards.ieee.org). The industry apparently observed a newer and more capable network standard nearly every other year. Under such rapidly developing technology environment, it has become increasingly difficult for smaller organizations to evaluate and implement specific wireless network technology that best suits their needs. In other words, before smaller organizations completely grasp the features of technological capability, newer devices or services might have already appeared in the market. How SMEs survive or even compete in such a constantly developing environment offers an intriguing question for research investigation.

My research investigation is based on the case study methodology, which aims to provide an in-depth understanding of participant organizations’ experiences of wireless networks. Case study research is commonly recognized as a suitable methodology when the research purpose seeks a deep understanding of situations within single settings similar to my case investigation [13, 14].

The participant organization reported here is often considered as a small community hospital that was merged into one of the largest hospital chains in the U.S. in the late 1990s. Primary data collection was derived from semi-structured interviews with fifteen individuals including IT staff, physicians, nursing, and administrators. All interviews were digitally recorded and transcribed, which resulted in 134 single-spaced pages of textual data, which provided some preliminary findings of how leapfrog effects change this
community hospital’s IT and business operations.

Examples of preliminary findings included:
(1) Late implementation of wireless networks also led to newer version and higher functionality of wireless network technology.
(2) Newer version of VoIP (Voice over Internet Protocol) phones provided more convenient and satisfying features to physicians and nurses.
(3) Other new development of wireless technologies that were recently available provided immediate benefits that other hospitals have not yet experienced.

Implications could thus be extended to SMEs that face similar turbulent technology environment. More specifically, while SMEs might lack of financial and technological resources, their network infrastructure and technology requirements are often less complicated, which allows more flexible implementation or agile upgrade. Such agile movement could create certain leapfrog effects that help SMEs surpass larger organizations that often require complex project planning to upgrade or renovate network infrastructure. More detailed discussion of managerial implications and future research directions will be provided at the conference.

References
AN EXPLORATION INTO THAI INTERNET USERS’ ATTITUDE TOWARDS CAPTCHA

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Abstract
CAPTCHA standing for Completely Automated Public Turing test to tell Computers and Humans Apart has received a remarkable amount of attention. Deciphering distorted texts mostly in English is still a human, not a computer task, that could help prevent abuse of online services. The current CAPTCHA requires users to be able to read English alphabets. As such, Thai CAPTCHA may be the choice for Thai Internet users who are not familiar with English. However, no published work has examined the extent to which Thai Internet users are aware of CAPTCHA. This study thus attempts to survey their awareness of, and attitude toward, CAPTCHA.

Based on the 340 number of usable online questionnaire submission, Thai Internet users are aware of CAPTCHA but their understanding needs little fine-tune. Using exploratory factor analysis, their attitude towards CAPTCHA was classified into two dimensions. They perceived (1) drawback of general CAPTCHA and (2) feasibility of Thai CAPTCHA.

In addition to extending our insight into application of CAPTCHA in the Thai Internet user context, online service providers could initiate certain plans in response to their attitude and understanding.

Keywords: Thai users, CAPTCHA, Internet, attitude, exploration.

Problem statement
CAPTCHA or Completely Automated Public Turing test to tell Computers and Humans Apart is an automatically created, and publicly available test in which distorted texts are presented to humans so they could decipher the texts but computers could not [1]. This is how online service providers could prevent hackers from abusing their services since only humans, not computers, could decode the distortion. Typically, users will receive a box on a screen containing texts that had been altered so optical character recognition (OCR) can not read them. The users will then type those decoded texts in the box to confirm they are humans. Without CAPTCHA, spammers may be able to draft automated code that could automatically register for a large number of electronic mail accounts subsequently used in their scam. According to the example of CAPTCHA in Fig. 1, a subscriber will decode eight altered texts and type H5XGEYNA in the box beneath the array of texts to indicate he or she is a human, not automated computer software.

Figure 1: Example of CAPTCHA at hotmail.com

Texts have been acceptable for CAPTCHA implementation [3] [12]. However, other contents have also been experimented. Hoping to help the blinds, Holman and colleagues [2] incorporated audio into textual CAPTCHA. Their preliminary assessment seems promising. This could inspire other scholars to develop sound-based CAPTCHA [6]. Yan and El Ahmad [4] contended that the wide acceptance of text CAPTCHA comes from a fair number of advantages including ease of use and effectiveness in preventing the abuse. Indeed, they have suggested a number of recommendations on how to develop usable CAPTCHA [4].

Security in electronic services has been enhanced because of the application of CAPTCHA. Free e-mail service providers have encountered chronic problems of those who signed up for hundreds of thousands of e-mail accounts. These addresses may then be used (1) in directing marketing campaigns including those for pornography websites or (2) by those who want to flood their opinions into web boards or public blogs without being traced their identities.

Not only does CAPTCHA help preventing abuse for electronic services, it also helps presenting knowledge. The best example of this contribution is through the reCAPTCHA project [7]. There has been an attempt to digitize contents in old books using OCR software. However, certain words are not OCR-readable because of classic printing styles with faded ink and yellow pages. von Ahn and coworkers [7] have used those words to display in CATPCHA so that humans could help deciphering the words. This reCAPTCHA has improved the performance of digitizing old printed...
CAPTCHA does have drawback. Since it requires humans to read distorted characters, it may impose particular problems on visually-impaired people, the blinds or the illiterates. Such concern results in a few projects that have tried to use other details to tell computers and humans apart. Yahoo has allowed the blinds to register for their services by providing their numbers which will later be used to verify their blindness [8]. Holman and colleagues [2] offered both visual and audio CAPTCHA and found that the blinds have no problems working with the audio version. Also, they contended that the use of audio-based CAPTCHA would gain higher acceptance only when the speech recognition is much improved [2]. Instead of making an attempt to decode fuzzy texts, ones should be more comfortable working with images of cats or dogs These animals have been known as humans’ best friends. Golle [10] thus adopted this concept to implement pictorial CAPTCHA and his results, although not through the comparison, have ascertained the high accuracy of this type of CAPTCHA. Based on this similar pictorial CAPTCHA, Gossweiler and coworkers [6] at Google used an experiment to verify their image-orienting CAPTCHA. According to their experiment, humans simply need to orient an actor in the image to the upright position using a variety of hardware tools. Computers, on the other hand, should not as yet figure out this task. Orienting an image may require a higher skill than just typing texts. This could then be the major concern in the work of Gossweiler and coworkers [6].

Even with normal humans does CAPTCHA still have problems. It is sometimes too difficult for them to understand those distorted texts [3] [5]. Given the fuzzy design background plus the heavily distorted characters, ones may constantly ask to change many sets of CAPTCHA before they could figure out correctly the twisted texts [4]. These researchers thus offer tips on how to create more usable CAPTCHA. Gossweiler and coworkers’ [6] project that requires humans to orient an image to the upright angle seems to alleviate the difficulty of text-reading.

The final drawback has to do with CAPTCHA’s context dependency. The original and specific context is that (1) a human with certain English reading skill (2) must understand an array of distorted characters blended in an obscured background and then (3) use a psychomotor skill interacting with certain hardware in order to type the decoded texts into the box before submitting them to verify that he or she is not an automated computer program. While the second and the third specific requirements have been addressed in previous paragraphs, the first or language dependency is particularly of our interest.

English has been one of the most frequently used languages on the computer screen [19]. It has however exhibited serious threat to copyrighted contents in other languages or to those who are unfamiliar with English alphabets. That is, if Thai innovators have drafted an online contents and they hope these will be sharable among Thai people, it would imply a serious need to develop a language-sensitive CAPTCHA. It would thus be able to tell computers and, say, Thai people apart. This need is evident in Shirali-Shahreza M. H. and Shirali-Shahreza’s [12] project in which Persian and Arabic CAPTCHA was developed. However, the main focus of their work was on the technical algorithm and little is on how Persian or Arabic speakers would react to this CAPTCHA in their own language. Moreover, Yan and El Almad [4] confirmed that those with no background in Latin alphabets had more serious problems in decoding CAPTCHA than those with the background. Our extensive literature review also found no development in Thai context, nor an investigation into how Thai people perceive CAPTCHA in general or Thai-CAPTCHA in specific. The development of Thai CAPTCHA would be useless if Thai people hold negative thought towards general or Thai CAPTCHA. Consequently, we attempt to examine the extent to which Thai Internet users are aware of CAPTCHA, especially those in Thai language.

**Research objectives**

Based on the study’s problem statement, we pursued the following objectives: (1) survey Thai Internet users’ awareness and understanding of CAPTCHA, and (2) examine their attitude towards CAPTCHA.

**Methodology**

This section will discuss five methodological topics: population and samples; instrument; data collection execution; validity and reliability issues; and data analysis framework.

**Population and samples**

Given this research’s main concern, the population must be Thai Internet users. According to the 2008 report of National Statistical Office of Thailand [18], the size of this population is 9,320,000. With a 5% error rate, the number of samples is 400 [17].

Initially, we made an effort to use a probability-based sampling technique. However, we were unable to locate a complete list of Thai Internet users and their contact addresses. As a result, we had to adopt a purposive non-probability sampling through an online channel. We believe
that the online questionnaire should be the most feasible means to access to such samples. Once the instrument was ready (detail of its development is in the next section), we posted an invitation to participate in our project on a fair number of web boards to which a variety of our target samples had contributed. Although this may pose certain limitation to the findings, it helps access to the distant group of Thai Internet users, thereby increasing the study validity [17]. To ensure the reach of only Thai Internet users, the invitation and the instrument were in Thai. Those who do not understand Thai would therefore be excluded from the study.

Instrument
Given the online survey approach, our questionnaire consisted of three sections. The first one captured a sample’s awareness and understanding of CAPTCHA. In this section were three main questions asking them (1) whether they had seen CAPTCHA, (2) in which websites they had encountered CAPTCHA, and (3) what the title and the main benefits of this CAPTCHA are. In the second section were 16 scales measuring their attitude towards CAPTCHA. The scales were adopted and adjusted based on previous studies examining attitude towards similar concepts [13] [14]. The final section gathered the samples’ demographic details including screening questions to ensure the subject’s eligibility (i.e., Thai Internet users) to this current project.

The questionnaire was drafted in paper, reviewed by two experts in information technology and pretested by peers in software development companies. Once finalizing the content, we converted it into the online version using an open source survey management program named LimeSurvey. We configured the online questionnaire following the program instruction and pilot-tested it with a different set of peers in order to maximize the instrument usability.

Data collection execution
As explained in previous sections, we had to adopt the purposive non-probability sampling. We thus approached samples using announcements posted in various web boards. In the announcement was invitation to participate in the study, followed by a link to the website containing the questionnaire. When a sample completed the response, all data were recorded in MySQL database. The data collection process took about 30 days to achieve 340 usable responses.

Validity and reliability issues
To respond to this study’s objectives, we strive to ensure the finding’s reliability and validity. Such effort includes the followings.

The questionnaire development received our high priority. Based on previous work [8] [13] [14], all items were carefully crafted so that samples would understand them properly. Several rounds of pretests and pilot tests were carried to improve the quality. Finally, each questionnaire was accompanied by an e-mail message detailing the researchers and their affiliations via which samples could contact in case of questioning.

Once transformed into the online version, the questionnaire was assessed, especially on how a sample would be able to fill in the questionnaire. Such assessment were to ensure (1) robustness of this online version, (2) the smooth flow of answering, and (3) the complete development and conversion of data file for further statistical analysis.

Data analysis framework
The framework has two folds. First, we employed descriptive statistics to report (1) the extent to which samples of Thai Internet users become aware and understanding of CAPTCHA and (2) their demographics. Second, we adopt an exploratory factor analysis (EFA) with principal component extraction and varimax rotation in order to examine broader constructs underlying their attitude towards CAPTCHA.

Given the exploratory nature of this research, it would be premature to test any hypotheses. However, our work should inspire following scholars to develop or even test any hypotheses in their own studies.

Results
Respondents’ demographics
Table 1 presents important characteristics of survey respondents, the highlight of which are as follows:
- Each gender holds about half of the respondents. 6 in 10 of them are 26-30 years old. The largest portion (95%) hold at least college degree and about a quarter have a computer-related major.
- The majority (85%) of respondents live in Bangkok. Note that 3% of them reside abroad. About the same portion (85%) have at least six years of experience with the Internet. When asked if having subscribed to any online services, 99% of the samples admitted it.

Table 1: Respondents’ demographic (N=340)

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>N (%)</td>
<td></td>
</tr>
</tbody>
</table>
Gender
Male 163 (52)
Female 177 (48)

Age
< 26 yrs 74 (22)
26-30 206 (61)
31-40 51 (15)
41-50 9 (2)

Highest education
Less than college 18 (5)
College degree 195 (57)
Master degree or higher 127 (38)

Whether educational major is computer-related
Yes 86 (25)
No 254 (75)

Current residency
In Bangkok metropolitan 289 (85)
In provincial area 39 (12)
Residing abroad 12 (3)

Experience with Internet (years)
< 3 yrs 3 (2)
3-5 47 (14)
6-9 149 (44)
10+ 141 (41)

Online service subscription
Yes 337 (99)
No 3 (1)

Thai Internet users’ awareness and understanding of CAPTCHA

According to Table 2, nearly all (99%) respondents had seen CAPTCHA. 88% contend that they had experienced CAPTCHA when they were engaged in clip, image or file sharing services. Indeed, the other two of the top three websites (or services) on which the respondents had seen CAPTCHA are webboards (60%) and e-mail (53%) services. The three locations where the smallest portions of the respondents admitted their encounters with CAPTCHA are (1) community or portal websites, (2) game and (3) news services. While the first accounts for 16%, the final two choices account for 14% and 8%, respectively.

We also attempted to learn the extent to which the respondents know about the proper title of CAPTCHA. While 59% of them admitted they had no idea of the title, 41% claim they were aware of it. Yet, only 9% of those who claimed they knew it were able to identify the correct title of CAPTCHA. This means, besides 59% who reported they did not know the title, there are still the other 32% who thought they had known it but what they knew was wrong. Among the incorrect names, CODE seems most common among these respondents, followed by PASSWORD, CHECK, and ENCRYPT.

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whether they had seen CAPTCHA (N=338)</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>335 (99)</td>
</tr>
<tr>
<td>No</td>
<td>3 (1)</td>
</tr>
<tr>
<td>On which websites or services CAPTCHA was seen (N=340=100%)</td>
<td></td>
</tr>
<tr>
<td>Clip image or file sharing</td>
<td>298 (88)</td>
</tr>
<tr>
<td>Webboards</td>
<td>205 (60)</td>
</tr>
<tr>
<td>E mail</td>
<td>181 (53)</td>
</tr>
<tr>
<td>Online transaction services</td>
<td>94 (28)</td>
</tr>
<tr>
<td>Blogs, or online diaries</td>
<td>87 (26)</td>
</tr>
<tr>
<td>Social network</td>
<td>84 (25)</td>
</tr>
<tr>
<td>Music offer</td>
<td>60 (18)</td>
</tr>
<tr>
<td>Community or portal webs</td>
<td>54 (16)</td>
</tr>
<tr>
<td>Game services</td>
<td>48 (14)</td>
</tr>
<tr>
<td>News services</td>
<td>28 (8)</td>
</tr>
<tr>
<td>Title in which CAPTCHA is known (N=335)</td>
<td></td>
</tr>
<tr>
<td>CODE</td>
<td>36 (11)</td>
</tr>
<tr>
<td>CAPTCHA</td>
<td>31 (9)</td>
</tr>
<tr>
<td>PASSWORD</td>
<td>15 (5)</td>
</tr>
<tr>
<td>CHECK</td>
<td>15 (5)</td>
</tr>
<tr>
<td>ENCRYPT</td>
<td>14 (4)</td>
</tr>
<tr>
<td>IMAGE</td>
<td>9 (3)</td>
</tr>
<tr>
<td>SUBMIT</td>
<td>6 (2)</td>
</tr>
<tr>
<td>BLIND</td>
<td>5 (1)</td>
</tr>
<tr>
<td>GOTCHA</td>
<td>2 (.6)</td>
</tr>
<tr>
<td>VISION</td>
<td>1 (.3)</td>
</tr>
<tr>
<td>ERROR</td>
<td>1 (.3)</td>
</tr>
<tr>
<td>I don’t know</td>
<td>199 (59)</td>
</tr>
</tbody>
</table>

Although less than 10% were aware of CAPTCHA’s correct title, 61% of the respondents knew its principal benefit: to tell computers and humans apart (see Table 3). 3 out of 10 samples misunderstood that CAPTCHA was mainly to authenticate service subscribers. Less than 10% improperly perceived the advantages. These incorrectly perceived advantages included protecting users from computer virus, preventing typographical error and signaling age-restricted websites. Readers must note from Table 3 that 16% of the respondents had no idea of what CAPTCHA could offer.

Attitude towards CAPTCHA

We asked the samples 16 scales to measure their attitude towards CAPTCHA. They would rate one if they found the scale least
favorable or five if most favorable. Descriptive statistics of these 16 scales are in Table 4. Skewness and kurtosis statistics are included to indicate that the distributions of these variables are almost normally distributed [20]. The three most favorable attitude scales are (1) there may be other better ways to do what CAPTCHA does, (2) Thai CAPTCHA could support the services only for those knowing Thai, and (3) CAPTCHA is effective. Their arithmetic means are 3.67, 3.66 and 2.96, respectively. Based on these three items, it seems that the respondents agree to the large extent on CAPTCHA’s positive attributes (i.e., effectiveness, good support for Thai people), although they perceive CAPTCHA may not be the best to distinguish between a man and machine (i.e., better tools than CAPTCHA may exist).

Table 3: Perceived benefits of CAPTCHA (N=340 =100%)

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>To tell computers and humans apart</td>
<td>61%</td>
</tr>
<tr>
<td>To authenticate service subscribers</td>
<td>27%</td>
</tr>
<tr>
<td>To protect against computer virus</td>
<td>9%</td>
</tr>
<tr>
<td>To prevent typographical error</td>
<td>8%</td>
</tr>
<tr>
<td>To indicate age-restricted websites</td>
<td>3%</td>
</tr>
<tr>
<td>No idea of what possible benefits are</td>
<td>16%</td>
</tr>
</tbody>
</table>

At the other end, the respondents rated three scales of attitude as least favorable: (1) Thai CAPTCHA is easier than typical CAPTCHA, (2) the respondents try to avoid working with CAPTCHA-enabled websites and (3) website designers find it difficult to incorporate CAPTCHA into their design. Their arithmetic means are 2.01, 2.19 and 2.26 respectively. Least favorable attitude may indicate a certain degree of disagreement. As such, interpretation of the three least favorable items could be that the respondents believe Thai CAPTCHA is somewhat difficult but still willing to use the websites equipped with carefully-designed CAPTCHA.

Such interpretation regarding Thai Internet users’ attitude towards CAPTCHA was made based solely on the three most and three least favorable attitude items. While it is useful to some extent, this understanding may present only fraction of small pictures of their attitude. Consequently, we performed an exploratory factor analysis on these attitude items in order to explore broader constructs underlying their perceptions. Prior to that, however, the scales with marginal variances (i.e., their standard deviations are less than one) were excluded from this analysis since they would not serve to differentiate among emerging factors [15]. The excluded items are detailed in Table 4.

Table 5 presents results of factor analysis that include the factor pattern matrix in which loadings of the attitude items on the two emerging factors are also included. The two factors together explained about 43% of the variance among the attitude items. According to Table 5, Factor I accounted for 23.2% of the variance. Highest loadings of the five attitude items on the first factor reflect Thai Internet users’ perceived drawback of general CAPTCHA. Factor II accounted for 19.7% of the variance. Three items loaded highest on this factor indicating their perceived feasibility of Thai CAPTCHA. Four attitude items were not assigned to any of these two factors since they did not load cleanly on either of the two factors.

We inspected the quality of these factor analysis results using Kaiser-Meyer-Olkin (KMO) index and Bartlett’s test of Sphericity. The KMO index is 0.779, the value of which Kaiser [16, p. 35] considered “meritorious.” Also, the statistics of Bartlett’s (996.686, df=66, p<.000) contends that the two factors parsimoniously and properly underscore Thai Internet users’ attitude towards CAPTCHA.

Table 4: Attitude towards CAPTCHA: Descriptive statistics

<table>
<thead>
<tr>
<th>Statements</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>There may be other better ways to do what CAPTCHA does</td>
<td>3.67</td>
<td>1.049</td>
<td>.474</td>
<td>-3.19</td>
</tr>
<tr>
<td>Thai CAPTCHA could support services for those knowing Thai language</td>
<td>3.66</td>
<td>1.327</td>
<td>-.644</td>
<td>-7.80</td>
</tr>
<tr>
<td>CAPTCHA is effective*</td>
<td>2.96</td>
<td>.878</td>
<td>-.089</td>
<td>-1.56</td>
</tr>
<tr>
<td>CAPTCHA enhances website creditability*</td>
<td>2.95</td>
<td>.952</td>
<td>-.257</td>
<td>-.432</td>
</tr>
<tr>
<td>I have confidence in CAPTCHA*</td>
<td>2.80</td>
<td>.949</td>
<td>-.106</td>
<td>-.48</td>
</tr>
<tr>
<td>Decoding CAPTCHA is difficult</td>
<td>2.69</td>
<td>1.242</td>
<td>-.213</td>
<td>-.947</td>
</tr>
<tr>
<td>I am more comfortable working with a website if it contains Thai texts</td>
<td>2.65</td>
<td>1.284</td>
<td>.283</td>
<td>-.942</td>
</tr>
<tr>
<td>I don’t like those unreadable texts</td>
<td>2.52</td>
<td>1.345</td>
<td>-.433</td>
<td>-.989</td>
</tr>
</tbody>
</table>

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Thai websites have capable CAPTCHA* 2.46 .896 .396 .322
Websites are more secured with Thai CAPTCHA 2.44 1.280 .479 -.885
Thai CAPTCHA may support proper use of copyrighted content 2.38 1.129 .401 -.636
Thai websites should use Thai texts in CAPTCHA 2.34 1.276 .630 -.643
CAPTCHA is unnecessary 2.27 1.060 -.601 -.184
Web designers find it difficult to incorporate CAPTCHA into the design 2.26 1.091 -.616 -.230
I try to avoid working with CAPTCHA-enabled websites 2.19 1.091 -.665 -.296
Thai CAPTCHA is easier than typical CAPTCHA 2.01 1.092 1.003 .397

Items with a standard deviation less than 1.00 are removed from factor analysis.

Table 5: Factor analysis result for attitude towards CAPTCHA

<table>
<thead>
<tr>
<th>Attitude</th>
<th>Factors I</th>
<th>Factors II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor I: Drawback of general CAPTCHA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I try to avoid working with CAPTCHA-enabled websites</td>
<td>.79</td>
<td>.11</td>
</tr>
<tr>
<td>Decoding CAPTCHA is difficult</td>
<td>.76</td>
<td>.01</td>
</tr>
<tr>
<td>I don’t like those unreadable texts</td>
<td>.75</td>
<td>-.03</td>
</tr>
<tr>
<td>Web designers find it difficult to incorporate CAPTCHA into the design</td>
<td>.74</td>
<td>.17</td>
</tr>
<tr>
<td>CAPTCHA is unnecessary</td>
<td>.57</td>
<td>.26</td>
</tr>
<tr>
<td>Factor II: Feasibility of Thai CAPTCHA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thai websites should use Thai texts in CAPTCHA</td>
<td>.10</td>
<td>.82</td>
</tr>
<tr>
<td>I am more comfortable working with a website if it contains Thai texts</td>
<td>.00</td>
<td>.73</td>
</tr>
<tr>
<td>Thai CAPTCHA is easier than typical CAPTCHA</td>
<td>.16</td>
<td>.82</td>
</tr>
<tr>
<td>Percent of Variance Explained</td>
<td>23.2%</td>
<td>19.7%</td>
</tr>
<tr>
<td>Not assigned</td>
<td></td>
<td></td>
</tr>
<tr>
<td>There may be other better ways to do what CAPTCHA does</td>
<td>.17</td>
<td>.13</td>
</tr>
<tr>
<td>Websites are more secured with Thai CAPTCHA</td>
<td>.16</td>
<td>.48</td>
</tr>
<tr>
<td>Thai CAPTCHA could support services for those knowing Thai language</td>
<td>-.02</td>
<td>-.04</td>
</tr>
<tr>
<td>Thai CAPTCHA may support proper use of copyrighted content</td>
<td>.26</td>
<td>.36</td>
</tr>
</tbody>
</table>

In addition, we used Cronbach’s alpha to examine the extent to which items that have highest loadings on each of the two emerging factors are reliable. The Cronbach’s alpha for the Drawback factor’s five items and that for the Feasibility factor’s three items are 0.78 and 0.74, respectively. Since a threshold of 0.70 or higher will indicate acceptable reliability [21], it is reasonable to claim the reliable quality of the two factors’ components.

Conclusion and Discussion
Based on the 340 usable questionnaire returns, our respondents are equally men and women, mainly (76%) in between 26-40 years of age and largely (95%) college graduates. Also, 9 out of 10 respondents have at least six years of experience using the Internet and virtually all of them have subscribed to online services. Comparing this profile to those Thai Internet users in [18], it is reasonable to assume the representativeness of our samples.

Thai Internet users are highly aware of CAPTCHA. The evidence of this overwhelming awareness comes from 99% of the samples could recall their encounters with CAPTCHA. Moreover, 88% confirmed its appearance in content-sharing websites. Although they are aware of CAPTCHA, their understanding seems partial. That is, less than a half of our respondents claimed they knew the proper term of CAPTCHA. Among those who made such claim, only 6% were able to identify CAPTCHA’s proper title. Had we asked what CAPTCHA stands for, it would have been embarrassing for the respondents. Furthermore, about a quarter (16%) of them admitted having no ideas of what benefit CAPTCHA could offer. About 73% of those who claimed knowing it were able to present CAPTCHA’s correct main benefit: To tell computers and humans apart.

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Results of Thai Internet users’ assessment of 16 attitude items indicated they were in favor of CAPTCHA’s effectiveness and support for Thai practitioners, if implemented in Thai. However, they doubt if there could be other ways offering better services than CAPTCHA. If individuals’ least favorable attitude indicates their agreement in the opposite of an attitude statement, the following conclusion should be valid. That is, Thai Internet users would agree that Thai CAPTCHA is as complicated as other CAPTCHA but they would have no objection working with websites containing thoughtfully-designed CAPTCHA.

A factor analysis on the 16 attitude items has shed new light on broader constructs underlying Thai Internet users’ perception towards CAPTCHA. Indeed, they perceive drawback of general CAPTCHA and feasibility of Thai CAPTCHA. Two conclusions are from these findings. First, Thai Internet users view general CAPTCHA as it still has certain limitations including the difficulty in decoding unreadable and heavily distorted texts. The second conclusion comes from the finding in which Thai Internet users perceive possible feasibility of Thai CAPTCHA. Such feasibility includes Thai Internet users’ preference to work with Thai CAPTCHA-enabled websites and Thai CAPTCHA’s ease of use.

The conclusion of these findings leads to the study’s contribution. Theoretically, it extends insight into application of CAPTCHA to the context of Thai Internet users. This non-English implementation has received more recognition [12]. Practically, we could offer two recommendations for practitioners. First, Thai Internet users are well aware of CAPTCHA but still hold incomplete understanding towards it. To prevent abuse of online services, responsible agents must therefore convey to the public correct messages on the concepts of CAPTCHA. Once they are clear about CAPTCHA, more adoptions of CAPTCHA in Thai online business environment could be on its way. Second, it is unfortunate that Thai Internet users perceive possible feasibility of Thai online business environment could be on its way. Since our focus is on Thai Internet users, it may pose the second limitation on generalizability of our findings. While the findings have shed light on the users, we have little to offer on Thai online practitioners. Fellow researchers may want to examine the practitioners’ reactions to both Thai and general CAPTCHA. The results once available would present a more complete picture of CAPTCHA adoption in Thai online business environment.

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THE VALUE OF SPONSORED ADS FOR XML DOCUMENTS

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Abstract
We study how sponsored ads which are classically inserted in Web pages could also be inserted in XML documents such as Ebooks. Advertisers set prices for words and DTDs, and a Vickrey mechanism would select an ad for some price.

The approximate distance between a document and any DTD, which is easy to compute, allows to associate a value to a new document in such a market, as a combination of the price and the distance.

We describe a simple auction for one ad and its generalization to several ads.

Keywords: XML, distances, auctions, value of information

Introduction
There is a large source of new documents in normalized XML formats, which can be freely distributed: short novels, technical documents, catalogs. This is a new market for sponsored adds.

We consider an economic setting, where sponsored ads can be inserted into XML documents, in particular Ebooks viewed as specific XML documents, and where advertisers target DTDs (Data Type Definition, i.e. XML Schemas) which generalize the classical keywords and capture the structure of the documents. As for sponsored ads such as GoogleAdWords where the advertisers define an ad and set private prices for sets of keywords, the advertisers define a similar ad but set private prices for several DTDs. We study a mechanism, inspired by Vickrey auctions which will allocate an ad to any Ebook for some price.

We use an Edit distance between documents and DTDs, which is easy to approximate [1], even on Streaming documents and associate to any Ebook its relative distance 0<\(d<1\) to all the known DTDs of the central mechanism. If the Ebook is at distance \(d_i\) of DTD \(\alpha\), valued for a price \(p_\alpha\), we define its private value as \((1- d_i)\cdot p_\alpha\). We then set a Vickrey auction [2] on these values: we allocate the ad with the highest value for a price of the second best value. We will show that this mechanism keeps the fundamental Vickrey properties.

This approach can be generalized to several ads in a given Ebook, and to several positions inside the document. In the first case, we allocate \(k\) ads instead of one ad, and in the second case we consider the distance as a dynamic value over the streaming document and record the positions which minimize the distances to several DTDs.

References
RESEARCH ON REPATRIATES’ INCENTIVE MECHANISM: BASED ON KNOWLEDGE TRANSFER PERSPECTIVE

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Abstract
Repatriates’ experience and knowledge is important competition advantage for the parent company in international business. This paper discussed repatriates’ incentive mechanism based on the perspective of knowledge transfer, established theoretic model of repatriates’ knowledge transfer incentive mechanism, and pointed out that knowledge transfer was a process of repeated game between the parent company and the repatriates, the establishing of knowledge transfer incentive mechanism was trying to reach the equilibrium of the game, it provided theoretic basis for promoting repatriates’ knowledge transfer effectivly.

Keywords: Repatriates, Incentive, Game, Knowledge Transfer

Introduction
Given the globalization of economies, the number of the expatriates is on an upward trend, consequently, repatriates management has been paying more attention. For a long time, researches from home and abroad always put emphasis on repatriates’ welfare and demand satisfaction from the perspective of cross-culture management. However, there is a neglected problem, what effect repatriates’ uncoded knowledge and the implication of that knowledge will have on increasing the level of the knowledge and enhancing the development of company. In practice, the result is that the repatriates choose to leave the company for they can’t bring their ability into play, accompanied with the companies’ lose for the spillage of knowledge. This paper solved this problem discussed above, it explored the repatriates’ incentive problem under knowledge transfer, in order to improve strategy consciousness for knowledge transfer, and provided theory evidence for establishing reasonable repatriates’ incentive mechanism.

Repatriates: knowledge assets attribute
Repatriates is not only a key resource to the knowledge about the host country’s market and economy, but also the important channel for transferring the knowledge across nations, they are the company’s vital human capital. Usually, repatriates will gain five kinds of knowledge during their overseas assignments: First, market related knowledge. Antal and Martin pointed out respectively that market related knowledge is a necessary condition for a company to operating successfully in a given market[1][2]. Under different circumstance, repatriates will learn to understand the new environment, they can gain the knowledge relate to the given market, such as local language, custom and business operating modes. Second, personal skills. These individual skills have a wide range, such as cross-culture, openness, confidence, flexibility and tolerance. Mayhofe and Adler indicated the improvement of repatriates’ these kinds of skills[3][4]. Third, managerial skills related to job. For the different working environment, repatriates should improve their managerial skills. Downes and Thomas manifested that their communication skills, project management skills and problem-solving skills will all be improved[5]. Fourth, network knowledge. Adler and Martin showed that repatriates’ social network will be established and extended. When they are doing business in the host county, they will interact with lots of local and foreign people, then their social network will be established, they can also extend their network in parent country. Fifth, general managerial knowledge. This kind of knowledge will help them become the candidates for senior management positions.

Concerning the five kinds of knowledge, comparatively speaking, some of them can be coded and transferred to company’s employees easily, such as market related knowledge, they are called explicit knowledge. Some can be transferred partly, such as network knowledge, however, others can be transferred hardly or not, for instance, personal skills, job related managerial skills and so on, they are called tacit knowledge. In order to get benefits from the knowledge, the company should put emphasis on repatriates management and motivation, and promote their knowledge transfer to the company. The useful knowledge which was arising from and be transferred by the repatriates, can be seen as valuable asset which is hard to copy, company can preserve and develop this kind of asset, and transfer it into rare competitive advantages in competition between companies,
which is impossible to imitate. However, if the company can’t be aware of the value of repatriates’ knowledge, or apply the assets without appropriate human resource policies and practice, it will lead to knowledge spillage, then the under-valued asset will bring lose to the company in global competition. Therefore, the importance of the repatriates’ asset attribute should be well appreciated.

Characteristics, process and cost of repatriates’ knowledge transfer

1. Characteristics of repatriates’ knowledge transfer

In terms of the analysis about the repatriates’ knowledge asset attribute above, we can indicate that knowledge transfer consist of explicit knowledge transfer and tacit knowledge transfer. Market related knowledge is explicit knowledge, it can be exchanged between individual employees easily, while something like personal skills, or job related managerial skills, which is hard to code, express or formulate, can not be transferred easily. Therefore, in order to enhance knowledge transfer effectively, we should focus on understanding the characteristics of tacit knowledge, these characteristics can be summarized as [6]: (1) Implicitness: Knowledge acquisition needs personal to experience, practice and understand. (2) Exclusivity: Individuals take the gained knowledge as a part of status and self-worth, so usually they do not want to share it with others free of charge. (3) Situation: Tacit knowledge is different when situation changes. (4) Accountability: Personal knowledge is directly related to personal performance in company, which determines the wealth and status individual will get. (5) Contribution: Personal knowledge forms organization’s knowledge, which is the basis of company’s sustainable competitive advantages, and will contribute to the competitiveness of the company.

2. Process of knowledge transfer

The process of repatriates transferring their knowledge to parent company’s employees is the basis of company’s knowledge transfer. Based on Szulanski about knowledge transfer process model and Alice Lam about knowledge transfer situation model[7][8], this study established repatriates’ knowledge transfer process model as following (see graph 1)

3. Cost of knowledge transfer

Knowledge transfer is defined as the process that the sender transfers the knowledge to the recipient, and should make sure that the recipient understand and accept the knowledge. Knowledge transfer process involves factors as knowledge sender, content of the knowledge, knowledge transfer channel and knowledge recipient, all these factors will directly affect the transfer cost [9]. Costs of repatriates’ knowledge transfer include:

(1) Cognitive cost. Cognitive cost is the result of the unsuccessful mutual understanding between sender and recipient, which will lead to lose of knowledge. The level of cognitive cost will be affected by the content of knowledge, knowledge transfer channel, organization characteristics of both sender and recipient, willing to transfer and experience of knowledge transfer. When the degree of tactitness of the knowledge is high, or the transfer channel being used can’t be understand easily, or knowledge characteristics has been changed by the characteristics of parent company or the unmatch of different company units, or when repatriates lack willing and experience to transfer, the cognitive cost will be increased.

(2) Opportunism cost. For repatriates, before knowledge transfer, potential knowledge recipient is unknown, so if the knowledge has been transferred successfully, the potential recipient don’t have to pay for it, moreover, they can resell the knowledge with no marginal costs, if parent company don’t have any scientific incentive or preserve mechanism, this kind of knowledge exchange will increase the cost of repatriates’ knowledge transfer. In addition, repatriates will be glad to see the fact that parent company relies on their knowledge, it means they can gain more value, and enhance their position in company, therefore, this motive to accumulate knowledge personally will hamper the share of knowledge, finally increase the cost of knowledge transfer.
Design the repatriates’ knowledge transfer incentive mechanism

1. Design principle
According to the above analysis about characteristics of repatriates’ knowledge transfer, we can analyze the existence of cognitive cost and opportunism cost of knowledge transfer cause obstacles in knowledge transfer especially tacit knowledge transfer. In order to reduce these obstacles, the company must establish the incentive mechanism to promote the knowledge transfer. Based on incentive theories, incentive is divided into intrinsic incentive and extrinsic incentive. Intrinsic incentive is brought by the job itself including the sense of interesting, achievement, responsibility and so on, and it performs as self-realization. Extrinsic incentive is the rewards except job, including the increase in remuneration, the promotion, and the improvement of interpersonal relationship and so on. If the intrinsic incentive and extrinsic incentive are the mutual independence and the additive relationship, dividing the intrinsic incentive and extrinsic incentive, corresponding to the division of the labor psychology that shows the concerning for intrinsic incentive and economic psychology that shows the concerning for extrinsic incentive, the company can manage according to their relative strengths and weaknesses to improve the incentive effect, however, theoretical research result indicates that under the existence of intrinsic incentive, these two kinds of incentive can exchange, namely there will have the mutual crowding effect [10]. In accordance with the economic principle, the company pays remuneration based on the staff’s marginal productivity, and the reliance on extrinsic incentive is more than on intrinsic incentive, the ideal extrinsic incentive system strictly obeyed the performance to pays remuneration, however, because of the existing of the incentive mutual crowding effect, all kinds of extrinsic incentive based on paying remuneration by performance strictly often has non-efficient behaviors in the circumstance of high intrinsic incentive, while intrinsic incentive has more advantage of overcoming the cognitive cost and opportunism cost in the process of improving tacit knowledge transfer. Therefore, incentive mechanism model in this paper is established in the theoretical analysis above.

2. Theory model of repatriates’ knowledge transfer
The repatriates’ knowledge transfer is the process of transfer their valuable knowledge from overseas to the parent company staff which involves two or more employees. Their knowledge transfer can affect the parent company staff’s behaviors, and can be restricted by parent company staff’s behaviors simultaneously. Knowledge transfer is the dynamic game process between repatriates and the parent company staff, so the construction of knowledge transfer incentive mechanism is a balanced outcome of the two side game actions.

Assuming that both of repatriates and parent company staff are the rational decision-making subject, they pursue maximization of individual income and their strategies are knowledge transfer or not. The value of repatriate A and parent company employee B is $W_{A1}$ and $W_{B1}$ respectively, their knowledge absorptive capability coefficient is $a_A$ ($0 < a_A \leq 1$) and $a_B$ ($0 < a_B \leq 1$) separately. New value produced after the knowledge transfer is $W_{A2}$ and $W_{B2}$, and the sender’s negative effect brought by the knowledge transfer is $W_{A3}$ and $W_{B3}$.

To simplify the question analysis, assuming that repatriates and parent company staff have the same value and absorptive capability, that means $W_{A1} = W_{B1} = W_1$, $a_A = a_B = a$, then the value produced after the knowledge transfer is the same as the sender’s negative effect brought by the knowledge transfer, namely $W_{A2} = W_{B2} = W_2$ and $W_{A3} = W_{B3} = W_3$.

Because repatriates may have game with many different employees in parent company, this constitutes repeated game and its game payoff matrix is shown as following graph 2:

As to the parent company which want to promote effective knowledge transfer, to establish a rational incentive mechanism means to make the repeated game above to sub-game perfect Nash equilibrium, at this time, repatriates A begins to choose knowledge transfer and continue to choose knowledge transfer, while once A doesn’t choose knowledge transfer, he will choose non-transfer forever. Similarly, if repatriates A once chose non-transfer, parent company employee B will also choose knowledge transfer. Otherwise, if repatriates A once chose non-transfer, parent company employee B will always choose
non-transfer. In this case, (transfer, transfer) is sub game perfect Nash equilibrium, and each employee obtains the income is $(1 + a)W_1 + W_2 - W_3$.

Specifically, assumed the discount factor is $\delta$, then we analyze repatriates A's selection strategy. If employee A chose non-transfer in a certain game stage, his income in this stage is $(1 + a)W_1 + W_2$, but his behavior would trigger B's "never transfer" punishment, so A's income of every subsequent stage is $W_1$. If A chose knowledge transfer, his income in this stage is $(1 + a)W_1 + W_2 - W_3$, because the both sides have knowledge transfer, the income of follow-up knowledge transfer process is $(1 + a)W_1 + W_2 - W_3$, and the more times of repeated game, the more income. If the repeated times are many enough to make total income meet the equation as follow:

$$(1 + a)W_1 + W_2 - \delta W_1 - \delta^2 W_1 - \delta^3 W_1 - \ldots = (1 + a)W_1 + W_2 + \delta W_1, (1 - \delta)$$

Then knowledge transfer is A's optimal choice. So, if meets the following conditions:

$$(1 + a)W_1 + W_2 + \delta W_1, (1 - \delta)$$

$$(aW_1 + W_2)$$

$$(1)$$

$$(2)$$

$$(3)$$

Then there is $\delta \geq W_3 / (aW_1 + W_2)$. That is, when the discount factor is big enough and bigger than $\delta$, A will choose knowledge transfer.

As to B, assumed $\delta \geq W_3 / (aW_1 + W_2)$, because B concerned the income of a certain stage, and when only he expected that A would continue to choose the knowledge transfer, B would choose the knowledge transfer. Because B expected A once chose transfer and continues to choose the knowledge transfer, the knowledge transfer is the optimal choice of B, otherwise, if A once chose non-transfer, B would never have knowledge transfer with A.

From the above analysis, it shows that, if $\delta \geq W_3 / (aW_1 + W_2)$, (transfer, transfer) is a sub game perfect Nash equilibrium in the repeated game between repatriates and parent company staff, and Pareto optimality (transfer, transfer) is every stage's equilibrium result, namely, they must give up the short-term income to obtain long-term income, so the staff choose the knowledge transfer and realize a win-win situation.

3. Discussion on theoretical model's application

The principle of the construction of above incentive mechanism model lied in after introducing the repeated game, the staff within organization considers about the discount factor of the total income rather than once income. As long as the discount factor of future income is big enough, the effective knowledge transfer can be achieved and maintained by the repeated game. This means the bigger long-term income of staff within organization, the more choice of knowledge transfer between employees. However, in reality, the company may face a lot of complex situations in promoting the effective repatriates' knowledge transfer which can affect the realization to the ideal equilibrium state. Analysis as follows:

(1) The internal situation of parent company, the characteristics of both sides in knowledge transfer and the different transfer channels required by the explicit and tacit knowledge can format the obstacles in the proceed of knowledge transfer and increase the cognitive cost of knowledge transfer which may cause repatriates and parent company staff to choose "knowledge non-transfer behaviors".

(2) The most difficulties in repatriates' knowledge transfer are obstacles of tacit knowledge transfer, which bring about the characteristics of tacit knowledge including exclusivity, accountability and contribution which can increase the opportunism cost of knowledge transfer and cause repatriates and parent company staff to choose "knowledge non-transfer behaviors".

(3) The repeated game model cannot realize sometimes in the real word for situational factors, if the company pays less attention on the intrinsic incentive and doesn’t build the awareness of long-term incentive mechanism of knowledge transfer, it also can lead to both of repatriates and parent company staff to choose “knowledge non-transfer behaviors”.

Conclusions

Repatriates are very valuable knowledge assets to parent company, however, only when their knowledge can be transferred, these assets can play their roles. Based on the above, the parent company must establish the effective repeated game mechanism. And this mechanism can have impact of the staff's choice and produce the optimal solution, namely, achieving the sharing purposes in the knowledge transfer. Therefore, the following measures must be taken:

(1) Making the repatriates' career planning. The parent company should have a complete career planning about repatriates,
including: the expatriate assignments’ nature, characteristics, time-span, the selection and training of expatriates; all kinds of problems may faced during the expatriate work period, the commutation with parent company; the arrangements after they returning and so on, especially the strengthen for the repatriates’ planning and management, so that when they return after finishing the assignments, they can adapt the work in parent company more quickly, have a good expectation to using their knowledge and experience, and be willing to carry on knowledge transfer to parent company.

(2) Establishing the knowledge transfer and sharing environment. The parent company must establish the knowledge environment which all of employees are willing to transfer and share knowledge to increase the discount factor of repeated game. Specifically, that is to strengthen the mutual communication among the staff so that the staff can fully realize the importance of knowledge transfer. The company must pay attention on the incentive of staff’s knowledge transfer and sharing behaviors, such as establishing the incentive systems including the knowledge salary payment system, knowledge promotion system and knowledge training system.

(3) Strengthening the effect on tacit knowledge transfer by the intrinsic incentive. On the one hand, the tacit knowledge is often accompanied by the team’s creative work and its complexity and difficulty makes the participants believe completion of the task itself is a kind of incentive and challenge. At this time, the parent company can increase the intrinsic incentive to enhance the participants’ learning and communication capacity and to promote the sharing knowledge in the team. On the other hand, because the tacit knowledge is difficult to be monitored and to be evaluated which make the extrinsic incentive often be ineffective. So parent company should rely on the intrinsic incentive to form the staff’s self-restricting mechanism which can promote the tacit knowledge separated from the supervisor and carried on transfer spontaneously, thus it will enhance the validity of knowledge transfer.

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References

INVENTORY MANAGEMENT OF PLATELETS IN HOSPITALS: OPTIMAL INVENTORY POLICY FOR PERISHABLE PRODUCTS WITH EMERGENCY REPLENISHMENTS

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Abstract
Platelets are short-life blood components used in hospital blood transfusion centers. Excluding time for transportation, testing, and arrangement, clinically transfusable platelets have a mere three-day life-span. This paper analyzes a periodic review inventory system for such perishable products under two replenishment modes. Regular orders are placed at the beginning of a cycle. Within the cycle, the manager has the option of placing an emergency order, characterized by an order-up-to level policy. We prove the existence and uniqueness of an optimal policy that minimizes the expected cost. We then derive the necessary and sufficient conditions for the policy, based on which a heuristic algorithm is developed. A numerical illustration and a sensitivity analysis are provided, along with managerial insights. The numerical results show that, unlike typical inventory problems, the total expected cost is sensitive to the regular order policy. It also shows that the optimal policy is sensitive to changes in the expected demand, suggesting to decision makers the significance of having an accurate demand forecast.

Key words: Perishable items, Platelet inventory management, Emergency orders, Stochastic dynamic programming

Introduction
Platelets are blood cells used by the body in the process of blood clotting. Platelet transfusion is often a vital part of treating patients with leukemia and other types of cancer, patients undergoing open heart surgery, and those in need of bone marrow and organ transplants. Currently, blood platelets must be stored at room temperature using environmental chambers because refrigeration changes their density and structure. Platelets are expensive and perishable. Typically, they can only be used for transfusion within five days after donation. After deducting the time spent in transportation, testing, and arrangement, clinically transfusable platelets have a mere three-day life-span in hospitals. Due to the short life-span and their medical importance, a critical issue to the decision makers of local hospitals is how to manage platelet inventory in a manner that minimizes outdates and satisfies the demand.

Local hospitals typically order blood products from a central blood center. A generally adopted method is a periodic review ordering policy with standing orders (regular order) at the beginning of the ordering cycle and ad hoc orders (emergency orders) during the cycle. The combined use of regular and emergency orders is considered an efficient way to reduce outdates and to lower the risk of shortages. A survey of 255 hospitals reports that 53% of them manage platelet supplies based on a combination of block ordering and ad hoc ordering, and that the rest use ad hoc orderings only[2].

Based on demand forecast, the manager issues a regular order to a central blood center. Regular orders are usually issued at the end of the day, and are fulfilled the next morning. Because of the short life-span of platelets, it is unlikely that the manager would consider regular ordering cycles of more than three days. For hospitals that do not have critical needs of platelets, it is common that regular orders are placed every other day. Between arrival of regular orders (the days without regular orders), the manager examines the platelet inventory level. If the level is judged to be unable to satisfy the anticipated demand before the next regular order, the manager issues an emergency order, which is usually received within an hour.

In practice, hospitals design their inventory policies based on experience. There are often complaints about frequent emergency orders, large amounts of outdates, or serious shortages. To have an effective policy, the decision maker must balance the critical costs of outdates, shortages, and emergency orders. However, determination of an optimal regular-emergency ordering policy to minimize the total inventory cost is a complex endeavor.

This research problem can be classified as a fixed lifetime perishable inventory problem with
stochastic demand and emergency ordering. There is a large body of literature on perishable product inventory problems ([7]; [13]; [16]). For fixed-life perishable problems with general stochastic demand, the determination of optimal regular order policies was first examined in [14], in which a product life of two periods was addressed and the convexity of the corresponding cost functions was characterized. The two-period problem was later extended to $m$ periods, and an algorithm to obtain the optimal ordering policies was designed ([11]; [12]). Similarly, bounds were developed for a near-myopic heuristic which searches for a desirable inventory policy ([15]). A combination of dynamic programming and simulation was applied to explore the “near optimal” inventory policies for platelets ([8]). In general, because of the complexity of tracking the states of $m$-period perishable products, analytical results have not been explored extensively.

For fixed-life perishable problem with Poisson demand, queueing properties have been utilized to examine the optimal inventory policy. In [6], the perishable inventory system was formulated as a two-stage queueing model (one holding fresh items and the other holding older items), where the system’s performance was approximated using simulation. A continuous review perishable system was analyzed in [9], where the expected inventory cost was characterized based on renewal demand and instantaneous replenishments. Assuming both the arrival of items and the demand are Poisson processes, [17] developed ergodic limits for the average inventory and outdates. Utilizing the steady state properties of a Markov chain, [4] obtained bounds on the limiting distribution of the number of outdates in a period.

The consideration of emergency order as a major aspect of an inventory policy for perishable products has not been addressed in the literature. For inventory research on nonperishable product, emergency order was featured as a complementary ordering policy in [3] and [18]. In the former, multiple emergency orders were allowed within a regular review cycle and were managed under a continuous review policy, where a complex control policy was derived based on stochastic dynamic programming approach. In the latter, emergency orders were restricted to specific review times, and a simple and time-invariant emergency order-up-to level was shown to be unique and was approximated using a heuristic algorithm.

In this paper, we address a platelet inventory problem characterized by a fixed-lifespan of three days, general stochastic demand, and a combined use of regular and emergency orderings, where regular orders are placed at the beginning of a cycle and emergency orders are periodically reviewed within the cycle according to an order-up-to level policy. There has been limited research that analytically models the perishable inventory problem beyond two periods for general stochastic demand, since the number of states explodes exponentially with the number of lifetime periods.

For perishable inventory with emergency orders, the convexity of the cost function for a general demand distribution is no longer assured. However, by first showing the existence of a unique interior stationary point and then proving the strict convexity at the point’s neighborhood, we are able to prove the uniqueness of a decision policy doublet that minimizes the total expected cost. We also derive the necessary and sufficient conditions for the optimal doublet, based on which a heuristic algorithm is designed.

Our numerical analysis shows that the total expected cost is sensitive to changes in the optimal regular order but not in the order-up-to level. Also, while both the optimal regular order and the order-up-to level are not sensitive to changes in cost parameters, both are sensitive to changes in the expected demand. It shows that the accuracy in estimating the expected demand is by far the most important aspect for the decision maker, as the error could result in a significant amount of extra costs.

In the ensuing sections, we first discuss the assumptions, followed by the development of the one cycle problem. Then the model is extended to a multi-cycle problem, and the optimal policy structure is examined. We derive the necessary and sufficient conditions for the optimal policy, based on which a heuristic algorithm is designed. Numerical illustrations and a comprehensive sensitivity analysis are provided, along with managerial insights.

**The Modeling Framework**

We consider a single-item periodic review inventory system that employs certain order amount for its regular order and an order-up-to level for its emergency order. Throughout the paper, we use period as a time unit (day), and cycle to express the interval of regular orders. To manage platelets with emergency ordering, the regular order cycles are limited to either two days or three days, because a one-day cycle would rule out emergency orders and platelets have a three-day lifetime. Since it is not uncommon for hospitals to place regular orders every other day, and as a start, we assume the regular order cycle to be two periods.

The decisions for this problem are regular order quantities $Q_s$ and the emergency order-up-to level $s_e$ (Figure 1). Here, we assume that all orders are placed at the start of a period and received instantaneously. This is a reasonable real-life approximation, since emergency orders are usually delivered promptly and regular orders arrive...
overnight. Also, unsatisfied demand of platelets is assumed to be backlogged, because of the critical nature of their medical significance. Moreover, we assume that the period demands are independent and identically distributed, and are satisfied according to a FIFO policy.

Another important assumption has to do with the vintage of the platelets. Regular ordered platelets are usually fresh. Since emergency platelets are expected to be used right away, blood banks may have the option to deliver platelets that are fresh, one-period old, or two-period old. Depending on the availability and policy between the blood bank and local hospitals, all three types of vintage are plausible emergency supplies. Here, we start our exposition with the assumption that emergency platelets are one-period old, because it offers certain modeling simplifications. At a later section, we will explore the scenarios where the emergency platelets are fresh or two-period old.

Notions:

\[ t_j = \text{demand in period } j \ (j=0, 1, 2) \] with distribution \
\[ F \text{ and density function } f; f(t) > 0 \text{ for } t > 0; \]
\[ f(t)=0 \text{ for } t \leq 0 \]
\[ \mu = \text{mean demand per period, } E[t] \]
\[ y_e = \text{emergency order amount} \]
\[ L_i = \text{shortage at period } i \text{ of a cycle } (i=1, 2) \]
\[ x_n = \text{initial inventory of cycle } n \ (x \text{ for one-cycle problem}) \]

\[ z = \text{outdates of platelets ordered in this cycle} \]
\[ s_n = \text{emergency order-up-to level in cycle } n \ (s \text{ for one-cycle problem}) \]
\[ Q_n = \text{regular order quantity in cycle } n \ (Q \text{ for one-cycle problem}) \]
\[ c_e = \text{emergency cost per unit} \]
\[ c_p = \text{shortage cost per unit} \]
\[ c_r = \text{outdate cost per unit} \]

An emergency order is issued when \( Q - (t_0 - x)^+ \) is smaller than \( s \). We can express the emergency order as:

\[ y_e = (s - (Q - (t_0 - x)^+))^+ \]  \(1\)

Shortages may occur in both periods of the cycle. For the first period, shortage occurs when demand \( t_0 \) is higher than the sum of the regular order quantity and initial inventory:

\[ L_1 = (t_0 - Q - x)^+ \]  \(2\)

For the second period, shortage depends on the emergency order quantity and the inventory level at the end of the first period:

\[ \text{One Cycle Problem} \]

In this section we build expressions for costs of replenishing, shortages, and carrying for the one cycle problem. The expected cost of the whole cycle is the summation of these three types of costs. For replenishing cost, we focus on emergency cost since it is significantly more expensive than the regular cost. For carrying cost, we focus on the cost of outdates, which is the predominant part of the carrying cost.

The inventory level at the end of the first period is \( Q - (t_0 - x)^+ \), where \( t_0 \) is the demand in the first period. The plus function in this expression ensures that all initial inventories will deteriorate if they are not depleated at the end of the first period.
\[ L_2 = (t_1 - y_e - [Q - (t_0 - x)'])^+ \]
\[ = (t_1 - (s - [Q - (t_0 - x)])') - [Q - (t_0 - x)]' \quad (3) \]

For assessing the outdate cost, we need to consider the lag effect where outdates for the amount ordered in the current cycle occur only in subsequent cycles (see also [14] and [15]). Because the emergency orders are assumed to be one-period old, all the inventories at the beginning of the second period have the same age. Therefore, the outdate is
\[ z = (Q + (s - [Q - (t_0 - x)])')^+ \]
\[ = (Q + (s - [Q - (t_0 - x)])')^+ - [Q - (t_0 - x)]' \quad (4) \]
where \( [t_2 + (t_0 - x)]^+ \) is the total demand to be satisfied by platelets ordered in the cycle.

**Optimal Policy with Initial Inventory \((x \geq 0)\)**

We first address the optimal policy when there is initial inventory \((x \geq 0)\). The situation when there is backlog \((x < 0)\) is addressed in the next subsection.

**Expected Emergency Cost**

If \( Q \leq s \) and from (1), \( Q - (t_0 - x)^+ \leq s \).

Thus,
\[ y_e = \begin{cases} 
    s - Q, & t_0 \leq x; \\
    s + t_0 - Q - x, & t_0 \geq x.
\end{cases} \]

The expected emergency cost is
\[ E[y_e] = c_p \int_{t_0}^{\infty} (s - Q) dF(t_0) \]
\[ + c_p \int_{t_0}^{\infty} (s + t_0 - Q - x) dF(t_0) \]
where \( c_p \) is the emergency cost per unit. Here, we assume that the emergency cost is in terms of cost per unit, and that the fixed cost is negligible. The same assumption is adopted in [3] and [18].

If \( Q \geq s \), then \( y_e > 0 \) if only if
\[ s + (t_0 - x)^+ > Q. \]

Thus,
\[ y_e = \begin{cases} 
    s + t_0 - Q - x, & t_0 \geq Q + x - s; \\
    0, & \text{otherwise}.
\end{cases} \]

Then the expected emergency cost would be
\[ E[y_e] = c_p \int_{t_0}^{\infty} (s + t_0 - Q - x) dF(t_0) \]
\[ = c_p \int_{t_0}^{\infty} (s - Q + \mu - x + \int_{t_0}^{Q+s} F(t_0) dt_0) dF(t_0) \]

Note that when \( Q = s \), the two expressions of \( E[y_e] \) converge. This means the expected emergency cost is continuous at the point. Similarly, it can be shown that expected shortage and outdate are continuous at this point as well.

**Expected Shortage Cost**

For the first period,
\[ E[L_1] = c_p \int_{t_0}^{\infty} (t_1 - Q) dF(t_1) \]
\[ = c_p (\mu - Q - x + \int_{t_0}^{\infty} F(t_0) dt_0), \]

For the second period,
\[ E[L_2] = \begin{cases} 
    t_1 - s, & t_0 \geq s; \\
    0, & \text{otherwise}.
\end{cases} \]

and the expected shortage is
\[ E[L_2] = c_p \int_{t_0}^{\infty} (t_1 - s) dF(t_1) \]
\[ = c_p (\mu + s + \int_{t_0}^{\infty} F(t_0) dt_0). \]

If \( Q \geq s \),
\[ L_2 = \begin{cases} 
    (t_1 - Q)^+, & t_0 \in (0, Q]; \\
    (t_1 - Q - x + t_0)^+, & t_0 \in [x, x + Q - s]; \\
    (t_1 - s)^+, & t_0 \in [x + Q - s, \infty).
\end{cases} \]

Then the expected shortage is
\[ E[L_2] = c_p \int_{t_0}^{\infty} (t_1 - Q) dF(t_1) \]
\[ + \int_{t_0}^{\infty} (t_1 - Q - x + t_0) dF(t_1) dt_0 \]
\[ + \int_{t_0}^{\infty} (t_1 - s) dF(t_1) dt_0. \]

By integrating by parts twice, this expression could be simplified as
\[ E[L_2] = c_p (\mu - s + \int_{t_0}^{\infty} F(t_0) dt_1 - \int_{t_0}^{\infty} F(t_0) dt_0) \]
\[ + \int_{t_0}^{\infty} F(t_0) F(x + Q - t_0) dt_0. \]

**Expected Outdate Cost**

If \( Q \leq s \), the inventory level will be replenished to \( s \) at the beginning of the second period. Therefore, outdates only depend on emergency order level and demand of later periods. From (4), we have \( z = (s - t_1 - t_2)^+ \). Thus the expected outdate cost is
\[ E[z] = c_p (\mu - s + \int_{t_0}^{\infty} F(t_1) dt_1 - \int_{t_0}^{\infty} F(t_0) dt_0) \]
\[ + \int_{t_0}^{\infty} F(t_0) F(x + Q - t_0) dt_0. \]

The expected outdate cost would be

\[ z = \begin{cases} 
    (Q - t_1 - t_2)^+, & t_0 \in (0, x]; \\
    (Q - x - t_0 - t_1)^+, & t_0 \in [x, x + Q - s]; \\
    (s - t_1 - t_2)^+, & t_0 \in [x + Q - s, \infty).
\end{cases} \]
When its density function as of CDF functions is still a CDF function, we define simplified as continuous in $Q$ and $s$. However, the following lemma guarantees that discuss optimal policy for both cases listed in (5) and (6). The proof is in the Appendix. From the first statement of this Lemma, we know that the boundary solution is covered in the case $Q \geq s$, which means it is the only case we need to consider. Also, at the minimum, the optimal regular ordering quantity $Q$ will never be smaller than the emergency stock level $s$. We know that if the optimal policy doublet is an interior point of the feasible set, it must necessarily satisfy the first-order conditions
\[ \frac{\partial EC}{\partial Q} = 0 \quad \text{and} \quad \frac{\partial EC}{\partial s} = 0. \]

**Theorem 1.** For the one cycle inventory problem, there exists a unique interior global minimum for the expected cost function. The optimal ordering policies $(Q^*, s^*)$ are determined by the following two equations:
\begin{align*}
&c_p - c_c + c_p F(s^*) + c_c F^{(2)}(s^*) = 0, \quad (7) \\
&-c_p - c_c F(Q^* + x) + \int_s^{Q^*} F(Q^* + x - t_0)(c_p f(t_0), \quad (8)
\end{align*}
\[ + c_c f^{(2)}(t_0) dt_0 = 0 \]

The proof is given in the Appendix. From the proof, the convexity of the cost function in traditional regular-order perishable inventory system. From (7), note also that $s^*$ is independent of the initial inventory. This is true when the probability of an emergency order is non-zero. However, when the initial inventory is large enough to cover the demand during the first period for sure, (7) no longer holds and $s^*$ is no longer relevant (see A.1 in the Appendix).

Figure 2 is a typical plot of the Left Hand Side (LHS) of (7) and (8), with the periodic demand following a normal distribution and with given values of $c_p, c_c, c_r, \text{ and } x$. LHS of (7) is bounded between $-c_p + c_c$ and $c_c + c_p$, while LHS of (8) is bounded between $-c_p - c_r$ and $c_c + c_r$. The optimal policies $Q^*$ and $s^*$ are therefore the points where these two respective curves intersect with the horizontal axis. 

---

**Lemma 1.** 1. The expected cost function is continuous in $Q$ and $s$. 2. When $Q \leq s$, the expected cost will reach its minimum at the boundary where $Q = s$. 

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In previous discussions, we assumed the initial inventory to be \( x \geq 0 \). For \( x \leq 0 \), the formulation of the cost function as well as the optimum solution is very similar. For the sake of brevity, we list the major results as follows.

When \( Q + x \leq s \),

\[
EC(Q, s) = c_s(s + \mu - Q + \mu - x) + c_p \int_0^{Q+x} F(t_0)dt_0 + c_p \int_0^{s-x} F(t_0)dt_0 + c_p \int_0^{Q+x} F(t_1)dt_1 + c_r \int_0^{Q+x} F(t_0)dt_0 + c_r \int_0^{s-x} F(t_1)dt_1 + c_r \int_0^{Q+x} F(t_1)dt_1 + c_r \int_0^{s-x} F(t_0)dt_0
\]

When \( Q + x \geq s \),

\[
EC(Q, s) = c_s(s - \mu - x + \int_0^{Q+x} F(t_0)dt_0) + c_p \int_0^{s-x} F(t_1)dt_1 + c_r \int_0^{Q+x} F(t_1)dt_1 + c_r \int_0^{s-x} F(t_0)dt_0 + c_r \int_0^{Q+x} F(t_1)dt_1 + c_r \int_0^{s-x} F(t_0)dt_0 + c_r \int_0^{Q+x} F(t_1)dt_1 + c_r \int_0^{s-x} F(t_0)dt_0
\]

For the same reason as stated in Lemma 1, we only need to consider (10) to determine the optimal policy. Similar to (6), this cost function (10) has the boundary \( Q + x = s \).

**Corollary 1.** For any initial inventory \( x \leq 0 \):

1) The optimal order policy doublet \((Q^*, s^*)\) given by the following two equations is the unique and global optimum solution for the one cycle expected cost function.

\[
c_v - c_p + c_p F(s^*) + c_r F^{(2)}(s^*) = 0,
\]

\[
-c_v - c_p + c_p F(Q' + x) + \int_0^{Q' + x} F(Q' + x - t_0)c_f(t_0)dt_0 + c_r f^{(2)}(t_0)dt_0 = 0
\]

2) At the optimum, \( Q'(x) = Q'(0) + |x| \).

The proof is given in the Appendix. Equation (13) of Corollary 1 shows that the optimal regular order quantity is the sum of two parts, the optimal order with zero initial inventory and the backlog. Note that \( Q^* \) at zero initial inventory is already covered in (6).

### The Dynamic Approach for the Multi-cycle Problem

In this section, we extend the single cycle model to a multi-cycle model, where a sequence of ordering decisions is made. As is common with periodic review inventory problems, our mode of analysis is the functional equation approach of dynamic programming.

First, we need to formulate the inventory level at the end of a cycle. This is given by the following lemma. Note that we label the cycles backward, starting with the final cycle as cycle 1.

**Lemma 2.** If the inventory level at the beginning of cycle \( n \) is \( x_n \), the ordering policies are \( Q_n \) for the regular order and \( s_n \) for the emergency order-up-to level, and the demands for the two periods of the cycle are \( t_0 \) and \( t_1 \), the inventory level at the end of the cycle would be

\[
x_{n+1}(x_n, Q_n, s_n, t_0, t_1) = \begin{cases} Q_n - t_1, & t_0 \in [0, x_n]; \\ Q_n + x_n - t_0 - t_1, & t_0 \in [x_n, x_n + Q_n - s_n]; \\ s_n - t_1, & t_0 \in [x_n + Q_n - s_n, \infty). \end{cases}
\]

Proof is obvious and is omitted. Define \( C_n(x_n) \) as the minimum expected discounted cost of the last \( n \) cycles where \( x_n \) is initial inventory of the cycle \( n \). Similar to our discussions in the one-cycle problem, each cycle contains exactly two periods and all fresh inventory will perish in three periods. We define
\[
B_{n}(x_{n},Q_{n},s_{n}) = EC(x_{n},Q_{n},s_{n}) + \alpha \int C_{n-1}(x_{n-1}(x_{n},Q_{n},s_{n},t_{0})dF(t_{1})dF(t_{0}).
\]

(15)

Then the principle of optimality for this model takes the form

\[ C_{n}(x_{n}) = \inf_{Q_{n},s_{n}} B_{n}(x_{n},Q_{n},s_{n}) \] for \( n \geq 1 \). In (15), \( EC(x_{n},Q_{n},s_{n}) \) is the one-cycle cost function whose properties are analyzed in the previous section and \( \alpha \) is the discount factor (\( \alpha \in [0,1] \)). In the ensuing theorem, following a similar approach as in the one-cycle problem, we demonstrate inductively that the existence and uniqueness of the optimal policy for the last \( n-1 \) cycles is preserved in the last \( n \) cycles.

Theorem 2. For the last \( n \) cycles with initial inventory \( x_{n} \), we have the following properties:

1) For any given \( x_{n} \), there is a unique stationary point \( (Q^{*}_{n},s^{*}_{n}) \) given by the solution to the following expressions:

\[
s^{*}_{n} = G^{-1}_{n}(c_{p} - c_{c}),
\]

(16)

\[-c_{p} + c_{p} F(Q_{n} + x_{n}) + \int_{0}^{\infty} F(Q_{n} + x_{n} - t)g_{n}(t)dt = 0, \quad \text{if} \quad x_{n} \geq 0,\]

(17)

\[Q^{*}_{n}(x_{n}) = Q^{*}_{0}(0) + |x_{n}|, \quad \text{if} \quad x_{n} \leq 0,
\]

(18)

where

\[g_{n}(x) = c_{p} f(x) + c_{c} f^{(2)}(x) + \alpha \int_{0}^{\infty} C_{n}(x-t)f(t)dt,\]

and \( G_{n}(x) = \int_{0}^{\infty} g_{n}(t)dt \) for \( x > 0 \) and \( n > 0 \).

The proof is given in the Appendix. Recall that in the single-cycle model, it is shown that for the optimal policy, \( s^{*} \) must be less than \( Q^{*} \), that the optimal policy with initial backlog is to order the sum of optimal quantity with zero initial inventory and the backlogged amount, that the optimal policy exists and is unique, and that the necessary and sufficient conditions for the optimal policy with non-negative inventory are provided in (7) and (8). For comparison, equations (7) and (8) can be respectively expressed as

\[
s^{*} = G^{-1}_{0}(c_{p} - c_{c}),
\]

\[-c_{p} + c_{p} F(Q_{0} + x_{0}) + \int_{0}^{\infty} F(Q_{0} + x_{0} - t)g_{0}(t)dt = 0,
\]

For the multi-cycle model, according to Theorem 2, the basic features of the one-cycle problem are preserved. That is, \( s^{*}_{n} \) is less than \( Q^{*}_{n} \). The optimal regular order quantity can be expressed as

\[Q^{*}_{n}(x_{n}) = Q^{*}_{0}(0) + |x_{n}|.
\]

The two properties of Theorem 2 state that there exist a unique stationary point for the total cost function, and that the unique point \( (Q^{*}_{n},s^{*}_{n}) \) is a global minimum solution. The necessary and sufficient conditions for the optimal policy are provided in (16)-(18).

Note that (16)-(18), similar to (7)-(8), indicate that the initial inventory of each cycle does not affect the emergency order-up-to level, as long as the initial inventory is not unreasonably high. This largely reflects the vintage condition of the initial inventory. Because of the assumption that emergency orders are one-period old, the initial inventory of the following cycle is then two-period old and will perish before the next emergency orders. Hence, for the scenario where the emergency order is one-period old, each cycle’s initial inventory has no effect on the order-up-to level.

A Heuristic Algorithm for the Multi-cycle Inventory Problem

In the multi-cycle problem, the optimal order policies for each cycle are determined sequentially. For the optimal policy doublet of cycle \( n \), we need to know the explicit decision function of the cycle \( n-1 \), and so on. This is essentially a discrete-time, continuous-state, stochastic optimization problem. Based on the sufficient and necessary conditions for the optimal policies developed in Theorem 2, we provide a heuristic algorithm to approximate the optimal solution for the multi-cycle problem.

The heuristic algorithm is as follows. As an initial setup, for each cycle \( j \), estimate the range of the initial platelet inventory. Discretize the non-negative range into \( m \) equal intervals depending on the precision desired. For negative range of \( x_{j} \), let them be treated as if the initial inventory is zero. For the root-finding steps, we select the adjacent integer (to the root) that has the smallest residual value.

Step 1. For cycle 1, determine \( s_{1}^{*} \) by finding the root of equation (7) using a linear search.

Step 2. For each state of \( x_{1} \), determine \( Q_{1}^{*} \) by substituting \( s_{1}^{*} \) into equation (8) and finding the root of (8) using a linear search.

Step 3. For cycles \( j = 2, \ldots, n \), determine \( s_{j}^{*} \) by finding the root of equation (16) using a linear search.

Step 4. For each state of \( x_{j} \), determine \( Q_{j}^{*} \) by substituting \( s_{j}^{*} \) into equation (A.12) in the Appendix and by finding the root of
of (A.12) using a linear search.

**Step 5.** Calculate the total expected cost \( C_n \) using the expression (A.8) in the Appendix.

**Numerical Illustration and Sensitivity Analysis**

Consider a local hospital making platelet inventory decisions daily based on a weekly forecast, approximately 3 cycles. Demands (in terms of pools) are assumed to be normally distributed and within the range \([1, 200]\); the estimated cost parameters and the initial inventory are shown in Table 1. These are realistic estimates of real-life data (Haijema et al., 2007). Using the heuristic algorithm developed in the preceding section, we now examine the model’s behavior with several sets of numerical investigations. The algorithm is coded in Matlab 2007b (a copy of the main code is shown in the Appendix). We have run a number of instances, each of which takes less than a few seconds on a typical personal computer.

**Table 1. Parameters of the Numerical Example**

<table>
<thead>
<tr>
<th>Number of Cycles</th>
<th>( c_e ) (US$100/pool)</th>
<th>( c_o ) (US$100/pool)</th>
<th>( c_r ) (US$100/pool)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>5</td>
<td>30</td>
<td>10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Initial Inventory (pools)</th>
<th>Mean of the daily demand ( \mu ) (pools)</th>
<th>Standard deviation ( \sigma ) (pools)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>100</td>
<td>25</td>
</tr>
</tbody>
</table>

Following the algorithm, a set of \( Q_1^* \) and \( s_1^* \) are first computed for a range of \( x_1 \). Then a set of \( Q_2^* \) and \( s_2^* \) are computed for a range of \( x_2 \). As shown in Table 2, the optimal ordering policy for an initial inventory of 30 units is \( Q_3^* = 225 \), \( s_3^* = 124 \), and the optimal expected cost is US$15,266. The breakdown of the optimal expected cost is: emergency cost (US$2,016), shortage cost (US$4,981), and outdate cost (US$8,269).

**Table 2. Optimal Policies for the Numerical Example (Base Case)**

<table>
<thead>
<tr>
<th>Cycle 1</th>
<th>( x_1 = 0 )</th>
<th>( s_1^* = 124 )</th>
<th>( Q_1^* = 254 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( x_1 = 1 )</td>
<td>( s_1^* = 124 )</td>
<td>( Q_1^* = 252 )</td>
<td></td>
</tr>
<tr>
<td>( x_1 = 2 )</td>
<td>( s_1^* = 124 )</td>
<td>( Q_1^* = 251 )</td>
<td></td>
</tr>
<tr>
<td>...</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( x_1 = 200 )</td>
<td></td>
<td>( Q_1^* = 150 )</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cycle 2</th>
<th>( x_2 = 0 )</th>
<th>( s_2^* = 124 )</th>
<th>( Q_2^* = 256 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( x_2 = 1 )</td>
<td>( s_2^* = 124 )</td>
<td>( Q_2^* = 255 )</td>
<td></td>
</tr>
<tr>
<td>...</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Figure 3.** Plot of the Expected Total Cost with respect to different values of \( Q_3 \) and \( s_3 \). For this example problem, it is interesting to observe that the expected cost function is sensitive to changes in \( Q_3 \). For example, a 10% increase in \( Q_3 \) results in an increase of around 15% in the total cost, while a 10% decrease in \( Q_3 \) would increase the total cost by around 20%. It can be observed that underestimating \( Q_3^* \) would result in a bigger error in the total expected cost than overestimating \( Q_3^* \) by the same percentage. On the other hand, the total cost is quite insensitive to changes in \( s_3 \). A 10% increase or decrease in \( s_3 \) results in less than 3% change in expected total cost.

Next, we explore the change in the optimal policy \((Q_3^*, s_3^*)\) with respect to the change in the cost parameters \( c_e, c_o \) and \( c_p \) (Figure 4). A decrease in the emergency cost \( \epsilon \) decreases \( s_3^* \) while increases \( Q_3^* \); an increase in the outdate cost \( c_r \) decreases both \( Q_3^* \) and \( s_3^* \); and an increase in the shortage cost \( c_p \) increases both \( Q_3^* \) and \( s_3^* \).
Moreover, our numerical analysis shows that the optimal \((Q_3^*, s_3^*)\) is insensitive to the changes of \(c_e\), \(c_p\) and \(c_r\). Especially, \(s_3^*\) is very insensitive to the change of \(c_e\); and \(Q_3^*\) is very insensitive to the change of all the cost parameters. For example, compared with the base case, if \(c_e\) is underestimated by 40%, the incorrect \((Q_3^*, s_3^*)\) would be (223, 131), only about 1% and 5% away from their respective optimal values. The corresponding expected total cost would be higher by roughly 1% from the optimal one.

Similarly, we explore the change in the optimal \(Q_3^*\) and \(s_3^*\) with respect to the change in demand parameters. We found that both the optimal \(Q_3^*\) and \(s_3^*\) are sensitive to changes of the expected demand (Table 3). For example, if expected demand is overestimated by 10% (from 100 to 110), the optimal policies change to (248, 134), which are about 10% and 8% away from the original values. The expected cost, using Figure 2, can be found as US$17,700, which is about 16% higher than the optimal cost. From Table 3, it appears that both underestimating and overestimating the expected demand has significant impact on the total expected cost, with underestimating having a higher impact.

With respect to changes in the standard deviation, there is little change in the total expected cost.

Table 4 illustrates similar behavior with respect to a set of uniform demand distributions. We observe the similar impact of the expected demand on optimal decisions. Again, the variance has little impact. In Table 5, we provide comparisons of the several typical demand distributions. It can be observed that the distribution, per se, has little impact on the decisions.

The preceding sensitivity analysis shows that the accuracy in estimating the expected demand is by far the most important aspect for the platelet

![Figure 4. Effects of Cost Parameters on the Optimal Policies](image)

More than 40% of the data is missing in this table.
inventory decision maker, as the error could result in a significant amount of extra cost. The analysis also points out that overestimating the expected demand results in a relatively smaller amount of error than underestimating it. However, changes in both the variance and the type of distribution have little impact on the optimal policy. In general, when there is a need to adjust the regular order, the decision maker should do so judiciously as the total expected cost is sensitive to the change in regular order. Such behavior is not observed regarding the emergency order-up-to level decisions.

For this one-period old emergency order scenario, the emergency order-up-to level is independent of the initial inventory of the cycle. Moreover, when there is backlogged demand in the beginning of the cycle, the manager can first refill the backlogged demand and then determine the regular order quantity for zero initial inventory.

Conclusion and Future works
This paper presents an analysis of a periodic review inventory system of a perishable product with emergency replenishments, characterized by fresh regular orders and one-period-old emergency replenishments. We first formulate the problem as a one-period model and then as a multi-cycle model. For both cases, we prove the existence of a unique optimal solution and derive the necessary and sufficient conditions for the optimal policy. A heuristic algorithm is designed based on the optimality conditions. We perform an extensive sensitivity analysis which, unlike typical inventory problems, shows that the total expected cost is sensitive to the regular order policy. It also shows that the optimal policy is sensitive to changes in the expected demand, suggesting to decision makers the significance of having an accurate demand forecast.

We believe this paper merely scratches the surface of this complex problem of perishable products and combined use of regular order and emergency order. There are quite a number of scenarios involving different combinations of cycle length and vintage of emergency orders. While there are many possible scenarios, each of which could have different results, we believe the approach taken in this paper is applicable to other scenarios as well. The scenario with fresh emergency platelets should be investigated next. It might be interesting to generalize the models in this paper by incorporating the fixed replenishing costs of regular and emergency orders and the examination of lost demand, thus making the model applicable to other perishable products.

Acknowledgement
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Appendix
Proofs of the Lemmas and Theorems are omitted here due to the limitation of the space, and are available on request.

References


ANALYSIS OF MAINLAND CHINA’S INTERNATIONAL AIR CARGO NETWORK: STATUS QUO AND CHALLENGES

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Abstract
Based on air cargo import and export statistics of China Customs, the international air cargo network structure and its flow characteristics in mainland China were studied in this paper. Overall development trends and flow distribution of international air cargo in mainland China were analysed. The major air cargo import and export countries (regions), the main categories of commodities, and the major customs and hub airports were identified. Through our study, a relatively complete view of international air cargo network in mainland China was constructed, in which the major flight routes linking destinations and sources of international air cargo as well as the categories and amounts of air cargo could be revealed. This paper also includes challenges to the further development of mainland China's international air cargo, and proposals to meet these challenges.

Keywords: Air Cargo, Logistics, Air Freight, Import and Export

Introduction
Air transport has become a major driving force for sustained economic growth due to the advantages of high-speed and being able to save the total transportation costs of supply chains. It is considered as the fastest and reliable way of efficiently linking national and global supply chains as well as long-distance markets. In this new era of rapid turnover in logistics, those countries with sound air cargo connectivity will gain more competitive advantage than others in trade and production [1]. China has the second largest air cargo market only surpassed by United States. China’s robust economic growth has provided the largest and best platform for the development of air transport industry.

With rapid growth of China’s air cargo, our study has more attention and attraction for researchers and reviewers. Existing studies addressed issues such as China's major aviation hubs and the overall pattern and composition of international air cargo [2], the network structure and flow characteristics of international air cargo [3], the development status and market barriers [4], etc. Though during past several years, the studies on China’s air cargo market have been gradually increasing, but they are lacking in deep analysis of China's international air cargo network. For this reason, we exploited the statistical data on air cargo import and export of the year 2006 obtained from China Customs so as to delineate the network structure and flow distribution of China's international air cargo with special focus on statistical analysis on route alignments of main sources and destinations of international air cargo along with cargo categories and amounts.

Traditionally, China Customs treats imports and exports between mainland China with Hong Kong, Taiwan and Macao as international trade, so we define the scope of study within mainland China's international air cargo. The objectives of our study are to build a relatively complete view of mainland China’s international air cargo network and grasp its status and characteristics. We also discussed the future challenges anticipated in the development of China's international air cargo and available relevant proposals.

Overall Development and Flow Distribution of International Air Cargo
Air cargo accounts for a very small share of total volume of national cargo. However, the commodities transported by air are generally high-value-added, so the ratio of the value of air cargo to total value of national cargo is still large. Statistics on national imports and exports of 2006 provided by China Customs, it can be seen that total value of air cargo reached nearly 1/5 of the total value of national imports and exports with a very small freight volume. From 2001 to 2006, the total value of air cargo increased with an average annual rate of 39%, which was considered as significant but swift increase than other transport modes (see Table 1).

Table 2 shows the distribution of 2006 air cargo imports and exports amount among several continents. Table 2 shows the geographic distribution of both export destinations and import sources revealing a marked concentricity in Asia, Europe and North America. Asia is the foremost origin of imports and destination of exports for mainland China’s international air cargo, followed...
by Europe and North America. In particular, the total value of imports from Asia is accounted for more than 80% of the total value of all imports. Although China has air cargo business with more than 200 countries/regions around the world, however, the business shares with other continents are still very small.

Table 1: Total value of Customs import and export vs total value of international air cargo

<table>
<thead>
<tr>
<th>Year</th>
<th>Total value of imports and exports (thousands of dollars)</th>
<th>Total value of air cargo imports and exports (thousands of dollars)</th>
<th>Percentage of air cargo</th>
<th>Growth rate of air cargo</th>
<th>Growth rate of imports and exports</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>509,651,090</td>
<td>66,636,409</td>
<td>13.1%</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>2002</td>
<td>620,766,074</td>
<td>87,727,676</td>
<td>14.1%</td>
<td>31.7%</td>
<td>21.8%</td>
</tr>
<tr>
<td>2003</td>
<td>850,987,563</td>
<td>138,770,605</td>
<td>16.3%</td>
<td>58.2%</td>
<td>37.1%</td>
</tr>
<tr>
<td>2004</td>
<td>1,154,554,329</td>
<td>208,638,268</td>
<td>18.1%</td>
<td>50.3%</td>
<td>35.7%</td>
</tr>
<tr>
<td>2005</td>
<td>1,421,906,172</td>
<td>270,781,944</td>
<td>19.0%</td>
<td>29.8%</td>
<td>23.2%</td>
</tr>
<tr>
<td>2006</td>
<td>1,760,686,452</td>
<td>339,029,738</td>
<td>19.3%</td>
<td>25.2</td>
<td>23.8%</td>
</tr>
<tr>
<td></td>
<td>Average annual growth rate</td>
<td></td>
<td></td>
<td></td>
<td>28.3%</td>
</tr>
</tbody>
</table>

Source: Import and export statistics of China Customs

Table 2: Distribution of air cargo imports and exports amount on continents

<table>
<thead>
<tr>
<th>Continent</th>
<th>Export Amount (thousands of dollars)</th>
<th>Percentage</th>
<th>Import Amount (thousands of dollars)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asia</td>
<td>65,551,953</td>
<td>42.0%</td>
<td>127,259,231</td>
<td>81.6%</td>
</tr>
<tr>
<td>Europe</td>
<td>44,116,604</td>
<td>28.3%</td>
<td>28,885,873</td>
<td>18.5%</td>
</tr>
<tr>
<td>North America</td>
<td>40,329,775</td>
<td>25.9%</td>
<td>24,259,906</td>
<td>15.6%</td>
</tr>
<tr>
<td>Latin America</td>
<td>2,956,179</td>
<td>1.9%</td>
<td>1,638,148</td>
<td>1.1%</td>
</tr>
<tr>
<td>Oceania</td>
<td>2,109,050</td>
<td>1.4%</td>
<td>279,915</td>
<td>0.2%</td>
</tr>
<tr>
<td>Africa</td>
<td>907,284</td>
<td>0.6%</td>
<td>735,276</td>
<td>0.5%</td>
</tr>
<tr>
<td>Total value of air cargo imports and exports</td>
<td>155,970,844</td>
<td>100.0%</td>
<td>183,058,350</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Source: 2006 air cargo import and export statistics of China Customs

The economic ties of China with countries/territories in North America, EU, ASEAN, South Korea, and Japan are improving year by year. The continuous increase in China’s foreign trade depicts that the international air cargo market will have a prospect for future. However, recent development shows that two regional markets namely North America and EU, especially the U.S. market, obviously take on one-way characteristics due to the imbalances in China’s foreign trade such as, almost full-loaded cargo departure from China while very low return load. In recent years, the ratio of export to import amount of mainland China’s air cargo is 3:1. However, there exists unidirectionality in China’s international air cargo market which will decline gradually in long term as China’s foreign trade turning into balance. Therefore, expanding international routes, especially the routes of China - North America, China - Japan, and China - Europe, will be beneficial for China’s air cargo business to gain more shares in international market [5]. At present the routes of China - North America and China-Europe are still major international air cargo routes. Their average annual growth rate in terms of air cargo amounts will reach 11.6% and 10.4% in 2015 respectively [6].

Major Sources and Destinations of International Air Cargo

Through the statistical analysis on international air cargo amount, we find the major import and export countries or regions are U.S, Hong Kong, Japan, Germany, Singapore, Netherlands, South Korea, Taiwan, Malaysia, UK, Philippine, and France. Among these countries, U.S is the major destination accounting for a quarter of the total export amount followed by Hong Kong and Japan (see Table 3). The top ten destination countries (regions) of air cargo exports cover 76% of the total export amount.

Table 3: Major destinations of air cargo exports

<table>
<thead>
<tr>
<th>Country (region)</th>
<th>Amount (thousands of dollars)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 U.S</td>
<td>38,446,230</td>
<td>24.6%</td>
</tr>
<tr>
<td>2 Hong Kong</td>
<td>18,428,259</td>
<td>11.8%</td>
</tr>
<tr>
<td>3 Japan</td>
<td>13,697,499</td>
<td>8.8%</td>
</tr>
<tr>
<td>4 Germany</td>
<td>13,173,372</td>
<td>8.4%</td>
</tr>
<tr>
<td>5 Singapore</td>
<td>8,082,271</td>
<td>5.2%</td>
</tr>
<tr>
<td>6 Netherlands</td>
<td>6,770,540</td>
<td>4.3%</td>
</tr>
<tr>
<td>7 South Korea</td>
<td>6,323,066</td>
<td>4.1%</td>
</tr>
<tr>
<td>8 Taiwan</td>
<td>5,331,630</td>
<td>3.4%</td>
</tr>
<tr>
<td>9 Malaysia</td>
<td>4,733,784</td>
<td>3.0%</td>
</tr>
<tr>
<td>10 UK</td>
<td>3,689,997</td>
<td>2.4%</td>
</tr>
</tbody>
</table>
Japan is the major source of air cargo imports, who accounted for 15% of the total import amount followed by Taiwan and U.S. The top ten origin countries (regions) occupied 85% of the total import amount (see Table 4). These major source and destination countries (regions) are concentrated in Asia, Europe and North America.

### Table 4 Major origins of air cargo imports

<table>
<thead>
<tr>
<th>Country (region)</th>
<th>Amount (thousands of dollars)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Japan</td>
<td>27,183,778</td>
<td>14.8%</td>
</tr>
<tr>
<td>2 Taiwan</td>
<td>25,078,268</td>
<td>13.7%</td>
</tr>
<tr>
<td>3 U.S</td>
<td>23,510,670</td>
<td>12.8%</td>
</tr>
<tr>
<td>4 South Korea</td>
<td>21,737,172</td>
<td>11.9%</td>
</tr>
<tr>
<td>5 China</td>
<td>16,619,484</td>
<td>9.1%</td>
</tr>
<tr>
<td>6 Philippine</td>
<td>10,557,203</td>
<td>5.8%</td>
</tr>
<tr>
<td>7 Germany</td>
<td>9,616,080</td>
<td>5.3%</td>
</tr>
<tr>
<td>8 Malaysia</td>
<td>9,208,126</td>
<td>5.0%</td>
</tr>
<tr>
<td>9 Singapore</td>
<td>6,866,346</td>
<td>3.8%</td>
</tr>
<tr>
<td>10 France</td>
<td>5,484,028</td>
<td>3.0%</td>
</tr>
</tbody>
</table>

Top-10 accumulative: 155,861,156 85.1%

Total import amount: 183,058,350 100.0%

Chinese economy has shown a strong growth due to large amount of foreign investments and competitive labor cost. Because of these factors, China has become the world's manufacturing center. Many important industries in China provide a wide range of products, including computer, telecommunication equipment and apparel. Air transport has become the preferred transport mode for these products. Since most of these products are for export causing a rapid growth in Chinese international air cargo business. Large quantities of air cargo are exported to Asia, Europe and North America, which greatly promotes China's air cargo market. The rapid development of China's international air cargo is facilitated by the growth of exporting high value-added products, which is closely related to the transformation of China's electronics industry from component production to final assembly and integrated production. The export of high-tech products is much higher than other products in terms of import and export amount.

Customs statistics of 2006 air cargo imports and exports shows that electronic product and machinery equipment are the most principal export commodities, which amounted over 80% of the total export (see Table 5). Table 6 lists the major destination countries (regions) of principal export commodities, in which U.S, Hong Kong, Germany, Japan, and Netherlands, etc. are included.

### Table 5 Major air cargo export commodities

<table>
<thead>
<tr>
<th>Chapter No.</th>
<th>Category of commodity</th>
<th>Amount (thousands of dollars)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Chapter 85</td>
<td>Motors, electrical equipments and parts; sound recorders and reproducers, television image and sound recorders and reproducers, and their parts and accessories</td>
<td>77,970,710</td>
<td>50.0%</td>
</tr>
<tr>
<td>2 Chapter 84</td>
<td>Nuclear reactors, boilers, machinery appliances and parts</td>
<td>49,832,591</td>
<td>31.9%</td>
</tr>
<tr>
<td>3 Chapter 90</td>
<td>Optical, photographic, cinematographic, measuring, testing, medical or surgical instruments and equipments, precision instruments and equipments</td>
<td>7,586,708</td>
<td>4.9%</td>
</tr>
<tr>
<td>4 Chapter 62</td>
<td>Non-knitted or non-crocheted apparels and clothing accessories</td>
<td>3,375,104</td>
<td>2.2%</td>
</tr>
<tr>
<td>5 Chapter 61</td>
<td>Knitted or Crocheted apparels and clothing accessories</td>
<td>2,557,117</td>
<td>1.6%</td>
</tr>
<tr>
<td>6 Chapter 71</td>
<td>Natural or cultured pearls, precious or semi-precious stones, precious metals; imitation jewelry; coins</td>
<td>2,055,809</td>
<td>1.3%</td>
</tr>
<tr>
<td>7 Chapter 29</td>
<td>Organic chemicals</td>
<td>1,737,010</td>
<td>1.1%</td>
</tr>
<tr>
<td>8 Chapter 27</td>
<td>Mineral fuels, mineral oils and their distillation products; bituminous substances; mineral wax</td>
<td>1,483,056</td>
<td>1.0%</td>
</tr>
<tr>
<td>9 Chapter 98</td>
<td>Special transaction and unclassified commodities</td>
<td>1,224,062</td>
<td>0.8%</td>
</tr>
<tr>
<td>10 Chapter 88</td>
<td>Aircraft, spacecraft and parts thereof</td>
<td>1,096,909</td>
<td>0.7%</td>
</tr>
</tbody>
</table>

Top-10 accumulative: 148,919,075 95.5%

Total export value of air cargo: 155,970,948 100.0%

### Table 6 Major destinations of air cargo exports

<table>
<thead>
<tr>
<th>Chapter No.</th>
<th>Major export destination countries (regions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter 85</td>
<td>U.S, Hong Kong, Germany, Japan, Singapore, South Korea, Taiwan, Netherlands, Malaysia, Finland</td>
</tr>
</tbody>
</table>
As shown in Table 7, high-tech products, machinery parts and industrial consumables are the most important import commodities, accounting for 85% of the total amount of air cargo imports. The principal sources of top-10 import commodities are given in Table 8, which include Taiwan, U.S., Germany, Japan, South Korea etc.

### Table 7 Major import commodities of air cargo

<table>
<thead>
<tr>
<th>Chapter No.</th>
<th>Category of commodity</th>
<th>Amount (thousands of dollar)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Motors, electrical equipments and parts; sound recorders and reproducers, television image and sound recorders and reproducers, and their parts and accessories</td>
<td>107,219,938</td>
<td>58.6%</td>
</tr>
<tr>
<td>2</td>
<td>Nuclear reactors, boilers, machinery appliances and parts</td>
<td>27,312,173</td>
<td>14.9%</td>
</tr>
<tr>
<td>3</td>
<td>Optical, photographic, cinematographic, measuring, testing, medical or surgical instruments and equipments, precision instruments and equipments</td>
<td>20,365,951</td>
<td>11.1%</td>
</tr>
<tr>
<td>4</td>
<td>Aircraft, spacecraft and parts thereof</td>
<td>10,468,028</td>
<td>5.7%</td>
</tr>
<tr>
<td>5</td>
<td>Natural or cultured pearls, precious or semi-precious stones; imitation jewelry; coins</td>
<td>2,476,753</td>
<td>1.4%</td>
</tr>
<tr>
<td>6</td>
<td>Miscellaneous chemical products</td>
<td>1,835,403</td>
<td>1.0%</td>
</tr>
<tr>
<td>7</td>
<td>Plastics and articles thereof</td>
<td>1,606,506</td>
<td>0.9%</td>
</tr>
<tr>
<td>8</td>
<td>Drugs</td>
<td>1,599,848</td>
<td>0.9%</td>
</tr>
<tr>
<td>9</td>
<td>Iron and steel articles</td>
<td>842,306</td>
<td>0.5%</td>
</tr>
<tr>
<td>10</td>
<td>Organic chemicals</td>
<td>816,952</td>
<td>0.4%</td>
</tr>
<tr>
<td>Top-10 accumulative</td>
<td>174,543,857</td>
<td>95.3%</td>
<td></td>
</tr>
<tr>
<td>Total import value of air cargo</td>
<td>183,058,779</td>
<td>100.0%</td>
<td></td>
</tr>
</tbody>
</table>

### Table 8 Major origins of air cargo imports

<table>
<thead>
<tr>
<th>Chapter No.</th>
<th>Major import source countries (regions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>85</td>
<td>Taiwan, Japan, South Korea, China, Philippine, U.S, Malaysia, Singapore, Germany, Hong Kong</td>
</tr>
<tr>
<td>84</td>
<td>U.S, China, Thailand, Japan, South Korea, Germany, Philippine, Taiwan, Singapore, Malaysia</td>
</tr>
<tr>
<td>90</td>
<td>Taiwan, Japan, U.S, South Korea, Germany, China, Netherlands, UK, France, Singapore</td>
</tr>
<tr>
<td>88</td>
<td>U.S, France, Germany, UK, Brazil, Japan, Singapore, Netherlands, Canada, Italy</td>
</tr>
<tr>
<td>71</td>
<td>Belgium, South Africa, UK, Japan, Germany, U.S, Switzerland, India, South Korea, Israel</td>
</tr>
<tr>
<td>38</td>
<td>Japan, U.S, Taiwan, Germany, South Korea, UK, Singapore, Malaysia, Hong Kong, France</td>
</tr>
<tr>
<td>39</td>
<td>Japan, U.S, Taiwan, South Korea, Germany, Singapore, China, Hong Kong, France, UK</td>
</tr>
<tr>
<td>30</td>
<td>U.S, UK, Germany, Switzerland, France, Italy, Ireland, Belgium, Japan, Sweden</td>
</tr>
<tr>
<td>73</td>
<td>U.S, Japan, Germany, Taiwan, Italy, France, Singapore, South Korea, UK, Switzerland</td>
</tr>
<tr>
<td>29</td>
<td>Japan, Ireland, Switzerland, Belgium, U.S, France, Sweden, India, Italy, Singapore</td>
</tr>
</tbody>
</table>

### Hub Ports of International Air Cargo

According to China Customs statistical data of 2006 air cargo imports and exports, the top ten customs for air cargo exports and imports are as follows:
shown in Table 9 and Table 10 respectively. Since air cargo must pass through the custom clearance whereas these custom facilities are only located at major airports. These airports are so-called hubs underlying the international air cargo network.

The accumulative amount of air cargo imports and exports through these hub ports amounted more than 96% of the total of national air cargo imports and exports as shown in Table 9 and Table 10.

<table>
<thead>
<tr>
<th>S.No</th>
<th>Customs</th>
<th>Amount (thousand of dollar)</th>
<th>Percentage</th>
<th>Economic zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Shanghai Customs</td>
<td>78,983,682</td>
<td>50.6%</td>
<td>Yangtze River Delta</td>
</tr>
<tr>
<td>2</td>
<td>Nanjing Customs</td>
<td>29,811,914</td>
<td>19.1%</td>
<td>Yangtze River Delta</td>
</tr>
<tr>
<td>3</td>
<td>Beijing Customs</td>
<td>23,160,650</td>
<td>14.8%</td>
<td>Bohai Rim</td>
</tr>
<tr>
<td>4</td>
<td>Tianjin Customs</td>
<td>5,643,449</td>
<td>3.6%</td>
<td>Bohai Rim</td>
</tr>
<tr>
<td>5</td>
<td>Qingdao Customs</td>
<td>3,233,430</td>
<td>2.1%</td>
<td>Pan-pearl River Delta</td>
</tr>
<tr>
<td>6</td>
<td>Xiamen Customs</td>
<td>2,419,616</td>
<td>1.6%</td>
<td>Pan-pearl River Delta</td>
</tr>
<tr>
<td>7</td>
<td>Hangzhou Customs</td>
<td>2,343,155</td>
<td>1.5%</td>
<td>Yangtze River Delta</td>
</tr>
<tr>
<td>8</td>
<td>Shenzhen Customs</td>
<td>2,059,570</td>
<td>1.3%</td>
<td>Bohai Rim</td>
</tr>
<tr>
<td>9</td>
<td>Guangzhou Customs</td>
<td>2,004,079</td>
<td>1.3%</td>
<td>Pan-pearl Rive Delta</td>
</tr>
<tr>
<td>10</td>
<td>Dalian Customs</td>
<td>1,546,263</td>
<td>1.0%</td>
<td>Bohai Rim</td>
</tr>
<tr>
<td></td>
<td>Top-ten accumulative</td>
<td>151,205,809</td>
<td>96.9%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total export amount</td>
<td>155,970,948</td>
<td>100.0%</td>
<td></td>
</tr>
</tbody>
</table>

Note: Shanghai Customs has two airports namely Pudong airport and Hongqiao airport

<table>
<thead>
<tr>
<th>S.No</th>
<th>Customs</th>
<th>Amount (thousand of dollar)</th>
<th>Percentage</th>
<th>Economic zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Shanghai Customs</td>
<td>74,039,541</td>
<td>40.4%</td>
<td>Yangtze River Delta</td>
</tr>
<tr>
<td>2</td>
<td>Nanjing Customs</td>
<td>45,256,166</td>
<td>24.7%</td>
<td>Yangtze River Delta</td>
</tr>
<tr>
<td>3</td>
<td>Beijing Customs</td>
<td>27,390,176</td>
<td>15.0%</td>
<td>Bohai Rim</td>
</tr>
<tr>
<td>4</td>
<td>Tianjin Customs</td>
<td>9,743,728</td>
<td>5.3%</td>
<td>Bohai Rim</td>
</tr>
<tr>
<td>5</td>
<td>Guangzhou Customs</td>
<td>4,437,796</td>
<td>2.4%</td>
<td>Pan-pearl Rive Delta</td>
</tr>
<tr>
<td>6</td>
<td>Xiamen Customs</td>
<td>4,148,693</td>
<td>2.3%</td>
<td>Pan-pearl River Delta</td>
</tr>
<tr>
<td>7</td>
<td>Hangzhou Customs</td>
<td>3,918,004</td>
<td>2.1%</td>
<td>Yangtze River Delta</td>
</tr>
<tr>
<td>8</td>
<td>Qingdao Customs</td>
<td>3,062,225</td>
<td>1.7%</td>
<td>Bohai Rim</td>
</tr>
<tr>
<td>9</td>
<td>Chengdu Customs</td>
<td>2,007,401</td>
<td>1.1%</td>
<td>Pan-pearl Rive Delta</td>
</tr>
<tr>
<td>10</td>
<td>Dalian Customs</td>
<td>1,905,311</td>
<td>1.0%</td>
<td>Bohai Rim</td>
</tr>
<tr>
<td></td>
<td>Top-ten accumulative</td>
<td>175,909,041</td>
<td>96.1%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total import amount</td>
<td>183,058,790</td>
<td>100.0%</td>
<td></td>
</tr>
</tbody>
</table>

Both air cargo imports and exports from Shanghai are ranked first, with an export amounting half of the total amount of national air cargo exports, and import amounting 40% of the total of national air cargo imports. Nanjing airport is ranked second, followed by Beijing airport.

As two of the most important gateways to China, Shanghai and Beijing, have naturally become the preferred airports for international air cargo. However, in the last few years, with the construction of new airport in Guangzhou and opening of fifth freedom rights in Xiamen, Nanjing and other cities, rapid development of logistics industry in general and especially in Shenzhen has caused more airlines to pay much attention to the huge freight market in South-East China. They tend to operate the international air cargo by direct departure from Guangzhou or Shenzhen directly, or transfer through Xiamen.

The main air cargo hub ports are located in China's three big economic zones, namely, Yangtze River Delta economic zone, Bohai Rim economic zone and Pan-Pearl River Delta economic zone. Yangtze River Delta economic zone which includes Shanghai, Nanjing and Hangzhou, has a nearly 3/4 of the total amount of national air cargo imports and exports, followed by Bohai Rim economic zone which includes Beijing, Tianjin, Qingdao and Dalian. The last is Pan-Pearl River Delta economic zone which contains Guangzhou, Xiamen, Shenzhen, and Chengdu.

Challenges to International Air Cargo and Proposals

The Expansion of International Air Cargo Market

The biggest impetus of sustained and rapid development of China's civil aviation comes from the continuous growth of Chinese economy. It will be very difficult for China to maintain a double-digit GDP annual growth rate in future as the base number of GDP increases. However, China’s airlines still have a strong desire to expand. Moreover, the role as an important bargaining chip in balancing international trade by purchasing aircraft will remain unchanged in the short term. To break the deadlock, China's airlines should improve their international
competition; meanwhile, look for new growth points from the broad market of sixth freedom rights, so as to be able to exploit invisible trade to replace visible trade featured with ever-increasing frictions. Since internationalization is in fact a double-edged sword, with the opening of international air traffic rights, the controversies over decline in international freight market share possessed by China’s airlines have been increasing [7].

The current cargo routes of China’s airlines are limited to traditional routes. In future, China’s cargo airlines must enhance competitiveness by opening up potential markets and improving the route network structure. The Middle East, South America, South Africa and other places are potential cargo markets. China’s airlines could consider entering these potential markets by a cooperative manner, such as joint ventures with other companies, finding sales agent, and class exchange, etc.

The cities in Western China as a potential market for airlines, are also need attention. China is implementing the strategy for developing the western region in order to solve the problem of uneven economic developments in East and West. With continuous and focus attention to develop Western part of China, and implementation of preferential policies tailored for the Western region, the demand on air cargo in the Western region will show an upward trend. Although at present there is no enough air cargo demand in Western region, its development prospect is optimistic. China’s airlines could put their capacity into the Western region in phases. Once conditions are ripe, airlines could further increase their capacity [8].

**Obsession with Unidirectional International Air Cargo**

The structural imbalance of China’s imports and exports is relatively obvious. Large trade surplus of China means export goods are more than import goods, coupled with weak marketing capabilities of domestic airlines in international market, all these factors render China’s airlines to operate with low international cargo and mail load factor of less than 60% in recent years.

It is well known that the major problem existing in Sino-US air transport market is the imbalance of freight. This imbalance is not just concerns over import and export volumes, but also over price, product structure and other aspects. The difference in Sino-US industrial structure and the nature of import and export trade, leads to this phenomenon which will always exist for a long period of time. In past decade, the imbalance of freight volume in Sino-US air cargo market has been gradually decreasing. According to Department of Transportation of U.S, the ratio of Sino-US air cargo outbound to inbound volume has dropped from 7:1 in 1995 to 5:1 in 2005. However, the air transport price per kilogram of import goods from U.S. equals to only one third of the price of export goods to U.S. As more and more airlines of China and U.S enter Sino-US air cargo market, the price competition will also be intensified.

**Inadequate Cargo Capacity and Imperfect Infrastructure**

The market loss due to lack in cargo capacity results embarrassing situation faced by China’s airlines. Unfortunately, there is no Chinese airline with more than 10 all-cargo aircraft. At the end of March 2006, all domestic airlines had only a total of 33 all-cargo aircraft, with total of 7, 700 tonnages capacity on all available passenger and cargo aircraft. On contrary, two companies namely UPS and FedEx have more than 1000 all-cargo aircraft in operations in U.S. The belly capacity of passenger cargo aircraft is still a major component of the entire cargo capacity resource in future. At present, cargo aircraft is still main large-size cargo aircraft, which is considered unfavorable to air cargo hub construction being unable to build up an effective air cargo route network. This is because building air cargo hub must rely on small and medium size aircraft to connect between non-hub and hub airports, and possess large size aircraft to connect amongst hub airports. Due to lack of air cargo hub, airlines are unable to effectively exploit the powerful ground-based service capabilities, maintenance support capability, and enlarge share in freight market that is already occupied by a hub, to expand their influence, attract inflow of goods around airports, and build up a network through transfer services [9].

The airport infrastructure and customs restrictions become important factors constraining direct departure of international air cargo from mainland China. As compared to perfect hub airport construction and network layout in neighboring countries, China has only Beijing and Shanghai cities which can barely compete with them. The long-standing emphasis on passenger transport instead of cargo transport is because of the number of airports being far less than the requirements of airlines and shippers in respect of infrastructure, freight operational efficiency and other aspects. Moreover, the procedure and system for logistics and transport operations adopted by mainland China’s customs have low cargo processing speed.

We therefore propose that domestic airlines being more all-cargo aircraft can be used to expand fleet size gradually and optimize the route network, and eventually realize the cargo operational mode of “all-cargo aircraft as principal, supplemented with belly compartment of passenger aircraft”. In the meantime, domestic airlines should strengthen the hub construction at base airports; spread out air cargo
network and expand market scope through hub airport; expand and improve the ground-based distribution network by various ways so that air transport and ground transport can achieve a seamless interface.

Lack of Competitiveness in International Air Cargo Market

China's air cargo companies are still very young, whose management experience remains inadequate as compared to many large international shipping companies. This makes China’s airlines very hard to gain a foothold in international cargo market. For domestic airlines, one feasible way of obtaining management expertise is to build strategic alliances with leading foreign airlines [10].

The service awareness of domestic air cargo companies is relatively weak. They only care whether goods have been shipped to destinations, while rarely consider such service innovations as how to accelerate carriage speed, ensure cargo security, and provide customized products, and so on. The price factor and service environment of domestic airlines still need to improve. Under the circumstances of different airlines having similar flight routes and time windows, price becomes one of the major factor affecting the choice of airline. Compared to China’s airlines, the cost advantage of foreign airlines allows them to lower price on the premise of maintaining certain profit, thus take away a large number of freight sources. In this case, competing on price blindly with foreign airlines will only result in loss. For China’s airlines, the preferred option is to adjust the product structure and sales strategy, increase the proportion of high value-added products, and improve the cargo and mail load factor [11].

China’s airlines must first strive to complete high-quality basic services, such as improving the speed of goods flow, and ensuring cargo security. In addition, China’s airlines should provide value-added products through service innovation. Service innovation is to provide the service that other airlines cannot offer, but is needed by customer or customer is willing to receive. If an airline creates new services for customer beyond the core product of airport-to-airport transport, such as air transport and logistics advisory service, special warehouse management service, personalized services for high-end customers, and so on, then its products will be infinitely extended.

Furthermore, domestic airlines may choose to join a suitable air cargo alliance. By cooperating with other members of the alliance, airlines can enhance the whole competitiveness of the alliance; expand air cargo network more rapidly at a lower cost. In addition, gradually introducing freight products that meet the alliance’s service standards, airlines can benefit by improving management level for freight products and thus increasing flight revenue. Again, cost can be reduced through joint procurement of alliance.

Conclusions

The rapid growth of China’s economy along with unceasing expansion of China’s foreign trade, have greatly promoted China's air cargo industry, especially the international air cargo industry. Based on the statistical data of 2006 air cargo imports and exports obtained from China Customs, this paper describes the basic structure and flow distribution of mainland China’s international air cargo network. The study shows that the ratio of total amount of imports and exports by air to that of all imports and exports has been increasing. The origin and destination countries (regions) of mainland China’s air cargo imports and exports are concentrated in Asia, North America and Europe, while Asia is the foremost origin and destination. Electronic, mechanical and high value-added products are main commodities of mainland China’s air cargo imports and exports. The top ten hub airports of air cargo imports and exports in mainland China are located in three economic zones, where Shanghai, Nanjing and Hangzhou airports belonging to Yangtze River Delta economic zone own nearly 75% of the total amount of air cargo imports and exports. Shanghai is the biggest hub in mainland China, accounting for almost half of the total amount of national air cargo imports and exports. The further development of mainland China’s international air cargo has to deal with following challenges: expansion of international air cargo market, obsession with unidirectionality of international air cargo for a long time, inadequate cargo capacity and imperfect infrastructure, as well as lack of international competitiveness of domestic airlines.

References


MEASUREMENT AND ANALYSIS OF BILATERAL COSTS BETWEEN CHINA AND TRADING PARTNERS BASED ON THE REVISED GRAVITY MODEL

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Abstract
A revised gravity model has been adopted in the thesis to measure the changes of bilateral trade costs of China and other 28 countries during 1992～2007. The results are as follows: China’s trade costs take on a declining trend and the bilateral trade costs between China and developed countries is lower than that of developing countries. As the trade costs between China and major trading partners take on a declining trend, which even has room for further decline, the major policy significances in this thesis are that China shall continue to excavate the way to reduce the trade costs in order to further enhance the export competitiveness.

Key words: trade costs, gravity model, cost measurement

1. Forewords
Trade cost is also called transaction cost, which includes all the costs for delivering the products to the ultimate consumers. As is well known, the decrease of transaction costs will enhance the degree of specialization of economic entities, increase the transactions between the entities, extend the market scale and increase the varieties of the products. On the contrary, if the transaction costs are too high, the transactions between the companies will decrease. In case the transaction costs are infinitely large up to the limit, no transactions will take place between any two companies in two countries. Currently, trade costs widely exist in international trade under the tides of global economic integration. The level of trade costs has been a decisive factor in determining whether the trade transactions will take place or not. To explore and measure the trade costs of a country can not only reveal its degree of integration into the world economy and its international competitiveness, but also have practical significance for a country’s trade policy.

Since the adoption of the reform and open policies, China has made a remarkable progress in foreign trade. During 1980～2007, China’s cargo export volume grows at an annual average rate of 25.62%, which is 18.32% higher than the world’s average growth rate in cargo export volume during the same period and the average contribution rate of it to the GDP growth achieves 27%, which is also 10.15% higher than the average level of all the developing countries. (It is calculated according to the calendar year of “China Statistical Yearbook” and the World Trade Organization) The constant economic growth of China in the past 30 years obviously benefits from the rapid growth of the foreign trade. However, we have noticed that some problems have been caused by the rapidly developing trade pattern of China: Chinese enterprises rival with each other to participate in the work division system of global value chain through processing trade (processing on consignment or OEM) which is a trade pattern characteristic of low-tech, low added value and labor-intensive low-road manufacturing and assembly links.

This will inevitably bring about some problems such as the low exports value, environmental pollution during manufacturing and increasing trade frictions etc. Generally, what influence will such trade development bring to China? If China’s trade development just relies on the increase of export quantity of local enterprises instead of improving the quality of the productivity of the enterprises, this kind of foreign trade is unsustainable, nor is the role it plays in driving the economic growth of China. Therefore, the measurement of China’s trade costs under such background can not only provide direct evidence for the performance of China’s foreign trade, but also be of vital importance for comprehending the pattern of trade and specialization China adopts in participating in the international division of labor. It has been an important subject of practical value and political connotations of China to make objective comments on the trade cost relations between China and the trading partners, and to discuss the interaction mechanism between them systematically. So The revised gravity model is adopted herein to measure and research the bilateral trade costs between China and 28 trade partners.

The structure of the remaining parts of the thesis is as follows: The second part is introduction to the international research background and the related research achievements. The third part is introduction to the empirical
methods and the data, while the forth part is presentation and analysis of the major calculation results, The fifth part is the summary.

2. Research Background and Literature Review

Issues related to cost are the primary issues in economics. Each significant development in economics is embodied in the development of cost, and each important economist has given its unique answer to issues related to cost in the history of economics. The cost of international division of labor and international trade consists of costs of resources reallocation and costs of transaction. The former refers to cost of converting the productive structure, which falls into the category of production and is the object of study in microeconomics; the latter falls into the category of circulation and is the object of study in international trade theories. From the perspective of the development history of international trade theories, scholars have carried out a detailed analysis of the benefits of international division of labor and international trade as well as issues related to production cost. However, they have not conducted a careful and systematic study of the transaction cost of international division of labor and international trade. Attention has been paid to the production cost very early in the international trade theory, but transaction cost has not been the major object of study in international trade theory all the time. Even if some scholars mention this question indirectly, they just skate over such issues with scattered elaborations.

Trade costs have been almost excluded in the conventional trade theory and trade model (Behrens etc.2007) [1]. Firstly, what conventional trade theory has always paid attention to is visible costs such as tariff and tariff barrier. On the one hand, the tariff data is available, which makes the empirical research easy to carry out. On the other hand, the cost of tariff is determined by the trade policy, which is an endogenous process of decision-making and provides an attractive subject for research. On the contrary, it will take much time and effort to obtain the data of the transportation cost, information cost and cost of contract performance etc.. What’s more, some relative data may not be available at all. Secondly, the trade costs is very difficult to be incorporated into the normal form of perfect competition due to uncertainty leading to balance, which is the backbone of the trade theory. Finally, people generally believed that the different components of trade cost can be simplified into a single parameter (Samuelson, 1954) [2].

At present, trade costs have been a core concept in the trade theory. Melitz(2003) [3] founded the so-called New-new International Trade Theory with the critical assumptions of heterogeneity of manufacturers and sunk cost of export. It is the sunk cost of export that puts heterogeneity of manufacturers into play. In Krugman(1980,1991)’s theory of economic geography, trade costs is the key factor to comprehend the locational choice of enterprises and the concentration and spread of the space of economic activity [4][5]. Benard(2006) [6] have expanded a Single product company to Multi-product company, and every product has corresponding sunk cost of export so as to explain the export and production adjustment in the company.

Moreover, Helpman(2007) [7] holds that different sunk costs of export shall be paid to enter into different countries to explain zero trade and unilateral trade. Andersen and Wincoop(2004) [8] thought that trade costs is of vital importance, also pointing out that trade costs is equal to 170% customs duties. Obstfeld and Rogoff(2000) [9] regarded the trade costs as the key to solve the mysteries of all the other open macroeconomics and noted that trade costs is the common answer to explain the 6 big doubts in the domain of international trade. Hummels(2001) [10] believed that trade costs played a core role in international specialization and the trade model and any experiential assessment involving international specialization and trade model may face trade costs finally. Kancs(2007) [11] divided the trade costs into variable trade costs and fixed export cost, holding that different trade costs have different influences on export growth. He inspected the influences caused by the invariable trade costs and the fixed export cost on the export growth of the countries of southeastern Europe under the frame of the heterogeneous trade model of the enterprises.

The importance of trade costs determines the necessity for measuring the trade costs. As for merchandise trade, trade costs consist of transportation cost (shipment cost and time cost), policy barrier(tariff and non-tariff barrier), information cost, the cost paid for guaranteeing contract performance, payment of overcoming the linguistic and cultural differences, expense spent in currency conversion and risk of exchange rate, cost of the law and control in importing countries and the distribution cost for wholesale and retail sales etc.. People have already reached the consensus about the importance of the trade costs, and recent research has supplied attracting clues. However, there are rare evidences about the nature, scale and structure of trade costs (Hummel,2001). How to measure trade costs is still confusing. At present, there are limitations in either measuring the trade
costs directly or indirectly. For example, direct measurement of the trade barriers. Although there are many indexes for direct measurement of the trade barriers such as the level of customs duty, the coverage ratio of each non-tariff barrier and the premium of exchange rate in black market etc., the nominal customs duties promised by various countries, especially the duties of manufacturing industry will be reduced greatly after multi-round bilateral and multilateral consultations. More and more countries have resorted to non-tariff barrier as the major means of trade protection. However, it is hard to quantify non-tariff barrier precisely and different kinds of non-tariff barriers have different restrictive effect. Each index has its own limitation in application and it is hard to draw a consensus conclusion for different means of measuring, which will affect the reliability and accuracy of the direct measurement. Therefore, researchers mainly measure the trade costs indirectly.

Most scholars adopt the gravity model to measure trade costs indirectly. Anderson (2003) has revised the traditional gravity model through adding the overall multilateral trade costs of both sides in the trade on the basis of the traditional regressive variable so that the bilateral volume of trade becomes the function of the economical scale and the relative trade costs. The basic form of the gravity model is as follows:

\[ X_{ij} = a_1 Y_i + a_2 Y_j + \sum_{m=1}^{m} \beta_m \ln(Z_{ij}^{m}) + \epsilon_{ij} \]  

(1)

\[ X_{ij} \] is the log value of the export volume from country I to country j. \( Y_i \) and \( Y_j \) are the log value of the GDP in exporting country i and importing country j respectively, \( Z_{ij}^{m} \) is the proxy variable related to trade costs, \( \epsilon_{ij} \) is disturbance item.

McCallum(1995) [14] adopted this method to measure the trade between American and Canada, and found that the trade volume between the various provinces in Canada was 22 times as much as that between American various states and Canadian various provinces. Rose (2000) [15] inspected the influences of the monetary union on trade with this method, finding that the trade volume between the various provinces in Canada is only 1.5 times as much as that between American various states and Canadian various provinces.

Just because of the defects of traditional trade gravity model in measuring the trade costs, some economists have begun to try to amend and extend the traditional gravity model. They deduced the gravity model of micro-theoretical foundation Through the general equilibrium model, and they determined the trade cost afterwards instead of beforehand, and took the impact of multilateral resistance into account. Anderson and van Wincoop(2003) estimated the McCallum(1995)'s regression equation with the American data, finding that the trade volume between the various provinces in Canada is only 1.5 times as much as that between American various states and Canadian various provinces.

\[ X_{ij} = \frac{Y_i Y_j}{P_i P_j} \left( \frac{T_{ij}}{P_i P_j} \right)^{1-\rho} \] 

(2)

\[ X_{ij} \] is export from country I to country j, \( Y_i \) and \( Y_j \) is GDP of country I and country j respectively; \( T_{ij} \) is iceberg trade costs, \( P_i \) and \( P_j \) is the price index, \( P \) is the elasticity of substitution. The key meaning of the equation is that the trade between two regions is determined by the relative trade costs. In the above equation the price index \( P_i \) and \( P_j \) represent the term of multilateral resistance. However, it is not an ideal method to use the price index to replace the multilateral resistance. Novy(2006) pointed out that
the comparative static analysis is invalid, for both production and consumption are exogenous in the model of Anderson and van Wincoop, and the changes in trade costs affect not only trade volume, but also affect production and consumption. In short, the current indirect methods of measuring trade costs are unsatisfactory and an improved method is expected. (Anderson and van Wincoop, 2004).

The researches on trade costs of the domestic scholars mainly focus on two aspects: Li Kunwang and Huang Jiuli (2006) and Li Kunwang etc. (2006) estimated China’s manufacturing industry and degree of freedom in the bilateral trade between China and its major trading partners through making use of the model of fixed effect and on the basis of the new economic geography model respectively, which has provided useful exploration for understanding the changes of China’s trade openness. But the defect of the former lies in that it ignores the influences on bilateral trade costs by the multilateral resistance. The computational formula derived from the new economic geography model by the latter is over-simplified and they used a single parameters to cover all the trade barriers. Shi Bingzhan (2008)[19]and Qian Xuefeng, Wang Qi (2008) [20] have adopted the improved gravity model to measure the bilateral trade costs with its trading partners since 1980s respectively and revealed the downward trend in trade costs.

To conclude, these documents have provided a deep insight for us to understand the relationship between trade costs and the growth of trade, however, there are some shortcomings. First of all, most of the documents have directly adopted the traditional gravity model as the means of research, thus they fail to explain the mechanisms between the development of trade and trade costs clearly in theory. Secondly, most of the literature are on the basis of enterprise-level survey data in empirical studies. However such data are hardly available, and even if the data are obtained, the conclusions may be not comprehensive due to the quantitative limitations of the samples. Finally, as for the perspectives of research, no documents except Novy (2006) have separated the different effects on trade development by different trade costs, which is very important for choosing the developmental path of China’s trade. Compared with the current research, the main contributions of this article are as follows: Such deficiencies can be made up for by referring to the improved gravity model provided by Novy (2006) and the bilateral trade costs between China and other 28 countries since China’s reform and opening to the outside world have been measured comprehensively. As shown in relevant studies, the bilateral trade costs of the tariff equivalent between China and other 28 countries has been less than 50% decreasing by 30% averagely compared with that in 1992. Particularly, the empirical research on China is favorable not only to understand the nature of China’s trade prosperity and the meaning of welfare, but also to provide rich policy implications for choosing the path for the further development of China’s foreign trade as well as the empirical evidences for the trade model of enterprise from large developing countries.

3. Empirical Methods and Data Sources

3.1. Novy model

Novy (2006) put forward a convenient and easy equation of gravity model through dividing the export commodities into tradable goods and non-tradable goods, extending the bilateral model to multilateral model, and integrating Samuelson (1954)’s iceberg type trade costs and Krugman (1980)’s framework of monopoly competition into the gravity trade costs. The equation is as follows:

\[ E_{ij} = s_j (Y_i - E_i) s_j (Y_j - E_j) \]

\[ (1 - \tau_{ij})^{\rho - 1} (1 - \tau_{ji})^{\rho - 1} \]  

(3)

In the equation, \( E_{ij} \) and \( E_{ji} \) are the export from country I to country j and the export from country j to country I respectively, \( E_i, Y_i \) and \( E_j, Y_j \) are country I and country k’s total exports and GDP respectively, \( s_i \) and \( s_j \) are country j and country j’s share of tradable goods respectively, \( \tau_{ij} \) and \( \tau_{ji} \) are the trade costs of the export from country I to country j and that of the export from country j to country I respectively, \( \rho \) is the elasticity of substitution.

The above equation shows that if the bilateral trade costs \( \tau_{jk} \) and \( \tau_{kj} \) are very high, the bilateral trade \( E_{jk} \) and \( E_{kj} \) will drop; if the share of tradable goods are very low, the bilateral trade \( E_{jk} \) and \( E_{kj} \) will decline too. In the traditional gravity model, bilateral trade is only determined by the \( Y \), but in the equation by \( (Y_j - E_j) \) and \( (Y_k - E_k) \), \( Y_j - E_j \) represents the market potential actually, which is the potential tradable part of j’s output that don’t happen in fact.

If the potential of the bilateral market increases, the bilateral trade will also expand. What’s more, the equation reflects the impact of multilateral resistance, and bilateral trade is determined by the level of bilateral trade costs corresponding to their average trade costs. For example, suppose that other
conditions remain unchanged, if the average trade costs between \( j \) and the other country \( l \) (\( k \neq l \)) decline, the actual total trade export \( E_\gamma \) will increase and the bilateral trade will decrease between \( j \) and \( k \). Therefore, the actual total export \( E_\gamma \) and \( E_\delta \) imply the average trade costs, which represents the multilateral resistance. As the data of the actual total export can be obtained directly, it avoids the problems caused by using the price index that can’t be observed as the multilateral resistance in Anderson and Wincoop’s model.

In addition, as both production and consumption are endogenous in Novy(2006)’s model, comparatively static analysis can be carried out effectively. In order to measure the trade costs easily, it is assumed that the bilateral trade costs is symmetric(\( T_\gamma = T_\delta \)) and the share of bilateral tradable goods is equal(\( s_j = s_k \)). Then, we can easily obtain the computing formula of the trade costs:

\[
\tau_\gamma = \frac{E_\gamma E_\delta}{(Y_j - E_j)(Y_k - Y_k)s^2} \quad (4)
\]

Obviously, if the bilateral trade increases, it means that it is easier for the two sides to develop trade, and the trade costs will come down in case that other conditions remain unchanged, and if the increase in output has not led to an increase in bilateral trade, it in fact means that the bilateral trade costs goes up. Therefore, use of Novy(2006)’s model and methods will not only greatly improve the defects of the traditional gravity model and the current gravity model with theoretical foundation but also make data availability convenient and feasible.

3.2. Data sources

If we want to measure the bilateral trade costs between China and the 28 major trading partners by using Novy’s model and methods, first we need to acquire the actual data of mutual exports between China and its trading partners and each of their actual total exports as well as the actual data of GDP. The relevant data of each country’s export come from the United Nations Commodity Trade Statistics Database (UN COMTRADE), while the data of each country’s GDP is obtained from the International Monetary Fund (IMF).

In the calculation of the trade costs, the numerical value of GDP and trade costs are the value of the current year, for the trade costs is a ratio not influenced by the deflating index. In estimation of the gravity model, as the index of parity income of purchasing power is more suitable for estimation of the long-term trade flow, the figures of GDP in this paper is calculated on the bases of purchasing-power parity (PPP) in the IMF database according to the sample study period. The data of distance has been adopted in the form of the spherical distance from Beijing to the other political or economic center of countries as the explanatory variable, which is from "distance calculator" on site www.indo.com. And the data of exchange rate is from “China Statistical Yearbook 2008". The 28 countries we have selected are as follows: Brazil, Turkey, the Philippines, Mexico, Finland, Denmark, Pakistan, Sweden, Ireland, Israel, Switzerland, Argentina, Greece, New Zealand, Norway, Russia, Canada, the United Kingdom, Germany, France, the United States, Australia, India, Indonesia, Egypt, Italy, Thailand, the Netherlands. The time span of the sample we have selected is from 1992 to 2007.

The value of the two parameters (the share of tradable goods) and \( \rho \) (elasticity of substitution) in the equation (2) is very difficult to estimate directly from the data. As for the tradable share, evidences show that the tradable output is between 0.3 to 0.8 (Evenett, Keller, 2002) [21], Novy(2006) and Jacks etc.(2006) [22] set \( s \) at 0.8. Considering that there are 15 developed countries as well as 13 developing countries in our 28 sample countries, the share of tradable goods should be high. Therefore, we think that it is appropriate to set \( s \) at 0.5. As for the elasticity of substitution, low elasticity of substitution means that the consumers lack sensitivity to the price and trade costs, and they tend to conduct more trade as a result. Anderson and van Wincoop (2004) have summarized all the estimated results of all the existing literature and they thought the value of the elasticity of substitution \( \rho \) may fall into the range between 5 and 10. In order to explore the impact on trade costs from the elasticity of substitution better, we will set the value of \( \rho \) at 5(low), 8(middle), 10(high) respectively.

According to Novy (2006)’s research thoughts and methods, when \( s=0.8, \rho=8 \), we have measured the changes in bilateral trade costs between China and other 28 countries from 1992 to 2007 by using bilateral trade data. In order to solve the problems of period heteroskedasticity and autocorrelation in the model, we adopt generalized least squares (GLS) in the thesis to carry out the multiple linear regression analysis based on the panel data.

\[
\begin{align*}
\log \tau_{ij} &= \epsilon + \beta_1 \log rate \\
&+ \beta_2 \log distance + \beta_3 \log Y_i \\
&+ \beta_4 \log Y_j + \beta_5 \text{ high} \\
&+ \beta_6 Apec + \beta_7 Asean \\
&+ \beta_8 EU + \beta_9 WTO + \epsilon
\end{align*}
\]  
(5)
\( \tau_y \) means country I to country j’s trade costs; rate is the exchange rate for RMB against the U.S. dollar; and distance is for the absolute distance between country I and country j; \( Y_I \) and \( Y_j \) are the GDPs of country I and country j respectively. Ape, WTO, EU, Asean are virtual variables; 1 indicates that country j belongs to the trade group, while 0 is for not; The level of national income in the country is i subject to the division of the country in International Monetary Fund, and set high for dummy variable, 1 for developed countries, 0 for underdeveloped countries.

The results of the multiple regression are as follows:

\[
\log \tau_y = 0.027637 \log \text{rate} + 0.063842 \log \text{distance} - 0.106516 \log Y_I - 0.052159 \log Y_j - 0.018167 \text{high} - 0.044207 \text{Apec}
\]

\( (6) \)

\( (4.27) \) \( (13.12) \) \( (-16.64) \) \( (-9.16) \)

\( (-3.00) \) \( (-6.65) \)

\( R^2=0.93 \) \( DW=2.04 \) \( S.E.= 0.96 \)

\( F=1129.84 \)

Regression results show that the seven explanatory variables pass the examination and the other explanatory variables have maintained high significance on the basis of the unchanged effectiveness of the regression equation. Among them, the value of \( R^2 \) indicates the high fitting optimization, and strong interpretation to the reality; the value of DW indicates that the explanatory variables are independent of each other and there is no correlation; the test value of F indicates that the explanatory variables of the equation generally have a significant linear effects on the explained variables through the general linear significance test of the equation.

4. Analysis of the Research Results

4.1. The cost of China’s foreign trade shows a downward trend

When \( s=0.8, \rho=8 \), the bilateral trade costs of equivalent tariff between China and other 28 countries comes down from 61.1% to 49.1% during the year 1992 to 2007, decreasing by 12% averagely, which reflects the ever increasing extent of openness of China to the outside world and the accelerating integration into the global economy.

We can clearly see that the bilateral trade costs of equivalent tariff of China and other 28 countries have declined greatly and the trade costs with 28 major trading partners has fallen below 50% in 2007. Among them, the trade costs of the United States has decreased from 51.3% in 1992 to 39.6% in 2007, Canada from 55.9% to 48.0%, France from 59.1% to 48.6%, Germany from 53.6% to 40.4%. The orders in terms of the margin of decline from big to small are as follows: India (19%), Ireland (18%), Brazil, the Philippines, Israel, Thailand (17%), Argentina (16%), the Netherlands, Mexico (15%), Finland (14%), Germany (13%), the United States, Australia (12%), France (11%), the United Kingdom, Sweden (10%), Italy (9%), Canada (8%), Greece, New Zealand, Norway, Russia, Egypt, Pakistan (7%). Obviously, the trade costs of China and other developing countries decrease faster.

4.2. China’s major trading partners showed a downward trend in bilateral trade costs

All of our trading partners’ trade costs show a downward trend from the year 1992 to 2007. For example, the trade costs with the developed countries has less than 50%, while the trade costs with the developing countries are close to 50%, which indicates that the higher the income level is, the lower the policy cost is.

4.3. The changes in bilateral trade costs under different elasticity of substitution.

<table>
<thead>
<tr>
<th>countries</th>
<th>the average decline in trade costs from 1992 to 2007</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( \rho=5 )</td>
</tr>
<tr>
<td>Brazil</td>
<td>0.15</td>
</tr>
<tr>
<td>Turkey</td>
<td>0.10</td>
</tr>
<tr>
<td>Philippines</td>
<td>0.17</td>
</tr>
<tr>
<td>Mexico</td>
<td>0.13</td>
</tr>
<tr>
<td>Finland</td>
<td>0.13</td>
</tr>
<tr>
<td>Denmark</td>
<td>0.10</td>
</tr>
<tr>
<td>Pakistan</td>
<td>0.06</td>
</tr>
<tr>
<td>Sweden</td>
<td>0.09</td>
</tr>
<tr>
<td>Ireland</td>
<td>0.16</td>
</tr>
<tr>
<td>Israel</td>
<td>0.14</td>
</tr>
<tr>
<td>Switzerland</td>
<td>0.10</td>
</tr>
<tr>
<td>Argentina</td>
<td>0.15</td>
</tr>
<tr>
<td>Greece</td>
<td>0.06</td>
</tr>
<tr>
<td>New Zealand</td>
<td>0.07</td>
</tr>
<tr>
<td>Norway</td>
<td>0.06</td>
</tr>
<tr>
<td>Russia</td>
<td>0.08</td>
</tr>
<tr>
<td>Canada</td>
<td>0.09</td>
</tr>
<tr>
<td>The United Kingdom</td>
<td>0.10</td>
</tr>
<tr>
<td>Germany</td>
<td>0.14</td>
</tr>
<tr>
<td>France</td>
<td>0.10</td>
</tr>
<tr>
<td>the United States</td>
<td>0.13</td>
</tr>
<tr>
<td>Australia</td>
<td>0.13</td>
</tr>
<tr>
<td>India</td>
<td>0.18</td>
</tr>
<tr>
<td>Indonesia</td>
<td>0.10</td>
</tr>
</tbody>
</table>
When $\rho = 8$, the bilateral trade costs of China and 28 countries dropped by an average margin of 12% from the year 1992 to 2007 (as is shown in Table 1). In order to test the different influences on trade costs by the different values of the elasticity of substitution $\rho$, we have further calculated the tariff equivalent of trade costs of China and 28 countries respectively when $\rho = 5$ and $\rho = 10$. From As shown in Table 1, different elasticity of substitution have more effect on the absolute value of the cost. For example, in 2007 (as is shown in Table 2), the bilateral trade costs between China and USA drop to 32.4% when $\rho = 10$, while they are as high as 58.6% when $\rho = 5$. And it is also the case with the trade costs between China and other countries. However, obviously the changes in trade costs rather than its absolute magnitude truly reflect the degree of openness of a country. We have found that although the influences of the different value of $\rho$ on the absolute value of trade costs are not quite large, different values have not changed the trend of the bilateral trade costs between China and 28 countries.

### Table 2 the decline in trade costs in 2007

<table>
<thead>
<tr>
<th>countries</th>
<th>$\rho=5$</th>
<th>$\rho=8$</th>
<th>$\rho=10$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil</td>
<td>0.69</td>
<td>0.49</td>
<td>0.41</td>
</tr>
<tr>
<td>Turkey</td>
<td>0.75</td>
<td>0.55</td>
<td>0.46</td>
</tr>
<tr>
<td>Philippines</td>
<td>0.63</td>
<td>0.44</td>
<td>0.36</td>
</tr>
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gross domestic product is large, it will not only provide a wide range of market activities to manufacturers, but also lay a basis for enterprises to strengthen the production of differentiated products in case of increasing returns to scale so as to promote bilateral trade development; and the rise of the level of pre capita income will increase the consumers’ demand for differentiated products.

The historical changes on the impact of trade costs are significant. This shows that late-development trading partners have gradually enhanced their understanding of China so that the gap of information cost caused by historical factors will be narrowed.

5.Conclusion and Policy Significances

The traditional gravity model and the current gravity model with the theoretical basis have some defects of various extent when used for measuring the trade costs. The methods and models put forth by Novy(2006) have improved the defects, which is also easy and available to acquire the data. Using this method to measure the bilateral trade costs of equivalent tariff between China and 28 countries, we find that China and these countries’ trade costs of equivalent tariff have been fallen below 50% and the average margin of decline is up to 12% from the year 1992 to 2007. As the 28 countries occupy a quite important position in China’s foreign trade, the bilateral trade costs with them, to some extent, can reflect China’s level of the overall trade costs. This fully shows that the ever-increasing extent of openness of China to the outside world is and the accelerating integration into the global economy during the 15 years.

This conclusion has not only provided a new analytic perspective for us to understand the expansion of China’s export trade. What is more, it has provided rich policy implications. For the Government, it can reduce the cost of exports, and promote the development of bilateral trade as well as raise China's international trade competitiveness by means of the multilateral trading system, bilateral trade agreements etc. Certainly, this thesis is a preliminary research. Due to data availability and other reasons, this thesis has only studied the export trade and trade cost of China and the 28 major trading partners from the year 1992 to 2007.

In fact, the expansion of the period span and section capacity of the sample will help us to conduct a more comprehensive analysis of the relation of the bilateral trade costs’ changes between China and major trading partners since China’s reform and opening up, and of the different countries (both developed and developing countries), also which can also help us to set up differentiated suitable trade policies according to local conditions. We believe that these are research directions that may yield more research achievements in the future.

References

615–623.


TUG OF WAR BETWEEN THE RETAILERS AND CONSUMERS: THE PHENOMENON OF GROUP PURCHASE IN CHINA

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Abstract
Retailing shops are the contact points between customers and supply chain. On one hand, the retailers need to satisfy the customers by providing the right and enough products to ensure the service level; on the other hand, the retailers also need to minimize the costs while satisfying the customers. This paper uses a case study of GOME to illustrate Tuangou, a relatively new phenomenon that has spread rapidly in China, and to show how the company responded to the group purchasing shoppers. The case presents a tug of war happening between the retailers and consumers. The implications of Tuangou to the stakeholders in group purchase are also discussed.

Keywords: Electronic Commerce, Group Purchase, Supply Chain, Consumer Behavior

Introduction
One main task for retailers is to satisfy the customers by fulfilling their needs. In other words, the retailers need to maintain the service level that customers expected. At the same time, the retailers also need to try all the efforts to minimize the cost (or maximize the profits). How to keep a good balance between the cost minimization and service maximization becomes the most critical and challenging work for the retailers. From the customers’ point of view their decisions are on location, time, type, variety, quantity, price, and among others. The retailers need to take into account these issues for retailing, shelf, and inventory management. The retailers may do regular basis or event driven promotion on certain products to attract the customers by decreasing product price. The retailers may increase the customers’ satisfaction by offering wide variety or high inventory. The retailer may also give customer more flexibility on ordering, shipment, or pickup. There are always pros and cons for each option that retailers try to implement.

The concerns for major stakeholders can be discussed from the following three aspects: customers’ choice toward retailers and product, interaction between customers and retailers, and relationships between the retailers and its upstream partners in the supply chain.

• Customers’ choice toward retailers and product. The customers could purchase certain product at the specific shop. The customer may also purchase through other channels and means to order or to pick up, e.g. ordering on Internet shop, post mail for catalog shopping, telephone ordering for TV advertisement. The main concerns focus on ordering online and purchasing at shop.

• Interaction between customers and retailers. Since the retailers need to keep a good balance between the cost control and service requirement, normally they would be very vigilant on demand variability which is critical in inventory cost. Normally promotion will result in higher demand in a short period as a spike that reflects the higher demand variability. On the contrary, Wal-Mart adopts “everyday low price” strategy to have a better control in order to stabilize the demand.

• Relationships between the retailers and its upstream partners in the supply chain. The retailers need to work closely with upstream partners (e.g. distributors and manufacturers) to ensure timely and satisfactory supply. The demand variability is transferred, propagated, and amplified to the upstream partners and consequently it forms the bullwhip effect. The upstream partners can alleviate the bullwhip by information sharing or strategic partnerships (e.g. vendor management inventory, VMI). The Chinese term Tuangou could be translated as “team buying” or “group purchase”. It referred to a consumer buying practice in China that unknown consumers joined together via the Internet and leveraged their collective bargaining power with retailers to get discounts that individuals could not. Typically, the group would gather at an agreed time and location, and would show up unannounced at a retail store. The practice had its original in on-line chat rooms but had spawned numerous websites, such as 51tuangou.com, SHtuangou.com, or 020tgw.com, specializing in organizing Tuangou sessions. This form of new buying behavior had quickly spread.
throughout China. Consumers were organizing themselves via various Tuangou websites to go Tuangou for all sorts of goods and services, ranging from home appliances to automobiles, and from wedding packages to building/renovation materials for new homes.

Some suggested that Tuangou was a natural extension of the bargaining culture of China, where shoppers typically treated sticker prices as the starting point for negotiations [1]. This, perhaps, explained in part why regular on-line shopping had not taken off in China, which had more than 110 million Internet users. Many on-line shoppers in China still prefered cash-on-delivery or checks to on-line payment systems or payment by credit cards. According to Ouyang Jixing, deputy director of www.020tgw.com, “On-line shopping has been around for a few years, and Chinese people realize that it’s quick and easy, but there’s a crisis of trust and honesty. How do you know whether to trust the seller?” Chinese web surfers were also very skeptical about the goods that they would get from on-line shopping. Tuangou offered consumers an alternate means to leverage the Internet and killed two birds in one stone – it allowed consumers to get better prices by combining their bargaining power, and, as opposed to on-line shopping, it provided consumers a form of protection against getting faulty items or knock-offs.

By 2005, Tuangou was a way of life of the Chinese web surfers. Regular trips to retailers selling all sorts of products and services were organized through these websites. One such example was a group of Nanjing citizens, who organized regular shopping trips to the IKEA in Shanghai via the Nanjing 51tuangou.com [2]. To get on the trip, one could simply sign up on-line and pay a small fee for the transportation by coach. Apparently, these Tuangou sessions had lived up to their reputation. One participant in Shanghai saved RMB500 on a Plasma TV over the GOME price on a Tuangou trip with Shtuangou.com [3]. Others bought a Kodak digital camera (and an SD card) with a street price of RMB6,500 for less RMB4,000 with other freebies as more memory cards and camera pouches [4]. By end of 2005, the largest Tuangou website, 51tuangou.com, had hundreds of thousands of members. Regional websites, such as Shtuangou.com or 020tgw.com, were also catching up quickly with tens of thousands of members and growing. And by one estimate, the volume of transactions completed during Tuangou sessions nationwide was in the millions per day [5].

Group purchase was not unique to China [6]. For decades in western countries, neighbors organized themselves into groups to get discounts for all sorts of goods. One person would be responsible for negotiating the volume discount, grouping and passing on the order, organizing the deliveries, and performing the treasury function. During the early part of the second half of 1990s, group shopping was one of the hot opportunities sought after by dot.coms. Websites were set up to group consumers together that were interested in buying a certain item, and to negotiate volume discounts on the consumers’ behalf with manufacturers and wholesalers. Effectively, these companies were acting as an intermediary This was what set them apart from the Chinese Tuangou. These companies, as “online brokers”, asked people to sign up online stating an interest to buy a certain product if it hit a certain discounted price; the more people signed up, the more the price would drop, so at the end everyone was guaranteed to get the product for the price they had signed up for, or for less. As an intermediary, these companies took payments from the consumers, got the goods delivered to the consumers, and earned a commission in the process. Whilst Tuangou in China was organized through websites and that consumers agreed the gathering location, time and date, no intermediary was involved in the negotiation and in the transaction. Consumers were physically present at the retailers, bargained for discounts with their volume presence, paid the retailers directly, and walked out with the goods they wanted.

As Tuangou caught on quickly and spread like wild fire in China, it became a phenomenon that retailers could not ignore. Different retailers took different stands [7]. Luxury goods retailers, such as LVMH, adopted a fixed price policy that stopped Tuangou at the door. Others treated Tuangou shoppers with trepidation as they feared the aggressiveness of such groups, and hoped the increased sales volume would make up for the lost margin. Some tried to manage it by working with Tuangou websites to pre-arrange Tuangou sessions. These retailers would not entertain “surprised” Tuangou, and might close their doors to regular customers so that they could focus on dealing with Tuangou shoppers.

GOME, founded by Wong Kwongyu, had grown from merely a 100-square-metre store in Beijing in 1987 to being the industry leader in electrical and home appliances retail in China with 259 traditional stores and four digital stores by the end of 2005. Its success stemmed from its low margin, high volume strategy, which was complemented by its quest for service quality and innovation. In 2005, GOME, alongside with many retailers in China, faced a new challenge – Tuangou or group purchase. In order to amass bargaining power to demand for discounts from retailers,
consumers with similar needs in China were united by Internet chat rooms and would show up en masse at retailers at pre-agreed time and date. The crowd put relentless pressure on retailers and pressed for greater discounts. This emerging consumer behavior had spread like wild fire. From home appliances to automobiles, and from furniture to wedding packages, consumers leveraged retailers with their collective bargaining power. Retailers had reacted differently. Some yielded to the pressure and offered greater discounts, some only entertained Tuangou that had been pre-arranged and/or pre-registered, and others refused to give in with a fixed price policy. GOME took a proactive stand and welcomed Tuangou shoppers with a series of Tuangou events organized both locally and nationally.

Case Study: GOME and Group Purchase [8-10]

GOME, an electrical appliances shop in Beijing, was started by Mr. Wong with a loan of RMB30,000 back to the beginning of 1987. The late 1980s was the time when demand for imported home electrical appliance was growing rapidly, and GOME benefited from the high demand for and high margin of imported products. In 1990, as the market and competition grew, Wong realized the need to establish a competitive edge, and he decided to adopt a low price policy. To do so, he had to by-pass the intermediaries and started to deal directly with manufacturers. Bolstered by strong market demand, GOME was able to instigate a low margin, high volume strategy. In 1996, when indigenous home appliance manufacturers, led by Sichuan Changhong Electrical, were gaining consumer acceptance, GOME shifted from purely selling import products to including products from indigenous and joint-venture brands. Since 1998, the company has been expanding into Tianjin, Shanghai and among other cities. As GOME expanded and its turnover rose, GOME was soon among the top retailers in China. July 2004, GOME reached another milestone – it successfully obtained a listing on the Hong Kong Stock Exchange by way of a backdoor listing. GOME’s turnover for the nine-month period ending December 31st, 2004 reached RMB9.7 billion (~US$1.21 billion).

GOME’s mission was to serve its customers the best it could. The company was committed to providing its customers with competitive prices, wide product selection, convenient locations and professional customer service. To do that, GOME adopted a two-pronged approach. It first set out to build customer goodwill and loyalty by providing them good shopping experience. And since competitive pricing was the pinnacle of GOME’s business model, it sought to maintain its position by enhancing its purchasing power with an expanding retail network and by driving improvements internally. Building on its mission and guiding principle, GOME attempted to establish its own corporate culture on the following five pillars: (1) Be a pioneer and contribute to the society, (2) Keep promises and be credible, (3) Uphold integrity and develop people, (4) Hire for capability and hire locally, and (5) Establish a strong brand and emphasize image.

GOME’s Strategy

Low price and low cost was the cornerstone of GOME’s competitive strategy. Products available at GOME were typically priced 10-15 % less than those at conventional department stores. While this tactic cut into GOME’s margin, it created significant attraction to consumers and generated sales volume. This worked like a continuous downward spiral – as low price brought greater sales volume, volume enabled GOME to buy at even lower prices from manufacturers, which in turn allowed GOME to sell at even lower price and generate even greater volume, which further strengthen GOME’s bargaining and buying power.

Another tactic employed by GOME to secure low price and high sales volume was exclusive selling right. GOME would obtain exclusive selling right of certain products from a manufacturer in exchange for a large volume purchase to ensured competitiveness over its competitors and to help improve attractiveness to consumers. To further strengthen this tactic, GOME, armed with market information, would work with manufacturers and order customized products that provided functionality, appearance and price that better match consumer needs.

Whilst low price and low cost was success formula, GOME sought to complement it with high quality service. In November 2001, GOME rolled out a large-scale quality service campaign “GOME Service Project” with a series of new services that were firsts of their kinds in China, such as “money back guarantee”, “complaint award”, “Mysterious shoppers”, and “shopping from afar”. Leveraging GOME’s extensive retail network, this service allowed customers to order and pay for a product in one GOME store and have it delivered in another GOME store in the network. In the following years, GOME continued to introduce such new services as “lowest price guarantee” and “household appliances hospital”. In October 2005, it launched a nationwide “membership system”. Depending on the spending pattern, patrons would be invited to join as rainbow, silver, gold or platinum card members, and enjoy a series of benefits including...
enhanced interest free installment plan, bonus points, trade-in, on-site support, members-only shopping, and so on.

GOME intended to continue to expand in 2006, and planned to open about 120 to 150 traditional stores and three mega stores. With the establishment of a management centre for second tier market, special attention would also be given to strategic opportunities in second tier cities and to enhancing the quality of store operations in these cities. New service categories, products would be introduced to widen the product range and to more effectively utilize space and resources.

**GOME and Group Purchase**
As the largest retail chain in China, GOME could not shun away from Tuangou shoppers. Indeed, GOME was featured in one of the most highly quoted news article about Tuangou in the western world. According to the news story, some 500 shoppers gathered outside the GOME superstore in Guangzhou on a Friday afternoon. Hours later, they emerged from the store with boxes of cameras, DVD players and flat-screen televisions, all bought with 10-30% discount.

When it came to dealing with Tuangou, GOME chose not to be a sitting duck. In early 2006, GOME launched the “GOME Tuangou Day Project”. To kick off this initiative, GOME designated April 2006 as the Tuangou month, and on a selected day in April 2006, selected GOME stores would be closed for Tuangou shoppers only. Shoppers could sign up on-line, by phone or in person at the GOME store, providing personal details and details of the desired products, and would receive 5-40 % discount. Furthermore, each Tuangou shopper would also enjoy following privileges.

- A Tuangou VIP card and a minimum of two per cent discount on any products (except for selected items) in the store;
- A complimentary gift from GOME; and
- Regardless of the amount patronized, be eligible to enter into a luck draw.

As part of the GOME Tuangou Day Project, GOME also set aside a selected day of each month as Tuangou day. GOME would roll out the “Tuangou Banquet”, which was touted to be the largest Tuangou event of the year. Individual GOME stores could also cooperate with local Tuangou websites to advertise and organize Tuangou trips. Furthermore, GOME would work with corporations and residential areas to arrange special VIP “close store” shopping events, providing shoppers with bargains and a great shopping experience.

While GOME had its own bold expansion plan in 2006 and proactive tactics to deal with Tuangou shoppers, the number of Tuangou websites continued to increase and their membership continued to grow. It was still too early to tell if Tuangou posed more a threat or an opportunity to GOME. GOME needed to determine if it really had its head around this rapidly spreading phenomenon and whether it was compromising other customers with its proactive tactics towards Tuangou.

**Impact of Group Purchase**
In this section, the discussion will focus on the implications of Tuangou to consumer behavior and purchasing process, the response from GOME, and other alternative strategies the retailers may consider.

**The decision making process of Tuangou shopper**
To understand the Tuangou behaviour, we can start by looking at the type of consumer decision making it represents. A consumer decision making can vary by how complex and expensive the product is and by how involved a consumer is in the buying process. The complexity, level of spends, and consumer involvements are all ranked high [11] as follows.

- **High in Complexity.** Tuangou shoppers in China are buying fairly complicated products such as automobiles, electronic devices, wedding packages, etc. Unlike walk-in purchase, Tuangou shoppers can have enough time to know the product really well. Unless they know the products they want really well, i.e., product features, options, price, etc., and they have compared and contrasted similar products, they don’t know if they are getting a good deal. Thus Tuangou typically involves fairly complicated products.

- **High in Level of Spend.** There is little point of going Tuangou for everyday items (e.g. staple and toilet papers) when they are readily available, low in spend, and the amount one can save in real terms is quite minimal. Since the efforts put in Tuangou are normally more than walk-in purchase and online purchase, Tuangou shoppers tend to buy items that they only buy once in a while (e.g. wedding packages, furniture, or goods that are of a durable nature like TVs or cameras). Such goods also tend to be high in the level of spend.

- **High in Consumer Involvement.** Unlike buying everyday items (e.g. shampoo or newspaper) which are very simple transactions, Tuangou shoppers are very much involved, from gathering information...
to determine the products that they want to buy, selecting the retailers, signing up on a Tuangou session, to actually showing up and bargaining with retailers.

There are three types of consumer decision making: (1) **extensive decision making** (which requires most time and effort as the purchase involves complex or expensive items), (2) **limited decision making** (which requires moderate level of efforts in searching and comparing alternatives), and (3) **routine decision making** (which usually involve packaged goods that are simple, inexpensive and familiar and that consumers may have developed their favorite brands or products) [18]. It can be concluded that a Tuangou purchase is one of an extensive decision making. A typical consumer decision making process may consist of the following stages: (1) need recognition, (2) alternative search, (3) alternative evaluation, (4) purchase decision, and (5) post-purchase evaluation [12]. In the case of a Tuangou purchase and walk-in purchase, the salient features at each stage are summarized in Table 1.

### The response from GOME to Tuangou shoppers

GOME has basically declared war (in a positive sense) to Tuangou shoppers. It recognizes that Tuangou is an unstoppable force. So, rather than resisting it, GOME has chosen to go with it in a controlled manner with Tuangou sessions organized by its own stores. GOME first rolled out its plan with Tuangou month, which was April 2006. Then it set aside one day in each month as Tuangou day. It further announced the biggest Tuangou event of the year in November. With these and other incentives that GOME offers to Tuangou shoppers, GOME is trying to achieve the following.

- Since all Tuangou sessions at GOME are organized by GOME, GOME will know prior to any Tuangou session that how many people are coming when and what exactly they are looking to buy. Armed with this information, GOME can better plan its offers to the shoppers, and better stock its inventory to minimize disappointments. This is doable because Tuangou is an extensive decision making purchase and the consumer knows well in advance what they want.
- Since only a limited number of people are allowed in any given Tuangou sessions, GOME avoids an overly large crowd that can be difficult to control and limits its exposure to reduced margins.
- With its doors closed to the regular shoppers during a Tuangou session, GOME also avoids any potential conflicts and dissatisfaction arising from different prices being offered to Tuangou shoppers and to regular shoppers.
- GOME could make use of these sessions to sell off soon-to-be-replaced models and free up its warehouses for new arrivals. This is probably a reasonable expectation as Tuangou shoppers are not likely to be after the cutting edge products. In other words, in terms of adopter categories, they are unlikely to be innovators or early adopters but are more likely to be the early majority or late majority [13]. This makes it possible to sell the more mainstream items or soon-to-be replaced models.
- GOME’s bold expansion has affected other aspects of its financial performance.

In short, while its Cost of Goods Sold (COSG) has gone up nearly 43%, its inventory value has more than doubled, thus lowering its inventory turnover from over 10 to about 6, and increasing its days inventory by over 70%. GOME is now tied up with more inventory and its inventory is turning slower than before. If we look at GOME’s financial leverage, Tuangou may help GOME ease its pressure on inventory turnover and get the extra cash that helps pay off its liabilities [14, 15]. Nonetheless, GOME also runs the following risks.

- It is unclear if GOME can really stop unannounced Tuangou shoppers. If they show up in a huge group and demand large discounts, they can be difficult to control.
- To what extend GOME compromises its sales to and healthier margins from regular shoppers by turning them away when Tuangou is in session?
- While GOME continues with its bold expansion plan, which will negatively affect GOME’s margin, a concomitant welcome to Tuangou shoppers will put a bigger dent in GOME’s financial performance.
- GOME has been building up its reputation as a quality service provider with all sorts of value-added services available to regular shoppers and GOME members. Offering further discounts to Tuangou shoppers may make regular shoppers and GOME members wonder if it is worthwhile to shop as regular shoppers or GOME members when huge savings can be gained up front from Tuangou sessions.

It is important to point out the pros and cons of other options GOME may adopt. The comparisons of several such options are summarized in Table 2.
Discussion
We take into account Tuangou or group purchasing and re-visit the discussion from three aspects: customers’ choice toward retailers and product, interaction between customers and retailers, and relationships between the retailers and its upstream partners in the supply chain.

- Customers’ choice toward retailers and product. Two extremes are selecting, purchasing, and pickup purely at brick-mortar shop or on the internet shop (e.g. Amazon). One hybrid model is order online but pick up at the shop near by. Group purchase combines ordering online and purchasing at shop together but differs from the hybrid model in several aspects. It is only product selection is via the Internet or email and reaming still is conducted in the shop. In addition, the price is flexible or negotiable (i.e. not determined). Further, it is for collective force to aggregate demand rather than individual power of purchasing.

- Interaction between customers and retailers. Marketing promotion is used to boost up the sales and the price is the demand variability causing the higher inventory cost. The control is on the retailers’ side. However, group purchasing implies the promotion is, on the contrary, driven by customers and this will end up with even higher uncertainty in demand. The trials of Tuangou for certain time (i.e. day, week, or month), product, and location (i.e. shop) is to maneuver the extent to move the control back to the retailers.

- Relationships between the retailers and its upstream partners in the supply chain. The group purchasing indeed has a profound impact on the retailing side. The demand uncertainty is passed on to the upstream and worsens the bullwhip effect. In addition, it becomes more challenging to satisfy both types of customers (i.e. original customers and group purchasing customers). This triggers the partnerships with upstream players in order to be more flexible and responsive.

If the lens move back to GOME case, it has done a fair bit managing the impact of Tuangou while accepting its challenge. But besides those tactics designed specifically to deal with Tuangou, we also need to look at other areas that make GOME a strong competitor in its sector – home electrical appliances retailing. GOME’s competitive advantages are built on its relationship with suppliers, its logistics network, its retail network, its quality and innovative service, and its knowledge of market and consumer information.

Suppliers probably have a love-hate relationship with GOME. For one thing, it drives them nuts to reduce prices and margins. For another, it promises sales volume, which is very hard to ignore. GOME can leverage this relationship and help suppliers to increase sales volume for products targeted Tuangou shoppers. This can help lower the cost of goods sold of GOME to Tuangou sessions and maintain a healthier margin.

Looking at its logistics network and retail network, from empirical data, GOME can identify locations that are best suited to deal with Tuangou shoppers from both the demand standpoint and from the operations and logistics standpoint. GOME can then focus its attention on specific locations to deal with Tuangou shoppers the way that it has been and keep its doors in other stores open all year round to better serve regular customers and GOME members. This would also help GOME improve its profit margins.

Armed with market and consumer information and the ability to deliver quality and innovative service, GOME can continue to exploit the more profitable segments such as those high-end electronic appliances commanding a bigger profit margin. When we analyze the consumer decision-making process for Tuangou and non-Tuangou customers, we realize that they are quite different and need to be catered for differently. If we look further into the smaller segments, we find further differences and better ways to serve different segments. In particular, establishing GOME in the more profitable segments will ensure better margins and make it more resilient to both secular downturns and challenges from Tuangou shoppers.

Conclusions
Retailing shops are the contact points between customers and supply chain. On one hand, the retailers need to satisfy the customers by providing the right and enough product to ensure the service level; on the other hand, the retailers also need to minimize the cost (or maximize the profits) while satisfying the customers. In addition to the natural conflict on price between the retailer and the customer, usually they also have many other different agenda, such as spectrum of product variety and promotion/discount. Nevertheless, the retailers struggle to keep certain degree of control on retailing in order to keep a good balance between coat and service issues. The shops are like a battle field for tug of war between the retailers and consumers. As the emerging phenomenon of group purchase (a.k.a. Tuangou in Chinese), the war transforms into a quite different form.
Tug of War Between the Retailers and Consumers: the Phenomenon of Group Purchase in China

Tuangou is a relatively new phenomenon that has spread rapidly in China. It is still a growing phenomenon and very little research has been done on it. Tuangou is not really a brand new phenomenon nor is it unique to China. It is found that (1) Tuangou is one of an extensive decision making purchase, (2) Tuangou shoppers have good ideas of what they want and have made up their mind about the specific products that they desire to purchase, and (3) they are likely to be among the early majority or late majority. With these understandings, a company such as GOME can determine what tactics may and may not work. In the process, the company also needs to think about its overall strategy and positioning in the market place, and makes sure it holds its right course and does not overly cater for one segment (especially one that cuts into its margin).

The main issues for the stakeholders in this business scenario (i.e. group purchase) to consider are as follows:

- Customers - to take or not to take. The customers need to consider the tradeoffs between time, location, price, flexibility, product selection, privilege, and among others. Though customers need to put in a lot of efforts, tuangou allow them to enjoy some benefits of both online and offline purchase. They can use Internet to search for information on the product and organize more people to negotiate with the retailers. Meanwhile, they can assess the retailers and the product characteristics in “a deterministic manner” in traditional offline retailing [16].

- Retailers - to do or not to do. The retailers may benefit from higher sales for certain popular product types in a short time; however, the retailers also need to watch out the risk of losing control on the demand and enhancement of customer loyalty.

- Product - to offer or not to offer. The question about what kinds of product is good candidates for group purchase does not seem trivial. The examples provided in this paper only serve as the starting point to explore the possible decision issues for right product to be offered by the retailers and to be accepted by the customers.

- Upstream - to follow or not to follow. Tackling the problem of group purchase is not limited to the retailer side. All the other upstream partners in the supply chain may suffer from greater demand variability and contribute to enhance the agility, adaptiveness, and alignment for better control as well [17].

References


Table 1. The summary of the salient features for Tuangou purchase and walk-in purchase

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<thead>
<tr>
<th>Stages</th>
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<th>Salient features (when, where, how, etc.) of walk-in purchase</th>
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<tr>
<td>1. Need recognition</td>
<td>Well in advance of the purchase, not likely to satisfy an immediate need</td>
<td>Probably well in advance of the purchase, could be due to an immediate need, e.g., broke down of an air-conditioner in the middle of summer</td>
</tr>
<tr>
<td>2. Alternative search</td>
<td>Well in advance of the purchase, using various channels (on-line, store visits, asking friends, asking store sales, etc.)</td>
<td>Probably done during the store visit, though research in advance using various channels as described in a Tuangou may be done as well; more likely to be influenced by what’s available in the store</td>
</tr>
<tr>
<td>3. Alternative evaluation</td>
<td>Well in advance of the purchase, using various channels (on-line, store visits, asking friends, asking store sales, etc.)</td>
<td>Probably done during the store visit, though research in advance using various channels as described in a Tuangou may be done as well; more likely to be influenced by the sales person</td>
</tr>
<tr>
<td>4. Purchase decision</td>
<td>Pretty much made when signing up on a Tuangou session</td>
<td>Probably made during the store visit, may be decided in advance</td>
</tr>
<tr>
<td>5. Post-purchase evaluation</td>
<td>Less likely to have cognitive dissonance</td>
<td>More likely to have cognitive dissonance as product research and comparisons done are probably less rigorous</td>
</tr>
</tbody>
</table>

Table 2. The comparison of possible options for GOME

<table>
<thead>
<tr>
<th>Options</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do not entertain Tuangou at all.</td>
<td>GOME can adopt the same policy as LVMH.</td>
<td>As GOME is positioning itself as the low-cost/price seller providing quality service, turning Tuangou away can be bad to the company image that GOME has worked so hard to build. It can also shut the door to a great way to sell soon-to-be outdated items fast.</td>
</tr>
<tr>
<td>Embrace Tuangou with your open arms.</td>
<td>It shows that GOME doesn’t fear Tuangou and is confident in its ability to make money with low margins. It is consistent with the price-leader image that GOME has built.</td>
<td>This can be very disruptive to normal sales operations, and can cause dissatisfaction with regular customers (as they may feel discriminated). Anyone can walk into a GOME store and claim to be there for Tuangou on any given day. Impact on margin can be significant.</td>
</tr>
<tr>
<td>Open GOME outlets and use them to get rid of outdated items</td>
<td>This is perhaps a good alternative to dealing with Tuangou shoppers in regular stores. This completely segregates Tuangou shoppers from regular shoppers and they have very different requirements and would need to be served differently. GOME can entertain Tuangou any time at</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>This creates a new set of questions that GOME needs to address. How many such outlets should it open and where should they be located? How do these outlets fit into the overall logistic/supplier-relationship that GOME has established? While these questions may not be “cons”</td>
</tr>
<tr>
<td>GOME to pre-arranged <em>Tuangou</em> sessions.</td>
<td>these locations and whether they are pre-arranged or strictly unannounced. And GOME can still get rid of outdated goods quite easily.</td>
<td>per se, they do pose implications to the cost structure of GOME, may upset <em>Tuangou</em> shoppers as it may become inconvenient for them to do <em>Tuangou</em>.</td>
</tr>
</tbody>
</table>

*Tuangou*
A STUDY ON THE SATISFACTION OF SUPPLY CHAIN MANAGEMENT SYSTEM FROM THE VIEW OF JUSTICE AND VALUE

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Abstract
Due to the common, most enterprises have utilized information technology (IT) to enhance their competition and performance. Meanwhile, governments in Taiwan have encouraged enterprises to adopt e-commerce by putting policies and facilitating technology. Nevertheless, only few literatures discuss or evaluate the satisfaction of E-SCM after establishing information systems by enterprises. This research attempts to integrate three well-founded theories – Information System Success model (ISS), Organization Justice Theory and Consumer Value to develop our model. Using Structural Square Modeling (SEM) analysis performed on results of a questionnaire given to the providers of SCM who have established the E-SCM in their enterprises. The results showed that the distributive justice, procedural justice and interactive justice in the organization justice theory have a significant effect on the performance outcome in the E-SCM. It also showed that the system and service quality in the IS success model and the cost and service value in shopping value have a significant effect on the satisfaction of the E-SCM. The contribution of this study can be further research in academic and practical.

Key words: Information System (IT), Electronic Supply Chain Management (E-SCM), Organization justice, Consumer value, IS success model (ISS).

Introduction
Electronic Supply chain management integrates many activities of the supply chain through improving the relationship between it in order to achieve constant competence. Some scholars [1] also suggest the goal of E-SCM is that customers simultaneously need to keep the balance between cost and customer satisfaction, through the integration of logistic and information flow among all of the supply chain. With the improvement of internet technology, the trend of globalization, the shortening of product life cycle, and the incensement of customer service needs, the issue of supply chain management has become more focused.

Simultaneously, since the prosperity of internet, e-commerce has become a trend among all the enterprises and they applied information technology to promote their competence. Due to the encouragement of government policies, all the enterprises digitalize their supply chain management. From around 1980, Taiwan started to promote an industrial automation development plan. With the change of external factors, the focus on industrial automation gradually transformed to the digitalization in the business process. Some government authorities such as the Department of Industrial Technology, the Industrial Development Bureau, the Ministry of Economic Affairs, the Commerce office of the Ministry of Economic Affairs, and the Institute for Information Industry, have already foreseen the importance of the supply chain. They were actively promoting supply chain management related plans to industries, for instance, the A and B plan, the digitalizing plan among systems and within systems. This is especially the case in digitalization among manufacturing industry. So far till 2003, they have established 39 digitalizing industrial chain systems in all the key industries, which have driven the coordinative digitalization working mechanism among more than 7,000 small and medium enterprises.

However, there are very few related studies on the actual result of the system being built from the digitalization which were supported by the government. Therefore, the purpose of this study mainly focuses on supply chain management satisfaction. Based on related studies in the past, there were more studies that discussed the key success factors of suppliers adapting supply chain management than studies related to the satisfaction after suppliers successfully adapted the supply chain system. This study tend to integrate (1) the IS success model in the information management field, (2) the equity theory of organizational behavior and (3) consumer value in marketing to the theoretical study model. Also, this study is going to discuss the possible factors that might affect the satisfaction of...
the E-SCM for the suppliers. From the successful model of Equity theory and value theory which are combined with the IS point of view, we are going to have a further discussion about the satisfaction of adapting the E-SCM. This related topic is rarely discussed either in Taiwan or overseas. Therefore, it is very original.

We chose company K to be the study example. Company K is the biggest motorcycle manufacturer in Taiwan, and it has been the best seller for six years. It is an epitome company with a completed supply chain and demand chain system. Company K joined the VNET project which was held by the Industrial Development Bureau, Ministry of Economic Affairs, and it helped Company K to build an E-SCM and provided it for all the suppliers. The purpose of Company K to build the E-SCM was to promote added value among enterprises with which it could also promote the company and its supplier’s operational management. So, to evaluate the advantages and the disadvantages of E-SCM, the most direct approach is to evaluate the satisfaction of the users using the E-SCM. This will also helps us to understand the effective factors of the E-SCM and we can put these factors in consideration for further improvement of this system.

In sum, the purpose of this study is to mainly discuss suppliers’ satisfaction after using the E-SCM provided by the central factories. The study methods covered is the information system, organization justice and the shopping value theory. The aims of this study are as follows: 1. To integrate the IS success model, the organization justice theory and the consumer value theory, in order to discuss the effects of the satisfaction after the suppliers adapted the E-SCM. 2. To verify the methods of the satisfaction of the E-SCM by survey research in order to discuss the relations among all the concepts in the method. 3. To provide a reference for enterprises who would like to introduce the E-SCM in the future and the factors that should be considered when designing the system according to the result of this study.

**Theoretical background, Research model, and Hypotheses**

This study integrated the related aspects from the ISS model, the Organization Justice Theory, Consumer Value Theory and the Consumer Behavior Intention. It established and discussed the effects of satisfaction of the E-SCM after the suppliers introduced the system. Figure 1 depicts our research model and hypotheses.
the intranet and extranet of an enterprise, to achieve in the era of E-commerce.

User Satisfaction
The idea “User Satisfaction” was introduced firstly by in 1963 [5], it argued that if the information system could meet users need, it also could increase the user information satisfaction; however, if it failed, it failed the user information satisfaction, too [6] [7].” Some scholars believed that when the user satisfaction goes down in a certain level, its user is going to stop continue using the system. Some scholars [9] [10] [11] also both agreed that it will have a great impact on user satisfaction if the system can meet its user’s expectation.

Consumer Satisfaction
Internal marketing means that enterprise treats its staff as the customers, and to take one step further by selling the organization to them [12]. On the other hand, “customer satisfaction”, in fact, has various definitions from the scholars in different study fields. The beginning of the study of “Customer satisfactory” started with a study by consumer satisfaction [13]. Since then, the study increased the interest of scholars to study “costumer satisfaction” further. Some scholars [14] concluded the different opinions from scholars of consumer satisfaction, and pointed out two of the aspects: Transaction–specific and Cumulative. Transaction–specific means the after-evaluation of the consumer’s consumption experience or locations to determine the effects of a specific product or a specific service; Cumulative means the completed evaluation mainly of the service experience, the product experience and the consumption experience that can be the index for enterprises’ operating performance. After integrating the opinions from scholars [15], indicated that consumer satisfaction comes from the anticipation and expectation towards the product before a consumer decide to purchase it and the recognition from a consumer after purchasing the product, its functional performance or the service of it after purchasing. Then to compare the level of happiness and disappointment of the two, there is a difference between the two since positive satisfaction or negative satisfaction can occur.

Related Literature of IS Success Model
After deeply explored and organized hundreds of articles [16][17] that had published on the information system journal, they raised the revised IS success system. They updated the model as follow: Service Quality, system quality, information quality, and claimed this model can be used in E-commerce.

Service Quality
After studying the related study articles and having in-depth interview with enterprises and customer groups, some scholars [18] had established a model. He thinks the good and the bad of a service can be determined by its service quality. The so called service quality is to have an evaluation that is judged over a long period of time and it can also be judged by the attitude towards a service. They added the definition of service quality in 1988 [19], they argued that a service quality should be ranked from the good and the bad of a service which happened when passing on procedures and the interaction between a customer and a service provider. They also emphasized that it is the customer that define the service quality, not a manager.

Scholars indicated service quality is the reason to form service value [20]. They also proved that service quality has a significant impact on service value awareness of the customer in the evidence research. Some scholar further raised service value as the top model due to the relations among service quality, service value, and customer satisfaction and the behavioral intention [21]. In this model, service value was interpreted into the exchanging compensation between the sacrifice of service quality and awareness. In addition, the recognition of service value is able to affect the purchasing will of a consumer.

Therefore, the service quality of a supply chain information system which is provided by a central factory will affect the satisfaction and the service value of the supply chain information system for the suppliers. For this reason, we raised two hypotheses as follows.

Hypothesis 1: The better the service quality of the E-SCM of a central factory, the higher the satisfaction of its supplier.

Hypothesis 2: The better the service quality of the E-SCM of a central factory, the higher the service value of the supplier.

System Quality
System quality was defined as a measurement of an information processing system [16]. Some scholars [22], however, defined system quality to whether you can find any bug in the system, the consistency of the user interface, the easy-to-use factor, the reaction rate of the interactive system, and the maintenance of the program code and its quality. Simultaneously, the service quality of URLS included the speed of reaction and accessibility of a system [23]. The former represents the waiting gap between the user and the URL he/she is using, the later represents the instant providing from the related system of a URL. This research showed that the reactive speed of a URL is the most significant effect judged by the user.
From the discussion above, we raised a hypothesis as follow:

**Hypothesis 3: The better the service value in a E-SCM, the higher the satisfaction of the suppliers of the E-SCM.**

**Information Quality**

Some scholars [24] [25] defined information quality as the information which is produced by the system that should meet the requirements of users, which includes: content, accuracy and formality. They measure covered the measurement of information quality. The index of this measurement was information accuracy, information completeness, information relevance, the need of information content, and the instant of information. According to our study, E-SCM is an information system [26]. Based on this discussion, we raised a hypothesis as follow:

**Hypothesis 4: The better the information quality in an E-SCM, the higher the satisfaction of the suppliers in the E-SCM.**

**Organization Justice Literature Review**

In a practical situation, “Organization Justice” is one of the key factors a manager needs to be concern of when giving an order. In a theoretical situation, “Organization Justice” is an important construct in organization management. The idea of organization justice was brought out through concepts of the Equity Theory and Distributing Justice which was brought out by a social psychologist [27], in addition, to expand and to integrate with theories from other scholars [28]. The key variable of organization justice is the objects chosen for comparison with the justice of organizing. These objects can be classified into three categories: Others, Systems, and Oneself.

A scholar [27] emphasized the recognition of the result of distribution equity, in other words, distributive justice. The model of both Equity Theory and Distributive justice, however, can not completely predict the reaction from the understanding of people who are treated unequally [29] [30]. Therefore, the following researches brought out the theory of procedural justice [31], which means the equity people sense during a series of procedures. The drawing of procedural justice expanded the study of distributive justice. According to the study, it showed that the awareness of rewarding distributive justice is not as important as the awareness of procedural justice [32]; some scholars [33] organized distributive justice and procedural justice related documents. According to a scholar [33], based on the experience, the scholars differentiated and connected the variables of organization justice, and they showed that there are two components in procedural justice: Formal process and interactional justice. They [34] also brought out interactional justice, emphasized the treatment that the members of an organization received, and if the communication among them had produced the awareness of equity.

However, there are some scholars that think that interactional justice should belong to the third type of justice [35] [36] [37] [38] [39]. However, it is still not clear to determine if organization justice is able to narrate by using two or three factors [40]. Therefore, our study integrated all the point of views from the scholars mentioned above to start our research: Distributive justice, procedural justice, and interactional justice, to discuss the generality among the effects from different variables.

**Work Performance**

The Equity Theory [27] indicates the increase or the decrease of working performance of staff comes from the recognition of equity of gaining, which means when a staff compares the input and output with a certain object. If his/her ratio is equal to the comparative object, it is fair; if not, this staff is possible to experience unfairness, nervousness and even unhappiness in these emotions. Some scholars also introduce and expand the concept to organizations. The equity concept in the organizational field has more attention on the recognition of equity from its staff. As a result, with more recognition of organization justice and the more equal a manager treats its staff, helped staff to play other roles that are not in their field better. The staff also will also have a better working performance in return to the organization. In short, the increase of organization equity recognition helps to increase the working performance in an organization.

**Distributive Justice**

Many related researches mainly quote the Social Exchange theory to judge if it is equal enough [27]. Evidence in research showed that distributive justice can be flexibly applied in a different environment (from work to family, goals & from productivity to group interaction), and different motivations (from individual motivations to compelled motivations). Our research inferred that when a central factory changes its result aspect from a supplier’s operating procedure, including: the way it acquire the orders, the numbers of orders, the amount of money from accounts receivable, it might affect the distributive justice recognition from psychological awareness, thus, affects the feeling result of the central factory to its information system. From the discussion above, our study raised a hypothesis:

**Hypothesis 5: The better the distributive justice in a supply chain management, the higher the...**
performance outcome from the supplier to its E-SCM.

Procedural Justice
Two important concepts of procedural justice were found out in litigation [41], they are: process control and decision control. Process control is the solution of a lawsuit that must go through a series of official law procedures, and before the decision is made, people have a right to express their opinions and be involved in the procedure. Decision control means whether a litigant has an actual control power to his/her decision making, the main concern is focus on the legal procedure aspect. Later, a scholar [33], transferred procedural justice from the traditional result-oriented to procedure-oriented, which means from “how much the reward is?” to “how to decide the reward.” He found out that even though at the end a person received unreasonable distribution, this person also recognizes it is fair because of procedural justice [42]. Therefore, our study inferred that when the operating procedure is fair enough in a central factory, there is more satisfaction from a supplier to the E-SCM of a central factory. From the discussion above, our study raised a hypothesis as follow:

Hypothesis 6: The better the procedural justice in a supply chain management, the higher the satisfaction of a supplier from an E-SCM.

Interaction Justice
“Interaction Justice” was firstly brought out by the scholars [34]. By reviewed the related literature [43], he raised up two constructive aspects of procedural justice, one is formal justice: a definition that is similar to the general definition of procedural justice; another one is interaction justice: an equality evaluation from a person when receiving an interpersonal relationship, which is either one-way or two-way. Interaction justice emphasizes on communication policy, an appropriate way for staff to complain when they are not satisfied with their work, a compensation policy, and the adjustment of false distribution. Therefore, whether a central factory provides a complaint procedure for a supplier in order to express a supplier’s feeling, it is going to have a great impact on a supplier’s awareness of his/her interaction justice. From the discussion above, we raised a hypothesis:

Hypothesis 7: the better the interaction justice in a supply chain management, the higher the performance outcome from a supplier to its E-SCM.

Value
“Value” was firstly mentioned in the marketing field. When a scholar raised the aspect of costumer-orientation, he suggested that a product in order to please a customer creates “value” [44]. Scholars also suggested that Value is the comparison between receive and gain [45]. A scholar gave a completed definition to “Value”: “Value is a completed evaluation that consumers made for the effectiveness of a product, which is based on the recognition of costs and benefits. “Benefits” varies among people, for instance, some people want to benefit from quality, other want to benefit convenience. “Costs” is the same, some people are more concerned about time cost while some people are more concerned about money cost, or the energy it is going to cost them on a certain thing. So, “Value” represents the exchange after both obtaining and devotion.] [46].

The Consumption Values concept model which was raised by a scholar [47], divided consumption value to three parts: cost-based value, quality, and performance outcomes. The “Value” aspect in the consumption value concept model [47] covered product value and service quality. Since this study is discussing the satisfaction of suppliers after using the E-SCM built by the central factory, this study tend to adapt and illustrate the service value, information value, and information quality in the IS success mode [16]. We are not going to have a further discussion about the independent variable, ideal standard, from a Value aspect in the Consumption Value Concept [47]. However, in supply chain management, a party with an advantageous position, for instance, the central factory, is about to require another party, like, the supplier, to join the establishment of an inter-organizational information system. Although the supplier in this framework plays a role of a consumer, it can only accept the information system which is organized by the central factory. It doesn’t have a chance to choose or compare it with other information systems. Due to this reason, we are not going to have a further discussion about the behavioral intention aspect from the satisfaction model of the consumer behavioral intention [21]. In this article, we only chose satisfaction as the independent variable of performance outcomes, cost-based value and sacrifices.

Performance Outcomes
The performance outcomes which are mentioned in consumption value model [47], indicated the period of time after a consumer consumes and the sacrifice happens to a consumer, after the comparison of his/her feelings. It is a comparison of explicitness, in terms of a consumer being able to use some of the standards in his/her mind as established standards to do comparison. After comparing with these cost and benefit standards, it transforms performance outcomes to a specific feeling, for instance, pleasure, monetary value, or a kind of utility. Consequently, after a supplier use the E-SCM, a supplier compares
Hypothesis 8: After a supplier using the E-SCM, the better the performance outcome is, the higher the satisfaction of the E-SCM is.

Hypothesis 9: After a supplier using the E-SCM, the better the performance outcome is, the higher the cost-based value is.

Cost-based Value
In cost-based Value, we adapted the concept of transaction costs. Scholars [48] brought out the idea that when a buyer choosing to trade in a traditional marketing environment or E-commerce environment, this buyer has to take in consideration six related costs, these are: 1. Price of a product, 2. Searching costs, 3. Risk costs, 4. Delivery costs, 5. Business costs, and 6. Marketing entry costs. Consequently, the profits that a supplier receive after using supply chain management, compares with the related costs the supplier has to take, it is able to influence the satisfaction of a supplier from the central factory information system. Based on the discussion above, we raised a hypothesis as below:

Hypothesis 10: The better the cost-based value of the E-SCM used by a supplier, the higher the satisfaction to the E-SCM.

Perceived Sacrifice
A scholar [46] suggested that a sacrifice mainly includes perceived currency value and perceived non-currency value. Currency value is the actual price which is experienced after a supplier use an information service, like, an internet platform fee. In addition, the supplier perceived currency value is the transformed perception, for example, “expensive” or “cheap”, from the actual price to a meaning form. On the other hand, the perceived non-currency value price includes the searching costs, time costs, and psychic costs that a supplier must pay when enjoying the information service. Cost-based Value in the model of consumption value [47] is the effectiveness of a product and service experienced by the supplier, but not its costs. Based on the discussion above, there are two hypotheses we raised:

Hypothesis 11: The less the perceived sacrifices of the E-SCM used by a supplier, the higher the cost-based value to the E-SCM.

Hypothesis 12: The less the perceived sacrifices of the E-SCM used by a supplier, the higher the service value to the E-SCM.

Service Value
“Values” is based on four of the following definitions: lower price, the benefits gained from a product, the exchange of price and quality, and the exchange of costs and benefits [46]. Scholars [20], moreover, suggested integrating these four definitions into one, which is: “based on the service effectiveness, consumers have an overall evaluation of the benefits they receive and the costs they pay. Hence, the service value produced by the supply chain information system from central factory used by a supplier is able to influence the satisfaction of central factory E-SCM to a supplier.” Therefore, this study raised the following hypothesis:

Hypothesis 13: The better the service value of E-SCM used by a supplier, the higher the satisfaction to it.

Method
Research Methods
The methods of this study are an individual case in-depth interview of the qualitative method and quantitative method investigation research method. A scholar suggested this research method is very helpful when doing a study [49]. If it can be combined with the case study method in a qualitative analysis, it has a great improvement to the research result. The research method of this study verified the research hypothesis and the integrated model of the consumption value concept development, used the result of an individual in-depth interview and research method to test and verify the recycled questionnaires by analyzing the data and the models according to structural method.

Variable Measurement
The variables in this study can be categorized into a dependant variable, medium variable, and independent variable. The independent variable in the model are: service quality, system quality, information quality, distributive justice, procedural justice, interaction justice, performance outcomes, and sacrifices; the medium variable are: cost-based value, service value; the dependent variable is measured by the performance outcome satisfaction of the E-SCM. Each measurement item is rated according to the Likert rating scale (from 1: very disagree to 5: very agree). In order to receive a questionnaire that has good credibility and effectiveness, the variable measurement is based on related literature, and adapts a rating scale that is credibility proved with efficient effectiveness. During the process of this questionnaire designing, there was a professor that had a careful and deep discussion of the content, in order to promote the face validity and content validity of this questionnaire. Finally, there was a
trail of this questionnaire, in order to reinsure the quality of it.

The Discovery and Result of Individual In-depth Interview
The choice between single case and multiple-case
The single case is adapted at the stage of exploratory in the beginning of a research and later as a theory of denial. The multiple-case design can be used in case comparison and analyzed to develop or extend theories [50] [51]. The verification of this study is based on the consumption value concept [47] and is built by the framework of the study of satisfaction of the E-SCM, in terms of observing the key factors that influence the satisfaction of suppliers. For the purpose of the study, it should go through the deep understanding of the multiple-case design in order to carry out cross case analysis to seek for a general principle and not to focus on the overall discussion on a single case. Therefore, it is appropriate for this study to adapt a multiple-case design.

The choice of cases
The study is based on suppliers’ point of view to measure the conceptual framework of the satisfaction of the E-SCM. Therefore, the choice of samples focuses on the suppliers who have close cooperation with central factory. The businesses of suppliers are: frames, plastics, engines, electronics, and others. The multiple-case in-depth interview samples are mainly enterprises in southern Taiwan. They are wide spread in the industrial areas of Kaohsiung city, Kaohsiung county, and Tainan. When we choose our cases, we consider the scale of supplier enterprises and their willingness. We firstly interviewed them through phone calls to decide our interview objects. There were three electronics enterprises that accepted our request.

Data analysis and the Result
A case study is often criticized due to a weak generalization [52]. By posting and emailing the questionnaire, the study collects all the questionnaires answered by suppliers who use the E-SCM, then analyzed these questionnaire by SPSS and SEM to test and verify the data and models from the research models and hypotheses of this study.

Retrieved Questionnaire and sample characteristics
The sample in our study is majored in the suppliers who are using the supply chain management of KYMCO. We sent out a total of 374 questionnaires. Considering the low retrieval of the questionnaire, the person in charge of central factory supply chain system visited these objects in person or informed them by phone after posting the questionnaires. Moreover, a notice was also sent out through email about the internet questionnaire to increase the numbers of samples. The details are as below: There were 110 questionnaires sent out by visiting objects in person, the number of retrieved questionnaire was 104 copies. Questionnaires sent by post: 60, retrieved: 55. Questionnaires sent by email: 204, retrieved: 93. The total amount of send out questionnaires was 374 and we retrieved 252 copies that is a retrieval rate of 67.3%. Deducing 10 copies of invalid questionnaires due to same reply, valid questionnaires were 242 copies with a valid retrieval rate of 64.7%.

This study is using ANOVA and General Liner variable analysis to have a satisfied analysis of the significance through the information from both individual and company traits. We found that the satisfaction showed in questionnaire-filling personal attribute, the most significant difference is the age group, specially the age group between 20s to 30s and 50s above. The group of 20s to 30s has a higher satisfaction with the E-SCM that is more than the group of 50s. Our research suggests that this is due to their motivation and acceptance in learning IT technology and how to use it.

In the attribute of computer skill level, objects who are very good at computer skills, the level of the satisfaction with the E-SCM is acceptable> passable> bad, this also presents a significant difference. Based on our analysis, the competence of computer skill could also influence the recognition of satisfaction among users. There are not any significant differences in other attributes; for instance, age, educational background, and the time spend on the internet. Therefore, from the finding of the questionnaire-filling personnel we can find that there is a connection between the two attributes mentioned above and the satisfaction ranking.

The verification of Questionnaire Credibility
This study carried out the analysis to the validity and credibility of information from valid questionnaires. First, we started analyzing the construct validity from the rating scale, then started analyzing convergent validity and discriminant validity. The analysis of information credibility, we measured and explained it according to Cronbach’s alpha measurement instrument. The eleven aspects in our study’s credibility range are between 0.880 and 0.948. Both of the figures is larger than 0.7; the overall figure of Crobach’s alpha is 0.975, which shows our questionnaires have a very high credibility. Consequently, the framework has reached a certain standard of credibility.

This study adapted all kinds of questions in supply chain management as a basis to extract the representative factors. It analyzed each question of
the questionnaire by principle component analysis, and used it as preparation work for factor analysis. We set up the eigenvalue greater than 1, and use varimax of orthogonal rotation as a factor rotation, and chose the question that the loading modulus greater than 0.5 after the rotation as the component. There were 67 questions and we drew out eleven main components. Total variance explained is 74.34%. Finally, we named each component according to the content of questions covered in each of them.

The examination of research model
Since Structural Equation Modeling (SEM) in expressing processing procedure is able to test and estimate the causal relationship by a series of structural formulas and able to frame a casual diagram through casual relation in order to have a clear understand of a research aspect [53]. Moreover, we tested and verified the suitability of the model by adapting EQS6.1 software, used the Maximum Likelihood to estimate the measurement model, and analyzed all the aspects which are the representative scores of the sum of all the questions.

After integrated all the questions by their aspects and analyzed through EQS, the index of matching rate from each aspect model, like, CFI, NFI, and IFI all reached to a perfect acceptable standard (CFI=0.946, NFI= 0.939, IFI= 0.947- these are all greater than 0.9); GFI= 0.898, NNFI= 0.859- these also close to the fitting standard, so is SRMR which is 0.066. Consequently, it shows the relations among all the aspects defined in the model fits the proved information. After confirmed the model has a certain fitting rate, we further inspected the relations among all the aspects, which are the hypotheses raised in this study. We integrated the routes and relations among all the aspects to figure 2.

We are going to discuss and integrate the reasons and analyze the result of some hypotheses that are not supportive.

The relations between Information Quality and Satisfaction
When we were retrieving the questionnaires, we were informed by our team members that the carrying out of supplier informationalization doesn’t bring any convenience or simplification on workload. However, they have to recruit people that have ability to work out the system with the central factory for promoting activities. Due to the frequency of information staff leaving their jobs due to the rapid changing of society, these supplier managers can only choose staff that has the same ability among the staff they already have to work on this practice. Due to the increasing workload, the staff who are chosen to work on this task can only try their best to process the information from the E-SCM provided by the central factory, but they are able to consider the information quality whether it is good or bad, and they have no extra time to discuss and improve the problem with the information staff in the central factory. Therefore, we can say that the information quality of the central factory doesn’t influence the overall satisfaction of the E-SCM.

The relations between Performance Outcomes and Satisfaction
Performance outcomes means that after suppliers compared the external standards with their internal standards, the comparison transforms to some specific feelings, for instance, purchasing procedures, shortening of operation terms, the decrease of stocks, and the increase of actual delivery rate, shortening the order processing cycle, promoting delivery rate, improve the defection of products, and accounts receivable. Due to the fact that the items we mentioned are mostly beneficial to the enterprises themselves, the operators can not feel that they are benefited by that. Moreover, a dominant central factory requires their suppliers to compromise the introduction of the E-SCM. Consequently, to the suppliers, in order to get orders, they have no choice but to change their internal operating procedure in order to compromise the information system provided by the central factory. Some related studies in the past also indicated that there is a possibility of user denial when a new information system is introduced. So, the change of procedures to these suppliers might not be able to shorten their practical operation procedures and they have to do poorly-work done over again. Therefore, the better the performance outcome from a supplier, the better the satisfaction towards E-SCM does not exist.

Illustration and Discussion

Figure 2. The analysis result of this research model, note: ***, p<0.01

Research Contribution

The 9th International Conference on Electronic Business, Macau, November 30 - December 4, 2009
The contribution of this study can be classified into two categories as follow.

**Integrating the satisfaction model theory framework**

From the research in the past related to the satisfaction of the E-SCM, most of them used the supply chain partnership as a main subject and used the elements of cooperation, commitment, trust, conflicts, to discuss the satisfaction of suppliers. However, due to the lack of discussion of related topics, our study takes the supplier chain users’ point of view, applied the IS success model, the organization justice theory, the consumption value concept and the consumer behavioral model as an integrated basis, to measure the satisfaction study model of E-SCM built by the central factory. Therefore, there is an importance and necessity to our study to integrate the different concerns of the satisfaction framework, to test and verify the casual relations among all factors.

**Conformation of the key factors which influence a E-SCM**

We can tell from the conclusion of our study, from a supplier user’s point of view, that the distributive justice, procedural justice, and interaction justice, as three variables in the E-SCM have a great impact on the performance outcome in an E-SCM. The service quality, system quality in the IS success model and the Cost-based value and service value in the consumption value concept, these four variables has a great impact on the satisfaction of an E-SCM. On the other hand, the performance outcome and sacrifices of these two variables in the consumption value concept have a great impact on the service value in E-SCM. In conclusion, after integrating the illustrations above, this study suggests that if a central factory is about to foresee and understand and deal with these influential factors, they are more likely to be able to win higher support and satisfaction from suppliers in E-SCM.

References


A Study on the Satisfaction of Supply Chain Management System


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MINDLESSLY FOLLOWING PARTLY MINDLESS LEADERS THE CASE OF RFID IMPLEMENTATIONS

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Abstract
This paper studies drivers for RFID (Radio Frequency IDentification) adoption. The mindlessness/mindfulness theory is applied to the context of RFID implementation decisions. Several types of mindless and mindful decision making drivers are put forward. Hypotheses are tested using a questionnaire that was answered by 122 Chinese companies. The data shows mixed support for the applicability of the mindlessness/mindfulness theory. Companies which notice other companies adopt RFID technology are motivated to adopt the technology as well. Late RFID implementers seem to take decisions more mindlessly than early RFID implementers. Still, early RFID implementers also take decisions mindlessly. Neither late implementers nor early implementers can be qualified as being fully mindless: both groups also take decisions mindfuly.

Keywords: RFID adoption, survey, mindlessness, mindfulness

Introduction
Radio Frequency Identification (RFID) technology is a tracking technology that can be used to create a network of things. Every object can be identified by reading the tag that is attached to it. This tag can contain any data valuable for the user. Data is transferred from the tag to the reader via radio-waves. Reading data thus not requires being in line-of-sight as bar-code technology does [1]. In general it can be stated that RFID has more potential to provide freedom and supply-chain visibility to any process [2] but it becomes much easier to implement when it is standardised. Several organizations, such as the Massachusetts Institute of Technology’s Auto-ID Centre and the International Standard Organisation (ISO), have been developing standards. It is obvious that standardisation of RFID is not an easy thing. The frequency is part of the complexity. For instance the North American standard for Ultra-high-frequency is not accepted in France as it interferes with French military bands [3]. One of the solutions to this issue was to design agile readers which could read several frequencies, therefore avoiding doubling costs of readers for companies dealing with international suppliers or buyers [2]. Furthermore, different types of waves have been categorized, each of them having their positive and negative sides [4]. Since it is a wireless technology, the environment, the air, the humidity, the components of scanned objects or containers can influence the signal. This prevents the possibility of a fit-to-all solution. Therefore, every usage needs a customised solution. Moreover, the lack of software dedicated to the integration of back-end applications has made the implementation difficult. Additional costs for programming can be necessary to match the languages of the software, and if this issue is not carefully considered, may threaten the implementation of the RFID system [2].

Clearly, RFID implementations take some doing. It is important to weigh costs against profits that can be achieved by the company. This paper reports on a research project that investigates drivers of RFID adoption. In what follows, we first present the current state of RFID usage, to get an image of the advantages that can be achieved through RFID technology. After that, we focus on one specific theory that could help explain what drives companies to adopt RFID technology. More specifically, Swanson and Ramiller [5] showed that many technology investments are characterized by mindlessness and the paper at hand investigates whether mindlessness also plays a role in RFID adoption.

RFID in practice
RFID technology was implemented by huge entities such as Wal-Mart [6] [7], the Department of Defense of the United States of America [8], Best-Buy [9] [10] in the USA, Metro [11], Tesco [7] and Marks & Spencer [7] in Europe. The Chinese government also applied the technology for its Identification Cards [12]. The global market of RFID including tags, systems
and services was estimated to be of $4.93 billion in 2007, and to increase to $27 billion by 2018. In volume, the quantities of tags sold have more than doubled, from 2006 with 1.02 billion tags, 2008 is expected to have seen 2.16 billion tags sold [13]. Researchers have increasingly turned their attention toward this topic [14] and studied technical aspects, application areas, and security and policy issues. Ngai identified that 80% of literature has been oriented towards the tags and antennae and that the first step was to solve all technical issues, to focus later on the implementations and their outcomes [14].

Later in this paper we will present a survey we conducted on RFID in China. Therefore, it is interesting to shortly investigate the situation in China first. The Chinese market’s value for RFID has become the largest in the world. In 2008, $1.96 billion were spent in the country. The delivery of identification cards, which is a gigantic project of $6 billion, accounted for $1.65 billion in 2008. Once these cards are delivered and requests for ID cards are saturated, the Chinese RFID market is expected to decrease below the US and Japan, but to keep on its fast growth.

Table 1 shows how the volume of tags is expected to increase in every sector of the Chinese economy [15]. As the technology evolves, actors tend to get the best benefits out of RFID and look for new usage. Wireless information can provide benefits in a large amount of industries.

<table>
<thead>
<tr>
<th>End User</th>
<th>Category</th>
<th>Application</th>
<th>Tag Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>China Railway nationwide rollouts</td>
<td>Passenger Transport,</td>
<td>RFID ticketing</td>
<td>3 billion</td>
</tr>
<tr>
<td>Nationwide rollouts</td>
<td>Animal and Farming</td>
<td>Live pig tagging</td>
<td>1.3 billion</td>
</tr>
<tr>
<td>Food and Drug Administration</td>
<td>Financial Security Safety</td>
<td>Anti-counterfeiting drugs</td>
<td>over 1 billion</td>
</tr>
<tr>
<td>Nationwide rollouts</td>
<td>Books, Libraries, Archiving</td>
<td>Book tagging</td>
<td>500 million</td>
</tr>
<tr>
<td>Major appliance manufacturers</td>
<td>Manufacturing</td>
<td>Product line management</td>
<td>hundreds of millions</td>
</tr>
<tr>
<td>Nationwide rollouts</td>
<td>Animal and Farming</td>
<td>Pet dog tagging</td>
<td>150 million</td>
</tr>
<tr>
<td>National Tobacco Project</td>
<td>Retail Consumer Goods</td>
<td>Anti-counterfeiting logistics</td>
<td>37.5 billion packs</td>
</tr>
<tr>
<td>China Post nationwide rollouts</td>
<td>Land and Sea Logistics, Postal</td>
<td>Mailbag tracking</td>
<td>100 million</td>
</tr>
<tr>
<td>Chinese government mandate</td>
<td>Financial Security Safety</td>
<td>Firework Tagging</td>
<td>45 million</td>
</tr>
<tr>
<td>Level 3 hospitals rollouts</td>
<td>Healthcare</td>
<td>Hospital inpatient tagging</td>
<td>20 million</td>
</tr>
<tr>
<td>Major Sea Ports Rollouts</td>
<td>Land and Sea Logistics, Postal</td>
<td>Container Tracking</td>
<td>Tens of millions</td>
</tr>
<tr>
<td>Chinese Army</td>
<td>Military</td>
<td>Logistics</td>
<td>Tens of millions</td>
</tr>
<tr>
<td>Alcohol</td>
<td>Retail Consumer Goods</td>
<td>Anti-counterfeiting alcohol</td>
<td>Tens of millions</td>
</tr>
</tbody>
</table>

In the airlines and airports sector, RFID promises a better traceability during transportation and supply of numerous parts. RFID was applied by the McCarran International Airport and Hong Kong International Airport to tag baggage. Since airports represent a vast structure, RFID has been considered for managing food trolleys, enabling a fluid access to car parks, organising taxi arrivals, etc.

Also, RFID has been considered as a technology that could have great results once adapted to the management of livestock. It can enable automation of farming activities such as weighing and feeding. Lack of traceability, fears of illegally imported meat and current health issues can be mitigated with a tag tracing the animal from its origin [17]. In China, the number of pigs tagged is expected to reach a number of 1.3 billion every year by 2018 [15].

The difficulty with library management has been the large quantity of references. Often applied as a sticker in the inside cover of a book, RFID can speed-up the book identification, enable self checkout, fight book-theft, and sort and control the inventory faster [18] [19].

There have been studies about automatic identification of customers. Banks hope they can improve their services by identifying their customers as soon as they enter the bank via the tag mounted on their credit card [21]. Nowadays, over 17 million cards are in circulation with 95% of Hong Kong people aged between 16 and 65 using this system [16].

Healthcare industry has seen the use of RFID as a means to prevent errors which can have dramatic consequences in this industry. Hospitals
have implemented RFID to monitor patient movements and to maximise room utilisation. The market of RFID tags and systems dedicated to healthcare is expected to increase from $120.9 million in 2008 to $2.03 billion in 2018 [22].

The increasing sizes of sea carriers and ports have encouraged the use of RFID to track containers [2].

Manufacturing has also been a relevant domain of RFID applications. This was especially the case in the car manufacturing industry as it requires a large number of parts and a strong flexibility to provide high diversity of models and options. RFID has been used to identify containers, pallets, organize the inventory better and track the forklifts [2].

The mandate issued by the Department of Defense of the United States is the most resounding example that military industry could show us. In extreme conditions, RFID enables a quick identification of the ammunition left, but also the food, water and other supplies that can be needed during military operations. It is also used to track shipments of containers [23].

Clearly, RFID technology could be useful in many companies. However, organizations often suffer from mindlessness behavior when it comes to new technologies: they implement some technology because others have implemented it, without investigating whether such a technology investment really fits their specific company. Such projects often fail. It is the goal of this paper to investigate whether the mindlessness theory also applies to the RFID technology. In what follows we first shortly present the mindfulness/mindlessness theory and develop hypotheses with respect to RFID adoption. Next, we present the research methodology and survey results and we discuss the results.

**Hypotheses about RFID Adoption**

IT (Information Technology) innovations are supposed to be grounded in organizational facts and specifics, but often they are not. The mindlessness and mindfulness perspective enlightens the way in which a company may consider investing in a new technology and has been discussed by Swanson and Ramiller in MISQuarterly [5].

The mindless firm pays no attention to the firm’s own circumstances. It engages in some innovation because it is impressed by success stories that appear to validate the innovation as a good or even an irresistible idea. It invests in some technology because ‘everyone is doing it’ or it is ‘time to catch up’. The mindless firm typically turns to the dominant vendor within the industry, as there is no need to consider anything else. After all, the adoption decision was not guided by attention to organizational specifics. Assimilation is regarded as unproblematic: end-users will get some application and have to fend for themselves. If the end-user does not like the application, not the application is considered wrong but the user is considered to be at fault. The mindless firm believes that the technology under consideration is not critical to its distinctive competence and it is content to be a follower rather than a leader. It will therefore wait for innovations to come to the firm, rather than seeking intelligence about innovations. It is confident that others will call the important innovations to its attention.

Companies often choose to be mindless. After all, mindfulness represents a costly and demanding sensemaking regime. Mindful decisions are “discriminating choices that best fit a firm’s unique circumstances, rather than familiar and known behaviours based on what others are doing”. A mindful decision is based on elements grounded in the firm’s own specifics and helps decide whether, when, and how the investment should be done. Five attributes characterize the best behaviour to achieve mindfulness in IT innovation [5]:

- **Preoccupation with failure** enables to keep a close eye on operations. Any quiet period would be considered as missing underlying troubles.
- **A reluctance to simplify interpretations** enables resistance to the simplified image of the organizing vision.
- **Sensitivity to operations** brings light on small details that, even though they appear to be minor, can actually have huge consequences.
- **A commitment to resilience** reflects the desire to use an adaptive and flexible way as unknown events are expected to be too numerous.
- **A reliance on expertise over formal authority** enables to apply the best answer to specific issues when one has more expertise than the actual responsible.

Mindless decision taking might also show up in RFID implementation decisions. For instance, a company might blindly copy the pallet-level-tagging that is used in another company, while case-level-tagging would be better in their case. This could lead to project failure. For example, a case study in the Cruise ship industry [28] pointed out that – although pallet-level-tagging might be appropriate in other cases – the implementation of pallet-level-tagging in this specific case could not be justified (but case-level-tagging could be feasible). The appropriateness of the technology depends on case-specific elements, such as the size of the...
timeframe during which deliveries can happen (e.g. to the ship). The reason for this is that, if deliveries can happen during a longer time span, only one door and one portal per ship need to be used for delivery so that deployment costs would be lowered significantly.

Our study puts forward several hypotheses on RFID adoption, based on mindlessness/mindfulness theory. These are given in the following sections.

**Signs of mindless decision making**

Mindless behaviour can show in many ways and several variables should thus be considered when determining whether a company behaves mindlessly or not. Companies may be influenced to invest in a technology because it is fashionable. RFID, which is seen as a technological breakthrough, can be considered as fashionable and this aspect has to be considered as a variable possibly leading to mindless behaviour. The fact that the number of implementations can positively influence the perception and adoption of a technology is also described by the Mindlessness Theory. Observations of implementations done by competitors, buyers, suppliers and companies in other industries should thus also be taken into account when determining the role of mindlessness. Similarly, demands (e.g. from buyers) to implement the technology should be considered. We then define mindless decision making as decision making where such fashionableness, observations or demands play a role.

We define two subtypes of mindless decision making: internally-driven mindless decision making, and externally-driven mindless decision making. Externally-driven mindless decision making concerns requirements formulated by external parties to implement some technology, whereas internally-driven mindless decision making involves a free choice to behave mindlessly (e.g., to be driven by observation of competitor implementations).

As stated above, mindless firms are content to be followers rather than leaders. Therefore, we would expect companies that have not yet implemented RFID technology (but plan to implement it) to show more mindless behaviour than companies that have already implemented it.

**H1a:** Companies that are still planning to implement RFID technology show more internally-driven mindless decision making than companies that have already implemented the technology.

Followers often make the assumption that the initial implementers did not behave mindlessly and that they, therefore, can be followed. This leads to a second hypothesis:

**H2:** Early RFID implementers do not make decisions mindlessly.

Mindlessness theory reveals that observing implementations by others could motivate companies to adopt some technology: ‘if they are doing it, it must be good’. In this paper we investigate the role of four groups of ‘others’: competitors, buyers, suppliers and companies in other industries.

For early adopters there are only few implementations (if any) in their own industry. Therefore, if they would show mindless behaviour, it is likely to stem from observing companies in other industries. For companies who adopt the technology later, mindless behaviour would seem more justifiable if it would stem from observing behaviour of competitors (rather than companies in some other industry), which are at least in the same business. We can then put forward the following hypotheses:

**H3a:** Internally-driven Mindless decision making by early adopters is driven more by observing behaviour of companies in other industries than by observing competitors, suppliers or buyers.

**H3b:** Internally-driven Mindless decision making by late adopters is driven more by competitor behaviour observation than by observation of behaviour of companies in other industries, suppliers or buyers.

**Signs of mindful decision making**

The importance of the confirmation or disconfirmation of the mindlessness hypotheses mentioned above can only be estimated correctly if ‘mindfulness’ is assessed in the same study. According to the TAM (Technology Acceptance Model [27]), a technology is more likely to be accepted by users if it has a higher perceived usefulness and ease of use. A mindful company would consider acceptance by users an important issue. The elements mentioned in the TAM should thus be considered when making an implementation decision.

**H4a:** Companies that consider RFID technology to be easy to use and useful are
Companies often make implementation decisions that may look useful and easy from a business standpoint while they neglect the technological complexity of the implementation. For example, many mergers and acquisitions went wrong (e.g. in the banking industry) because the difficulty of integrating the computer systems of the different companies was much more complex than assumed. As an extension to what is suggested by the TAM, not only the ease of use, but also the ease of implementation would thus be considered by a mindful company:

**H4b:** Companies that consider RFID technology to be easy to implement in their company are more likely to implement it.

If late implementers are to be followers in the sense that they copy what others are doing, they should primarily be characterized by mindless decision making rather than by mindful decision making and they probably assume that early adopters make decisions mindfully. This leads to the following hypothesis:

**H5:** Companies that are still planning to implement RFID technology show less mindful decision making than companies that have already implemented the technology.

Hypothesis 1 suggests late adopters show more mindless decision making than early adopters. The idea arises that decision making by late adopters might show no properties of mindfulness.

**H6:** Late RFID implementers do not make decisions mindfully.

### Research Methodology

A survey was conducted to test our hypotheses. A questionnaire was created with the aim of discovering drivers and inhibitors of RFID adoption by companies. It has been translated from English to Chinese and distributed to a list of 500 companies based in mainland China. The questionnaire was in Word format and sent by e-mail to the contact list. 136 questionnaires have been received back and 122 of them were usable. Questions were designed to provide all the information needed to test the hypotheses and moreover to propose more hypotheses for further studies.

Respondents evaluate different statements on a 7-point Likert scale (“1” meaning they strongly disagree with the statement and 7 meaning they strongly agree). We questioned different drivers that either motivated or would motivate the investment in RFID. We included a question asking if the person considered him or herself as the most knowledgeable to fill out the questionnaire. This enabled us to check whether the distribution of the questionnaire was well-targeted.

Respondents were mainly IT Directors (39%) and Responsible of Logistics (36%) with a less significant part of Managing Directors (14%), General Managers (8%) and CEO’s (3%). The knowledge of each respondent regarding RFID was measured from 1 to 7 and resulted with a mean “knowledge” of 5.61 and a standard deviation of 0.74. A large majority of the companies stay open to new technologies but do not belong to the innovators (61%). 16% try to use the latest technologies, while, in the contrary, 22% avoid them. In our sample, 12% of the companies are using RFID technology. 13% plan to use it in the short term (within a year), 25% may use it within 5 years, and 4% dropped the project after trying. The biggest share is for the companies who are currently not planning to implement RFID technology (45%).

To test our hypotheses, we divided the sample in three different groups:

1. **Group 1: the early implementers.** This group includes all companies which already use RFID extensively or plan to use it more extensively in the future and those that attempted to implement the technology in the past but dropped it (20 observations).
2. **Group 2: the late implementers.** This group includes those running tests and which will start using it shortly and those planning to start using it the next few years (47 observations).
3. **Group 3: the non-implementers.** This group includes companies that are currently not thinking about implementing this technology (55 observations).

To test the drivers and inhibitors we used the Student’s t-test. This is the most “appropriate whenever you want to compare the means of two groups” and enables to conclude whether these are statistically different from each other. To test the hypotheses, we mainly compared the means of groups 1 and 2, and the means of groups (1+2) and 3.

### Research Results

To test H1a (whether late implementers show more internally-driven mindless decision making than early implementers) the means of the answers to the following questions of groups 1 and 2 were compared: Were you motivated to start using RFID in your company because …

- companies in other industries are implementing
it,
- some of your important suppliers have implemented it,
- some of your important buyers have implemented it,
- some of your competitors have implemented it,
- it gives credibility to the organization and appears as technologically updated.

The results of the test are shown in Table 2. Hypothesis 1a is confirmed by the data (p < 0.005).

Table 2: Test results for Hypothesis 1a (equal variances assumed after successful Levene’s Test for equality of variances)

<table>
<thead>
<tr>
<th>mean group1</th>
<th>mean group2</th>
<th>t-value</th>
<th>df</th>
<th>Sig. (1-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.3200</td>
<td>4.6723</td>
<td>-3.823</td>
<td>65</td>
<td>0.000</td>
</tr>
</tbody>
</table>

To test H1b (whether late implementers show more externally-driven mindless decision making than early implementers) the means of the answers to the following questions of groups 1 and 2 were compared: Were you motivated to start using RFID in your company because …
- your important suppliers asked you to use it,
- your important buyers asked you to use it.

Table 3 shows there is no statistically significant evidence that late implementers show more externally-driven mindless decision making than early implementers.

Table 3: Test results for Hypothesis 1b (no equal variances assumed)

<table>
<thead>
<tr>
<th>mean group1</th>
<th>mean group2</th>
<th>t-value</th>
<th>df</th>
<th>Sig. (1-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1500</td>
<td>4.0426</td>
<td>0.761</td>
<td>38</td>
<td>0.226</td>
</tr>
</tbody>
</table>

To test H2 (early implementers do not make decisions mindlessly) the maximum score on the questions mentioned for H1a and H1b of each respondent was taken. It was investigated whether the average of those maximums was higher than ‘4’, the neutral value. The results are shown in the top row of Table 4. The hypothesis can be rejected (p < 0.005). Early implementers thus also make decisions mindlessly.

We additionally tested whether taking the average score over all questions mentioned in H1a and H1b (instead of the maximum score) for each respondent would lead to the same conclusion, to investigate whether mindlessness is not just due to one single factor. The results of that test are shown in the second row of Table 4. Again, the conclusion is that early implementers make decisions mindlessly (p < 0.005).

Table 4: Test results for Hypothesis 2

<table>
<thead>
<tr>
<th>mean group1</th>
<th>mean group2</th>
<th>t-value</th>
<th>df</th>
<th>Sig. (1-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. 5.5000</td>
<td>4</td>
<td>11.052</td>
<td>19</td>
<td>0.000</td>
</tr>
<tr>
<td>Avg. 4.2350</td>
<td>4</td>
<td>4.064</td>
<td>19</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Table 5: Test results for Hypothesis 3a (mean value for influence of companies in other industries = 4.95)

<table>
<thead>
<tr>
<th>mean group1</th>
<th>t-value</th>
<th>df</th>
<th>Sig. (1-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>suppliers 4.15</td>
<td>2.886</td>
<td>19</td>
<td>0.004</td>
</tr>
<tr>
<td>buyers 4.25</td>
<td>2.052</td>
<td>19</td>
<td>0.027</td>
</tr>
<tr>
<td>competitors 4.4</td>
<td>2.773</td>
<td>19</td>
<td>0.006</td>
</tr>
</tbody>
</table>

Table 6: Test results for Hypothesis 3b (mean value for influence of competitors = 5.02)

<table>
<thead>
<tr>
<th>mean group2</th>
<th>t-value</th>
<th>df</th>
<th>Sig. (1-tailed)</th>
</tr>
</thead>
</table>
suppliers 4.6190| -3.420  | 41 | 0.001          |
|buyers 4.6429  | -2.284  | 41 | 0.014          |
|other industries 5.1905| 0.909   | 41 | 0.816          |
Table 5 shows the results of the t-tests done to test hypothesis 3a. Internally-driven mindless decision making by early adopters is driven more by observations of implementations done by companies in other industries than by observations of implementations done by competitors, suppliers or buyers (p < 0.05). No statistically significant differences are found between the role of suppliers, buyers and competitors for early implementers (results not shown in the table).

For late adopters, observations of competitor behavior became more important than observations of buyer and supplier behavior (see Table 6). However, no statistically significant difference was found between the role of competitor implementations and implementations done by companies in other industries (which are still statistically significantly more important than implementations of suppliers and buyers) to drive the implementation decision.

Test results (not shown in tables here) show that observations of implementations done by companies in other industries have a statistically significant motivation to implement the technology, both for early implementers (t=4.790, p=0.000) and late implementers (t=8.180, p=0.000). For late implementers, observations of implementations done by competitors (t=10.311, p=0.000), suppliers (t=5.758, p=0.000) and buyers (t=4.599, p=0.000) also form a statistically significant motivation (i.e., response >4) to implement the technology.

The hypotheses mentioned above focus on mindless ‘motivators’. Swanson and Ramiller [5] also mention variables that could be seen as ‘signs’ of mindless behavior (rather than drivers). The mindless company is for example said to regard assimilation as unproblematic: it is “a simple matter of rolling out the innovation to its end-users, who will in effect be left to fend for themselves. Initial confusion, frustration, or resistance may be dismissed as anomalous or attributed to shortcomings in the users themselves” [5, p 564]. Both, early implementers and late implementers in our sample, seem to show signs of this. When asked if they would be demotivated to start using RFID technology if they thought their employees would feel threatened by the implementation of the new technology, both groups gave a response that was statistically significantly lower than 4 (the neutral value). This is shown in Table 7.

Table 7: Implementers would not be demotivated to use the technology if employees would feel threatened by it

<table>
<thead>
<tr>
<th>mean group1</th>
<th>compared to</th>
<th>t-value</th>
<th>df</th>
<th>Sig. (1-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max.</td>
<td>5.5000</td>
<td></td>
<td>19</td>
<td>0.000</td>
</tr>
<tr>
<td>Avg.</td>
<td>4.2350</td>
<td></td>
<td>19</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Table 8: Implementers would not be demotivated by implementation difficulties

<table>
<thead>
<tr>
<th>mean group1</th>
<th>compared to</th>
<th>t-value</th>
<th>df</th>
<th>Sig. (1-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max.</td>
<td>4.2500</td>
<td></td>
<td>19</td>
<td>0.204</td>
</tr>
<tr>
<td>Avg.</td>
<td>4.2128</td>
<td></td>
<td>46</td>
<td>0.124</td>
</tr>
</tbody>
</table>

Table 9: Test results for Hypothesis 4a (equal variances assumed after successful Levene’s Test for equality of variances)

<table>
<thead>
<tr>
<th>mean group1+2</th>
<th>mean group3</th>
<th>t-value</th>
<th>df</th>
<th>Sig. (1-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max.</td>
<td>5.5000</td>
<td></td>
<td>19</td>
<td>0.000</td>
</tr>
<tr>
<td>Avg.</td>
<td>4.2350</td>
<td></td>
<td>19</td>
<td>0.001</td>
</tr>
</tbody>
</table>
Similarly, the respondents were asked whether they would be demotivated to start using RFID technology if implementing the RFID technology next to the legacy system would be relatively difficult. Neither early nor late implementers would feel demotivated by this problem (value not significantly higher than 4, see Table 8).

Hypothesis 4a (concerning the role of perceived usefulness and perceived ease of use) was tested using the following questions: Do you agree on the following statement:

- RFID is a technology that is easy to use.
- RFID can be useful for your company.

The average of the replies to these questions was compared for two groups: the early and late implementers on one side and the non-implementers on the other side. The test results in Table 9 show there is a statistically significant difference between both groups ($p < 0.005$). Consequently, the higher the perceived usefulness and ease of use, the higher the chance a company is implementing RFID technology.

Hypothesis 4b (concerning the role of perceived ease of implementation) was tested using the following question:

- Do you agree on the following statement: RFID is a technology that is easy to implement?

The test results, shown in Table 10, indicate there is a statistically significant difference between implementers and non-implementers ($p < 0.005$). Companies that find the technology harder to implement are thus less likely to have implemented the technology.

The confirmation of hypotheses 4a and 4b reveals that companies generally show signs of mindful decision making: the higher the considered usefulness, ease of use and ease of implementation, the higher the chance the technology gets implemented. These results should, however, be seen in light of the test results on Hypotheses 5 and 6.

Hypothesis 5 states that early implementers show more mindful decision making than late implementers. The test results in Table 11 confirm this hypothesis ($p<0.005$). The results are based on the average response of each implementer with respect to the four following questions: Were you motivated to start using RFID in your company because it allows you to …

- be more efficient (e.g., material receipts,…).
- monitor closely what others in your Supply Chain are doing.
- collaborate with other companies in your Supply Chain.
- reach a higher quality.

Table 11: Test results for Hypothesis 5 (no equal variances assumed)

<table>
<thead>
<tr>
<th>mean group1</th>
<th>mean group2</th>
<th>t-value</th>
<th>df</th>
<th>Sig. (1-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.8625</td>
<td>5.4149</td>
<td>4.657</td>
<td>33</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Early implementers thus show more mindful decision making than late implementers. We note that additional tests (with results not shown in the tables) reveal that late implementers in turn make decisions more mindfully than non-implementers ($t=11.876$, $p=0.000$) and that non-implementers make decisions more mindlessly than early and late implementers ($t=10.577$, $p=0.000$) (when we asked them hypothetical questions: ‘would you be motivated…?’).

Finally, the responses to the four questions mentioned with hypothesis 5 were compared to the
neutral value ‘4’ to test hypothesis 6 (that late RFID implementers do not make decisions mindfully). The top row of Table 12 takes into account the maximum values given per respondent on one of the four questions. The second row considers the mean value given per respondent on the four questions. Both tests indicate that late implementers make implementation decisions mindfully.

**Discussion and limitations**

The fact that hypotheses 1a and 2 are confirmed seems worrying. It leads to the conclusion that **mindless followers follow leaders that show mindless behavior.** Late implementers might assume that early implementers did not take decisions mindfully, but such assumption seems invalid. The main mindlessness driver is the observation of behavior of companies in other industries. Probably early implementers hope to get a competitive advantage by introducing some practice in their industry which proved successful in another industry. Another important mindlessness driver, especially for late implementers, is the competitor’s behavior. Companies can only get a competitive advantage if they function differently from their competitors. Mindless companies have been said not to believe they can get competitive advantages by implementing some technology [5]. Therefore, it is no surprise that late implementers base mindless decisions on observations of competitor behavior, rather than buyer or supplier behavior. The fact that late implementers’ decisions are still driven by implementations done in other industries could be a consequence of the fact that some late implementers still want to get competitive advantages by using the technology in a new way in their industry and that RFID implementations currently are not yet that old that we can talk about really late implementers.

The fanaticism of early and late implementers ‘to move forward’ suppresses demotivations that could arise because of potential problems with employees and legacy systems. The fear from what other companies might achieve and the fear of missing an opportunity seems bigger than the fear from internal problems. Internal factors are supposed to be under control or are at least not supposed to cause big problems. This fits Swanson and Ramiller’s view on mindless companies, which regard assimilation for example as unproblematic.

This paper thus shows a number of drivers for companies to make decisions mindlessly (like behavior of companies in other industries) and shows signs of mindless decision making (e.g. regarding assimilation as unproblematic). The important conclusion is that early implementers also take decisions mindlessly. Late implementers should be aware of that. On the one hand, mindless decision making is a dangerous regime and following some mindless leader seems even more dangerous. On the other hand, if the leader is doing some practice mindlessly, his practice might fail (because it does not fit his enterprise) whereas the practice might succeed in the follower’s company (by coincidence). A follower thus still has a (small) chance of getting a competitive advantage by copying the innovator.

While the fact that **mindless followers follow leaders that show mindless behavior** might be worrying, our research also points out that early implementers show more mindful decision making than late implementers. The followers thus at least follow leaders that seem more mindful than them. Neither early nor late implementers can be qualified as purely ‘mindless’ or ‘mindful’ decision makers. They combine both, characteristics of mindful and mindless decision taking. As mindfulness is an expensive approach, a ‘healthy’ mix of mindfulness and mindlessness may be appropriate. This mix is different for early implementers than for late implementers. This change in mix over time seems logical: the more prior implementers have used the technology successfully, the smaller seems the chance of the implementation going wrong in your company and thus the less sense it makes to pursue expensive investigations whether the technology would be beneficial to your company. The function describing this change in mix over time should depend on the technology that is considered: the more adaptation is needed to the specific company, the more risky is mindless decision making (and the higher competitive advantages can become). Further research is needed to investigate the function describing the change in mix.

One strength of this paper is that it considers both, mindlessness and mindfulness, in the same study. A study focusing on only one of the two could lead to wrong conclusions: our study indicates that mindlessness and mindfulness do not exclude each other. Researchers should thus note that detecting mindlessness in some case does not mean there is no mindlessness (and the other way around). For researchers it is also important to note that there is no straight line between the expected technology acceptance by users and the decision to implement the technology. Factors related to mindless decision taking are also part of the picture.

There are several limitations to the research reported here. First, the research was conducted in a single country. Prior research has shown that culture plays a role in technology adoption. Straub [24], for example, applies Hofstede’s dimensions...
[25] to compare the diffusion of e-mail in Japan and in the United States, and puts forward the significant role of ‘uncertainty avoidance’ in the adoption process of communication media. More recently, Bartikowski, Fassot and Singh [26] extended the TAM model to integrate a dimension entitled “cultural adaptation”. Further research should investigate the role of mindfulness/mindlessness in other countries. Another limitation of this study is that it is not assessed which characteristics are most important in the decision taking: those pointing to mindless decision making or those pointing to mindful decision making. We believe such a comparison based on survey data would be incorrect, as companies probably tend to gloss over mindless behavior and thus probably automatically give lower scores to factors pointing at mindlessness.

Further research is needed to reveal the relation between mindfulness, the size of the perceived ‘requirement from the environment’ to move on and the internal risks the company is willing to bear. Problems in the financial industry recently revealed that managers take big risks in an attempt to gain huge profits and that they get big bonuses for doing so. Mindlessness was stimulated. Mindlessly pursuing some opportunity that may be there is dangerous, especially if it is not decently investigated whether that opportunity is attainable for your specific company. Further research is needed on the right balance between mindfulness and mindlessness. This could lower the number of IT project failures and improve the image of the IT proficiency.

Conclusions

This paper presents findings from a survey conducted among 122 Chinese companies about drivers for RFID adoption. More specifically, the applicability is tested of Swanson and Ramiller’s mindfulness/mindlessness theory. The data gives mixed support for the applicability of the theory in the context of RFID implementations in China. The survey indicates that late adopters show more mindless behavior than early adopters. Importantly, those early adopters also show signs of mindless decision making! That is, mindless followers follow leaders that take decisions partly mindlessly. Companies are motivated to invest in RFID technology if they observe others in other industries are implementing it.

Our research also points out that neither late nor early implementers can be qualified as fully mindless decision makers. All implementers make the implementation decision part mindfully, part mindlessly. Early decision makers make their decisions more mindfully and less mindlessly than late implementers. A healthy mix between mindless and mindful drivers is important. The evolution of this mix over time for some technology should be a function of the specifics of that technology and is the topic of further research.

References

Mindlessly Following Partly Mindless Leaders the Case of Rfid Implementations


CHARACTERISTICS OF VALUE BUNDLES IN RFID-ENABLED SUPPLY NETWORKS

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Abstract
In order to avoid ruinous price competition, companies are intensely seeking new ways to stand out from competitors in a global market scenario. In response to this aim, value bundles provide an approach to grade up existing offerings from isolated goods and services to integrated problem solutions for specific customer needs. This differentiation strategy relies on supply networks as an essential enabler. However, the effect of RFID as a major innovation in supply chain networks on their ability to enable value bundles is widely unexplored. In this paper we use the morphological method to identify typical characteristics of value bundles in RFID-enabled supply networks. The outcome is a set of characteristics which allows for categorization and, based on this, structured comparison of any respective value bundles. The categorization is illustrated and validated with three case studies.

Keywords: value bundles, RFID, supply network, strategic supply networks, supply chain management

Introduction
In the global market scenario offerings from companies are easily comparable. In such competitive markets often price leadership is the answer to gain market shares – a strategy which includes the risk of minimizing contribution margins. Therefore, differentiation could be a more eligible strategy. A promising way for differentiation on the market is providing value bundles as an integrated solution of purchasing goods and services [1]. Although value bundles are partially established as offerings on the market, the management of value bundles with common business processes like supply chain management is not well supported [2]. Research on value bundles management is mainly focused on developing enhancements for established business processes. Only little research in the area of value bundles in supply networks although supply networks are considered as an appropriate way to realize value bundles.

The research objective of this paper is to contribute to reference modeling in the area of value bundles and supply networks by deriving a classification of value bundles in RFID enabled supply networks. For this we derive characteristics from literature and modeling concepts and apply them to several case studies of value bundles. The outcome is a set of characteristics and instances of value bundles in RFID enabled supply networks which should be considered when using RFID technology to improve supply chain management for value bundles.

The paper is structured as follows: in the second section we explain the background of value bundles, supplier networks and RFID according to the existing literature. In the third section we derive the characteristics of value bundles in RFID-enabled supplier networks and consolidate them by using the morphological method. In the fourth section we illustrate and validate our results by the categorization of three case studies from various industries. In the fifth section we reflect on the results with regard to possible standard types of value bundles in RFID enabled supply networks. In the last section we draw conclusions and discuss further research.

Background
Value bundles
To step out of the trap of decreasing margins value bundles are an appropriate way the make a difference in the market [3]. Value bundles are an integrated combination of physical products and services with the goal to solve a specific customer problem [4]. Generally spoken value bundles are combinations of physical products, services and intangible assets like guaranties or accrued rights. From a customer point of view, value bundles occur as integrated solution with mostly no possibility to recognize the single components of the bundle. From a supplier point of view the value bundle can be divided in different components. Depending on the degree of occurrence value bundles can be subdivided in four components: standard physical products, standard services, customer specific products and customer specific services. The cut off between these four components is not dichotomous but the transitions between the elements are linear in the way that there are multiple options in combining different elements to value bundles.
One central point of the concept of value bundles is that the starting point for the service provision is not the single service but the customers need to solve a problem [4]. Therefore the focus of all modeling concerning value bundles is the customer point of view. In summary a value bundle is a specific combination of physical products, services and intangible assets aligned on customer needs.

Integration is a core characteristic of value bundles. This means not only the integration of products and services to a combined solution but also the integration of processes on the customer side and on the supplier side [5].

The level of integration may vary in value bundles [6]. On the one side there are standardized physical products combines with services directly related to the physical product. The integration is very loose and there would be the possibility to offer the individual parts of the bundling also stand alone. On the other side there is the business case of performance contracting where the offer of a value bundle consists of several service agreements to the customer [7]. These service agreements make use of the physical products and service combined in the value bundle but the customer only deals with the service agreements. From the customer point of view it is not possible to split the physical parts in the value bundle from the service parts.

Value bundles may change their composition during their product life cycle. Product life cycle can be separated in three stages: product construction, product utilization and follow up use [8]. In the first section product construction focus is on identifying, evaluate and establish relationships between the relevant suppliers for the value bundle. In the section of product utilization the attention is drawn on the interaction between the suppliers and the customer, to keep up service agreements and further intangible assets. There is also a need to identify risks in order to fulfill the requirements the customer has on the value bundle. In the follow up use the main concern is on getting the value bundle out of use in an appropriate way or the manage substitution with new value bundles. The summary of the product life cycle section and the corresponding focus areas are displayed in Tab. 1.

<table>
<thead>
<tr>
<th>Product Life Cycle section</th>
<th>Focus areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product construction</td>
<td>Supplier identification</td>
</tr>
<tr>
<td></td>
<td>Supplier evaluation</td>
</tr>
<tr>
<td></td>
<td>Supplier selection</td>
</tr>
<tr>
<td>Product utilization</td>
<td>Supplier interaction</td>
</tr>
<tr>
<td></td>
<td>Customer interaction</td>
</tr>
<tr>
<td></td>
<td>Risk Management</td>
</tr>
<tr>
<td>Follow up use</td>
<td>Decomposition</td>
</tr>
<tr>
<td></td>
<td>Substitution</td>
</tr>
</tbody>
</table>

High integrated value bundles with a significant fraction of services and intangible assets are considerably integrated in the business processes of the customer. Regarding performance contracting as the highest form of integration value bundles are a direct part of the customers’ business processes. By a process perspective again assuming a appropriate information infrastructure there are three possible types of process integration between the customer processes and the supplier processes: by the focal supplier, by a combination of focal supplier and one or more n-tier supplier or even directly by a n-tier supplier (Fig. 2).

Supply Networks
There are several ways to establish offerings consisting of value bundles depending on the core competencies of the regarded company. Possible forms of the realization of value bundles may be classified in a hierarchical form, a cooperation or a market form [9]. Coming from a very focused structure as a production company it is possible to establish an additional service organization within the company to support value bundling. The same scenario holds vice versa for a company solely
focused on service offerings. This hierarchical organization form is often used in an early stage of offering value bundles. A second option for provisioning value bundles is the generation of combined offerings from the market. The offering company buys additional service or products from the market and combines these purchased services or products with their own offerings to a value bundle. This arrangement works well in situations where there is only a tight integration of the individual parts of the value bundle and with no significant integration of the value bundle in existing customer processes. The third option is to establish tight cooperation between different supplier companies [10]. This option leads to supply networks to support the construction and use of value bundles.

Supply networks base upon the concept of supply chains management. The supply chain has been defined as ‘the network of organizations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate customer’ [11]. Supply chain management aims to increase transparency and alignment of the supply chain’s coordination and configuration by looking not only at the next entity or actor but looking across the entire supply chain, regardless of functional or corporate boundaries [12].

Supply networks consist of several independent suppliers from whom one of these suppliers is considered to be a focal supplier having the offering for the customer. The focal supplier organizes all aspects of the value bundle in the supply network. Although the organization of supply networks is slightly complex, the benefits of this organization form for value bundles are immense. The attention of this organization form is in the linkage of business process and therefore a useful method to organize value bundles. Concerning highly integrated value bundles, the delivery of these bundles happens in a service process which is tightly integrated to relevant customer processes.

Value bundles in terms of supply networks are value bundles with the elements of the bundle coming from more than one supplier. Suppliers for different parts of the value bundle are considered to be independent companies. To pay attention to the customer perspective of the value bundle in the following one supplier will be identified as focal supplier. The focal supplier is the supplier with the commercial contact to the customer and is furthermore the head of the supplier network. Every other supplier is directly or indirectly (via another supplier) connected to the focal supplier (Fig. 3).

Fig. 3: Concept of a supplier network for value bundles

With the concept of a focal supplier it is natural to assume that the service provision is solely made by the focal supplier whereas every other supplier in the supply chain makes his service provision directly or indirectly to the focal supplier. By establishing a suitable information infrastructure it would be possible to consider three forms of service provision: by the focal supplier, by a combination of focal supplier and one or more n-tier supplier or even directly by an n-tier supplier.

RFID in Supply Chain Management

RFID is an automatic identification technology [13] which is expected to enhance many of the supply chain operations, affecting both intra- and inter-company processes. Core opportunities of using RFID in supply chain processes are cost reduction and the improvement of service levels. The standards for implementing RFID technology in the supply chain are set by EPCglobal [14]. One central part of the standardization is a globally unique electronic product code (EPC) [15]. By using an EPC each instance of a product may be uniquely identified in the supply chain and may include more information e.g. the producer of the product or the product type. EPCglobal suggests building information systems architectures in which unique product code observation data are globally available. Thus, every participant in the value chain can ask information about a specific product code from the appropriate company that holds this information.

RFID enhances core supply and demand chain management operations. The range is from warehouse management systems over retail distribution systems up to customer service systems [16]. Concerning supply networks the full benefits of RFID will be achieved only when all members of the supply network implement the technology.
Identification of the characteristics

In the following we follow the morphological method [17] in order to identify the characteristics of value bundles in RFID-enabled supply networks and find an exhaustive set of instances for each of them. Finally, the results will be combined to a morphological box. The characteristics are organized in three groups: strategic, assembly and utilization issues.

Strategic issues

First, we have to analyze, in which part of a supply chain process a value bundle may increase value through RFID technology. The decomposition of a complete supply chain management process delivers the sub-processes production, procurement, redemption, shipment, customer service, delivery and return [18].

Another crucial question is the impact of RFID on the supply chain management process. Regarding the general impact of IT on business processes like automation, information enhancement and transformation [19], in a RFID context the impact of the technology on the supply chain management process can be separated in handling time reduction, resource usage reduction, shrinkage reduction, failure reduction, process information and customer satisfaction [20].

In a supply network for value bundles added value may arise for different participants of the supply network. The value added may be solely at the customer side, solely at the supplier side or may be comprehensive of both customer and supplier. It would be preferred to derive clear intersections of the bandwidth of value add between customer and supplier. Following the examined examples no further classification can be detected. This will be part of further research.

A supply chain involves different actors to establish flows of goods and information [21] [22]. It is necessary to analyze every actor of the supply chain for the impact of RFID technology. Supply chain actors will be divided by raw-material supplier, supplier, producer, center of distribution, carrier and customer following a classification from [23].


The distinction whether RFID is supported in only parts of the supply network or in the whole network completes the discussion of the strategic factors.

Assembly issues

Assembly factors describe key issues in the stage of construction of value bundle. In a supplier network the focal supplier issues his demand to the members of the network. Those members which are able to fulfill the demand partially or complete answer back with their product and service information. In a following negotiation phase all contracts will be evaluated and selected. Then the value bundle is established and may be presented to the customer.

One critical issue is the categorization of the value bundle. Components of value bundles may be classified in four categories: standard purchasing goods, standard services, customer-specific purchasing goods and customer-specific services [24]. The value bundle combines parts from these categories to one single offer to the customer. Therefore it is necessary to investigate the influence of RFID-technology in these categories.

Another critical question is the ratio of integration of the value bundle service provisioning. Following [24] there is a continuum from small to high depending on seven criteria of the value bundle service provisioning. Criteria range from the type of customer value over ratio of technical integration up to the variability of the service provisioning on a timeline. Although in a sense of a continuum there is no clearly intersection there is a need to take the criteria of value bundle service provisioning integration in account for investigating the influence of RFID-technology in the different scenarios. Therefore we make a breakdown of the continuum in three parts: small, medium and high. Small and high follows the definition in [24]. Medium will be defined when the value bundle service provisioning tends in four of the seven criteria to one side of the continuum and tends in three of the seven criteria on the other side of the continuum.

Looking at the outcome of the value bundle there are different possibilities how the service provisioning of the value bundle is combined. These different combinations of the outcome are named as intangible asset ratio. The first possibility is a product orientation. An example for a product oriented value bundle is the selling of a machine combined with a service contract. A second possibility is an availability orientation. An example for this kind of orientation is the selling of a machine in combination with a availability guarantee. Output-orientation is a third type of orientation. This type of orientation holds true when selling not a machine plus different services but selling the output of the machine as production factor [25].

Utilization issues
One goal of value bundle is to increase the value of the bundle for the customer in contrast to the offer of the single components of the value bundle [26] [27]. Therefore the customer appreciates a higher value for the value bundle which is an important selling factor for providers of value bundles. The appreciation of the value bundle may be distinguished in appreciation benefit and appreciate costs [28].

Value bundles may differ in their composition during their product life cycle. To investigate the issue of RFID technology related to the product life cycle there will be a segmentation of the life cycle process in the steps pre-use, use and after-use.

Consolidation

As a last step we combine the resulting characteristics of value bundles in RFID-based supply networks and their instances to a morphological box [17] as displayed in Fig. 4.

**Exemplary application**

In the following chapter we illustrate and validate the categorization with three typical examples from plant engineering and construction, ICT hardware vending and HVAC.

**Case study 1: Remedial action in the plant engineering and construction industry**

In the plant engineering and construction industry remedial action is a typical process. In case of a malfunction of a plant it is necessary to evaluate the problem and to initiate the process of remedial action. This process can be concerned as a value bundle [29].

Looking in detail at the process following the example in [29] by the view of the results for RFID-enabled networks there is a clearly classification of this process into the morphological box. The plant is expected to function properly. Therefore the value bundle is product oriented. The identification of the problem may be done by the customer or, if it not possible, by the supplier of the plant. If there is a part of the plant out of order there will be a repair service or a substitution of the broken part. This takes a procurement process to order the new part. The RFID impact type is customer satisfaction and the supplier network participant is both because of the interaction in the process of failure detection. It is a B2B scenario with the possibility of partial supporting of supply network with RFID technology. The value bundle consists of standard purchasing goods on the one side and customer-specific services on the other side. The customer appreciates the benefits of the value bundle. The corresponding morphological box is displayed in Fig. 5.

**Case study 2: Proposal process from an ICT vendor**

Value bundles are common in the ICT industry [30]. Examples therefore are operating, maintenance and support of an IT network infrastructure. To create an offering to the customer is often very complex. Generally customers do not know their requirements in detail [31]. Furthermore the supplier must have knowledge about the business models and the business processes of the customer to customize the offer to the potential requirements of the customer in the future [32]. Value bundles are an appropriate possibility to support these interactions between customer and supplier to size the right offering. Looking at the case study in [33] the example of the value bundle proposal preparation can be categorized in the morphological box as follows. The whole process serves as customer service and the RFID

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**Fig. 4:** Morphological box of value bundles in RFID-enabled supply networks

**Fig. 5:** Morphological box for remedial action in the plant engineering and construction industry

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The 9th International Conference on Electronic Business, Macau, November 30 - December 4, 2009
impact type is the optimize process information and therefore lead to customer satisfaction. The main participant in the value added supplier network is the customer, whereas the supply chain actors are the customer and the supplier who handles all possible combinations of products and services in terms of a value bundle. The described scenario is a B2C interaction but it might as well be a B2B interaction for business customers. RFID technology might enhance partial subnets of the relevant supply network.

The value bundle consists of standard purchasing good e.g. telephones and telephone modules and standard services according to the selected modules. The interaction ratio is small because of the low complexity of the value bundle. It is product oriented with the goal to serve as a basis for the following process steps implementation and operations support. The customer will appreciate the benefits of the value bundle, the product life cycle is pre-use. The corresponding morphological box is displayed in Fig. 6.

![Fig. 6: Morphological box of a proposal process from an ICT vendor](image)

**Case study 3: Customer Service reports from a company in the HVAC industry**

Looking in the HVAC industry (Heating, Ventilating and Air Conditioning) in Germany one can see typical value bundles in supply networks. Generally customers receive a value bundle consisting of technical equipment and services for the support of the equipment. The technical parts come from production companies whereas the service comes from small and midsize service companies [34]. In the case study [35] the customer service report as part of the value bundle is described which will be categorized into the morphological box.

The customer service report is done by service engineers at the customers place. In theses service reports the engineers report their work, their working time, used material and measured data from the plants. The reports are issued to a central server and will be stored in a database for further reporting and analyzing. The value bundle can be categorized in the RFID-relevant processes customer service and delivery. The impact is to reduce handling time by identifying technical parts by RFID technology, to reduce failure by reducing manual data collection and to enhance process information. The value add is mainly on the supplier side whereas the supply chain actors are the supplier and the customer. The business case may be applicable in B2B, B2C and B2A and there may be a RFID support for the complete process.

The value bundle is highly user specific both in the purchasing goods and the services. The interaction ratio of service provisioning is medium in the case that the operating of the plant is done by the customer. The outcome is availability-oriented. The customer appreciates the benefits of the solution and the value bundle is in the life cycle phase of use. The corresponding morphological box is displayed in Fig. 7.

![Fig. 7: Morphological box of customer service reports in the HVAC industry](image)

**Reflection**

After classifying examples of value bundles in different industries, we will now try to identify some recommendations for the enhancement of supply networks for value bundles by RFID technology.

We can see in the three different scenarios that there are several possibilities to increase the value of the supplier network through RFID technology. Example 1 is a mixed scenario. Customer and supplier work together on a common issue. The value bundle consists of quite standard products and
services and is product oriented. RFID technology is able to improve the logistic chain of the business case. The process of dealing with the shipment of spare parts will lead to faster replacement cycle and an improvement of customer satisfaction.

Looking at example 2 it is a very customer-centric example providing relevant and useful information to the customer to allow him to configure an optimal proposal. As one can see on the RFID impact type RFID technology is able to improve customer satisfaction and to increase the quality of process information to the customer. It is a product-oriented scenario with low complexity in the structure of the value bundle.

Taking example 3 this is a supplier-focused scenario where RFID technology is mainly able to improve the logistics chain of the value bundle. It’s a complex scenario with highly customer-specific components of the value bundle. The chance of RFID technology in this example is to reduce handling time and to reduce failure which leads to a higher customer satisfaction.

Regarding this it might be obvious that by classifying more examples of value bundles this may lead to standard types of value bundles suitable for different RFID enabled supply networks.

**Conclusion**

The research objective of this paper was to develop a set of characteristics and instances for value bundles in RFID enabled supply networks. Based on existing reference models and modeling concepts of value bundles, supply networks and RFID technology we developed a full set of 11 characteristics in three areas and consolidated them to a morphological box. The characteristics have been illustrated and validated by the categorization of three case studies from various industries.

The results of our paper allow for categorization of any given value bundles in RFID-enabled supply networks as well as for their structured comparison. It is not unlikely that the application of our categorization tool to a higher number of case studies will show typical patterns and thus lead to a derivation of standard types of value bundles in RFID enabled supply networks.

Furthermore, our results help practitioners to systematically identify benefits of RFID technology in their supply networks for a differentiation strategy based on value bundles. According to this, the improvement of existing networks as well as an optimized selection process for sub-suppliers can be endorsed.

Beyond the abovementioned analysis of a larger case study sample and derivation of standard types, further research comprises reference modeling. According models would allow practitioners to introduce an engineering approach to finding, evaluating and selecting optimal supply networks for a given value bundle as well as to identifying potential value bundles for given supply networks. Besides the obvious advantages, this could improve stability and long-term relationships in supply networks for value bundles.

**Acknowledgement.** The authors thank Laura Goeke and Frank Becker from the wi-mobile Research Group for partial support.

**References**


Characteristics of Value Bundles in RFID-Enabled Supply Networks

1992,


[34] L. Breunig, Technischer Kundendienst: Kunden gewinnen und halten mit aktiven Servicestrategien. Augsburg: WEKA Verlag, 2001,

Abstract
Supply chain management has two streams of strategies, namely lean and agile. However, current RFID applications tend to overlook supply chain strategies and are designed for obvious RFID applications, like simply replacing barcodes. However, the full potential of RFID might not be achieved when RFID applications are not aligned with the supply chain strategies. Therefore, this study analyzes the current literature to investigate whether RFID applications are indeed misaligned with their strategies. Results shows that RFID is still at its infancy and most RFID applications focus on cost reduction, a lean practice, and less attention has been paid on how RFID can satisfy customer demands, an agile practice. It is therefore suggested that management should ensure that RFID applications are aligned with their supply chain strategy, in order to gain the most benefits out of RFID.

Introduction
RFID holds the promise to revolutionize supply chain management, by providing visibility to all supply chain partners. Wal-Mart and other major retailers started the RFID inertia by mandating their top suppliers to tag cases and pallets with RFID tags in 2005. However, RFID is still far from reaching its critical mass. As a matter of fact, RFID adoption has been stagnating after the RFID mandates from the major retailers [1]. The RFID adoption has been relatively slow partly due to the fact that we are not fully aware of the benefits it can bring [2] and due to the fact that RFID has not brought the envisaged benefits yet.

One of the explanations of the unclear benefits might be explained by that all supply chains are treated as equal when designing RFID applications. However, literature has actually already defined two different types of supply chain strategies, namely lean and agile. Where lean focuses on eliminating waste and where agile focuses on satisfying customer demands. Nevertheless, supply chain strategies are often ignored when designing IT and information sharing applications. It is therefore very plausible that current RFID applications are not aligned with their supply chain strategies. Authors like [3] support this view, as they imply that many RFID applications merely replicate Wal-Mart’s example. Thus Wal-Mart’s RFID application was initially designed for a typically lean supply chain, but replicated to both lean and agile oriented supply chains. This obviously limits the true potential of RFID applications and we therefore need to realign RFID applications with the supply chain strategy.

The major purpose of this study is twofold. First, this study provides a landscape of the current RFID applications, by reviewing the existing literature. Secondly, this study verifies whether the existing RFID applications are aligned with the supply chain strategy.

Literature review
Supply chain strategies
One of the first recognized supply chain strategies is mass production, as introduced by Henry Ford in the early 20th century [4]. Mass production created standard processes to effectively and efficiently manufacture products in house. In the 1970s Toyota developed the Toyota Production System, based on the Just in Time (JIT) principle and what later has become lean production [5]. The main philosophy of lean is to eliminate waste, e.g. redundant cost and labor. Soon the lean philosophy was not only applied by manufacturers, but was applied across supply chains, due to globalization and rapid technological innovations [6]. Agile supply chains can be traced back to the 1990s and its main philosophy is to be flexible in order to meet the fluctuating customer demands [7]. Fischer [8] was one of the first to suggest that lean and agile are supply chain strategies and he was one of the first to explain which specific supply chain strategy to use in different market environments. The market place in combination with the product type should determine the appropriate supply chain strategy, as shown in Table 1.

<table>
<thead>
<tr>
<th>Predictable market place</th>
<th>Functional product</th>
<th>Innovative product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volatile market place</td>
<td>Mismatch</td>
<td>Agile</td>
</tr>
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</table>

Table 1. Supply Chain Strategies
Lean and agile supply chain strategies have been widely used to explain many SCM phenomena. Moreover, many academics developed variants of the lean and agile supply chain strategies. Leagile strategy was proposed by [9], where lean is used in the upstream supply chain and where agile is used in the downstream supply chain. Moreover, the supply chain strategies were extended by taking the supplier uncertainty into account [10]. Albeit supply chain strategies have evolved, they are still based on the elemental lean and agile philosophy. Therefore, this study considers only lean and agile as supply chain strategies in order to keep the study parsimonious.

IT and information sharing are often considered as enabling factors in supply chain management [11] and both have been widely discussed in the supply chain management context. Lean has two paradigms regarding IT and information sharing, where one side supports that IT and information sharing can improve the lean principle [12]. While others question whether IT and information sharing is useful and suggest that they actually create more overhead and maintenance, and thus waste [13]. On the other hand, IT and information sharing seems to be the foundation of agility, as it enables better coordination between supply chain partners in order to meet the customer demand [14]. Thus the literature advocates that IT and information sharing is more effective for agile supply chains than lean supply chains. However, as aforementioned many RFID applications are replicates of Wal-Mart’s RFID application, which was designed for a lean supply chain. As a result many RFID applications are not aligned with the (agile) supply chain strategy and possibly limit the potential RFID benefits.

**RFID diffusion**

RFID is a prominent technology that has been much discussed recently and the discussion is expected to further extend [15]. The technology is often discussed as it can integrate the material flow with the information flow, providing a real-time track and trace of products [16]. It is even proclaimed to be as revolutionary as the Internet [17]. RFID is far from reaching a critical mass, despite the envisaged benefits. Literature suggests that lack of standards, privacy and security issues, high RFID tag cost, and unclear benefits are the main barriers RFID adoption [18] [19] [20]. The lack of standards is currently being addressed by EPCGlobal [21] and the high tag cost should drive down with the rapid technological improvements. Privacy and security issues of RFID are a major concern and have been extensively covered by many studies [22]. However, the benefits of RFID remain elusive and are typically reported by only a few case studies [23], leaving managers to make decisions while they are still uncertain about the true RFID benefits like ROI and inventory turnover [20].

**Methodology**

This study provides a landscape of the current RFID applications by reviewing the literature. Academic journals were examined, as we believe that they usually provide the most in-depth and objective reviews of RFID applications. Only studies that covered actual RFID applications or studies that proposed applications with a real case to test the proposed application were considered, mere conceptual work is omitted as they are not designed or tested against a specific supply chain strategy. Moreover, theses, dissertations, textbooks, conference papers, and unpublished papers were excluded, in order to keep the papers consistent and of high quality. The following five electronic databases were consulted for this study: ABI/INFORM, Academic Search Premier, Emerald Fulltext, Science Direct, and IEEE Xplore. The search was based on the keywords “RFID” and “radio frequency identification”. The full text of each article was reviewed to only include those that were considered as RFID applications, as aforementioned. We found a total of 1542 articles with the matching keywords and out of those articles only 21 satisfied our RFID application criteria.

The 21 studies were classified into lean or agile supply chains, in order to provide a supply chain strategy view of the RFID applications. The supply chain classification was done according to the classification as proposed by [8]. First of all, the articles are reviewed for whether the demand is either stable (lean) or uncertain (agile). Secondly, the product type is analyzed for whether they are functional or innovative. Studies where the supply chain strategies could not be determined were excluded. Moreover, the RFID applications were analyzed for the supply chain practices as illustrated in Table 2. Lean practices and agile practices This allows us to verify whether RFID applications were implemented in alignment with the respective supply chain strategy. Notice that the “soft practices”, which are tailored to sociological aspects, were excluded, as these are unlikely to be directly influenced by RFID. The reader is referred to [12] [24] [25] for more readings about the supply chain practices found in Table 2.
An overview of the RFID applications studies can be found in Table 3. The overview shows that almost all RFID application studies were published after 2006, which can be explained since Wal-Mart started the RFID inertia in 2005. Even though the goal is to discuss RFID applications on a supply chain level, the overview illustrates that most of the RFID applications are designed and implemented on an organizational level and only a few studies share information between supply chain partners let alone share information across the entire supply chain. However, the true benefit of RFID lies in information sharing across the entire supply chain as aforementioned. For instance, when inventory levels are shared the Bullwhip effect can be lessened [26] and the production planning can be improved [27].

The overview also illustrates that many of the RFID applications are for inventory tracking purposes, where it can generally depict a more up to date and accurate picture of the inventory. Only a few of the studies like [28] demonstrated that RFID can be used for redesigning the supply chain and creating new business opportunities, rather than only replacing barcode or automating certain manual processes.

Furthermore, the overview illustrates that the supply chain strategy and the supply chain practices of the RFID applications are not always aligned. A summary of the alignment between supply chain strategies and supply chain practices is illustrated in Table 4. The overview shows that 8 out of the 21 RFID applications are lean supply chains and 13 are agile supply chains. The overview also shows that 7 out of the 8 lean supply chains implemented RFID applications aligned with their strategy and only 3 out of the 13 agile supply chains implemented RFID applications aligned with their strategy.

Thus 11 out of the 21 RFID applications are tailored to supply chain practices that are not aligned with their supply chain strategy. The misalignment can be attributed to that most of the RFID applications, 14 out of 21, are tailored to lean practices. Thus the RFID applications are mostly tailored to lean practices disregarding the supply chain strategy, while the literature suggested that IT and information sharing is more effective for agile supply chains. This finding indicates that RFID is not optimally used to support their supply chain strategy.

**Discussion**

The literature shows that there are two streams of supply chain strategies, namely lean and agile. However, the literature review showed that RFID applications are often not tailored to the practices that aid the supply chain strategies. Studies like [49] demonstrated that the correct supply chain practices can improve the supply chain strategy and hence the performance. Moreover, as aforementioned the literature suggests that IT and information sharing should aid the agile supply chains more than the lean supply chains. The RFID application review on the other hand illustrates that most supply chain strategies focus on lean practices disregarding the supply chain strategies. The literature also showed that current RFID applications address most lean practices, but left various agile practices unexplored. A possible explanation of this phenomena is that lean practices often focus on waste reduction, and thus cost, which is relatively easy to quantify and where agile practices focus on customer demand satisfaction, which is more difficult to quantify. Moreover, most of the RFID applications are focused on internal operations and automating processes, which is more along the line of lean thinking. This also indicates that we are only at the start of the RFID diffusion, as the true potential of RFID lies in redesigning supply chains and developing new business opportunities [50].

This study suggests academics and practitioners to take the supply chain strategy into account when designing and discussing IT and information sharing applications. The literature shows that supply chain strategies are well known and they usually discuss operational issues. However, IT and information sharing can support those operational issues and attention should be paid when designing them. Moreover, the study also suggest to further investigate in the supply chain practices that RFID has left unexplored, e.g. supplier network, concurrent business activities, customer driven innovation, and use flexible production technology.

**Table 2. Lean practices and agile practices**

<table>
<thead>
<tr>
<th>Lean</th>
<th>Agile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pull approach (Kanban)</td>
<td>Close supplier relationship</td>
</tr>
<tr>
<td>Inventory reduction</td>
<td>Enterprise integration</td>
</tr>
<tr>
<td>Quick setups / orders</td>
<td>Concurrent business activities</td>
</tr>
<tr>
<td>Quality at source (Jidoka)</td>
<td>Customer requirement satisfaction</td>
</tr>
<tr>
<td>Supplier networks</td>
<td>Rapid development cycles</td>
</tr>
<tr>
<td>Continuous improvement (Kaizen)</td>
<td>Customer driven innovation</td>
</tr>
<tr>
<td></td>
<td>Use flexible production technology</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lean</th>
<th>Agile</th>
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<tbody>
<tr>
<td>Supplier networks</td>
<td></td>
</tr>
<tr>
<td>Continuous improvement (Kaizen)</td>
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<tr>
<td>Inventory reduction</td>
<td></td>
</tr>
<tr>
<td>Quality at source (Jidoka)</td>
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<tr>
<td>Supplier networks</td>
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<td>Continuous improvement (Kaizen)</td>
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<td>Pull approach (Kanban)</td>
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<tr>
<td>Quick setups / orders</td>
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<tr>
<td>Enterprise integration</td>
<td></td>
</tr>
<tr>
<td>Concurrent business activities</td>
<td></td>
</tr>
<tr>
<td>Customer driven innovation</td>
<td></td>
</tr>
<tr>
<td>Use flexible production technology</td>
<td></td>
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</tbody>
</table>

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production technology. Note that most of the unexplored supply chain practices are agile, which according to the literature can greatly facilitate the supply chain performance.

Table 3. RFID applications overview

<table>
<thead>
<tr>
<th>Article</th>
<th>Strategy</th>
<th>Practices</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>[17]</td>
<td>Lean</td>
<td>Kaizen Monitors the repairable airplane items in an aviation engineering company.</td>
<td></td>
</tr>
<tr>
<td>[29]</td>
<td>Lean</td>
<td>Inventory reduction Kaizen Investigates at how RFID data can be used to better track inventory.</td>
<td></td>
</tr>
<tr>
<td>[30]</td>
<td>Agile</td>
<td>Enterprise int. Inventory reduction Kaizen Visualizes processes by capturing 3PLs’ RFID data and shares them over the Internet.</td>
<td></td>
</tr>
<tr>
<td>[31]</td>
<td>Lean</td>
<td>Jidoka Ensures that bottles go through all the dispense processes.</td>
<td></td>
</tr>
<tr>
<td>[32]</td>
<td>Agile</td>
<td>Kaizen Monitors the calibrated tools location and that they do not unauthorized leave the plant.</td>
<td></td>
</tr>
<tr>
<td>[33]</td>
<td>Agile</td>
<td>Kaizen Quick set up/order Uses RFID over existing GSM network to automate receiving incoming goods.</td>
<td></td>
</tr>
<tr>
<td>[34]</td>
<td>Agile</td>
<td>Jidoka Ensures that the correct parts are assembled on the right chassis.</td>
<td></td>
</tr>
<tr>
<td>[35]</td>
<td>Lean</td>
<td>Quick set up/orders Tracks and traces trucks that go in and out of the Shanghai Port.</td>
<td></td>
</tr>
<tr>
<td>[36]</td>
<td>Lean</td>
<td>Kaizen Monitors the use of pallets throughout the supply chain.</td>
<td></td>
</tr>
<tr>
<td>[37]</td>
<td>Lean</td>
<td>Inventory red. Manage retail inventory of chilled groceries and ensures that products are sold before the due date.</td>
<td></td>
</tr>
<tr>
<td>[38]</td>
<td>Agile</td>
<td>Kanban Close sup. rel. Proposes a multi agent auto replenishment system based on RFID.</td>
<td></td>
</tr>
<tr>
<td>[40]</td>
<td>Agile</td>
<td>Kanban Track and traces the pre-cast components in a storage yard.</td>
<td></td>
</tr>
<tr>
<td>[41]</td>
<td>Agile</td>
<td>Inventory red. Rapid dev. Cycles Track and traces the inventory of “RFID unfriendly” pipe spools.</td>
<td></td>
</tr>
<tr>
<td>[42]</td>
<td>Agile</td>
<td>- Monitors the inventory in a warehouse.</td>
<td></td>
</tr>
<tr>
<td>[28]</td>
<td>Lean</td>
<td>Customer req. sat. Tracks and traces the physical locations of containers in a container depot and keeps track of the container conditions.</td>
<td></td>
</tr>
<tr>
<td>[43]</td>
<td>Agile</td>
<td>Kaizen Investigates how real time tracking of inventory can improve the operations of the manufacturer.</td>
<td></td>
</tr>
<tr>
<td>[44]</td>
<td>Agile</td>
<td>Enterprise int. Allows RFID tags to capture the production information of semi conductors and provides the information to the retailers.</td>
<td></td>
</tr>
<tr>
<td>[45]</td>
<td>Lean</td>
<td>Inventory reduction Investigates whether RFID is cost effective when it is used for product shrinkage.</td>
<td></td>
</tr>
<tr>
<td>[46]</td>
<td>Agile</td>
<td>Inventory reduction Utilizes RFID to identify the misplacement of goods in a retail shop.</td>
<td></td>
</tr>
<tr>
<td>[47]</td>
<td>Agile</td>
<td>- Investigates how RFID can benefit a car manufacturer in the shipping yard of a car manufacturer.</td>
<td></td>
</tr>
</tbody>
</table>

Table 4. Supply chain strategies aligned with practices

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Practices aligned</th>
<th>Practices misaligned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lean</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Agile</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>Total</td>
<td>11</td>
<td>10</td>
</tr>
</tbody>
</table>

In practice supply chain management might not have such a clear distinction between lean and agile supply chain strategies. For instance, an organization can follow both lean and agile supply chain strategies. According to the literature agile supply chains try to satisfy the changing customer demand, but not at an unlimited price. Therefore, agile supply chains will also often focus on waste reduction, once the customer demand is satisfied or when the product is matured [51]. Albeit there might not be such a clear distinction between the two supply chain strategies, this study can provide management with a guidance of how to implement RFID. After all, management should be aware whether the priority should be set to waste reduction or customer demand satisfaction.

This study only looked at academic publications, which limited the RFID applications to 21. Therefore business journals should be analyzed in the future to confirm the findings. Moreover, this study will continue and will develop a framework that can explain how different types of RFID applications can impact lean and agile supply chain strategies. First, the RFID applications are categorized according to different types of RFID applications. Subsequently, the
different types of applications are analyzed to verify how they impact different strategies. Furthermore, we will investigate whether it is possible to describe which type RFID application is more beneficial for certain supply chain strategies and/or supply chain practices.

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UNCONVENTIONAL NEGOTIATION: SURVEY AND NEW DIRECTIONS

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Abstract
The increasing demand for building large-scale complex and distributed systems such as Cloud/Grid computing systems accentuates the need for complex negotiation mechanisms for managing computing resources. The contribution of this paper includes: 1) summarizing classical negotiation problems and conventional negotiation in terms of the utility function, strategy, and protocol, 2) discussing the differences between conventional negotiation and unconventional negotiation, 3) reviewing and comparing the state-of-the-art developments in both relaxed-criteria negotiation, and complex and concurrent negotiation, and 4) suggesting new directions in complex negotiation and its applications.

Introduction
Negotiation denotes the process of two or more agents (with disparate interests) searching for an agreement on some issues (e.g., price) [1]. The search process involves exchange of information, relaxation of initial goals, and mutual concessions. Automated negotiation among distributed systems (e.g., multi-agent systems and software agents) is becoming increasingly important because automated interactions among software agents can occur in many different contexts in which conflicts and differences need to be resolved. For instance, e-negotiation is a desirable mechanism for resolving differences in trading terms in e-commerce and supply chain management, and more recently for resource (co-)allocation in Grid computing. Research on engineering e-negotiation agents has received a great deal of attention in recent years.

The contribution of this paper includes: 1) summarizing classical negotiation problems, and conventional negotiation in terms of the utility function, strategy and protocol, 2) reviewing and comparing the state-of-the-art developments in unconventional negotiation such as relaxed-criteria negotiation, and complex and concurrent negotiation, 3) discussing the differences between conventional negotiation and unconventional negotiation, and 4) suggesting new directions in concurrent negotiation and its applications.

Conventional Negotiation

In the literature in bargaining (negotiation), the seminal works of Nash [2], and Rubinstein and Osborne [3-4] established the essential frameworks and foundations of bargaining theory.

Bargaining Problem: In [3], a bargaining problem is specified as follows. There is a set of \( N \) bargainers (players or agents). The negotiation outcomes are: 1) agents reaching an agreement or 2) negotiation terminating with a conflict \( D \). Each agent has a negotiation set or agreement set \( A \) (see [3, p. 9]), which represents the space of its possible deals or proposals for reaching agreements with its opponent, and the agent has a preference ordering over the set \( A \cup D \). There is a utility function \( U \) for each agent that represents its preference ordering by associating each negotiation outcome with a number, such that more preferred outcomes are associated with larger numbers.

Utility function: An agreement may take many forms. It can be a price or a detailed contract that specifies the actions to be taken by agents [3]. In classical bargaining problems involving price-only negotiation between two agents, and [3], the utility function \( U^b \) of \( B \) is defined as follows. Let \( IP_B \) and \( RP_B \) be the initial and reserve prices of \( B \). Let \( D \) be the event in which \( B \) fails to reach an agreement with its opponent. \( U^b(IP_B,RP_B) \leq D \leq 0 \) such that \( U^b(D)=0 \) and for any \( l_B \in [IP_B,RP_B], U^b(l_B) > U^b(D) \). Furthermore, if \( B \) is a buyer (consumer) agent, then \( U^b(l_B) > U^b(IP_B) \) if \( l_B < IP_B \). If \( S \) is a seller (provider) agent, then \( U^b(l_S) < U^b(IP_B) \) if \( l_S < IP_B \) such that for any \( l_B \in [IP_B,RP_B], U^b(l_B) > U^b(D) \).

Negotiation strategy: If \( B \) and its opponent \( S \) are sensitive to time, then let \( \tau_B \) be the deadline of \( B \), and \( \tau_S, IP_B \) and \( RP_B \) be the deadline, initial price, and reserve price of \( S \). In a one-to-one negotiation, the only factor affecting both agents is their deadline. In [5-7], \( B \) and \( S \) adopt time-dependent strategies. Let \( \lambda_B \) and \( \lambda_S \) be the time-dependent strategies of \( B \) and \( S \), respectively.

The proposal \( P_t^b \) of \( B \) at time \( t, 0 \leq t \leq \tau_B \), is determined as follows:

\[
P_t^b = IP_B + \left(1 - \frac{t}{\tau_B}\right)\lambda_B + (\tau_B - t)\lambda_B + (RP_B - IP_B)
\]

where \( 0 \leq \lambda_B \leq 1 \), and \( IP_B \) and \( RP_B \) are \( B \)'s initial price and reserve price, respectively.
The proposal $P_t^S$ of $S$ at time $t, 0 \leq t \leq \tau_S$ is determined as follows:

$$P_t^S = IP_S - \left(1 - \frac{1}{\tau_S}\right)(RP_S)$$

where $0 \leq \lambda_S \leq \infty$, $IP_S$ and $RP_S$ are $S$'s initial price and reserve price, respectively.

**Negotiation protocol:** Negotiation between $B$ and $S$ is carried out using the Rubinstein’s alternating-offers protocol [4] as follows. $B$ makes an offer at $t = 0, 2, 4, \ldots$ $S$ makes a counter offer at $t = 1, 3, 5, 7, \ldots$ During negotiation, $B$ (respectively, $S$) uses eq. (4) (respectively, eq. (5)) to generate an offer (respectively, a counter-offer). Negotiation terminates (i) when an agreement is reached, or (ii) with a conflict when either $B$'s or $S$'s deadline is reached.

**Optimizing utility:** The problem is to find a value of $\lambda_B$ (respectively, $\lambda_S$) that would optimize $U_B$ (respectively, $U_S$) given different parameters (e.g., deadline, initial price, and reserve price).

### Conventional Negotiation vs. Unconventional Negotiation

In this paper, conventional negotiation [1-8] approaches are identified with the following characteristics:

1. An agreement is reached when one agent proposes a deal that matches (or exceeds) what another agent asks for.
2. Agents focus only on optimizing utilities.
3. When contracts are established, agents are bound to them (i.e., no agent can breach a contract).
4. Agents negotiate with other agents for one type of goods/service in only one market.

**Agreements and utilities:** In conventional negotiation, agents evaluate (counter-)proposals using some utility function $U(P)$ and typically accept a proposal $P$ based on whether the opponent's proposal generates an expected payoff that is equal to or higher than some expected payoff. For example, if agent $B_1$'s proposal $P_1^B$ generates a payoff of $U(P_1^B)$, $B_1$ will typically accept another agent $S_i$'s (counter-)proposal $P_1^S$ only if it generates a payoff $U(P_1^S)$, such that $U(P_1^S) \geq U(P_1^B)$. Since agents in conventional negotiation mechanisms are utility-maximizing agents, they are not designed with the flexibility to consider reaching a faster agreement by accepting $P_1^S$ if $U(P_1^S) < U(P_1^B)$ even if the difference $|U(P_1^S) - U(P_1^B)|$ is (very) small. In multi-lateral negotiation, an agent may run the risk of losing deals in the face of strong competition. The idea of relaxed-criteria negotiation proposed by Sim [9] redefines the notion of reaching a consensus in negotiation by allowing agents to overlook very small differences in their proposals, and hence, slightly relaxing the conditions for reaching agreements. Unlike conventional negotiation where agents only strive to optimize their utilities, in relaxed-criteria negotiation, agents attempt to enhance their success rates in negotiation and to reach faster agreements while also attempting to optimize their utilities.

**Contracts:** In conventional negotiation, an agent is bound to a contract once it is established (i.e., neither party can breach the contract). In unconventional negotiation, Sandholm et al. [10] proposed the idea of leveled commitment contracts for a two-player game, where each player can be freed from a contract by paying a penalty fee to the other player, and the level of commitment is set by breach penalties. Allowing decommitments enables an agent to profitably accommodate new negotiation events that make some old contracts unbeneificial. This enables an agent to take on unbeneificial contracts in anticipation of better contracts in subsequent negotiations. For example, in Grid resource negotiation, the reasons for allowing decommitments are as follows: 1) if a consumer cannot acquire ALL its required resources before its deadline, it can release those resources acquired so that resource providers can assign them to other consumers, and 2) decommitment allows an agent that has already reached an intermediate contract for a resource to continue to search for better deals before the termination of the entire concurrent negotiation.

**Markets:** In conventional negotiation, regardless of the number of agents (participants), (i.e., whether it is a one-to-one, one-to-many, or many-to-many negotiations), agents negotiate for only one type of goods/service within one market. A recent work by Sim et al. [11] considered a complex concurrent negotiation mechanism in which an agent conducts simultaneous and parallel negotiation activities with agents in multiple e-markets for acquiring multiple types of resources.

### Relaxed-criteria Negotiation

In Sim’s relaxed-criteria negotiation [9], two rules were defined for allowing agents to reach agreements:

**R1:** An agreement is reached if an agent $B_i$ and its opponent $S_i$ propose deals $P_i^B$ and $P_i^S$, respectively, such that either 1) $U(P_i^B) \geq U(P_i^S)$ or 2) $U(P_i^S) \geq U(P_i^B)$, where $P_i^B$ and $P_i^S$ represent the buying and selling prices, respectively.

**R2:** An agreement is reached if either 1) $\eta = U(P_i^S) - U(P_i^B)$, such that $\eta \rightarrow 0$ or 2) $\eta = U(P_i^B) - U(P_i^S)$, such that $\eta \rightarrow 0$, where $\eta$ is the amount of relaxation determined using a fuzzy decision controller (FDC) together with a set of relaxation criteria.

In conventional negotiation, agents follow...
Rubinstein’s alternating-offers protocol and only use R1 for determining whether an agreement is reached. In Sim’s relaxed-criteria negotiation protocol, agents use both R1 and R2 for determining whether an agreement is reached.

Sim’s relaxed-criteria negotiation is generally designed for many-to-many negotiation, and agents are programmed to slightly relax their bargaining terms in the face of intense pressure (e.g., urgent need to acquire a resource, or facing fast approaching deadlines). Since notions such as “very slight” difference in proposals, “strong” competition, and “fast” approaching deadline are vague, an FDC together with a set of 16 fuzzy rules were used in [9] to guide agents in making decisions when relaxing their aspirations. In relaxing its bargaining terms, an agent in [9] is influenced by factors such as degree of competition (\( \vartheta \)) and its opponents’ counter-proposals. Both \( \vartheta \) and \( \varepsilon \) collectively form the antecedent of the fuzzy rules. The amount of relaxation \( \varepsilon \) is the consequent of a fuzzy rule. Whereas \( \vartheta \) and \( \varepsilon \) are the inputs to the FDC, \( \varepsilon \) represents the amount that an agent would relax its bargaining terms in a given situation (the output of the FDC).

In [12], the idea of relaxed-criteria negotiation was generalized by augmenting the designs of negotiation agents with additional fuzzy controllers to allow even more flexibility in negotiation. In [12], agents can both 1) raise their expectations in extremely favorable markets and 2) lower expectations in extremely unfavorable markets (i.e., relaxing their bargaining criteria). In relaxing their bargaining criteria, agents in [12] use the same set of relaxation criteria (degree of competition and eagerness) as agents in [9]. In raising their expectations, agents face two challenging decisions: 1) whether to postpone reaching consensus and 2) duration to postpone deal. In very favorable market conditions, an agent \( B_i \) may receive (\( >1 \)) proposals \( O = \{ P^1, \ldots, P^S \} \) from its opponents \( S_1, \ldots, S_o \) that are better than or equal to its own proposal \( P^B \), such that \( U(P^B) \geq U(P^S), \forall P^S \in O \). Hence, \( B_i \) may postpone its decision to reach a consensus with an opponent in the hope that it can achieve a higher utility than \( U(P^B) \). However, in multi-lateral negotiation, if \( B_i \) postpones its decision to reach a consensus, it also runs the risk of not completing the deal with any of its opponents eventually. Hence, \( B_i \)’s decision to postpone a deal depends on the number of agents \( N_o \) with a proposal that is better than or equal to its own proposal. If \( N_o \) is a sufficiently large number, then it would be advantageous for \( B_i \) to postpone its deal. However, \( B_i \) needs to determine how large \( N_o \) should be for a given market condition. For different market situations, \( N_o \) is determined by the degree of competition (\( \vartheta \)) that \( B_i \) faces and its eagerness (\( \varepsilon \)) to acquire a resource/service. If \( B_i \) is very eager to acquire an urgently needed resource or faces very strong competition, it may not postpone the deal if \( N_o \) is not much larger than 1. Both \( \vartheta \) and \( \varepsilon \) collectively form the antecedent of the fuzzy rules of an FDC (called FDC1 in [12]) for determining \( N_o \). If \( B_i \) decides to postpone its decision to reach a deal, it has to decide the duration \( T_p \) for postponing the deal. Two factors that affect \( T_p \) are the fraction of remaining trading time \( T_p=(\tau-t)/\tau \) (where \( \tau \) is the deadline and \( t \) is the current round) and \( N_o \). Both \( N_o \) and \( T_p \) collectively form the antecedent of the fuzzy rules of an FDC (called FDC2 in [12]) for determining \( T_p \).

Whereas slightly lowering expectation may increase the probability of reaching consensus in adverse market conditions, slightly raising expectation may enhance the utilities of agents in extremely good (albeit, rare) market situations. Stochastic simulations in [12] demonstrated that agents in [12] following the generalized relaxed-criteria negotiation protocol achieved 1) higher average utilities than agents in [9] following the relaxed-criteria protocol and 2) higher success rates than agents in [13-14] following alternating-offers protocol (i.e., agents that do not relax their bargaining terms nor raise their expectations).

Subsequently, the work in [9] was adapted to automated negotiation in Grid resource management. In Sim’s relaxed-criteria G-negotiation protocol [15-16], agents representing resource providers and consumers are programmed to slightly relax their bargaining criteria under intense pressure (e.g., when a consumer has a higher demand for resources) with the hope of enhancing their chance of successfully acquiring resources. A consumer agent and a provider agent are both designed with an FDC: FDC-C and FDC-P, respectively. Two different sets of relaxation criteria (for consumers and providers, respectively) that are specific to Grid resource management are used as inputs to FDC-C and FDC-P, respectively.

Two criteria that can influence a consumer agent’s decision in the amount of relaxation of bargaining terms are: 1) recent statistics in failing/succeeding in acquiring resources called failure to success ratio (\( fs_r \)) and 2) demand for computing resources called demand factor (\( df \)). If a consumer agent is less successful in acquiring resources recently to execute its set of tasks, it will be under more pressure to slightly relax its bargaining criteria with the hope of completing a deal. If a consumer agent has a greater
demand for computing resources it is more likely to be under more pressure to slightly relax its bargaining criteria. Both \( f_s \) and \( df_r \) are inputs to \( FDC-C \), and the output is \( \eta \) (the amount of relaxation) [15-16].

Two criteria that can influence a provider agent’s decision are: 1) the amount of the provider’s resource(s) being utilized (the utilization level \( (ul_t) \)) and 2) recent resource requests from consumers (the request factor \( (rf_j) \)). If more of its resources are currently being utilized or are occupied, then a provider is less likely to slightly relax its bargaining terms. If there are fewer recent demands from consumers for resources, a provider is more likely to slightly relax its bargaining criteria since it is under more pressure to lease out its idle resources. Both \( ul_t \) and \( rf_j \) are inputs to \( FDC-P \), and the output is \( \eta \) [15-16].

The fuzzy rules for \( FDC-C \) and \( FDC-P \) in [15-16] and the \( FDC \) in [9] were manually generated, and agents in [9] and [15-16] negotiate in only one market. In [17], relaxed-criteria negotiation agents were designed to negotiate in more than one e-market and with the capability to continuously enhance their performance by evolving their fuzzy rules as they negotiate in more e-markets. Like agents in [9, 15-16], agents in [17] also follow Sim’s relaxed-criteria negotiation protocol. Whereas there are two inputs to \( FDC-C \) and \( FDC-P \) in [15-16] and the \( FDC \) in [9], there are three inputs to the \( FDC \) in [17]. The three inputs corresponding to the set of relaxation-criteria are: 1) time pressure, 2) degree of competition, and 3) the relative distances from the opponents’ proposals. When an agent’s deadline is fast approaching, an agent is under more (time) pressure to relax its bargaining criteria. Hence, at the start of negotiation, an agent is less likely to overlook small differences in proposals. Like agents in [9], an agent in [17] that faces more (respectively, less) competition is more (respectively, less) likely to relax its bargaining criteria to reach an agreement. Another criterion for relaxation is the relative distances between the proposal of an agent and all the proposals of its opponents. The general idea is that if the best proposal from an agent’s opponent is very close to its own proposal relative to all other proposals from all other opponents, then it seems prudent that an agent should relax its bargaining terms and reach a consensus with the opponent with the best proposal. The impetus of the work in [17] is using an evolutionary procedure for learning effective relaxed-criteria negotiation rules that will enhance the performance of agents in terms of negotiation success rates, utility, and negotiation speed. Using the negotiation outcomes (success rates, utility, and negotiation speed) of agents in each e-market as data sets, at the termination of the negotiation process for each e-market, a \( GA \) is executed to evolve a new set of fuzzy relaxed-criteria rules of agents. The new and enhanced set of fuzzy rules will be adopted to guide agents in relaxing bargaining terms when it negotiates in a new e-market, and this process continues as agents improve their performance as they negotiate in new and different e-markets. This self-improving characteristic represents the latest state of development in relaxed-criteria negotiation.

**Concurrent and Complex Negotiation**

This section reviews complex negotiation in which agents conduct concurrent and simultaneous negotiation activities, and can potentially be freed from intermediate contracts by paying penalty fees.

Rahwan et al.’s [18] one-to-many negotiation model consists of one buyer and multiple sellers, and the buyer has a number of sub-negotiators. There are multiple negotiation threads, and in each negotiation thread, each different sub-negotiator conducts a one-to-one negotiation with a different seller. Four strategies were proposed in [18] for controlling and coordinating multiple simultaneous one-to-one negotiations: 1) Desperate Coordination Strategy (DCS), 2) Patient Coordination Strategy (PCS), 3) Optimized Patient Coordination Strategy (OPCS), and 4) Strategy Manipulation Coordination Strategy (SMCS). In DCS, the coordinator agent terminates all negotiations once any negotiation thread reaches an agreement. In PCS, the coordinator agent waits until all sub-negotiators have completed negotiation, then chooses the best offer. In OPCS, the coordinator uses the negotiation outcome from a negotiation thread to influence the performance of other negotiation threads. For example (see [18, p. 201]), if one sub-negotiation found a deal with utility 7, then in other negotiation threads, any offers with utility lower than 7 will be considered unacceptable. In SMCS, the coordinator may modify the negotiation strategies of different negotiation threads at runtime. For instance, if a deal has been secured in one negotiation thread, the consumer can adopt a “take-it-or-leave-it” strategy in other negotiation threads [18, p. 201].

Nguyen et al. [19] also proposed a one-to-many negotiation model consisting of multiple concurrent one-to-one negotiations. Unlike agents in [18], agents in [19] adopt the time-dependent concession-making strategies in [7]: 1) Conceder (quickly conceding to its reservation value), 2) linear strategy conceding to its reservation value, and 3) Boulevard (maintaining its value until the deadline is almost reached, then rapidly conceding to its reservation value). [19] introduced more flexibility to their concurrent one-to-one negotiation model by allowing buyer and seller agents to renege on deals (i.e., decommit deals) at the expense of paying penalty fees. Whereas [10] proposed leveled
commitment contracts for a two-player game, [19] extended the work in [10] to concurrent negotiation involving one buyer and many sellers, and included two additional features: 1) reasoning about when to decommit from a contract and 2) determining whether a new contract is acceptable by considering decommitment thresholds. In [19], the penalty fee is dynamically computed as a percentage of the utility of the deal and the time when the contract is broken. A new contract is acceptable if the utility gained by taking the new contract is greater than that of the current contract after paying the penalty fee for decommitment, and the degree of acceptance is above a predefined threshold \( \theta \) that specifies the extent that a buyer agent should accept proposals. A buyer agent in [19] adopts either of the two commitment management strategies: greedy \((\theta=0)\) (tends to accept any possible deal) or patient \((\theta = 0.5)\) (only deals that provide a certain expected utility value will be accepted). Additionally, there are two types of provider agents in [19]: loyal providers that will never renege on contracts and partial providers that will possibly renege on contracts.

Sim et al. [11] proposed a concurrent negotiation model consisting of multiple one-to-many negotiations. Designed for bolstering Grid resource co-allocation, the concurrent negotiation model consists of a coordinator which coordinates the parallel negotiation activities for acquiring \( n \) different types of Grid resources in \( n \) different resource markets. In each resource market, a consumer agent negotiates simultaneously with multiple resource provider agents for one type of Grid resource. Furthermore, both consumer and provider agents can be freed from a contract by paying penalty fees to their opponents. In negotiating for one type of Grid resource in a resource market, there is a commitment manager that manages both commitments and decommitments of (intermediate) contracts. In [11], three classes of commitment management strategies (CMSs): {Linear-CMS, Conciliatory-CMS, and Conservative-CMS} were defined by combining the commitment management steps with the time-dependent concession making functions in [6]: 1) conservative (maintaining the initial price until an agent’s deadline is almost reached), 2) conciliatory (conceding rapidly to the reserve price), and 3) linear (conceding linearly). In [20], Sim et al. adopted an Adaptive-CMS in which the commitment management steps were combined with an adaptive concession making strategy. An agent’s adaptive concession making strategy in [20] is derived from its current bargaining position in a resource market. For instance, a consumer agent is in an advantageous (respectively, a disadvantageous) bargaining position if it is negotiating in a resource market with more (respectively, fewer) provider agents. The coordinator can coordinate the parallel negotiation activities in \( n \) resource markets using: 1) the Utility-oriented Coordination Strategy (UOCS) and 2) the Patient Coordination Strategy (PCS). In the UOCS, at each negotiation round, the coordinator determines whether to terminate the entire concurrent negotiation based on the predicted utility changes received from every commitment manager for each one-to-many negotiation. In the PCS, the coordinator terminates all concurrent negotiations when it acquires all required resources without considering time constraint. In [20], the prediction in the change of utilities in the UOCS was enhanced using linear regression (the Regression-based Utility-oriented Coordination Strategy (RUOCS)). Favorable empirical results in [20] show that agents adopting the RUOCS achieved the highest final utilities among the three coordination strategies (RUOCS, UOCS, and PCS).

Conclusion and New Directions

This paper has discussed the differences between conventional negotiation and unconventional negotiation and summarized the state-of-the-art developments in both relaxed-criteria negotiation, and complex and concurrent negotiation.

Whereas game-theoretic research [2-4] provides solution concepts for optimizing agents’ utilities in simpler negotiation settings (e.g., one-to-one negotiation), relaxed-criteria negotiation offers a novel approach in solving much more complex negotiation problems using heuristics to improve success rates and negotiation speed. Whereas researchers in game theory [2-4] provided solution concepts for determining equilibrium strategies for negotiation, they did not provide techniques for computing and finding these equilibrium strategies, and [21] has shown that finding the equilibrium strategies is NP-hard even in a simple one-to-one negotiation setting. Through empirical studies, relaxed-criteria negotiation aims at providing an alternative means for studying the behaviors of negotiation agents in complex environments.

In conventional negotiation, participants negotiate in the same market (i.e., within one market). In concurrent negotiation, a participant conducts simultaneous and parallel negotiation activities with resource providers in multiple e-markets to acquire multiple types of resources. Furthermore, in complex negotiation, both buyers and sellers can renegotiate on (intermediate) contracts by paying penalty fees. In conventional negotiation, agents negotiate only in one e-market for one product/service, and the attributes that may complicate the design of negotiation mechanisms include: 1) the number of negotiation participants and 2) the number of issues involved in negotiation. In complex negotiation involving decommitments and parallel negotiation activities in multiple e-markets, there are two
additional attributes that contribute to the complexity in concurrent negotiation: 1) the number of e-markets that an agent is involved in and 2) the number of times that contracts are breached before negotiation terminates.

New direction: The increasing demand for building large-scale complex and distributed systems such as Cloud/Grid computing systems accentuates the need for complex negotiation mechanisms for managing computing resources. Supporting resource co-allocation is essential for Grid computing because 1) computationally intensive applications often require more resources than a single computing machine can provide, and 2) an application may require multiple types of computing capabilities from different resource owners [22]. Successfully obtaining contracts from multiple resource owners for simultaneously accessing several resources is a very challenging task given that stakeholders often have different requirements. Allocating multiple resources in a coordinated fashion across virtual organizational boundaries is also a very difficult problem (e.g., mapping application workflows consisting of interacting components that need to be executed in a certain partial order to Grid resources is an NP complete problem [23]). One way of solving such a hard problem is to use heuristic approaches (e.g., relaxed-criteria negotiation). This paper suggests that a relaxed-criteria concurrent negotiation mechanism may be an appropriate tool for facilitating Grid resource co-allocation. In a relaxed-criteria concurrent negotiation mechanism, 1) agents in a Grid resource market follow a relaxed-criteria negotiation protocol, and perhaps adopt a set of criteria in [15-16] (i.e., failure to success ratio, demand factor, utilization level, and request factor), for relaxing bargaining terms, and 2) coordination of the parallel negotiation activities may be achieved by adopting one of the three coordination strategies in [11, 20] (RUOCS, UOCS, and PCS).

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References


A MODEL OF E-BANKING APPLICATIONS EVOLUTION ISSUES

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Abstract
As a specific case of E-Commerce, E-Banking is a typical service combining a communication and a distribution channel. E-Banking applications have continuously evolved over the time, from their appearance in a context of innovation in the banking sector to the relative standardisation and convergence of current state. Several players in the banking sector were studied in order to learn specifics of client segments and implementation of requirements. This paper presents a simple model for the core issues of the evolution in E-Commerce applications. The research target is to extrapolate a framework from E-Banking case studies to understand the main business drivers over web-based applications evolution and change management.

Keywords: E-Commerce Applications Evolution, E-Banking, IT Alignment

Introduction
E-Banking developed and evolved rapidly during the last ten years. IT innovations like web-commerce and secure information exchanges have been a triggering factor for E-Banking appearance. E-Banking functionality is also evolving continuously, driven by the necessity to cover new clients’ needs and to procure more integration between electronically available banking services. The evolution of demand in online services induces a continuous evolution of the underlying E-Banking applications. This pressure to evolve raises a number of interesting questions not only to developers and maintainers but also to executive managers, some of these issues can easily be extrapolated to other web-based e-commerce applications and change management.

Scope of Research and Related Work
From the most general point of view, the evolution of E-Banking applications falls within the domain of software evolution. We use two criteria to specify the scope of our research within the common evolution of software: the type of application and its application domain. The choice of E-Banking applications was influenced by the following factors: web applications’ evolution is not trivial and less studied, E-Banking applications are evolving continuously.

The close standing domains of E-Banking applications’ evolution are: software evolution, web applications’ evolution, E-Banking. In this paper, we mention some but not all of the existing publications covering these topics.

Lehman [7], Cook [3] and Ciraci [2] brought meaningful contribution to the domain of software evolution. But being focused on the “traditional” and desktop applications, none of these works consider the E-Commerce applications’ evolution. Among other efforts to support the web applications’ evolution, we can mention the following publications:Giuseppe and al. [5] try to put forward an approach for supporting web applications’ evolution by reverse engineering analyses of the existing web applications with limited documentation. Daniel and al. [4] use active rules for automatic evolution of adaptive web applications. Bebjak and al. [1] in order to reduce costs and increase the speed, are proposing an approach for web applications’ evolution using aspect-oriented design patterns.Hong and al. [6] in their publication discuss users’ feedback and a requirements management system that must help to support the financial portal evolution. They agree with the fact of the importance and complexity of corporate financial portal evolution, and underline the iterative and contentious character of the evolution. The key incentive of evolution for them is feedback or a change proposal coming from the end user. Wu and al. [15] are talking about core capabilities necessary for E-Banking. While mentioning “planning a new IT infrastructure” and “delivering differentiated services” among eight core capabilities, they don’t clearly distinguish a capability to conduct applications’ evolution easily. Shah [9] investigates the factors that are critical to the success of E-Banking. Like the previous authors, while talking about “system integration” and “organisational flexibility”, researchers don’t focus on applications’ evolution.
In this paper we focus on the evolution of E-Banking applications as it is perceived by the users through the user interface and as it is driven by the continuous change in offered services.

We based our research partially on the results of related works, but neither of them talks about the phenomenon of evolution in E-Banking application. That is why in the next paragraph we give a definition of E-Banking applications’ evolution as we see it.

E-Banking
E-Banking or Electronic Banking is an externalisation of front-office processes and bank services towards clients using information technologies. E-Banking is a virtual front office (counter) with no human actors on the Bank side participating in the interaction. Using a standard web browser, a client can be in contact with his bank from anywhere. This makes access to the E-Banking channel universal, as is the case with any other E-commerce service. E-Banking in contrast to the traditional banking provides a service with a new quality and features. The banker is replaced by a piece of software. There are cases where the bank has no physical counter at all, only virtual ones. All interaction with customers is done through a website, supported by a telephone hot line. This is the case of Swissquote - a Swiss bank that is purely electronic [13].

E-Banking Evolution
We consider E-Banking applications’ evolution as a process, progressively changing functionalities of the underlying applications throughout time. Evolution has a continuous character. In contrast to a purely versioning process with difficult migration steps, an evolving application passes smoothly from one state to another. At each new state, the application either offers new functionalities or existing parts of it are enhanced. The complex character of E-Banking applications’ architecture, organisational structure and technical infrastructure, makes E-Banking evolution highly complex. That is why multiple issues can be associated with this phenomenon.

In figure 1 below, we give an example of the trade-off between business needs and specific requirements, requirements implementation and requirements’ evolution.

Figure 1. Requirements Implementation
Specified by business and realized, a requirement Req. 1 satisfies only a part of what business may need. To be developed this requirement needs some components c1, c2, c3. Some of these components exist; some of them are to be developed. After some time, a new business requirement Req.2, very close to the previous one, may appear. In other words, Req.1 evolves to Req.2, which uses some common components and covers partially the same business needs. The matrix components/requirements are highly useful for the management of requirements’ evolution and required components. The time needed to align an application to new requirements is typically 6 to 12 months [14].

As a specific example, we present here a sequence of evolution in E-Banking application for private clients of a Geneva private bank for the period from 1999 to 2007 [12].

Figure 2. A Geneva private banking functionality evolution

We mentioned that functionality was evolving continuously in order to support core banking activities. This example shows not only the need for evolution during the last ten years, but what is also highly important, the need for further evolution in the nearest future.

Research Methodology
We used interviews of e-banking experts as a starting point for our research. The main data were collected through series of interviews with different actors coming from various financial institutions. The target group for our research included: traditional private bank, universal bank, insurance company, consulting company and software development company. The last two actors deal as external providers of IT services and products for financial institutions such as banks and investment funds. The specifics of the financial sector – highly reserved character of the IT security policy, due to confidentiality issues - make quantitative research almost impractical: e-banking applications managers consider this subject as too sensible strategically to accept answering general surveys. That is why a first round of interviewed actors was limited to the companies mentioned
above. Then we applied content analyses to interviews results. The way the research was carried out can be depicted by the following figure:

Figure 3. Overall methodology

A number of hypotheses coming from the study of the related work, the knowledge of the E-Banking applications lifecycle and our intuition were formulated:

- H1: E-Banking applications evolve continuously rather than by very different versions,
- H2: this evolution is complex and has a multi-dimensional character,
- H3: applications evolution is directly driven by business evolution.

In order to test these hypotheses a questionnaire was created. It contained about forty questions concerning different evolution issues. Next, this questionnaire was used as a guideline for conducting the interviews with the number of financial sectors’ actors. The results of the interviews were systematized and then analysed according to content analyses methodology [8]. We can classify our research methodology as being mostly "interpretation-centric". Various data was gathered including facts, negotiated meanings by subjects/researchers and subjective understanding [10]. The answers to closed questions received during each interview confirmed the existence and importance of an issue. Then, we drew more detailed conclusions from the answers of the opened questions. In order to retrieve and group the issues, we considered the significance and the concerns interviewees given to each of them. Finally, we draw a set of major issues associated with evolution of E-Banking applications from this analysis. In fact, the results of interviews confirm the hypotheses formulated at the beginning. As we mentioned above, we based partially our hypotheses on the results of the related works, but neither of them talks about phenomenon of E-Banking applications evolution. We made the first attempt to consolidate the issues in a more detailed manner (see the next section). The consolidation of the issues is necessary in order to receive an adequate tool, [16] proceed to obtain their matrix of factors in fairly similar manner.

A simple model of E-Banking evolution issues

The purpose of the next stage of our research was to organize issues into three groups, by main research hypotheses. At the current stage of our research we try to identify the specifics of the influence of each group on E-Banking applications’ evolution. In figure 3, we present a simple model structuring issues by their groups. The structuring of issues in this way is a first step towards a fully detailed model of E-Commerce applications’ evolution issues.

Figure 4. Influence of different issue groups on application evolution

Issues belonging to different groups influence application evolution in different ways. The issues of the first group H1 stipulate that the evolution phenomenon has a continuous character. The issues of group H2 either facilitate the evolution or complicate it. The issues of the last group serve as a powerful engine of evolution and stimulate it.

Group 1 implies that E-Banking applications must be aligned with bank business strategy. Bank business strategy needs to be updated and rectified in order to respond to a constantly changing business environment. This changing business environment makes E-Banking application’ evolution almost never-ending.

Group 2 includes facts such as that E-Banking applications’ evolution is complicated and expensive; it is conducted by different actors, it depends on bank organisational structure and IT architecture. We collected evidence that better organisational, methodological approaches and technical tools can facilitate evolution considerably.

Group 3 comprises the main drivers of E-Banking applications’ evolution. The satisfaction of clients’ needs and the evolution of bank business models are amongst the most important incentives. The entrance of a bank into the new market or change in local regulations may lead to E-Banking applications’ evolution as well.
Finally we stipulate that the ability of a bank to support evolution of applications is one of its core capabilities.

Conclusions
First, we identified issues associated with E-Banking applications’ evolution. Some of the identified issues are valid for other close standing domains; some of them are specific for E-Banking applications’ evolution. We made the first attempt to consolidate the issues in a more detailed manner. The next step will be the elaboration of the model, which can be used for evaluation of: the extent of the exposure of some application to evolution, the easiness/impediment of the evolution process implementation. After this, we plan to test the elaborated model, by applying it to the evolution processes of some real life complex E-Banking example. Finally, the model may be complementary to such existing methodologies and frameworks as ITIL or COBIT.

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References
FOREFRONT OFFICE IN SERVICE SYSTEMS: CONCEPT AND DESIGN

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Abstract
Conventionally, service systems have been considered to comprise two main offices: the front office and the back office. However, a new managerial office is needed to relate customers with technology as technology-based services play a critical role for customers prior to two main offices. Nevertheless, there is no attention to management of this new area. In this sense, this paper suggests a novel concept of the “forefront office” as the new area to represent service activities. The forefront office is defined as a service facility which allows customers to be provided with services by themselves using technology-based services prior to the front office. For design of the proposed forefront office, a modified service blueprint is proposed. Following on the design structure of the forefront office, three topologies of the forefront office are also proposed based on the modified service blueprint. The forefront office is expected to reduce labour costs and improve customer satisfaction in terms of mass customization.

Keywords: Forefront Office, Technology-based Services, Topologies, Modified Service Blueprint, Service System Design

Introduction
Service system design has been considered as an important task in service management [1] [2]. In service systems, importance of a customers’ role has been increased since customers take an active role as a coproducer or partial employee [3] [4] [5] [6]. Conventionally, the service systems have been recognized to comprise two main offices based on the degree of customer contact with service providers: the front office and the back office [7] [8]. As technology has enhanced service systems, however, service systems are no more treated as the two offices. This is especially true of technology-based services which are service activities between customers and technology to provide services efficiently in service systems [9] [10]. Conventional offices have limitations to represent these activities. Service companies’ efforts to integrate technology-based services into service systems are increasingly high in the practical fields due to social, operational, and economic issues [11] [12] [13]. As numerous studies have proved the positive performance of technology-based services for customers [12] [13] [14] [15], technology-based services play an important role to support processes for customers prior to interaction with service providers in the front office. Technology-based services have enabled customers to be provided with services by themselves ahead of the front office [11] [16]. In other words, this allows the delivery of services regardless of contact with service providers in the front office. It indicates that they help customers to be provided with services in a “fore” area of the front office regardless of service providers. Nevertheless, there is no consideration about this new area to design and manage technical support for customer actions ahead of the front office. So far, most studies on design of service systems have simply recognized this fore area to be parts of service activities rather than an essential area in service systems [17] [18]. Therefore, the study on an additional office remains as a void for holistic service systems.

In this sense, this research aims to suggest a novel concept of the “forefront office” in service systems to fill up the void. Prior to the outset of further research, the forefront office should be clearly defined. The forefront office is a fore service facility of the front office which enables the customers to deliver their required services by themselves regardless of interaction with service providers in the front office. Consequently, adding the forefront office is helpful to management of relationships between customers and technology in detail.

For management of the forefront office in service systems, it should be designed systematically. As means for design of the forefront office, a modified service blueprint is suggested in this paper. The service blueprint has been graphically useful and understandable [19] [20] [21]. Unlike previous research on the service system design, however, two main reasons the service blueprint cannot be a tool as design of the forefront office occurs. First, it views the customer actions as activities between customers and service providers whereas the forefront office focuses on customer actions as the new office which aims to represent interaction between customers and
technology. Second, it is difficult to draw different relationships between the forefront office and another office. Therefore, service blueprint will be modified by adding new layers and lines. It is expected to capture holistic service systems with the forefront office.

More importantly, it should be noted that the forefront office can have different characteristics and structures according to types of relationships between customers and technology. In this regard, this paper also shows topological types of the forefront office for identification of each characteristic and management of relationships. The topology can be useful for visual design of whole relationships easier to understand.

The remaining part of this study consists of four main sections: concept of the forefront office, design of the forefront office, topologies of the forefront office, and conclusion and future research. Firstly, following on from a literature review, the concept of the forefront office is introduced in service systems. Secondly, this paper focuses on designing the forefront office using the proposed service systems. Secondly, several topologies of the forefront office are suggested based on the modified service blueprint. Also, this paper ends with conclusion and proposes future research.

**Concept of the Forefront Office**

**Past Research on Service Systems**

In general, three approaches to the service system design are considered [2]: a production-line approach, a customer as a coproducer approach, and a customer-contact approach. With these approaches, service systems are divided into the front office with high-contact operation and the back office with low-contact operation [7] [8].

Firstly, the production-line approach attempts to translate a successful manufacturing concept into the service sector. It gains a competitive advantage with standardization of repeated services in a controlled system to ensure consistency and efficiency. For the successful production-line approach, service systems are designed through the division of labour, the substitution of technology for people, and the service standardization [2] [22].

Secondly, the customer as a coproducer approach encourages active customer participation in the service process [3] [4] [5] [20]. This approach also enhances the competitive advantages of cost leadership by reduction of labour costs. For example, as customers are involved in service systems by self-services, customer participation increases the degree of customization.

Finally, the customer-contact approach refers service systems to the perspective of both approaches to justify different customers’ requirements and maximize the efficiency. According to a customer contact approach, the service systems are separated into high- and low-contact customer operation [7] [23]. The low-contact operation, which is also called as the back office, is run as manufacturing to increase efficiency. In this regard, the production-line approach is usually organized in the back office. In contrast, the high-contact operation, which is also defined as the front office, is based on customers as coproducers to achieve customization. Meanwhile, a concept of “mid-office” proposed to investigate a linkage as a platform between the front office and the back office in the financial institutions. The purpose of the mid-office is to operate different kinds of back offices [24].

Recently, performance of service systems have been enhanced as technology is being evolved towards a support to customer actions [12] [16] [25]. In addition, the characteristics of service systems have been changed since customers directly operated technology-based services in various service fields [2] [12] [15]. It allows customers to be provided with services regardless of contact with service providers. Customers can deliver services by themselves ahead of the front office. It is supporting the need to design a new service office based on customers and technology.

**Impact of Technology-based Services on Service Systems**

As impact of advances in technology on service systems are increasingly high, a number of studies are conducted concerning classification of technology-based services for how to relate technology with customers and servers [2] [9] [10]. In practice, five types of technology-based services were suggested in terms of relationships among customers, service providers, and technology as shown in Figure 1 [9] [10].

Technology-free services have no relationships with technology as shown in Figure 1. In this case, technology does not play a direct role and customers have direct interaction with service providers. Most professional services such as law and consulting are involved in this type. Based on technology-free services, technology-assisted services have one more relationship between technology and service providers as shown in Figure 1(b). This provides the support systems or tools for service providers to deliver services efficiently. In technology–assisted services, technology is incorporated to streamline service processes by supporting the service providers. This mode has usually worked in the back office.

However, Figure 1(c), 1(d), and 1(e) have been developed as the interface to deliver services
for customers. The most significant distinction is the relationships between customers and technology compared to Figure 1(a) and 1(b). The virtual service area can be emerged from these relationships such as call centers and web sites. Technology-facilitated services relate customers with service providers by access to the technology. For example, the service provider shows seats available on a video monitor in a theatre. In contrast, technology-mediated services have no direct relationships between customers and service providers. The reservation system through call centers is one of the popular cases for this type. Finally, technology-generated services are characterized by direct relationships between customers and technology. In this case, the service providers are totally replaced with technology that allows customers to deliver services by themselves.

In summary, technology-based services are a support entity for either service providers or customers. However, it should be noted that this study is to design the forefront office to represent direct interaction between customers and technology. Therefore, the scope of this study includes the technology-based services which are related with customers, Figure 1(c), 1(d), and 1(e).

 Proposed Concept: the Forefront Office
As reviewed above, the front office is the service facility which is designed from the customer’s perspective due to the high degree of customer contact. In the front office, service providers have tried to satisfy various customer needs based on back office to improve the efficiency and assist the service providers’ work [7] [8]. Recently, however, technology also plays important roles for customer actions ahead of the front office.

Since technology has changed characteristics of service systems for customers, technology-based services are becoming one of the most challenging issues. Technology-based services can facilitate and mediate service activities between customers and service providers for both efficiency and customer satisfaction concurrently [12] [15] [16] [25]. Moreover, they allow the customers to self-serve as the producer, not the coproducer [2] [12]. It indicates that customers can be provided with their required services ahead of interaction with service providers.

In this sense, this paper suggests the forefront office which focuses on relationships between customers and technology ahead of the front office. Compared to the conventional two main offices, the forefront office has distinct characteristics in terms of the degree of customer contact, actors, strategy, purpose, and service areas, as summarized in Table 1. The forefront office can be used to substitute technology for service providers and assist directly customer actions using technology. Fundamentally, actors in the forefront office are the customers who operate technology-based services by themselves. Accordingly, although the degree of contact is high, technology-based services supports low costs and high customer satisfaction since the customers are less or not dependent on service providers. They can also satisfy various requirements of customers with provision and delivery of customized services. It indicates that the forefront office can achieve improvement of both efficiency and customer satisfaction in terms of mass customization. Consequently, the forefront office is defined as the service area ahead of the front office where customers provide and deliver

Figure 1.
Types of technology-based services: (a) technology-free services, (b) technology-assisted services, (c) technology-facilitated services, (d) technology-mediated services, and (e) technology-generated
services regardless of service providers in order to take full advantage of both the back office and the forefront office.

Table 1.
Comparison of the forefront office between main offices in service systems

<table>
<thead>
<tr>
<th></th>
<th>Back office</th>
<th>Front office</th>
<th>Forefront office</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degree of customer contact</td>
<td>Low</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Actor</td>
<td>Service employees</td>
<td>Service employees, customers</td>
<td>Customers</td>
</tr>
<tr>
<td>Strategy</td>
<td>Standardization</td>
<td>Customization</td>
<td>Mass customization</td>
</tr>
<tr>
<td>Purpose</td>
<td>Efficiency</td>
<td>Customer satisfaction</td>
<td>Efficiency, customer satisfaction</td>
</tr>
</tbody>
</table>

Design of the Forefront Office

Conventional Design Tool: Service Blueprint

For strategic development and management of service systems, the service blueprint is one of the most useful and widely used methods. The service blueprint was initially developed to visualize service systems by Shostack [19] [21] and since then, extended further by Kingman-Brundage [26] who called the service blueprint as the service logic map. The service blueprint is defined as “a picture or map that accurately portrays the service systems so that the different people involved in providing it can understand and deal with it objectively.” [18] It has been utilized in many service industries such as a hotel, hospital, and airport industry for different purposes: process design, visualization, and diagnosis of service failures [1] [19] [21] [26]. Most cases have investigated service activities which relate the customers and service providers, and manage possible service failures during service processes.

The service blueprint consists of two dimensions. On the one hand, the horizontal axis takes account of activities and relationships during the service processes. It represents how service providers interact with customers for management of service systems. On the other hand, the vertical axis comprises five areas of actions: physical evidence, customer actions, service employees’ actions in onstage, service employees’ actions in backstage, and support processes for service providers. The lines which separate the areas of actions are identified for interaction of service processes between areas. The line of visibility especially divides service systems with the front office and the back office as shown in Figure 2.

As a further study of the service blueprint, the service logic map was also proposed [26]. This design tool considered customers’, employees’, and technical logics of services in order to suggest the integrated system of service logic. In the perspectives of the service logic map, the bottom of the service blueprint was divided into the support zone and the management zone. Planning, managing, and controlling activities are described to supervise the service processes in the management zone. In general, technology-assisted services can be used in the support processes to control service processes for service providers efficiently and effectively. As a result, the service logic map has advantages on the design of the back office in detail for satisfying customers’ needs.

However, the design of the relationships between customers and technology for technology-based services still remains as a remarkable issue in order to structure and visualize more actual integrated service system. As reviewed above, none of the previously developed methods suffice the characteristics of the forefront office, further supporting the need to design a new design tool.

Proposed Design Tool: Modified Service Blueprint

Taking the issues faced through the previous service blueprint into consideration, the service blueprint for the forefront office is modified as shown in Figure 3. Compared to the conventional service blueprint, the modified service blueprint has two significant changes.

Firstly, forestage support processes is added on the front office. The forestage more focuses on the technology-based services with respect to customer actions regardless of service providers ahead of the front office. This change is helpful to representation for relationships between customers and technology. Also, it takes account of the relationships with another stage in holistic service
systems as the interface. Secondly, two line of interaction are employed by as a result of the first change: the line of physical interaction and the line of human interaction. The line of interaction in the conventional service blueprint is divided into the physical interaction and the human interaction to represent customer–technology and customer–service providers relationships from the first change, respectively. These lines are provided to identify and portray the relationships among customers, technology, and service providers more specifically in the forefront office.

In summary, the forefront office consists of two areas, the forestage support processes and the customer actions. It also contains two interaction lines between the layers and the areas. These changes allow the holistic design of integrated service systems. In the next step, it is used for classification of the forefront office topologically linking customers with technology-based services and service providers.

**Topologies of the Forefront Office**

In this section, three types of the forefront office will be suggested with further attention to topological design for management of service systems. Overall, design of the forefront office is following on the forestage support processes and two lines of interaction. Based on the forestage support processes, the three topologies can be identified with different connections between the forefront office and another office using the modified service blueprint. Also, topologies indicate how customers interact with technology and service providers in terms of two line of interaction. It visually represents the service activities and relationships with the forefront office in an initial phase of service system design.

**Incorporating the Forefront Office into Modified Service Blueprint**

Figure 4 shows three topological structures of service systems regarding the forefront office: the forefront-to-front topology, the forefront-to-back topology, and the forefront-only topology. The topology visualizes how to relate the forefront office with another layers or offices. Moreover, it provides valuable information for building service systems with technology-based services. In the figure, a circle stands for the technology and a square means a service entity. Also, an arrow represents processes in service systems.

Firstly, the forefront-to-front topology is suggested to connect the forefront office with front
office as shown in Figure 4(a). This topology aims to assist service providers through connection with customers ahead of the front office. It is used to facilitate service delivery in case parts of service activities are delivered from service providers due to the security or difficulty in use. In the forestage, customers are provided with services by themselves which are delivered from service providers in the front office. Secondly, the forefront-to-back topology is proposed to link the forefront office to the back office as shown in Figure 4(b). It is still quite similar with Figure 4(a), but there is no direct contact with customers adopting technology. Therefore, this topology seeks to mediate service activities between customers in the forefront office and service providers in the back office without direct interaction. It is used to overcome the spatial limitation, and thus, it saves labour costs and transaction time. Finally, the forefront-only topology indicates that the customers and technology are strongly coupled as shown in Figure 4(c). This topology is designed for enabling customers to be provided with services by themselves in any situation. Using this topology, the forefront office can reduce labour costs and increase customer satisfaction.

Each topology can provide a useful guidance to picture three types of forefront office in terms of advantages and disadvantages of technology-based services. The topology plays a critical role to design service systems in developing the successful service systems. A service manager can design or redesign their service systems with different purposes such as the facilitator, mediator, or generator. This implies that topologies are significant in that it encourages effective decision making in adoption of relevant service systems, and ultimately it considers improvement of both efficiency and customer satisfaction.

**Conclusion and Future Research**

Although interest in technology-based services for customers is increasing, yet, systematic design of the service office for relationships between customers and technology still has not been fully suggested. Therefore, this research suggested the forefront office in service systems. It defines a forefront office of the front office with technology-based services. Also, the modified service blueprint was also proposed to design the forefront office with the forestage support processes. This is not only to provide detail information visually, but also to design service systems easier to understand. Based on the modified service blueprint, three topologies of the forefront office are developed for the service manager to provide the useful guidance. According to topologies, service managers can obtain an insight to design appropriate service systems regarding interdependent relationships.

Through this research, two major contributions can be found. Above all, concept of the forefront office is firstly suggested in this paper. The area which represents relationships between customers and technology has not been considered in the previous research although customers play a critical role to provide services with technology. In this regard, this paper proposed the necessity and characteristics of forefront office in service systems. Consequently, this allows a service manager to fill up the void for holistic design of service systems including the front and back offices. Next, topologies of the forefront office can be used to manage service systems with different purposes. The topology provides useful information for a service manager to design or redesign service systems with respect to resources and infrastructures. According to each topology, service systems have different performance in terms of efficiency and customer satisfaction.

Despite critical contribution, this study has also two limitations which should be overcome in the future research. First, as the degree of technology integration is higher, service failure can be increased. Therefore, evaluating the forefront office should be conducted for validation. Although this paper claimed that the forefront office improves the efficiency and the customer satisfaction in terms of mass customization, the performance has not been identified regarding the service failure. Second, a selection of the most appropriate topological design should be considered by as a result of the first limitation.

With these limitations, the case study is being currently carried out for evaluating performance of the forefront office and selecting the most appropriate topology. In order to verify usefulness of the forefront office, the simulation will be attempted as the future research.

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**References**


IDEA DIAMOND: A SYSTEMATIC INNOVATION MODEL FOR SOCIAL NETWORK SERVICES

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Abstract
Social network service (SNS) – the web-based interaction tool introduced in late 20th century – has become increasingly popular in modern life. The SNS providers’ capability of launching a ‘killer application’, i.e., an attractive interface that motivates user engagement and stickiness, plays a crucial role in surviving the keen competition in the SNS market, and the development of such a service requires rapid and continuous innovation practice. This study proposes an IDEA Diamond model that aims to help SNS providers effectively develop (through a well-defined process and systemized methods/tools) new services that can meet user needs and deliver exceptional user experience.

Keywords: social network service (SNS), new service development (NSD), service engineering, service experience engineering (SEE), service innovation, killer application, user experience

Introduction
SNS is a web-based service via which users can manage their social network by selectively revealing their own profile and viewing others’ despite time or space limitations. Since the inception of BBS (bulletin board system, the earliest recognizable SNS) in the 1980s, prominent SNSs such as Wretch (Taiwan/1999), Cyworld (Korea/2001), Skyblog (French/2002), Facebook (USA/2003), Mixi (Japan/2004), Twitter (USA/2006) and Kai-Xin (China/2008) have arrived sequentially to buttress the sensational utilization of social network websites around the world. SNS allows users the freedom to ‘articulate and make visible social networks’ [1], which reinforces users’ sense of connection with other friends and thus their loyalty to the service.

Many SNS providers are seeking a ‘killer application’ that effectively boosts user volume, but no SNS provider can guarantee which application would ‘kill’ and how to make it happen. A question is therefore raised: Is there a systematic service innovation methodology that SNS providers can adopt to better understand what users want and, hence, engender the most desired ‘killer application’?

Available literature on service innovation contains new service development (NSD), service engineering, and service experience engineering (SEE). NSD aims to, based on a deep understanding of customer needs, offer customer-centric, quality services via a predefined set of activities that moves the project from the idea stage to final launch [2-15].

Although a large amount of NSD research has been accumulated, many service firms still lack strategic focuses, development competencies and appropriate organizational structures for service innovation in practice [15-18]. German scholars, deeming NSD purely marketing-oriented and unable to provide concrete methods/tools for implementation, coined a technical-methodological approach – service engineering. Service engineering borrows existing engineering know-how from traditional product development in the manufacturing sector to offer predefined guidelines, clarified order of activities, rigidity and situation-specific flexibility that help boost service development efficiency [19].

Most service engineering research results are kept in the database of the German industrial design institute Fraunhofer IAO, whose research activities focus on 1) planning a strategy aligned to the competitive environment and the market, 2) organizing future-oriented technology deployment structures, and 3) identifying advanced ICT systems suitable for companies in industry and the service sector [20]. A ServLab was founded in 2006 to offer multi-faceted solutions for industrial upgrades from ‘High-Tech’ (generic product development) to ‘High-Touch’ (integration of ‘soft factors’ such as human resources and customer interaction in service development). Figure 1 exhibits the service engineering process at Fraunhofer IAO.
Another reputable service innovation institute is the American global design/innovation consultancy IDEO. Founded in 1991 by David Kelley, IDEO has helped numerous companies deliver memorable user experiences and refine the experience delivery system via its design thinking (Figure 2) approach, which ‘uses the designer’s sensibility and methods for problem solving to meet people’s needs in a technologically feasible and commercially viable way’ [21].

To further enhance the mechanism of service development, the Institute for Information Industries in Taiwan incorporated Fraunhofer IAO’s service engineering technique with IDEO’s user experience analysis to construct a systematic service innovation methodology – the service experience engineering (SEE).

SEE divides service innovation process into three phases: 1) FIND, 2) InnoNet, and 3) Design Lab (Figure 3), with an ultimate goal of creating memorable service experience for users. Pine and Gilmore (1998) state that experiences represent the next step in the evolution of economy [22]. Design of experience involves a considerable amount of user interaction. SEE, hence, provides solid methods/tools for service providers to explore user concerns and improve the service itself and the service delivery system accordingly.

SEE can be considered the most full-fledged service innovation model for the moment, but its enormous architecture may cause implementation difficulty for practical users. In addition, available SEE-related documents neither give instruction on the methods/tools utilization nor categorize them by situation-specificity. Additional effort is required to translate the SEE framework into a more user-friendly action plan.

To overcome the insufficiencies of current service development models, a more inter-disciplinary, comprehensive and practical methodology must be built to help SNS providers boost innovation success rate. This need triggered the formulation of a new service innovation framework – the IDEA Diamond.

This qualitative study examines the IDEA Diamond’s feasibility in helping SNS providers deliver a ‘killer application’ and identifies variables (e.g., drivers, constraints, obstacles) that would affect the effectiveness and consequence of IDEA Diamond implementation. Approaches that optimize the IDEA Diamond’s value-add will also be sought. The IDEA Diamond was implemented with an established SNS provider on a trial basis and the process was documented as a case study.

**IDEA Diamond**

The IDEA Diamond consists of four stages – Investigation, Decision-making, Execution and Assessment (the name IDEA is the acronym of these four stages). User feedback collected in the final (Assessment) stage may identify more unmet market demand, spot new business opportunities and thus initiate another cycle of service innovation. Therefore the conceptual framework is represented with a diamond shape (Figure 4). The heart of the diamond is a theme that guides the entire service development process. It can be perceived as a motif on top of which the composition of a new service is built, or a mission statement that leads the innovation activities toward a singular goal without deviation. The execution of IDEA Diamond could be an iterative instead of a linear process despite its predefined order: Investigation → Decision-making → Execution → Assessment.

The concept of ‘diamond’ is inspired by Porter’s Diamond Model (1990). Every innovative idea can be viewed as a diamond in the rough. The purpose of building the IDEA Diamond is to transform innovative ideas into profitable service products, and such process resembles cutting a rough gemstone into a valuable jewel.
The IDEA Diamond, consolidating prominent NSD theories, splits the innovation process into 10 steps. Figure 5 illustrates how the 10 steps are assigned to the appropriate stage. Each process step aims to answer one or more key questions. Practical methods/tools from SEE and other available literature are adopted to help find answers and solutions. Flexibility remains in the selection of methods/tools to accommodate the executor’s resource, time and knowledge constraints. A review meeting takes place at the end of each process step to assess the feasibility of selected methods/tools and the implementation efficiency.

Unlike the product development activity in manufacturing that depends heavily on internal R&D staff, service innovation treats customers as a key source of information and creativity [23, 24]. Customer involvement thus plays a significant role in IDEA Diamond implementation. In addition to interviews and surveys, IDEA Diamond encourages potential users to contribute more to new service development and management by actively participating in idea generation, service design, prototyping, product testing and trouble shooting [25].

The next section provides an overview of the IDEA Diamond’s 10 process steps, 18 key questions and recommended methods/tools, with a description of each step’s major task.

STAGE I. INVESTIGATION

Step 1. Business Strategy Development

Key Question(s)
1.1 Does the innovator have macro-economic insight, i.e., a thorough understanding of the megatrend and the competitive environment?
1.2 What are the short--term and intermediate goals of this service innovation project?
1.3 What resources are available?
1.4 What is the most cost effective way to systemize the subsequent set of service innovation activities?

Suggested Methods/Tools
- Trend Analysis
- **Strategy Chart
- **Five Forces Analysis (Porter, 1979)
- Resource Planning

(Note: Tools with ** sign are NOT from SEE.)

Major Task Description
In this step, the innovator must:
1) Rapidly accumulate knowledge on the status quo and future possibilities of the industry;
2) Clearly define the goal(s) that will drive the innovation activities toward a singular direction without deviation.
**The Israeli physicist and management consultant E. M. Goldratt stresses in his business novel *The Goal* (1986) that, ‘Every action that does not bring the company closer to its goal is not productive…Productivity is meaningless unless you know what your goal is’ [26];
3) Wisely allocate resources available.

Step 2. Opportunity/Problem Identification

Key Question(s)
2.1 What is the market demand that has not yet been fulfilled by existing service products?
2.2 Does the collected data spot any problem or business opportunity?

Suggested Methods/Tools
- Market Research
- Requirement Analysis
Customer Observation
Silent Shopper
Customer Questionnaire
Means-End-Chain, MEC
Personal Conversation (Interviews)

**Major Task Description**
In this step, the innovator must:
1) Understand market needs, especially the unmet ones;
2) Identify the failure points within the delivery process of currently available service products.

STAGE II. DECISION-MAKING

Step 3. Market Analysis

**Key Question(s)**
Is there a specific market segment or target group that the service should be designed for? If yes, who are they?

**Suggested Methods/Tools**
- Evaluation of Customer Survey
- Demand Analysis
- Customer Value Analysis
- Lead User Analysis (*Persona)
- **STP

**Major Task Description**
In this step, the innovator must:
1) Determine the market segment and target group to focus on;
2) Verify the market position of the service in question;
3) Explore the demand of the ‘targeted customers’.
4) Compose a comprehensive business plan.

Step 4. Idea Generation

**Key Question(s)**
What are the possibilities for our new service product?

**Suggested Methods/Tools**
- **Brainstorming
- **Brainwriting
- Focus Group
- Customer Workshop
- Customer Panel

**Major Task Description**
In this step, the innovator must:
1) Collect as many creative ideas as possible, from both the internal service innovation team and potential customers.

**In Fraunhofer IAO’s service engineering model, idea generation precedes requirement analysis (Figure 1). The IDEA Diamond, however, switches the order with a belief that ideas should be generated based on surveyed customer requirements.**

Step 5. Concept Development and Evaluation

**Key Question(s)**
5.1 Which one of the ideas generated in Step 4 has the highest potential to become a profitable service product?
5.2 Reasons?

**Suggested Methods/Tools**
- Concept Test
- Kano Model
- Service QFD
- **Devil’s Advocate

**Major Task Description**
In this step, the innovator must:
1) Filter and prioritize ideas collected in Step 4 before putting them into practice;
2) Decide the idea that will be shaped into actual service product;
3) Document the ‘abandoned’ ideas for future use.

STAGE III. EXECUTION

Step 6. Service Design and Testing

**Key Question(s)**
Is the new service able to meet customers’ expectation and creating memorable experience?

**Suggested Methods/Tools**
- Service Simulation
- Scenario Technology
- Sequential Outcome Method
- Service Blueprinting
- Critical Incident Method
- Prototyping
- Service Test

**Major Task Description**
In this step, the innovator must:
1) Simulate the service delivery scenarios in detail;
2) Produce a service prototype;
3) Test the effectiveness of the service by offering free trials to potential customers;
4) Discover the service’s insufficiencies and make improvements.

Step 7. Marketing Program Development
Idea Diamond: a Systematic Innovation Model for Social Network Services

Key Question(s)
What is the most appropriate ‘marketing mix’ for this new service product?

Suggested Methods/Tools
● Service SWOT Analysis
● **Marketing Mix

Major Task Description
In this step, the innovator must:
1) Develop a marketing strategy based on a thorough analysis of the service’s strengths, weaknesses, opportunities and threats;
   Devise a feasible marketing plan.

Step 8. Full-Scale Launch

Key Question(s)
What are the most cost effective marketing tactics to launch the new service?

Suggested Methods/Tools
● **Advertising Campaigns
● **PR Events
● Customer Events

Major Task Description
In this step, the innovator must:
1) Optimize the advertising budget;
2) Inform potential customers of the new service;
3) Encourage potential customers to try the new service.

STAGE IV. Assessment

Step 9. Post-Launch Review

Key Question(s)
9.1 Does the new service fulfill the unmet market demand identified in Step 2?
9.2 Are there any failure modes in the delivery of the new service?
9.3 How should the failure modes be removed (e.g. by improving the existing product or developing a new one)?

Suggested Methods/Tools
● Customer Care Centre
● Evaluation of Empiric Reports from the Customer Contact
● SERVQUAL
● Customer Satisfaction Analysis
● Transaction Analysis
● Conjoint Measurement
● Evaluation of Customer Complaint
● Feedback of Losing Customer
● FMEA (Failure Modes and Effects Analysis) for Service
● Frequency Relevance Analysis

Major Task Description
In this step, the innovator must:
1) Collect customer feedback to examine service quality;
2) Evaluate the actual service delivery process and name problems that were not identified in the test stage (Step 7);
3) Improve the service and the delivery process if necessary.

Step 10. Follow-Up Marketing Research

Key Question(s)
10.1 Did the new service launched in Step 8 cause any significant impact to the overall market environment? How?
10.2 Did the new service trigger new customer requirements? What are they?
10.3 Is it time that a new round of innovative service development be initiated?

Suggested Methods/Tools
● User Group
● Customer Forum
● Customer Clubs
● Employee Exchange

Major Task Description
In this step, the innovator must:
1) Compare the market environments with and without the new service;
2) Analyze the current competitive environment;
3) Initiate a new round of service innovation if appropriate.

Case Study
YOSI, world’s largest Internet content provider, announced discontinuation of its unpopular SNS Y-Circle, which is the third SNS YOSI had decided to abandon. Such action has triggered users’ doubt on YOSI’s competitive advantage and sustainability in the SNS market. Meanwhile, YOSI’s new CEO Winona Ferguson has been pressuring the vice president Pete Lindt to launch a killer app that can defeat Facebook. To fulfill this mission, YOSI is commissioning a consulting-research team to employ IDEA Diamond in development of a killer application that can deliver exceptional user experience in the OpenSocial environment.

IDEA Diamond Implementation
In Step 1, a trend analysis was conducted through reviews of latest news, user behavior and available literature. A strategy chart was drawn to define
YOSI’s short-term goal (design a competitive OpenSocial network service) and intermediate goal (dominate the web trend via innovative applications). The chart also examined resource availability (inc. human resources, material/operational resources, and the immaterial resources) based on which the project scale is determined.

In Step 2, expert interviews and secondary research were conducted to discover the unfulfilled market demand, including customers’ implicit preferences, unsatisfied needs and problems encountered during service contacts.

A unanimous observation among all interviewees is that Taiwan’s SNS market has not yet seen any overwhelming success like Facebook’s. YOSI, padded by its superior technology and business size, still has a chance to impress Taiwan SNS users. However, YOSI should focus on a particular market segment (like Facebook’s initial focus on Harvard students) and investigate the motive/interest that pulls users to form a community. Data indicated that students aged 17–21 account for the highest Internet usage and demonstrate a strong need for online social-networking [27]; therefore the consulting-research team advised YOSI to target college students as the new OpenSocial app’s primary users.

In Step 3, YOSI accepted the consulting-research team’s proposal on target user selection. A lead user analysis, i.e., a persona analysis, was conducted to investigate the target group’s Internet use behavior.

In Step 4, ideas were cultivated through a brainstorming session and five focus group meetings that involved both the internal personnel (YOSI’s staff and the consulting-research team) and potential customers (sample college students). Over eighty percent of the invitees voiced that extracurricular activities/events constitute a major part of college life. A SNS with event-holding functionality that helps organize the events more efficiently would be highly appreciated. Functions should include event promotion, registration, photo/audio-visual clips posting, individual profile and chat room. Open APIs will also be attached to the service so third party developers can post new features to further enhance user experience.

In Step 5, all members within this service innovation project were invited to a Service QFD (quality function deployment, Figure 6) session, the purpose of which was to deploy the interrelationship between YOSI’s technologies and surveyed customer requirements, thus finding the most effective and competitive resource optimization strategy to devise the activity/event management site for college students.

**Turning Point: YOSI project team’s feedback**

Approaching the end of the QFD meeting, YOSI’s project team reflected that the activity/event management only targeted a limited number of users (college students), but YOSI preferred in a SNS that could serve the general public. Hence, a significant change was made – the activity/event management site was replaced with a service that provides discounts, coupons and group-buuy information with ‘widgets’ for everyday life (e.g. calendar, weather, map, etc.). Moreover, YOSI’s project team requested that a stronger ‘social’ flavor be added to the service to meet the company’s initial expectation of creating an ‘OpenSocial killer application’. Such adjustment entailed a refrain of certain process steps (Step 2 – 5).

**Repeated Step 2**

The repeated round of market research was conducted through literature and statistics review. Data indicates that the online ‘group buy’, leveraging the big volume of buyers to obtain a further discounted price, has enjoyed a dramatic growth, and college students in Taiwan are also highly enthusiastic in joining group-buy activities on PTT, Taiwan’s largest BBS. However, the functionality of PTT Group-Buy remains incomplete, causing participants to suffer the
redundant communication process with their peers. YOSI’s project team and the consulting-research team agreed to create a service that incorporates the spirit of PTT Group-Buy with more advanced and user-friendly features.

Repeated Step 2

The target group remains unchanged: Taiwan college students aged 17–21.

Repeated Step 4

The consulting-research team called for another brainstorming session to generate ideas for the new group-buy service, focusing on ways to strengthen the group-buy application’s ‘social’ meaning and its ‘pulling’ effect.

Repeated Step 5

Based on the Japanese quality control scholar Noriaki Kano’s Kano Model (1984) that divides product qualities into four categories – indifference, attractive, one-dimensional and must-be, the consulting-research team divided ideas collected in Repeated Step 4 into two major groups: the must-be qualities and the attractive qualities.

Must-be Qualities

(Primary functions to serve the group-buy purpose)

- Basic group-buy information
- Product description and price
- Important numbers, (e.g. minimum number of buyers required, participants accumulated, etc.)
- Delivery methods (e.g. mailing, face-to-face trading, etc.) and details
- Opinion exchange
- Log-in
- Calendar
- Search engine and keyword tags
- Interaction with other participating buyers
- Forum
- Instant messenger

Attractive Qualities

(Social-networking features that encourage users to stick to the site, interact with other peers and eventually pull more users in)

- Profile
- Friends list
- Real-time status update
- Virtual money
- Games

Due to time constraint and resource limitation, YOSI’s innovation of the group-buy application only progressed to Step 6 – Service Design and Testing.

Before realizing the group-buy service drafted in Repeated Step 5, the consulting-research team utilized Scenario Technology to simulate a user experience journey and identify the critical service contact points that might affect users’ perception of the service quality. Solutions to potential problems were sought and gaps were filled in this step to fortify the service architecture. The application was then prototyped based on a revised blueprint, and a series of service tests took place within the entire project team to assess the application’s eligibility for full-scale launch.

Conclusions

The world has been witnessing a shift from agricultural, industrial, service to experience economy, and it is now the novel experience during service encounter that distinguishes one product from other competitive offerings [22]. Researchers on new product development (NPD), new service development (NSD) and service engineering all believe that a systematic service development methodology that takes user needs into consideration can boost innovation efficiency, create user-centric service and thus deliver better user experience. In this research paper, a new service development model, IDEA Diamond, was devised and implemented to assist a reputable SNS provider in exploring unfulfilled market demand, identifying the most potential market segment and developing a new service catering to the target customers’ needs. Systematic, methodical-technological tools were utilized during IDEA Diamond implementation. The model is not limited to the SNS field but also applicable to the entire service industry. Employment of the IDEA Diamond would, overall, add ‘a unique mix of value’ [28] to the service companies on both strategic and operational level.

IDEA Diamond requires a consistent project theme, a comprehensive business strategy and precise goals, the combination of which would prevent the innovation personnel from going astray. For companies whose innovation used to be ad hoc, the IDEA Diamond offers clearly defined guidelines and situation-specific methods/tools to schematize the service innovation process. At the end of each process step, a review meeting is held to assure that the result of each activity meets the expectation of various stakeholders. The meeting not only examines what has been done in recent process steps, but also previews what will be done subsequently and evaluates resource allocation efficiency.
Before committing resources to idea realization, the innovation personnel is encouraged to quickly prototype the selected idea through various methods such as drawing pictures, handcrafting a trial product, plotting a service experience journey with user scenarios and forecasting the critical incidents during service contacts (Kelley, 2001). This action helps reconfirm the project direction and stimulate organizational learning that will benefit future development of new services. Since innovation is an ongoing process, a concept proven unsuccessful still helps accumulate experiences of concept prototyping and testing, which should be considered valuable asset in the company’s innovation knowledge base.

On the other hand, flexibility is allowed in the progression of IDEA Diamond’s 10 process steps. Despite the IDEA Diamond’s predefined order, some process steps may have to recur should the project direction be modified (as happened in the YOSI case). Implementation of the IDEA Diamond therefore becomes an iterate rather than a strictly linear procedure.

However, when IDEA Diamond helps reduce resource misuse and increase innovation success rate, it does not ‘guarantee’ success of the new service product for various reasons. Observed variables that impinge on the result of IDEA Diamond implementation are discussed as follows.

First, resource availability – including time, money and knowledge – determines the scope of the innovation project and thus the number of activities that are allowed to be executed. In-depth execution of service development methods/tools could be time-consuming. To accelerate the innovation process, an additional investment on human resource is required – either to hire first-tier field experts or to increase the number of participants. When budget constraint forces involvement of less costly or even voluntary manpower, knowledge and skill limitation of the personnel will likely lead to inadequate or inappropriate selection of methods/tools. Should there be a discrepancy between the amount of resource committed and the resource provider’s expectancy level on the project result, conflicts do occur.

Second, it is always a challenge for stakeholders to reach a consensus during the decision-making process. Take the YOSI case as an example. While the consulting-research team tried to create the service based on researched customer needs, YOSI denied the consulting-research team’s market-oriented proposal of building an event management site and decided to adjust the project direction to fit YOSI’s long existing organizational culture. Being the resource provider, YOSI apparently enjoyed higher judgment power than the consulting-research team and thus pressured the latter to comply. Given that YOSI had already failed several SNSs, discarding the consulting-research team’s market-research-based advice could render another loss of a promising opportunity. The company’s rejection may be analyzed in two folds. On one hand, YOSI still indulged itself in the old glory and refused to jump out of its current operational pattern. On the other, YOSI did not assign the right personnel – those with an entrepreneurial mindset – to this service innovation project. Analogizing the IDEA Diamond as a tool that carves a gemstone (i.e. a creative idea) into a precious treasure, the quality of the end product does not depend merely on the sharpness of the tool but also on the craftsmanship. In other words, the personnel’s capability of making the right decision directly affects the performance of the IDEA Diamond.

Third, although the IDEA Diamond aims to help the service sector in general, industry-specific requirements remain and whether the IDEA Diamond meets those requirements is still in question. OpenSocial, for instance, is an ultramodern subject field with several characteristics that are unique to conventional service industries. SNS providers in the OpenSocial environment encounter competition from every corner in the world since anyone with programming knowledge can produce a rival application. OpenSocial also requires speedy updates of service features before they are outdated, forcing SNS providers to constantly invite new engineering ideas in quantity without controlling quality. Rapid production of new applications, however, is simply not enough. Besides efficiency, SNS providers are also competing on the durability of a killer app. Hence, SNS providers must consistently monitor the market and cleverly use tactics to keep users excited. Even if SNS providers in OpenSocial context can largely leverage ‘user generated content (UGC)’, they are, from the management perspective, still responsible for initiating one or more key applications to retain users in the service and trigger open innovation. To judge which application or API is worth investing, SNS providers must need a deep understanding of what users want now and what users might want in the future. To solve the atypical challenges SNS providers are currently facing, adaptation of the IDEA Diamond to the OpenSocial context is still required.

Last but not least, the IDEA Diamond is a new model that has not yet been widely implemented in enterprises, and its ‘best practice’ is still under research. More empirical data must be collected to provide a quantitative review on the
IDEA Diamond’s effectiveness. However, full-fledged in its functionality, the IDEA Diamond does not promise profitability of the new service developed. Service providers still need strategic vision and a lucrative operational model to stimulate business growth. Only through a brilliant mix of the innovator’s commitment to the project, the amount of resource invested, the appropriateness of team building and the team leader’s project management expertise can the value of IDEA Diamond be optimized. For the IDEA Diamond’s future improvement and transformation, a potent measurement model that evaluates the IDEA Diamond’s comprehensiveness, compatibility, consistency and continuity must also be established.

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THE VALUE-EXPECTATIONS MODEL: A SERVICE INDUSTRY RELATIONSHIP FOR TARGETING CUSTOMERS

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Abstract
This study builds an equation relating business service expectation options (measured as expectation intention and expectation extension) against three multi-dimensional customer perceived value dimensions (measured as performance, service and satisfaction). The model is suitable for investigation of customer perceived service value under structural equation modeling approaches.

Keywords: customer service, value, satisfaction, performance, expectation, competitiveness

Introduction
Services provided by industries have correlated with customer perceived value and satisfaction [11] and have delivered sources of competitive advantage [22][27]. Traditionally, value has been interpreted as a functional, utilitarian view measured as the net ratio of benefits to costs [21]. Flint, Woodruff and Gardial [5] suggest that value may be better classified as a multi-dimensional construct capturing values, desired values and value judgment. The customer’s notion of value is what benefits and sacrifices perceive may exist. Hence, value interprets processes of customer feelings or beliefs regarding the service. Value is relative to what the customer perceives [9][10][15]. From a customer’s perspective value is central to core beliefs, desired end-states, or higher order goals [26]. Thus, value may be viewed as a multi-dimensional construct [18][24].

Mattsson [12][13] established three dimensions of value as emotional, practical and logical. The emotional dimension [6][16] builds into a customer satisfaction measure [24] and captures the expectations of the respondent during the experience of service delivery [2]. For example, in the acquiring a service offering the customer needs, brand expectations, product availability, enjoyable shopping experience, and store innovation together stimulate an emotional and satisfying service experience. Another practical dimension relates to the functional service experiences of the business-customer encounter which is captured as service value [1][4]. In services this may be measured as consultation and service received, the knowledge exchanged, and the net perceived value of the exchange processes. The logical dimension is the third value component. It focuses on the rational or transactional components of the service which is captured as performance value [6][16]. For example the quality of service, the reliability of advice and the skills and knowledge of the engaging services business staff contribute to this value dimension. Barnes and Mattsson [1] found all three value dimensions were important. We write this value construct as a function of these three dimensions and display it as Equation 1.

\[
\text{Value} = \text{fn}(\text{performance, service, satisfaction})
\]

Hartman [8] defines value as the level of goodness the intention of the existing concept actually delivered. Value resides in the relationship between the amount of goodness (or intention perceived by the customer) and the quantity that is actually perceived to be present (or the extension perceived by the customer) in the measured business service concept. Intention is defined as the goodness the customer perceives to be in the service. Others view this intention as a normative expectation [17][28] which can be conceptualised as the level of service that would be expected from an excellent service provider [7][14] operationalises this normative standard as the wish for a level of performance, whilst Swan and Trawik [23] describe this as the level at which the consumer wants the service to perform.

Mattsson [13] defines extension to be what the customer actually observes in this service, whilst Boulding et al., [3] conceptualises extension as predictive expectations, and defines these as the likely level of service that consumers expect to receive from a given service provider in a given situation.
Boulding et al, [3] suggests extension (or predictive expectations) such as a tourism destination virtual reality pre-travel viewing experience, would be lower than intention (or normative expectations) such as an activity, time and cost comparison of tourism destination mixes. Their finding is consistent with Rust’s [20] hierarchical scale of expectations. However extension and intention may be equal when the consumer believes the personal interactions with a service provider are optimal. This construct has been operationalised as expected standard [14], predicted expectations [23], Prakash [19], or the likely performance of a product [25]). Hence, the more net ‘goodness’ criteria the customer observes to be present, the more value is assigned and vice versa. For example, a customer seeks a cup of coffee and expects the coffee cup to be at least half full. Where the cup is half full the intention is equal to the value expected, and the extension contribution is zero. Where the coffee cup volume exceeds the intention level, the customer’s coffee cup value is extended (and the extension contribution is positive). Thus extension can be positive (more than fulfilled) or negative (less than fulfilled). Equation 2 captures this ‘Value-Expectations’ relationship.

\[
\text{Value} = \text{Intention} + \text{Extension}
\]

Equation 2

Since the above equations are interrelated we combine them to form the Value-Expectations relationship. This relationship is presented as Equation 3.

\[
f_n(\text{performance, service, satisfaction}) = \frac{\text{Intention} + \text{Extension}}{}
\]

Equation 3

This Value-Expectations relationship shows the business service expectation constructs of intention and extension are dependant on the customer perceived multi-dimensional value function.

**Value-Expectations Model**

The Value-Expectations relationship (as shown in Equation 3) may be deployed across a services business or industry to investigate the key customer engagement parameters deemed most likely to deliver future added value to the business model. We operationalize Equation 3 as the ‘Value-Expectations Model’ relationship as shown in Figure 1.

**Discussion**

The Value-Expectations Model links business service expectations as intention or new services initiatives and extension or innovative new services additions with customer value. Customer value is established from the literature as a multi-dimensional construct capturing performance, service and satisfaction. This model offers a suitable approach by which a business may monitor and manipulate its new service initiatives, and so deliver higher perceived net value outcomes to the customer. This model is being investigated by the authors under structural equation modeling to validate the literature supported Value-Expectations relationship.

**Conclusion**

This research opens a new arc of understanding, especially concerning the offering of new business service options, and of the customer’s perceptions regarding the value of these services. Measurement and adjustment of such business service options creates a pathway for the organisation to move its services offerings closer to its customers. This research offers new and wide-ranging applications to both research and services industries customer approaches.

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CONSTRUCTING AN ONLINE PROPERTY MANAGEMENT SYSTEM FOR LEISURE FARMS

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Abstract
Taiwan's flourishing tourism industry has stimulated the development of a small and medium-sized hotel industry, including leisure farms. Nevertheless, most small hotel operators lack sufficient hotel operation and management knowledge. Although the adoption of appropriate property management systems (PMSs) could help small hotels improve management performance, the huge purchase costs and maintenance expenses of conventional property management systems make them unsuitable for most leisure farms and other small hotels. In order to overcome this problem, this study tries to take a nominal leisure farm in South Taiwan as an example, and employs the "Web service" concept to create a suitable online property management system. The findings of this study reveal that a Web service model incorporating the concepts of "software as a service" and "service-oriented architecture" can successfully reduce software deployment time and costs, hardware adoption costs, and overall maintenance manpower costs.

Keywords: Leisure Farms, Property Management System, Software as a Service, Service-Oriented Architecture

Introduction
Contemporary management scholarship considers information to make an important contribution to a company's competitive advantage [1], and the use of information technology can reduce operating costs and increase sales revenue [2]. In addition, the organization has been seen as a system for obtaining, analyzing, and disseminating information, which is used to develop and maintain a competitive advantage [3]. Olsen and Connolly [4] suggested that knowledge and information are vital elements of competition for the hospitality industry. Taiwan's flourishing tourism industry has launched a trend towards small hotels such as boarding houses and leisure farms. In addition, stress associated with urbanization and industrialization has made travel an important leisure option for citizens. Rural tourism has become an important part of travel in Taiwan. The information systems used by small rural hotels are still not as good as those employed by large chain hotels. This is chiefly due to the fact that the integration systems designed in accordance with manual operating procedures and meeting the needs of large hotels are very expensive, and are mostly beyond the means of the operators of small and medium-sized hotels. Moreover, the management of a small hotel is extremely different from that of a business hotel, and most small hotel managers lack sufficient hotel management expertise, let alone the use of information technology to improve management efficiency. As a consequence, hotels of this type usually cannot find suitable stand-alone applications programs. Recently, information technology in the form of Web services has made great strides in terms of prices, delivery, and operating risk. In particular, the recently promoted SaaS (software as a service) concept has dramatically reduced system deployment costs, and the use of service oriented architecture (SOA) can ensure that system deployment can provide functional flexibility. As a result, this research tries to design an appropriate on-line property management system employing the foregoing system design methods and architecture in order to conform to the special conditions and operations of leisure farms.

The goal of this study is to develop an on-line property management system for leisure farms that can increase their competitive advantages, while providing a basis for the continuing development of information applications. The chief goals of this paper are therefore:
(1) To explore the characteristics of leisure farms, and gain an understanding of the information needs of property management systems.
(2) To use the Web service concept to develop an appropriate deployment model.
(3) To use a .NET platform application program to deploy the proposed on-line system.

Property Management System
The most important concept in the field of hotel software is that of systems integration, which refers to a hotel system's utilization and linkage. O'Connor proposes that property management system functions should include a record of guests registered at the hotel, confirmation of room type, maintenance and tracking of customer accounts and payments, front-desk tasks, and other tasks such as operating level and management level reports [5]. These
functions facilitate the management and control of the hotel as a whole. An ideal management system should possess a full range of functions, and should be able to handle all transactions from initial telephone queries to final billing. As far as detailed system functions are concerned, Kasavana and Cahill suggest that a property management system's main transaction processing functions should include the following basic items shown in Table 1 [6]:

<table>
<thead>
<tr>
<th>Back-office operating system</th>
<th>Front-desk service system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accounts receivable</td>
<td>Reservations</td>
</tr>
<tr>
<td>Accounts payable</td>
<td>Room management</td>
</tr>
<tr>
<td>Payroll accounting</td>
<td>Guest accounting</td>
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<tr>
<td>Inventory</td>
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<td>Purchasing</td>
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<td>Financial reporting</td>
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Table 1: Basic property management system functions [6]

It can be inferred from the foregoing literature that, although individual property management systems are composed of applications software directly connected with front-desk and back-office tasks, neither their constituent elements nor their necessary functions are entirely the same; rather, these two systems must work together to manage the hotel real estate and handle matters associated with guest lodging.

The first property management system was implemented at the New York Hilton Hotel in 1963 in order to achieve a degree of automation. This system employed computer control of front-desk operations (the system successfully improved operation control, reduced paperwork, and provided better services). Hoteliers began widely using information systems after this date [7]. According to a research report issued by the American Hotel and Lodging Association (AH&LA), although less than 10% of American hotels employed computerized operations in 1980, 95.3% of these hotels had adopted computer technology by 1994, and as many as 97.2% of all hotels with at least 300 rooms had computerized by that date [8].

Since widespread use of property management systems does not imply outstanding performance, however. Hensdill noted that hotels lagged far behind other industries in the application of automation, the main reason for this being that computer technology designed in accordance with the characteristics of the hotel industry had failed to meet hotels' operating needs [9]. Another reason for this was the fact that, in spite of the high cost of computer systems installation and subsequent maintenance, the systems failed to increase productivity to a degree proportional to their cost [8]. This was the so-called "Output Paradox" [10]. However, obtaining effective information is a key to success for all types of businesses, and information can be used to create a competitive advantage; hotels are certainly no exception to this rule. The hotel industry is a relatively mature industry, and the goal of hotel managers is typically to increase market share, and not to attempt to expand the market as a whole. As a consequence, although computerization has not been as urgent a task for medium and small hotels as it has been for large hotels, even smaller hotels cannot avoid this trend [8].

Taiwan's small hotel operators have been slower to apply information technology to their operations than their counterparts in other countries, and most small hotels are still at the computerization stage – i.e., they are still using computers merely for information storage, calculations, and printing of bills and invoices [11]. The research of Lin Yue-hsiu and Liu Tsong-zen indicated that domestic property management systems of a decade or more ago included front-desk operating subsystems, and the main functions of these subsystems consisted of guest history management, front-desk reception and cashier, house-keeping management, and telephone accounting system. Back office operating systems of the time had the main functions of accounting and ledger management, personnel affairs/payroll management, and inventory management [12]. Out of necessity, many systems included uninterruptible power supply (UPS) and antivirus subsystems. As far as contribution to hotel performance was concerned, the most appreciated function of such systems was their ability to effectively establish guest history portfolio files.

In the past, information technology research in the hotel industry chiefly emphasized methods of applying information systems, the advantages that could be obtained from adopting such systems [13], factors causing system deployment failure [14], the competitive advantage conferred by information technology when implementing strategies [15], the effect of information technology on hotel performance [16], effective existing application models [17], and factors affecting the use of information technology [18]. Past research on the adoption of information technology for management purposes by medium and small hotels analyzed background push/pull factors [19] and successful cases of adoption [20]. Research on the subject in Taiwan examined the state of the use of existing information technology in the hotel industry [12]. In line with the development of network technology in recent years, the hotel industry has also gradually begun to explore applications of this technology. Research on this aspect has investigated the effect of hotel web site attributes and characteristics on customer perceptions [21] and management of...
reservations through online distribution channels [22]. Domestic research has addressed the profit-making effectiveness of hotel websites [23] and analyzed service quality applications [24]. Most research in this area involving medium and small hotels has focused on preliminary application models, effect of Internet use on hotel coordination and performance [25], how the use of networks and online platforms enhance operating performance [26], and how to integrate the Internet with marketing information systems [27]. It can be seen from the foregoing studies that most research has not dealt with medium-sized and small hotels, and most work has addressed management issues after information system adoption. As a result, any research on the deployment of information systems at smaller hotels will be of significant academic value.

Methodologies

This study used the system development life cycle (SDLC) model [28] as research framework and derived the research workflow as shown in Figure 1.

![Figure 1: Executing Process of this research](image)

Figure 2: Process of prototyping model

This study employed a specific leisure farm in southern of Taiwan as its research subject. Because the deployment personnel encountered in this study did not understand the user's needs, and the user was unable to clearly and fully express his needs, the system development life cycle prototyping model shown in Figure 2 was used as a deployment program. This prototyping model enabled the rapid development of a prototype specifically focused on the user's needs and also easily grasped by technical personnel. The prototype served as a tool for user communication and learning, and facilitated the early discovery of problems. The prototype provided a basis for evolutionary improvement during the next cycle, and enabled the development of a complete initial prototype system.

Observation Method

Most observations were performed with the observer as a participant. The observation period consisted of July and August of 2008, and each observing period was two weeks in length. Observation time was from one to two days, and emphasis was placed on the farm operating environment and service processes. The study attempted to clarify questions posed to on-site employees in the event of poorly-understood problems and interaction between personnel. An effort was made to understand the effect of the environment and operations at the time of adoption on peripheral processes, and field notes were used to record possible system needs or risks.

System Analysis Tools

The service-oriented architecture concept was integrated with the characteristics of property management systems and leisure farms in order to enhance system application value. In addition, the software as a service method was employed to respond to leisure farms' cost and manpower considerations. Finally, the service blueprint design allowed the realization of a prototype property management system.

System development tools

A Collaborate Work Space (CWS) platform was used as a system core development platform. The rapid development platform was written by Star Software Co., Ltd. on the .NET framework, and was certified by Microsoft (certification no. Sm0703300607).

Results and Analysis

The recreational farm serving as the research subject was chiefly operated by a married couple, the couple's three children, their grandparents, and a small number of employees from outside the family. The farm was managed as a family business, and a total of approximately 20 persons worked at the farm. The farm's capital was roughly NT$10 million. The people living on the farm held various positions, and
were directly involved in serving guests.

The farm has been in existence for 17 years, and made a shift from agricultural production to tourism several years ago. At that time, many traditional farms gradually decided to combine tourism with production in line with the government's policy of promoting tourism and recreation. This farm thus transformed itself into a recreational farm.

The farm currently has 62 guest rooms, which is a typical size for a small hotel. Having been in existence for more than a decade, the farm possesses plentiful business experience. Because the farm has maintained long-term relationships with many companies and businesses, groups comprise a relatively large percentage of its guests. In addition, the recent increase in marketing in Malaysia and Singapore is gradually beginning to pay off, and the number of guests at the farm has been increasing.

After a site survey was performed using the observation method, it was found that the farm's location in a relatively isolated mountain area makes transportation somewhat inconvenient. As far as information equipment is concerned, the farm possesses only an Intel 486-grade desktop computer, which is used chiefly to record basic customer information and product documents, and to support Internet access for queries. Back office space at the farm is only about the size of an ordinary table counter. Operating procedures at the farms still involve ordinary pen and paper. Management is conducted on the basis of experience and estimates; printed reports are not usually employed. With regard to the degree of computerization, only the younger family members and personnel regularly use computers, and older persons involved with farm management are not very familiar with computer use.

**Problem Analysis**

The site survey revealed that the farm currently combines basic hotel functions with rural recreational activities. Due to the lack of manpower on the farm, however, only one or two family members or non-family employees are in charge of many departments. The farm lacks the resources to assign a dedicated information employee responsible for providing support. In addition, due to the farm's location in the mountains, the use of conventional hardware might result in maintenance difficulties. On the other hand, the farm's operating model has a high degree of flexibility, and customer accounts are handled using several methods. This aspect differs from the fixed business items of most ordinary hotels. The farm conducts most business manually, mainly using paper and verbal negotiations, and it has a relatively high information technology use threshold.

![Figure 3: Concept of a computer system [5]](image)

This system was developed on the basis of the system development life cycle concept. This study employs the proposal of O'Connor (2004), who suggested that computer systems are composed of the three constituent elements of hardware, software, and the user as shown in Figure 3, and classifies problem aspects as the three types of system hardware, application software, and operating procedures.

The site survey and the results of the analysis revealed that, due to system hardware restrictions and the farm's geographical conditions, operating costs entailed by the deployment of a conventional property management system (PMS) would be a major burden for the farm. In addition, installation of all equipment on the farm would force the farm to create the necessary space, and would also increase management costs. Furthermore, it would be difficult to obtain prompt maintenance by information personnel if a malfunction occurred. Because of this, it was necessary to simplify the system's routine operation and maintenance tasks, and thereby minimize the need for information management ability. With regard to application software, since the farm's management style and consumption model differ slightly from those of ordinary hotels, an ordinary property management system might be insufficiently applicable, and the high flexibility of the farm's consumption model might require a system containing corresponding operating concepts. In terms of planning operating procedures, it was frequently difficult to induce personnel who were familiar with the old model and who often lacked computer knowledge to move to the new system. Finally, the question of how to optimize process design was encountered. As a result, it was necessary to strengthen training associated with the foregoing problems. In conjunction with these issues, this study derived the response methods corresponding to each influencing factor as shown in Table 2.

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<tr>
<th>Aspect</th>
<th>Influencing factor</th>
<th>Response concept</th>
</tr>
</thead>
</table>

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System Analysis

With regard to system hardware deployment, the software as a service (SaaS) concept shown in Figure 4 is a means of providing software over the Internet. In this concept, a service provider (typically a small or medium-sized business) maintains necessary basic facilities and software/hardware operating platforms, and also bears responsibility for all preliminary installation and subsequent maintenance tasks. The user business does not need to purchase hardware or software, establish an equipment room, or hire IT personnel, and can use the system via the Internet. Many small businesses employing a SaaS model find that it can dramatically reduce huge front-end hardware expenses, and the only required equipment is an ordinary PC connected to the Internet. The SaaS model makes it unnecessary for businesses to purchase, install, and maintain basic facilities and applications programs [29].

Figure 4: Concept of software as a service (SaaS)

The service-oriented architecture shown in Figure 5 served as the central concept of application software design. Service-oriented architecture is a new type of system architecture that chiefly involves a set of software elements assembled to meet the needs of a business. These elements usually include software, services, and process elements. When a business faces external demands, the processes bear responsibility for defining external demand handling steps. Services encompass all program elements required in specific steps, and software elements bear responsibility for executing operating programs. Employing standardized middleware, the componentization of functions allows the business to access and assemble existing functional elements when it is necessary to compile a new system in order to meet certain needs, such as customer information queries, remittances, and corporate accounts; this approach can accelerate the commercialization of services [30].

Figure 5: Conceptual diagram of service oriented architecture (SOA)

Following the confirmation of system hardware and software concepts, operating procedures were formulated in accordance with Shostack’s service blueprint concept [31]. This involved the display of process steps and interactions, and interaction between users and the system, and description of various user actions and the system's corresponding responsibilities. After analyzing the service items required by leisure farm’s information system, the system functions were categorized as the following four items:

1. Reservation tasks: From a customer telephone reservation to completion of data entry and form print-out.
2. Reception tasks: From confirmation of information to assignment of a room after a customer arrives at the farm.
3. Lodging tasks: All service tasks while a customer is staying at the farm.
4. Check-out tasks: All information checking and accounts settlement processes when a customer checks out.

With regard to the influencing factors uncovered during problem analysis, this study proposed the remedies shown in Table 3 after analyzing the foregoing items.

Table 3: Deployment concepts and plans

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Response</th>
<th>Actual plan</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>System hardware</strong></td>
<td><strong>Simplification of overall preparation and maintenance work, elimination of information management system need</strong></td>
<td><strong>Use of SaaS concept to meet program needs, maintain infrastructure, and eliminate the need for equipment and software purchases</strong></td>
</tr>
</tbody>
</table>

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Influencing Factors

<table>
<thead>
<tr>
<th>Geographical location factor</th>
<th>Simplification of overall preparation and maintenance work, elimination of information management system need.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peripheral environmental factor</td>
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<tr>
<td>Capital restriction factor</td>
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</table>

Applications software

<table>
<thead>
<tr>
<th>Applicability factor</th>
<th>Repeated discussion of different design methods, and enhancement of system fine-tuning flexibility.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexibility factor</td>
<td></td>
</tr>
</tbody>
</table>

Operating procedures

<table>
<thead>
<tr>
<th>Habit shifting factor</th>
<th>Design of standard service processes, and use of training and auxiliary programs to increase usage.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use threshold factor</td>
<td></td>
</tr>
<tr>
<td>Process design factor</td>
<td></td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Application software</th>
<th>Use of the SOA concept to achieve componentization of functions and accelerate the commercial of functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating procedures</td>
<td>Use of the service blueprint concept to describe the system from the user's point of view in terms of actions and the system's functions</td>
</tr>
</tbody>
</table>

**System Deployment**

Because the system employs the SaaS concept, it can be accessed using an Internet browser. The structure of system function can be developed as shown in Figure 6.

![Figure 6: Structure of system functions](image)

A user can log on after entering a self-assigned account number and password. The system can be used remotely via a wireless network, and users can access the system program on the remote server. The operation screen of proposed system can be shown in Figure 7. The system contains the following six function modules designed to handle all process needs from arrival to departure:
(1) Basic information module:
This module contains initial settings for all products and services at the hotel, including all the room types and parameters in all room master files. With regard to maintenance of transaction codes, because most foods and recreational activities at the farm are limited to those involving locally-available resources, there will be frequent changes in transaction items. In order to facilitate operations, the system can accommodate user modification of functions in order to achieve greater flexibility.

(2) Guest management module:
The purpose of this module is to record various guests’ information. Because most guests at the farm arrive in groups, and most groups are from companies and stay at the farm on a regular basis, in order to make full use of guest consumption records, and to maintain and offer promotions to long-term guests, the guest database functions are designed to achieve the goal of guest relationship management. In addition, the guest consumption function can answer queries concerning guests’ consumption during past visits to the farm. Furthermore, because guests may pay using different methods, and payment for groups is often made via company accounts, a corporate account query function has been added to facilitate settlement of accounts.

(3) Reservation management module:
This module chiefly provides room inventory query and reservation entry functions for use at the time of reservation. If flexibility is required, the system’s room inventory can be temporarily adjusted in order to meet guests’ lodging needs. This module can also generate reservation-related reports; this function is currently mainly used to generate reservation reports and expected guest lists.

(4) Reception management module:
All functions required after guests arrive at the farm are contained in this module, especially entry and room assignment functions. Distinctions can be made between entry of individual guests and groups. To facilitate settlement of accounts, a main room number must be set when a group enters the farm. In addition, to accommodate guests who wish to change rooms on the spur of the moment, this module also contains a room change function.

(5) Account management module:
This module chiefly contains accounting and check-out functions, and allows guests’ single-stay consumption records to be queried, added, and modified. Guests are checked out from the system after completion of payment tasks. This module also contains lost-item handling, meal and other product consumption, and other income record functions.

(6) Night audit module:
This module is intended to allow the setting of shift-change tasks and generate reports concerning overall transaction records.

Conclusions and Recommendations
This study employed the Web service "service-oriented architecture" concept to develop a property management system. Due to the inherent flexibility of this system, in comparison with conventional systems, it can shorten the software development cycle. In addition, although the system's functions are designed to mesh with the characteristics of leisure farms, the system offers a high degree of extensibility and management and integration elasticity. Furthermore, the "software as a service" service provision model allows users to dramatically reduce the heavy cost of simultaneous hardware and software purchases, while simultaneously alleviating personnel and geographical problems affecting system maintenance.

Because this study looks at only a single case, the system provided in this study does not necessarily employ an optimal system model; it is, however, a successfully-deployed operating model offering a property management system to the special category of leisure farms. With technology popularization in the future, a comparative study examining several types of technologies or processes in the industry may be able to determine key factors affecting system deployment in the industry.

Acknowledgment. This research is partially the result of the 2008 Ministry of Education Technical College and Industrial Park Academic-Industry Collaborative Project F-61-017.

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A DYNAMIC SHIFT-SHARE ANALYSIS ON THE CHINA’S R&D: A STRUCTURE ANALYSIS

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Abstract
To evaluate the R&D development in China, we can inspect both the R&D expenditure and the research talent pool. In this paper, we analyze the structure of the researcher groups by using dynamic shift-share analysis (DSSA). The DSSA results show that there is still much room to improve in the structure of research group. The provinces/municipalities from eastern China did not perform well in engineering and education researcher groups while the provinces/municipalities from central and western China perform well in engineering, agriculture and education researcher groups. We suggest that the government planners should implement more effective measures to improve the structure of the researcher groups in order to spend the R&D fund wisely and attract more extra fund in R&D.

Keywords: R&D; Chinese economy; Dynamic shift-share analysis (DSSA).

Introduction
Underpinned by economic reforms and the “open door” policy, China has made remarkable progress in economic growth and it has grown tenfold in the past three decades. In the cycle of economic growth after 2000, China has been the power engines of the world economy. In 2007, the economy turned in another spectacular performance with gross domestic product (GDP) growing at the fastest clip in the past 13 years and the fifth year in a row in which GDP has expanded by more than 10 percent (Statistical Yearbook of China, 2008). A revision of the GDP figure by the National Bureau of Statistics of China in January 2009 further reviewed that China has leapfrogged Germany to become the world’s third-largest economy, with an annual GDP of 3.5 trillion U.S. dollar, only behind the U.S. and Japan. It is believed that it only takes three or four years for China to surpass Japan (4.4 trillion GDP) to become the world’s number two economy. Although the GDP growth rate of China has cooled to its slowest pace to 9.1 percent in 2008, which was affected by the global financial turmoil, the economic data released in the past few months has showed various evidences of recovery\textsuperscript{1} as domestic strength helps to offset external weakness. It is widely believed that China can achieve its growth target of 8 percent in 2009.

Owing to the high and inefficient consumption of energy and raw materials, environmental degeneration and low technology intensity of the current growth pattern of the Chinese economy, the Chinese government is facing the challenge of making the transition from sustained to sustainable growth from social, economic and ecological and environmental point of view. In order to sustain the excellent performance of economic growth and transform China into an innovation-oriented nation on the basis of the development of a national innovation system with strong innovation capacity, the Chinese State Council has identified research and development (R&D) as a driving force for the progress of society. It is seen as a source and backbone of sustainable economic growth, as well as a precursor to major technology breakthrough and industrial advancement. The National Guidelines for Medium- and Long-term Plans for Science and Technology Development (2006-2020) released by the Chinese State Council set a target to raise the weight of China’s R&D expenditure in GDP to 2 percent by 2010 and to 2.5 percent or more by 2020, with an science and technology advancement contribution rate reaching 60 percent, and a reduced dependency on foreign technology by at least 30 percent. The ambitious R&D expenditure target implies that R&D expenditure have to increase at a rate by at least 10 to 15 percent annually.

The R&D in China can be analyzed in two aspects: R&D spending and the scientific and technology workforce. To achieve the ambitious target on R&D, R&D expenditure has been growing rapidly at a staggering average annual rate of 22 percent since 1995 (Figure 1). In particular, this growth rate has remained at least 23 percent since 2004. According to the Statistical Yearbook of China 2008, the total national expenditure on R&D in 2007 continued to grow and reached 371.02 billion yuan (49.33 billion U.S. dollar), up by 23.5 percent. In

\textsuperscript{1} The signs of recovery include normalization in credit growth, fixed investment and real sales growth, and raw materials demand rebound.
terms of different regions, 12 provinces and municipalities have spent more than 10 billion yuan on R&D and the total expenditure on R&D by these 12 provinces is 299.46 billion yuan (39.82 billion U.S. dollar), which accounts for nearly 81 percent of the total national expenditures on R&D.

**Figure 1.** Total R&D Expenditure of China (Million yuan)

In terms of R&D intensity or R&D spending as a percentage of GDP, it rose from 0.6 percent in 1995 to 1.49 percent in 2007 (Figure 2), with an average annual growth rate of 8.3 percent. Similar to R&D spending, the R&D intensity has been rising rapidly in the last four years. It is clear from both the absolute and relative terms that expenditure on R&D in China is stunning, which makes China one of the influential global R&D players, ranked third in the world, only behind the United States and Japan in terms of total R&D spending.

**Figure 2.** R&D Spending as a Percentage of GDP

As we stated earlier in this section, to achieve the goal of R&D development it is implied that the R&D expenditure should increase at a rate of 10 to 15 percent annually, which is a very challenging task. Thus, it is advisable to analyze how to maximize the current resource on R&D by optimizing the structure of the pool of R&D personnel. In this paper, we focus on the second aspect of R&D development, the human resource pool. We are interested in analyzing the regional pattern of the distribution of R&D personnel from the perspective of the efficiency of the national talent pool. To address this research purpose, we use dynamic shift-share analysis (DSSA) to study whether the current distribution of the five groups of researchers is optimal in provincial level. Based on our analysis, we will provide suggestions to those provinces or municipalities on how to optimize the distribution of researchers.

The Chinese government is facing the challenge of making the transition from sustained to sustainable growth. To maintain its rapid growth rate, it is vital to increase the competitiveness of R&D which may provide extra sources of growth. One important issue to increase the competitiveness of R&D in China is to optimize the structure of R&D. DSSA is an ideal method to provide suggestions on the optimization. DSSA will allow us to find the relative competitiveness of each province/municipality for the five groups of researchers in our analysis. Moreover, the analysis of the components of the DSSA equations enables us to find out the sources behind the competitive advantage or disadvantage a particular province/municipality has gained in a particular researcher group. Based on the statistical results from DSSA, we are able to give useful...
suggestions on which research group a particular province/municipality should invest more and on which one it can spend less. These structure optimization suggestions are able to help policymakers to achieve the growth target of R&D not only by purely investing more money but also by allocating the limited resources more efficiently.

The paper is organized as follows. Section 1 is an introduction. Section 2 reviews the literature on shift-share analysis and the empirical applications in the competitive advantage analysis using both static and dynamic shift-share analysis in some of the sectors in tertiary industry. Section 3 discusses data and model specifications. Section 4 presents our empirical findings on the issues raised in the introduction. Section 5 contains the concluding remarks and policy suggestions. Topics for future study are also proposed.

Literature Review
The method DSSA we employed in this paper is an improvement from the well-known shift-share analysis proposed by Dunn (1960) and Perloff, et al. (1960). Shift-share analysis has been widely used in empirical analysis because of its obvious advantages over the traditional absolute or percentage value methods. For example, shift share analysis offer a new perspective to assess the economic performance and provides important descriptive data on structural change for policy makers by analyzing the structural change over time in the competitive position of one or more aspects of a region or a country’s economy. Moreover, shift-share analysis overcome the disadvantages of traditional absolute or percentage value methods by avoiding the mistake of overrating the importance of large income sources happened in absolute value method and the overrating of small ones happened in percentage value method. Shift-share analysis offers a good complement to those absolute and percentage methods. Empirical studies showed that Shift-share analysis has been recognized as an efficient method to assess and, to some degree, predict regional development and growth (Ashby, 1968; Chalmers and Bechelm, 1976; Dunn, 1980; Andrikopoulos, et al., 1987; and Keil, 1992).

Early application of shift-share analysis has focused mainly on regional economies and political economies. In the early 1990s, shift-share analysis was employed to analyze external trade in aspect of the export of goods at the sub-national level. Markusen, et al. (1991) used the shift-share method and estimated the share of employment growth for export and import penetration in nine US regions. Hayward and Erickson (1995) extended and applied the model to the North American Free Trade Area. Gazel and Schwer (1998) studied the growth of international exports of US states by focusing on demand conditions. Except for those trade related studies, in 1990’s, Shift-share analysis has also been employed in several studies analyzing the competitiveness among the East Asia countries (Herschede, 1991; Khalifah, 1996; Voon, 1998; and MAS, 1998a, b).

Because of the availability of longer time-series data, in recent studies, DSSA was more frequently used to analyze the competitiveness related issues. Sirakaya (2002) compared one form of dynamic shift-share techniques with the traditional static techniques using tourism employment data from the US state of Texas, and found that dynamic shift-share was superior to the static shift-share analysis in identifying the whole evolution of structural change. Nazara and Hewings (2004) proposed a dynamic shift-share model that was later applied by Shi et al. (2007) to examine the performance of the travel industry in China’s Jiangsu province.

Although shift-share analysis has been applied to study the competitiveness in different industries, it has rarely been used to analyze R&D, especially regional R&D. According to our knowledge, there is no empirical study on R&D in China using the DSSA method. The dynamic shift-share model used in this paper is a modification of the model proposed by Sirakaya (2002) and Nazara and Hewings (2004), and similar to that of MAS (2002) which used the dynamic shift-share technique to analyze the electronic export competitiveness of Singapore against five other East Asian economies (Malaysia, Taiwan, South Korea, Hong Kong and China).

The advantage of our model over those used by Sirakaya (2002) and Nazara and Hewings (2004) is that the differences in the performances of different provinces are accounted for by four components of Net Shift: the industry mix effect (IME), the competitive effect (CE), and the interactive effect (IE). We are not only able to identify whether a particular research group is a promising one, whether a particular province is gaining any competitiveness, but also study the interaction of these two effects. A comparison of the analytical results by analyzing the above three components enables us to optimize the structure of the R&D pool and allow the policymakers to make more wise investment decisions. A detailed description of the model is given in the next section.

Data and Method
Data Selection
In this paper, we use DSSA to investigate the structural composition of the five R&D researcher groups among the provinces/municipalities in China. The analytical results enable us to know whether a particular province/municipality is focusing correctly on the researcher groups on which it has competitive advantage. Moreover, by analyzing the
decompositions of the Net shift, we are able to trace the sources behind the advantage this province/municipality has gained. According to the Statistical Yearbook of China, the science and technology personnel are generally grouped into five categories: engineering, agriculture, scientific, health care and education. We collect continuous time series data on provincial level data for these five groups of science and technology persons for 30 provinces/municipalities, which provide us a full picture of the relative competitiveness of each province/municipality in mainland China. The data used in this study are the annual provincial numbers of researchers in the five researcher groups. All the data for this study are collected from the China Statistical Yearbook, various issues. The time span of the data is from 1996 to 2007.

Method Description

The method we employ in this study is DSSA, which is a dynamic version of the traditional shift-share analysis. The reason that DSSA is preferred over the shift-share analysis is that the shift-share analysis is generally a comparative static method. This comparative static method has obvious shortcomings as indicated by Barrf and Knight (1988): this comparative static approach mainly focuses on the changes between the beginning and the terminal years. To calculate the decomposed effects, either an average of the sector mix effect over the sample period or just the value at the beginning of the period is used. This is an obvious disadvantage because it neglects the dynamic changes during the sample period, which may be of great interest to the empirical researchers or government planners. In Barrf and Knight (1988), they use an export dataset as an example. They argued that if a country’s exports grow faster than those of the reference group, the comparative static approach will assign too little of the export growth to the “share effect”; and vice versa if the growth of a country’s total exports is lower than that of the reference group. Therefore they proposed a dynamic shift-share analysis (DSSA) technique which calculates the IME, CE and IE on an annual basis and then sum up the results over the study period.

We consider DSSA in this study as a measure of the gain or loss in a particular researcher group of a particular province/municipality in relation to a group of reference provinces or municipalities based on the model used in Wilson (2002) and Ha, Fan and Chang (2003). By definition, any difference between the performance of a particular province/municipality in a particular researcher group and that of the reference economies as a whole is referred to as the shift effect in that researcher group. The resulting net shift can be decomposed into three effects: IME, CE and IE. The composition of the models is as the following:

\[
(X_t^j - X_{t-1}^j) - X_{t-1}^j \sum_{i} \left( \frac{\hat{X}_{t,t-1}^{ji}}{X_{t-1}^j} \right) \left( \frac{\hat{X}_{t,t-1}^{ji}}{X_{t-1}^j} - 1 \right) = (1) \\
+ X_{t-1}^j \sum_{i} \left( \frac{\hat{X}_{t,t-1}^{ji}}{X_{t-1}^j} - X_t^j \right) \left( \frac{\hat{X}_{t,t-1}^{ji}}{X_{t-1}^j} - 1 \right) = (2) \\
+ X_{t-1}^j \sum_{i} \left( \frac{\hat{X}_{t,t-1}^{ji}}{X_{t-1}^j} \right) \left( \frac{X_t^j}{X_{t-1}^j} - \frac{\hat{X}_{t,t-1}^{ji}}{X_{t-1}^j} \right) = (3) \\
+ X_{t-1}^j \sum_{i} \left( \frac{X_t^j}{X_{t-1}^j} - \frac{\hat{X}_{t,t-1}^{ji}}{X_{t-1}^j} \right) \left( \frac{X_t^j}{X_{t-1}^j} \right) = (4)
\]

where the terms (1) to (4) are the net shift, industry mix effect (IME), competitive effect (CE) and interaction effect (IE), respectively.

The advantages of the DSSA used in this study has the following advantages: firstly, dynamic shift-share analysis allows the industry mix effect and the growth rate to vary over time, which results in the appropriate "share effect" assigned for each period which reflects accurately the structural change in industry over time. Secondly, the structure breaks and obvious trends are now easier to be identified as DSSA tracks the whole evolution of the sample period. Lastly, exceptional years or measurement errors are more easily detected with the dynamic shift-share analysis than with the traditional shift-share method which only uses the beginning and terminal years of the sample data (MAS. 2002). We will explain the three components of DSSA in the remaining section of this paper.

We first discuss the industry mix effect. By definition, industry mix effect measure the share of difference in net shifts attributes to the difference in structure composition between a particular province/municipality and the reference group as a whole. In our study, industry mix effect measures the difference between the share of a particular researcher group in a competing province/municipality and that of the reference group as a whole. If the share of a sunrise research group (defined as a research group with positive growth

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4 The 30 provinces and municipalities in our sample are: Beijing, Tianjin, Hebei, Shanxi, Neimeng, Liaoning, Jilin, Heilongjiang, Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Shandong, Henan, Hubei, Hunan, Guangdong, Guangxi, Hainan, Sichuan, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia, and Xinjiang.

5 This is the longest time series we are able to find because, not like the commonly used data such as GDP, the classifications for the R&D researchers are not consistent in the past issues of China Statistical Yearbook.
rate of numbers of researchers in the reference group) is higher in a particular province/municipality than that of the reference group or conversely if the share of a sunset research group (defined as a research group with negative growth rate of numbers of researchers in the reference group) is lower in a particular province/municipality than that of the reference group, this competing province/municipality would gain positive IME. A similar logic defines a negative industry mix effect.

The competitive effect identifies the difference in net shifts due to the difference in the growth rate of the number of researchers between a particular province/municipality and that of the reference group as a whole. In other words, the competitive effect reflects the contribution to the difference in net shift due to a deviation from the average growth rate of a particular researcher group in a particular province/municipality during our sample period. For our case, if the growth rate of the number of researchers of a particular province/municipality in a particular researcher group is higher than that of the group level, we say that this particular province/municipality has positive CE. Moreover, we call a particular province/municipality gaining 'competitive advantage' if it has positive CE. In other words, the province/municipality being considered outperforms the reference economy as a whole in that particular researcher group. However, if the growth rate of the number of researchers of a province/municipality in a particular researcher group is lower than that of the reference group, it will result in a loss of competitiveness in that researcher group for that particular province/municipality.

The last component of net shifts is the interactive effect, which is a comprehensive effect that incorporates both the effect of structure change and the issue of competitiveness. The interactive effect reflects the difference in net shift attributable to the interaction between structure composition and competitiveness. For our case, there are two ways that a province/municipality can gain a positive interactive effect. Firstly, in a particular sunrise researcher group if the share of that researcher group is higher than that of the reference group as a whole at the same time when it also gains competitive advantage in that research group. Alternatively, a particular researcher group can also obtain positive IE if a province/municipality has smaller shares in a sunset research group than the average level of the reference economy, and that province/municipality is also losing competitive advantage in that researcher group, then the particular province/municipality Conversely, a province/municipality will gain a negative interactive effect if it focuses on a researcher group where it is losing competitiveness or it is not specialized in a researcher group in which it is gaining competitive advantage.

According to our knowledge, there is no research on R&D in China using DSSA. Our research tries to fill this gap by using DSSA to analyze the researcher groups at the provincial level. One of the reasons why DSSA was not widely used was probably that time series data were not available for dynamic analysis. This kind of data is now easier to obtain from various sources, and therefore we are able to employ the DSSA method to analyze the composition of the researcher groups in R&D.

### Estimation Results

In this section, we first present the summary statistics on the scientific and technical personnel which may give some overall impression on the distribution of these research personnel in China. Secondly, we analyze the DSSA results for the five researcher groups. For each of the researcher group, we compare the results of net shift, IME, CE and IE, which show the composition of net shift. We then analyze the breakdown of the net shifts, IME, CE and IE to trace the source behind the competitive advantage or disadvantage one particular province/municipality has gained. Lastly, we compare the DSSA results of the 12 provinces/municipalities which accounts for about 80 per cent of the total R&D expenditure of China. From the analysis of the above three steps, we are able to find out whether the research personnel is properly distributed in province level in China and offers suggestions on which research group a particular province/municipality should allocate more resource.

### Summary Statistics on the Research Personnel

Figure 3 shows the shares of each of the researcher group in total number of researchers. Nearly 60 percent of the researchers in China are in education related institutions or enterprises, followed by engineering (22 percent) and health care (16 percent). There are only 3 percent and 2 percent of the researchers in agriculture and science related institutions or enterprises, respectively. Figure 3 indicates that most of the research talents are still in education related institutions or enterprises and to transfer the technologies from the lab to the marketplace, it is important to forge links between the public and private sectors. We can see the distribution of research personnel among the provinces/municipalities from Table 1. There are four provinces, Shandong, Henan, Guangdong, Hubei, which have more than 1 million researchers, while the province with the lowest number of researchers, Zizang, only have 42.4 thousands researchers. In Beijing and Shanghai, two of the most important cities in China, there are only about 340 thousands researchers. Note that we stated earlier in this paper that Beijing and Shanghai are among the 12
The statistics in this section indicates that there is a high R&D per researcher in these two cities. One interesting fact is that regional difference is not obvious in the amount of researchers, which is different from other economic indicators like GDP or tertiary industry output. Among the top ten and bottom ten provinces/municipalities, there are provinces/municipalities from western, middle and eastern China.

Table 1. The rankings of total number of researchers in 2007

<table>
<thead>
<tr>
<th>Rank</th>
<th>Region</th>
<th>Number</th>
<th>Rank</th>
<th>Region</th>
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DSSA results for engineering

Engineering is the second largest researcher group in China, accounting for 22 percent of the total research persons, only behind education. Table 2 shows the rankings of cumulative net shifts of engineering for the sample provinces/municipalities from 1998 to 2007. Twenty out of the thirty sample provinces/municipalities have positive cumulative net shifts. For the top ten provinces/municipalities, five of them are from western China, three of them from central China and only two of them from eastern China. In contrast, six of the bottom ten provinces/municipalities are from eastern China. The poor performance of the provinces/municipalities in eastern China is reflected in Figure 4, which shows the cumulative net shifts of the three regions. To see why the rankings of the provinces/municipalities from eastern China, the relatively rich region, are relatively low, we further look at the cumulative IME, CE and IE, which are showed in Tables 3 to 5. Table 3 presents the rankings of cumulative IME of engineering. Eighteen of the thirty provinces/municipalities gained positive cumulative IME. We find that only three of the top ten provinces/municipalities are from eastern China while five of the bottom ten provinces/municipalities are from this region. Similar results can be found in Table 4, which shows the cumulative CE of engineering. There are nineteen provinces/municipalities with positive cumulative CE. Among the top ten provinces/municipalities of cumulative CE, only two of them are from eastern China while seven out of the bottom ten are from this region. Different from NE, IME and CE, only seven of the thirty provinces/municipalities are with positive cumulative IE, which are showed in Table 5. By definition, one province/municipality can have a positive IE if the growth rate and the share of this particular province/municipality are higher or lower than the group level simultaneously. The DSSA results indicate that only seven of our sample provinces/municipalities satisfy this condition. Overall, eighteen, eighteen and nineteen provinces/municipalities got positive cumulative net shift, IME and CE, respectively, which means two third of the sample provinces/municipalities are with positive cumulative net shift, IME and CE. The structure composition of engineering group is satisfactory for western and central China but not for eastern China. By analyzing the breakdown of each of the components of IME, CE and IE, we find that the average growth rate of researchers in engineering

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related institutions and enterprises is -2.46 percent and the annual growth rates are negative in most of the sample years. It is clear that engineering is a sun-set research group. However, the shares in this research group are higher than the group level while the growth rates of the number of researchers in this research group are often lower than the average group level for most of the provinces/municipalities in eastern China. All these facts cause the low rankings in IME and CE and thus net shift for most of the provinces/municipalities in eastern China.

**Table 2.** Cumulative net shift of engineering from 1996 to 2007

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<thead>
<tr>
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<th>Rank</th>
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**Table 3.** Cumulative industry mix effect of engineering from 1996 to 2007

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**Table 4.** Cumulative competitive effect of engineering from 1996 to 2007

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Table 5. Cumulative interactive effect of engineering from 1996 to 2007

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Figure 4. Cumulative Net Shifts of the Three Regions for Engineering

DSSA results for agriculture

The number of agriculture researchers accounts for only 3 percent of total number of researchers in China in 2007. The overall performance of the three regions can be found in Figure 5, which shows the cumulative net shifts of these three regions. From Figure 5, we find that the overall performance of provinces/municipalities in western China is the best, especially after 2003 while the performance of provinces/municipalities in eastern China is poor with a declining trend during the whole sample period. Further detailed DSSA results are showed in Tables 6 to 9. There are twelve, fifteen, thirteen and eighteen provinces/municipalities with positive cumulative net shift, IME, CE and IE, respectively for agriculture researcher group. Table 6 shows the cumulative net shift for the thirty provinces/municipalities. Of the top ten provinces/municipalities in net shift of agriculture, seven of them are from western China and the remaining three are from central China while seven of the bottom ten provinces/municipalities are from eastern China. As most of the agriculture output is from central and western China, this result is
consistent from our expectation that research talents in agriculture related institutions and enterprises are mainly in provinces/municipalities from central and western China where R&D expenditure on agriculture is generally more than that of the provinces/municipalities. The growth rates of agriculture researchers are positive in eight of the eleven years of our sample period and the average growth rate is 1.64 percent. Thus, this researcher group is a sun-rise researcher group. By analyzing the results of IME, CE and IE, we find that those provinces in western China which top the cumulative net shift ranking are also ranked high in cumulative IME and CE. For example, Xinjiang and Ningxia are among the top ten provinces/municipalities in both cumulative IME and CE. In contrast, most of the provinces/municipalities from eastern China are ranked low in both IME and CE. By checking the breakdown of IME and CE, we find that those eastern provinces/municipalities are with lower shares and growth rates than the corresponding group levels. The well-structured of the agriculture researchers group is also reflected by eighteen of the thirty provinces/municipalities which all have positive cumulative IE. For the provinces/municipalities in central China, not like their counterparts in western and eastern China, they are evenly distributed in the DSSA rankings for agriculture researcher group. From the above analysis, we know that the distribution of research persons in agriculture researcher group is proper and the overall structure is satisfactory.

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Table 8. Cumulative competitive effect of agriculture from 1996 to 2007

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Table 9. Cumulative interactive effect of agriculture from 1996 to 2007

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Figure 5. Cumulative Net Shifts of the Three Regions for Agriculture

DSSA results for scientific research
In this subsection, we investigate the scientific researcher group. The number of scientific researchers in institutions and enterprises only
accounts for 2 percent of the total number of researchers in China. During our sample period, we see that, for the growth rates of the number of scientific researchers, except for a sudden drop of 6 percent in 2007, followed by a 6.48 percent recovery, there were only two small declines of 0.87 and 0.21 percent in 1997 and 2001, respectively. The average growth rate in our sample period is 2.43 percent and we can say that scientific researcher group is a sunrise researcher group. The overall performance of the three regions for scientific researcher group is presented in Figure 6. The provinces/municipalities in eastern China has obvious advantage in the scientific researcher group as reflected by the consistently positive cumulative net shifts during the whole sample period. In contrast, the overall performance of the provinces/municipalities in western China is not satisfactory with negative cumulative net shifts for the whole sample period. Tables 10 to 13 are the DSSA results, which show the net shift, IME, CE and IE, respectively. There are fourteen, fourteen and fifteen of the thirty provinces/municipalities with positive net shift, IME and CE respectively. The provinces/municipalities from eastern China seems better in scientific researcher group as reflected by six of the top ten and only one of the bottom ten provinces/municipalities in net shift are from this region. In contrast, none of the top ten provinces/municipalities in net shift of scientific researcher group is from western China and we are able to find six of them in the bottom ten. Following our standard procedures, we check the results from IME, CE and IE. We find that seven of the top ten provinces/municipalities in IME are from eastern China. The breakdown of IME equation further shows that most of the provinces/municipalities in eastern China have higher shares in scientific researcher group than the average group level, which together with the property of sunrise researcher group results in the good rankings of IME for provinces/municipalities in eastern China. For IE, five of the eleven provinces/municipalities with positive IE in scientific researcher group are from the western China. By checking the breakdown of IE, we find that provinces/municipalities in western China usually have lower share and slower growth rates than the average levels of the group in the scientific researcher group. The interaction between low shares and low growth rates results in the relatively high rankings of IE for provinces/municipalities in western China. The DSSA results from this subsection indicate that the regional distribution of scientific researchers in institutions and enterprises are not even, where the absolute numbers and growth rates of scientific researchers in provinces/municipalities from eastern China are higher than those of western China. One exception from the provinces in eastern China is Guangdong province which was ranked twenty in cumulative net shift and twenty eight in cumulative IME. The breakdown of the DSSA equations shows that both the shares and growth rates of Guangdong province in scientific researcher group are not satisfactory. The shares of the number of scientific researchers in total number of researchers are consistently lower than the average group level, although the magnitudes are not high. Six of the eleven growth rates of Guangdong provinces in the number of scientific researchers are negative, which is also a poor result.

Table 10. Cumulative net shift of science from 1996 to 2007

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Table 11. Cumulative industry mix effect of science from 1996 to 2007
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Table 12. Cumulative competitive effect of science from 1996 to 2007

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Table 13. Cumulative interactive effect of science from 1996 to 2007
DSSA results for health care research

The number of health care researchers are ranked third of the five researcher group, accounting for 16 percent of the total number of researchers. The time series of annual growth rates of the number of researchers in health care related institutions and enterprises are consistently positive during the whole sample period and the average growth rate is 2.29 percent, which implies that the health care researcher group is a sunrise researcher group. Different from the scientific researcher group, the overall performance of provinces/municipalities in central China is better than those of the other two regions (Figure 6). Except for the beginning year of the sample period, the cumulative net shifts are consistently positive in the remaining sample period for provinces/municipalities in central China. In contrast, the cumulative net shifts of provinces/municipalities in eastern and western China are negative in most of the sample period. However, the gap in the cumulative net shifts is narrowing down since 2001 between central and eastern China. In 2007, the performance of central and eastern China is very similar. The DSSA results for this researcher group are in Tables 14 to 17. There are twelve, fifteen, fourteen and eleven positive net shift, IME, CE, and IE, respectively, none of which have positive numbers more than half of the total numbers of provinces/municipalities. For regional distribution, we find that the regional distribution is even. There are four, four and three top ten provinces/municipalities of net shift in health care are from eastern, central and western China respectively. Similar results can be found in IME, CE and IE as we can see that the numbers of provinces/municipalities from each region in top ten and bottom ten of the rankings of IME, CE and IE are quite similar. In other words, no region has competitive advantage in terms of attracting more health researchers. However, eastern China has relatively higher attractiveness to health researchers as three of the top five provinces/municipalities are from this region. Guangdong province is the top performer in this researcher group as it is not only ranked top ten in all the four DSSA results but also ranked first in net shift, IME and IE. By checking the breakdowns of IME and CE, we find that the shares in health care researcher group are higher than the average group level from 1999 and nine of the eleven annual growth rates are positive in Guangdong province. The DSSA results indicate that Guangdong province has done an excellent job in attracting researchers in health care. In contrast to the competitive advantage Guangdong province has gained in health care researcher group, we find that Beijing is only ranked twenty one in net shift of health care. The breakdown of the IME and CE shows that Beijing do have higher share in health care than the average group level which is reflected by the high ranking in IME. However, the annual growth rates of researcher number are lower than the average group level in seven of the eleven years, which leads to a very low ranking in CE. The DSSA results indicate that although Beijing have competitive advantage in terms of absolute number of health care researchers and the shares of health care researchers in total number of researchers, it needs to increase its investment in attracting health care research persons to keep up the pace of development in China.

**Table 14. Cumulative net shift of health care from 1996 to 2007**

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### Table 15. Cumulative industry mix effect of health care from 1996 to 2007

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### Table 16. Cumulative competitive effect of health care from 1996 to 2007

<table>
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<td>23219.46</td>
</tr>
<tr>
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<td>Henan</td>
<td>22066.88</td>
</tr>
<tr>
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</tr>
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</tr>
<tr>
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</tr>
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<td>8858.98</td>
</tr>
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<td>9</td>
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<tr>
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### Table 17. Cumulative interactive effect of health care from 1996 to 2007

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<tr>
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<td>Shanxi</td>
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<td>Neimeng</td>
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</tr>
<tr>
<td>11</td>
<td>Gansu</td>
<td>-15961.37</td>
</tr>
<tr>
<td>12</td>
<td>Fujian</td>
<td>-17084.11</td>
</tr>
<tr>
<td>13</td>
<td>Hainan</td>
<td>-23426.79</td>
</tr>
<tr>
<td>14</td>
<td>Jilin</td>
<td>-27851.75</td>
</tr>
<tr>
<td>15</td>
<td>Guangxi</td>
<td>-32918.77</td>
</tr>
</tbody>
</table>
The number of education researchers in institution and enterprises are the highest among the five researcher groups, which accounts for 57 percent of the total number of researchers. To provide an overall picture of the performance of the three regions, we consult to Figure 8, which shows the dynamics of cumulative net shifts in education research for the three regions. From Figure 8, we find that both central and western China have positive cumulative net shifts in education research for most of the time period. In contrast, the overall performance of the provinces/municipalities in eastern China is weak and the cumulative net shifts are consistently negative. As most of the researchers are from universities and the Chinese government invests huge amount of fund in supporting research activities in universities, it is not surprised that nearly 60 percent of researchers are in education related institutions and enterprises. Firstly, we look at the time series of annual growth rates of this researcher group. Although the magnitudes of the growth rates are declining, all of them are consistently positive during the whole sample period, which means that the education researcher group is a sunrise researcher group. Secondly, we check the DSSA results for the education researcher group which are presented in Tables 18 to 21. After checking the rankings of net shift, IME, CE and IE, we find that the distribution of education researchers in top ten provinces/municipalities is quite even among the different regions in China. For net shift, three, three and four top ten provinces/municipalities are from eastern, central and western China. Similar distribution patterns can be found in the rankings of IME and CE. However, we also find that more than half of the bottom ten provinces/municipalities are from eastern China. The breakdown of the IME and CE of these eastern China provinces/municipalities shows that both the shares and the annual growth rates are lower than the average group level. The reason for the lower than the share and growth rate of the whole country for these eastern provinces/municipalities may be that to ease the inequality in education among different regions, universities are encouraged to admit more students and there were so many new universities, either

**DSSA results for education research**

<table>
<thead>
<tr>
<th>Rank</th>
<th>Province</th>
<th>Net Shift</th>
<th>Rank</th>
<th>Province</th>
<th>Net Shift</th>
</tr>
</thead>
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<td>Sicuan</td>
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<td>-246.60</td>
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<td>Hubei</td>
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</table>
state-owned or privately set up, founded in central and western China. In contrast, the numbers of students in universities in eastern China were quite stable in the last ten years. Moreover, the property of the research work done in those top universities in eastern China also determine that the orientation of their development may be technology intensive not researcher intensive, as the most advanced machines and technologies are applied in research centers in those universities while universities researchers, limited by technology, may do more fundamental researches which are more researcher intensive.

Table 18. Cumulative net shift of education from 1996 to 2007

<table>
<thead>
<tr>
<th>Rank</th>
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<th>NS</th>
<th>Rank</th>
<th>Region</th>
<th>NS</th>
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Table 19. Cumulative industry mix effect of education from 1996 to 2007

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<th>Rank</th>
<th>Region</th>
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Table 20. Cumulative competitive effect of education from 1996 to 2007

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<th>Rank</th>
<th>Region</th>
<th>CE</th>
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<td>46789.43</td>
<td>23</td>
<td>Jiangsu</td>
<td>-55255.17</td>
</tr>
</tbody>
</table>
In the previous sections, we analyze the structure of the researchers in China by DSSA. For each of the five researcher group, we judge the performance of provinces/municipalities by comparing their rankings in cumulative net shifts and further explain the results from cumulative net shifts by comparing the rankings in cumulative IME, CE and IE respectively. However, one may argue that these rankings may be attributable to other factors such as per capita GDP growth. A province/municipality with higher economic growth may help gaining competitiveness in attracting more researchers. In other words, these rankings may be just a reflection of the per capita GDP growth.

To answer this equation, we may refer to a non-parametric correlation analysis, called Spearman rank correlation analysis. Spearman (1904) proposed a simple method to assess how well an arbitrary monotonic function could describe the relationship between two variables. The most significant advantage of this method is that it does not require any specific assumption on the distribution and
particular nature of the relationship between variables. The equation of Spearman rank correlation, denoted by $\rho$, is\(^7\):

$$\rho = 1 - \frac{6 \sum d_i^2}{n(n^2 - 1)}$$

where $d_i = x_i - y_i$ is the difference between the ranks of corresponding values of series $X_i$ and $Y_i$. $n$ is the number of observations in each dataset (assume that the same number of observation for each dataset).

We perform the Spearman rank correlation analysis to examine the relationship between the average per capita GDP growth rate and the rankings of cumulative net shifts for the five researcher groups respectively. The statistical results of Spearman rank correlation analysis is presented in Table 22, where we provide the correlation coefficients and the corresponding $p$-value for each pair of series examined in our statistical analysis. We find that except for the health care researcher group, the cumulative net shifts rankings of the other four researcher groups do not have any significant correlation with per capita growth rate.

### Table 22. Spearman Rank Correlation Analysis

<table>
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<th>Growth</th>
<th>Engineering</th>
<th>Agriculture</th>
<th>Science</th>
<th>Health</th>
</tr>
</thead>
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<td>0.01</td>
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</table>

Note: The correlations and their $p$-values are reported.

\(^7\) If the ranks of the two series $X_i$ and $Y_i$ are equal, we should use the traditional Pearson’s correlation coefficient

$$\rho = \frac{n(\sum x_i y_i) - (\sum x_i)(\sum y_i)}{\sqrt{[n \sum x_i^2 - (\sum x_i)^2][n \sum y_i^2 - (\sum y_i)^2]}}$$

In this paper, we analyze the structure of the research talent pool of China by studying the relative competitiveness in the five researcher groups for the 30 provinces/municipalities from 1996 to 2007. To analyze the R&D development of a country, we can judge from two aspects: R&D expenditure and the number of researchers. In 2007, the R&D expenditure in China was the third largest, only behind the United States and Japan. The R&D intensity has risen 248 percent from 1995 to 2007, reaching 1.48 percent of GDP. The National Guidelines for Medium- and Long-term Plans for Science and Technology Development (2006-2020) released by the Chinese State Council set a target to raise the share of China’s R&D expenditure in GDP to 2 percent by 2010 and to 2.5 percent or more by 2020. Except for increasing expenditure on R&D, the research talents also play a crucial role to achieve the R&D goal, because they not only determine how to use the money efficiently but also attract further investment in R&D if they are able to generate more inventions and the inventions or innovations generated can be transferred to commercial products smoothly. The scientific and technological personnel in institutions or enterprises are divided into five researcher groups in China: engineering, agriculture, science, health care and education. We are interested in analyzing whether the structure of the R&D talent pool is appropriate by means of DSSA. DSSA is a mathematical method to analyze the competitiveness of each of the provinces/municipalities under investigation. A province/municipality is said to gain competitive advantage if it has a positive net shift in a particular researcher group. The net shift can further be divided into four components: IME, CE and IE. For each of the researcher group, we rank the provinces/municipalities by their values of net shift, IME, CE and IE, respectively. Through comparing the rankings of net shift, IME, CE and IE respectively, we are able to find out not only whether a particular province/municipality invests on the five researcher groups appropriately but also whether there is region inequality among the researcher groups investigated and what the source behind this

**Concluding Remarks**

In this paper, we analyze the structure of the research talent pool of China by studying the relative competitiveness in the five researcher groups for the 30 provinces/municipalities from 1996 to 2007. To analyze the R&D development of a country, we can judge from two aspects: R&D expenditure and the
inequality is.

For the engineering researcher group, we find that provinces/municipalities from eastern China occupy most of the places in the bottom of the rankings of net shift, IME, CE and IE. By analyzing the breakdown of the DSSA equations, we find that the shares in this researcher group are higher than the group level for provinces/municipalities in eastern China while this researcher group is a sunset researcher group. Furthermore, the growth rates of provinces/municipalities from eastern China in this researcher group are often lower than the group level, which lead to negative CE. The low IMEs and CEs lead to the low net shift of the provinces/municipalities in eastern China. In contrast, most of the provinces/municipalities on the top rankings of net shift, IME and CE are from central and western China. In a word, the provinces/municipalities from western and central China are generally gaining competitive advantage because they pay smaller attention to this sunset researcher group. For the agriculture researcher group, the provinces/municipalities from central and western China occupy the top ten positions for net shift, IME and CE while most of the bottom ten provinces/municipalities are from eastern China. This result is consistent with the reality in China as the agriculture output in China is mainly from central and western China. It is not surprised to see that the local governments of provinces/municipalities in these two regions to place more attention to attract the agriculture research personnel. For the scientific researcher group, the provinces/municipalities from eastern China seems more attractive as six of the top ten and only one of the bottom ten provinces/municipalities in net shift are from this region while none of the top ten provinces/municipalities in net shift of scientific researcher group is from western China and we are able to find six of them in the bottom ten. One exception from the provinces/municipalities from eastern China is Guangdong province in terms of its lower shares and growth rates than group level in the scientific researcher group. As for the health care researcher group, the distribution of provinces/municipalities from different regions is quite even and no region has competitive advantage in terms of attracting more health researchers. Eastern China seems having some competitive advantage as three of the top five in net shift are from this region. Two provinces/municipalities have attracted our interest. In contrast to the poor performance in attracting researchers in scientific researcher group, Guangdong province is the top performer as it is ranked first in net shift, IME and IE. In contrast, Beijing has not a good job in attracting research persons in this researcher group. The last sector we analyzed is the education researcher group, which is the largest researcher group in China. The consistently positive annual growth rates indicate that this group is a sunrise researcher group. The performance of the provinces/municipalities from eastern China is poor as the shares in education researcher group are consistently lower than the group level. Furthermore, the annual growth rates in these provinces/municipalities are also lower than the group level. These two facts cause the low rankings in net shift, IME and CE for most of the provinces/municipalities from eastern China. The reason may be that the top universities are mainly located in eastern China and the researches conducted in those eastern China universities are normally more technology intensive not researcher intensive. Moreover, to achieve the balanced education, local governments of provinces/municipalities in central and western China were encouraged to found more universities to provide more opportunities for students in those regions, which may lead to the high growth rates of research persons in those regions.

Some researchers may argue that the rankings in the cumulative net shifts may be influenced by other factors like per capita GDP growth. They postulate that provinces/municipalities with higher per capita GDP growth may obtain higher rankings in cumulative net shifts of the DSSA analysis. To offer some insights to this problem, we perform the Spearman rank correlation analysis on per capita GDP growth and the cumulative net shifts of the five researcher groups. The statistical results show that except for the health care researcher group, we are not able to find statistical significant correlation between per capita GDP growth and rankings in cumulative net shifts in DSSA.

To put everything into a nutshell, the structure of the researcher groups in the provinces/municipalities of eastern China is not suitable as those provinces/municipalities allocated too much on engineering which is a sunset researcher group by our definition. In contrast, they did not pay enough attention to attract education researchers, which is reflected by the lower shares and growth rates than the corresponding growth levels. The provinces/municipalities from central and eastern China seem having better structure in the five researcher groups as they invest more on agriculture and education researcher groups, where the central and western provinces/municipalities are the main producers of agriculture products and they are less developed in education.

As the huge research talent pool is the main factor that attracts foreign direct investment in China, we suggest the Chinese government planners should implement more effective measures to enlarge the researcher base and more importantly improve the structure of the researcher groups by investing more
on the sunrise researcher groups.

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ANOTHER LOOK AT PRICE PROMOTION

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Abstract
Weekly sales at retail stores exhibit several patterns that the existing literature on price promotion does not fully capture. In this paper we develop a simple symmetric model where duopoly manufacturers distribute competing brands through a monopoly retailer to serve consumers with heterogeneous reservation prices. We show that the heterogeneity in consumers’ reservation prices coupled with the retailer’s market power is sufficient to resolve the deficiency in the literature. We then show that, while pricing patterns under this model differ significantly from those under a model where the retailer has no market power, the manufacturers’ expected profits are the same in both cases.

Keywords: Sales Promotion, Pricing, Game Theory

Introduction
Price promotion at both the wholesale and retail levels is a ubiquitous phenomenon. As Raju et al. (1990) comment, short-term discounts are one of the major competitive weapons in the brand manager’s arsenal. Blattberg et al. (1995) also note that nondurable goods manufacturers spend more money on promotion than on advertising. The most frequently seen price promotions are probably the weekly markdowns at grocery stores. Table 1 below presents a series of such promotions.

Table 1 illustrates several prominent and interesting patterns. First, competing brands of the same product are featured in different promotional periods. That is, in a given week, at most one of the competing brands is featured. For example, Perdue chicken breast was advertised on sale during the week of March 25. Then, during the week of April 1, Tyson chicken breast replaced Perdue’s in the flyer.

Second, the promotional prices for the same product are similar both across competing brands and across different sales periods, even when the regular prices are different. For instance, Brawny and Scott paper towels had about a $2 difference in their regular prices, but their sales prices were both $4.99/pack. Third, the promotional prices represent relatively large discounts from the corresponding regular prices. In our sample above, we see price cuts of 30%-50% of the regular prices. Fourth, each of the brands was sold at the regular price more than half of the times. These patterns naturally invite a search for theoretical explanations. In line with the importance of price promotion, there has been substantial research to rationalize price promotion. Varian (1980) shows that stores may use price promotion to exploit information heterogeneity among consumers. Baye and Morgan (2001) further the analysis by studying the impact of a market for price information on retail pricing strategies on the homogeneous product market it serves. Along a similar line, Narasimhan (1988) analyzes differences in consumers’ brand loyalty and shows that firms employ mixed pricing strategy to attract brand switchers. Agrawal (1996), Lal and Villas-Boas (1998), Raju et al. (1990), Rao (1991) and Simester (1997) strengthen this argument of brand loyalty and extend it to more general settings. Conlisk et al. (1984), Sobel (1984), and Pesendorfer (2002), on another hand, examine price promotion in intertemporal settings and relate it to intertemporal price discrimination and intertemporal demand effects.

While these existing studies cast tremendous insights on understanding firms’ price promotion decisions, they cannot satisfactorily account for the patterns revealed in Table 1. In particular, models with common reservation price, such as Varian (1980), Lal and Villas-Boas (1996, 1998), and Baye and Morgan (2001), predict that everything is on sale everyday, yet the depth of sale can be any amount of a random draw from the equilibrium price distribution. Such predictions contradict some of the main characteristics of weekly sales at Kroger; namely, the alternating featuring of different brands in different weeks, use of the same sales price for competing brands, and deep discounts from the regular prices. In addition, in the Kroger flyers we observe that both of the competing brands have positive probabilities to be priced at their regular and promotional prices, whereas models with asymmetry

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1 Promotions at the wholesale level are called trade deals or trade promotions, and promotions at the retail level are called retail promotions. Among various forms of sales promotions, we concentrate solely on price cuts in this paper.

2 The data is obtained from weekly sales flyers at the Kroger stores in Bloomington, IN. The promotional prices listed in the flyers were typically valid for one week.

3 This phenomenon is also noted by Lal (1990), who attributes it to collusion between national brands.

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in brand loyalty, such as Narasimhan (1988) and Raju et al. (1990), prescribe that only the stronger brand has a positive probability of being sold at the regular price. Moreover, many studies in the literature, including Varian (1980), Sobel (1984), Narasimhan (1988), Lal (1990), Raju et al. (1990), and Baye and De Vries (1992), abstract away from the channel setting. But as shown by Lal and Villas-Boas (1996, 1998) and Baye and Morgan (2001), strategic interaction between channel members plays an important role in their pricing decisions.

Table 1: Price Promotions Observed in Kroger Weekly Flyers

<table>
<thead>
<tr>
<th>Product</th>
<th>Boneless Skinless Chicken Breast</th>
<th>Orange Juice (64oz Carton)</th>
<th>8 Roll Paper Towel</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Brand</strong></td>
<td>Perdue</td>
<td>Minute Maid</td>
<td>Brawny</td>
</tr>
<tr>
<td><strong>Regular Price</strong></td>
<td>$4.99/lb</td>
<td>$3.75/carton</td>
<td>$9.45/pack</td>
</tr>
<tr>
<td>03/25/2004</td>
<td>$1.99/lb</td>
<td>Not featured</td>
<td>Not featured</td>
</tr>
<tr>
<td>04/01/2004</td>
<td>Not featured</td>
<td>Not featured</td>
<td>Not featured</td>
</tr>
<tr>
<td>04/08/2004</td>
<td>Not featured</td>
<td>Not featured, $1.99/carton</td>
<td>Not featured</td>
</tr>
<tr>
<td>04/15/2004</td>
<td>Not featured</td>
<td>Not featured</td>
<td>Not featured</td>
</tr>
<tr>
<td>04/22/2004</td>
<td>$1.99/lb</td>
<td>Not featured, $1.99/carton</td>
<td>Not featured</td>
</tr>
<tr>
<td>04/29/2004</td>
<td>Not featured</td>
<td>Not featured</td>
<td>Not featured</td>
</tr>
</tbody>
</table>

In this paper, we employ a parsimonious model to reconcile the above inconsistency between the observed sales patterns and theory, and to also analyze how market structure affects promotional decisions. In our symmetric model, duopoly manufacturers distribute close substitutes through a common monopoly retailer to serve consumers with heterogeneous reservation prices. We show that the heterogeneity in consumers’ reservation prices (reservation price differential hereinafter) coupled with the retailer’s market power is sufficient to drive all the promotional patterns revealed in Table 1. We show that the retailer employs pure-strategy Hi-Lo pricing to exploit the reservation price differential, and it only does so when the size of the low valuation segment is large enough. The competing manufacturers, on the other hand, use mixed strategies in wholesale price cuts to compete for the chances of serving low valuation consumers.

We also highlight the effects of channel structure on sales patterns and welfare. A powerful retailer in the channel is able to set stickier retail prices that are not linear functions of the wholesale prices. Thus the Hi-Lo retail pricing will not break down even when the wholesale prices are only one penny apart. On the other hand, if the retailer has no power in the channel, pricing patterns at both the retail and wholesale levels change significantly. There are more price promotions and deeper discounts to benefit the consumers, but the manufacturers’ expected profits remain the same.

Our model integrates the extant models of price promotion with added features, which allows us to obtain better data fitting equilibrium pricing patterns than those predicted by the existing studies. For example, our base model can be thought as Narasimhan’s (1988) model with an added monopoly retailer and with reservation price differential between loyal consumers and brand switchers. Our direct selling model can be thought as a general version of Varian’s (1980) and the no-loyalty case of Lal and Villas-Boas’s (1998) models that allow reservation price differential. While none of these three models predicts a fixed promotional and/or regular price as seen in the Kroger flyers, our model does.

The rest of the paper is arranged as follows. In Section 2, we first analyze the base model with a powerful retailer, then deprive the retailer of channel power and solve for the resulted equilibrium, and in the end compare the price promotion patterns from these two models. Section 3 concludes.

Concluding Remarks
In this paper we examine the incentives for price promotion from a different perspective: the segmentation of consumer market based on reservation price. The results derived from our model do not depend on brand loyalty and can be applied to both the cases of repeatedly purchased products and those of durable goods. The predictions of our model are consistent with the price promotion patterns observed at retail stores. We have also shown that (1) heterogeneity in consumers' reservation prices is an important determinant of competitive price promotion strategies, (2) differences in market structure can result in significant differences in the pricing patterns at both the retail and wholesale levels, but (3) because of competition in the retail market, changes in market structure do not necessarily alter wholesale profitability.

References


RECYCLING E-WASTE: A SOLUTION THROUGH THIRD PARTY RECYCLER

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Abstract

With 50 million metric tons of e-waste disposed worldwide each year, e-waste recycling has become an increasingly important issue globally. The U.S. alone generated a total of 3.01 million tons of e-waste in 2007, of which only 13.6% was recycled. Improper disposal of e-waste poses an immediate and prominent threat to environmental and public health. Many electronic vendors have initiated either the Expended Producer Responsibility or the Producer Stewardship and launched manufacturer-sponsored recycling programs. Many of these programs, however, are in trouble because of the fee generated for recycling, thereby blocking the road for effective actions. In this paper, we propose a third party recycler model as an alternative solution to e-waste recycling. The third party recycler works as the intermediary between consumers (source of e-waste) and electronic vendors (recipient of recycled items) to recycle disposed electronics properly. The proposed information system is composed of five modules and supports the business operations and functionalities of the third party recycler. We hope the third party recycler structure will be adopted globally in the near future.

Keywords: e-waste, recycle, extended producer responsibility, producer stewardship, information system

Introduction

“Computers don’t have exhaust pipes, but their environmental impact is no longer invisible. The cumulative life cycles of billions of machines, from manufacture to usage to disposal, are combining into an environmental footprint large enough to attract widespread attention.” [18]

The advent of modern computing technologies is now providing powerful, affordable, and easy-to-use electronic devices and equipments to individual and corporate business users in support of communication, collaboration, and business operations, most of which are now carried out in a global manner. As a result, people have become increasingly dependent on such devices and equipment and consume a large amount of electronics in their everyday activities.

Despite the benefits, fast-growing computing technologies, unfortunately, have a dark side. The life span of electronics has been continuously shrinking because of the introduction of more superior and technologically advanced items [16]. Consequently, older computing devices are being replaced at an accelerated pace and generating an astonishingly large amount of e-waste, the numbers of which continue to increase every year. For instance, the world produces 20 to 50 million metric tons of e-waste annually [4]. China alone adds 2 million tons of e-waste and the number increases at rate of more than 10% each year, [20] American consumers replace their mobile phones every one and half years on average [14], producing 130 million discarded cell phones annually nation wide [12]. In China, 70 million mobiles phone and 5 million PCs are being discarded each year [21]. Likewise, more than 50 million PCs are disposed in the U.S. each year [18], with this number accounting for only 10% of the disposable computers [12]. The majority of defunct computers are not being used and simply collect dust.

In the past decade, governments and organizations worldwide have been investigating the causes and impacts of e-waste and have made great efforts to regulate the collecting and recycling of e-waste through legislative and public means. Extended Producer Responsibility (EPR) is so far the most widely adopted legislation, especially in the United States. Such recycling structure, however, has long been challenged by the fee generated for recycling and will be addressed by either the producer responsibility model or the consumer responsibility model.

In this paper, we propose a third party recycler model as an alternative solution to e-waste recycling. The third party recycler performs as the intermediary between consumers (source of e-waste) and electronic vendors (recipient of recycled items) to collect, inspect, recycle, and
Electronic waste (e-waste), sometimes called Waste Electrical and Electronic Equipment (WEEE), has been defined loosely to refer to any electronic products and appliances near or at the end of their useful life that have become obsolete, broken, or discarded [2][19]. The European Union (EU)’s WEEE Directive uses ten product categories to describe e-waste to include IT and telecommunication equipment, household appliances, consumer equipment, and so forth [9]. Generally speaking, e-wastes are commonly seen as discarded computers (desktop and laptop), monitors, video game consoles, mobile phones, printers, telephones, fax machines, TVs, VCRs, DVD players, video cameras, stereo systems, digital music players, and other electronic equipment.

The prevalent problem of e-waste recycling mainly comes from three issues. First, the amount of e-waste generated each year is enormous and keeps rising. According to the 2007 report released by the United States Environmental Protection Agency (EPA), the U.S. generated a total of 3.01 million tons of e-waste in 2007, an increase of 37.4% from five years ago. Unfortunately, only 13.6% of the 3.01 million tons were recycled, leaving 2.6 million tons of e-waste dumped into landfills and incinerators [8]. According to Electronics Take Back Coalition, an environmental activist group, all human kind globally generate up to 50 million tons of e-waste every year [4]; however, only a small percentage of this amount of e-waste is being recycled and 70% of the global e-waste is being dumped in China at the rate of 2,800 tons per hour [20]. Although the percentage of e-waste recycled has been slowly rising in the past decade, in the U.S. it stubbornly stayed in the lower ten percent range.

Second, toxic substances in e-waste are another aspect to the resisting to recycling e-waste products. E-waste contains toxic materials, such as lead, mercury, cadmium, brominated flame retardants (BFRs), plastics, and beryllium, all of which are harmful to humans and their environment [3]. In the U.S. and Europe, e-waste account from one to four percent of solid waste and is responsible for more than 70% of toxic waste annually [7]. Such hazardous material can leak into the groundwater when buried, contaminating the landfills, or it can enter the air through burning or dust [12].

Unlike clothes donated to the Salvation Army, e-waste has to be recycled properly because of the toxic material involved. Improper disposal of e-waste will pose an immediate and prominent threat to environmental and public health.

Some considerable amount of e-waste, meant to be recycled are, in fact, handled and processed through improper or even illegal means. Each year, tons of e-waste is transported to developing countries, such as China and South Africa, where valuable parts of materials, such as microchips, are stripped off by skilled workers and then later repackaged and resold to the electronics market. Some of these dangerous counterfeits made their way to, unfortunately, U.S. military computers and satellites [10].

The same story continues in the sweatshops of e-waste disassembling factories in India. Workers, some young children, dig in the piles of old computers, hard drives, and circuit boards, searching for precious metal such as gold, copper, and palladium [15]. Without the regulations from the local government, Indian produces 1.5 million tons of e-waste a year and illegally imports at least half of that amount from the West [15].

Last but not the least, individual consumers who are willing to dispose their used electronics properly often fail because of the lack of simple and convenient channels for recycling. Three out of four consumers find themselves clueless as how and where to dispose e-waste [12]. Instead of letting e-waste end up at the curb, governments and organizations around the globe are now taking effective actions toward the proper disposal and recycling of e-waste. Building a national e-waste recycling infrastructure for consumers and vendors becomes one of the most immediate and logical solutions for most countries.

Extended Producer Responsibility

The daunting fact of e-waste has caught the attention of heads of governments and organizations when they realized that a joint effort between the parties is more than necessary to address e-waste recycling successfully. Introduced by Organization for Economic Cooperation and Development in 1998 in U.S., the Extended Producer Responsibility (EPR), also called Producer Stewardship (PS), makes each producer responsible for “collecting and processing its own products at the end of their life” [16, p.337]. The European Union defines a producer as “any person
who 1) manufactures and sells own brand electrical and electronic equipment, 2) resells equipment produced by other suppliers under its own brand, or 3) imports or exports electrical and electronic equipment on a professional basis into a Member State” (European Union, 2002, p. L 37/27). The EPR, therefore, requests producers to take responsibility and minimize its negative environmental impacts from designing recyclable products in the first place (eco-design) to collecting those to be disposed at the end of the products’ useful lives.

Some major electronic vendors have initiated producer stewardship and have launched manufacturer-sponsored recycling programs to facilitate the recycling of e-waste, making good public image by taking the stand in support of environmental protection and green IT. Among this league are some well-known leaders in the computing and related industry. In 2005, Apple Inc. launched an iPod recycling program that allows users to trade their used iPods for a 10 percent discount on a new one [18]. Sony launched the Take Back Recycling Program in U.S. in 2007, allowing consumers to recycle all Sony-branded products for free at 80 Waste Management Recycle America eCycling drop-off centers throughout the country [13]. As early as 1987, Hewlett-Packard (HP) launched a series of e-waste initiatives, one of which provides a pre-paid envelope to return the used printer cartridge for recycling with each new cartridge sold. By July 2007, HP has recycled more than 1 billion pounds of electronics and print cartridges around the world [13].

The vendor-sponsored recycling programs took a big leap toward effective e-waste recycling, largely because of pressure from government legislation. For example, in the U.S., so far 20 out of 50 states and New York City have passed e-waste legislation mandating e-waste recycling [6]. Another 13 states proposed the e-waste recycling law in 2009 to be voted by the states [5]. Similarly, in Canada, the Information Technology Association of Canada and Electro-Federation Canada together funded the Electronics Product Stewardship Canada (EPSC) in 2003 to “design, promote, and implement sustainable solutions for recycling end-of-life electronics.” [1]. In Europe, the Directive on WEEE and the Restriction of Use of Certain Hazardous Substances (ROHS) have been adopted by member countries to guide the collection, treatment, and recycling of e-waste [17].

One big obstacle to the adoption of EPR initiatives appears to be the establishment of the fee structure to address the costs involved in e-waste collection, disposal, and management. The current suggestion is for the producers, as defined by EPR regulations, to take responsibility for the costs. In the U.S., nineteen of the twenty states who have passed the e-waste legislation are adopting a producer responsibility code which require manufactures and vendors pay for the recycling costs, which includes providing a free recycling option to consumers. By contrast, California switched such financial burden to the consumers (consumer responsibility), charging a $6 to $10 disposal fee on every computer and television purchased [11]. An often seen dilemma is that producers are not willing to pay for recycling because such costs, very likely, were not being considered in the initial pricing model; on the other hand, consumers are reluctant to take such responsibility because in some states, there is still option to trash e-waste for free, or they may choose not to recycle at all.

**Third Party Recycler Solution**

An alternative solution to e-waste recycling is to introduce a third party recycler, who performs as the intermediary between consumers (source of e-waste) and electronic vendors (recipient of recycled items) to collect, inspect, recycle, and distribute the usable parts of electronics as well as dispose unusable parts properly. Figure 1 illustrates the workflow of e-waste recycling through the third party recycler.

![Figure 1: Workflow of E-Waste Recycling through Third Party Recycler](image)

E-waste recycling starts with the consumer (individual or corporate business), who generates an order for his/her electronics. Such interaction can be initiated through web sites, short text messages on mobile phones, and phone calls made through a call center of the recycler. Items to be recycled will be picked up from the consumer, who may also drop them off at any designated location. Once arriving at the recycling center, items will first be inspected to determine whether they should be repaired or disassembled. Electronics that can be reused will be repaired with data cleaned. For
those to be disassembled, a few options are available. Refurbishment will be recommended if, by replacing some key component(s), the item can perform all functionalities successfully. Some other parts of the disassembled items will be recycled and returned to the original producers or other manufacturers who are willing to take the recyclable parts. Plastics and metals recovered from recycled items can be used in new computers and other products. After disassembling, some parts can no longer be used and will be sent to the disposal sites to be treated properly. Both repaired and refurbished electronics will become available in markets and shops selling used items, often at a much lower price than a brand new piece of equipment.

The third party recycler model allows consumers to return used products for free, thereby eliminating the consumers’ financial responsibility for e-waste recycling. To operate as a self-sustaining organization, the third party recycler can make a profit by reselling repaired and refurbished electronics to used-item markets and by selling recycled parts to vendors, manufacturers, and producers. (A more detailed analysis demonstrating the profitability for the third party recycler using economic models is presented in a separate paper.)

Five modules of the E-Waste Recycling Information System support the functionalities and business operations of the third party recycler (Figure 2). The Client Management module provides a real-time, online inquiry of recycling orders and the processing information. The Recycling Processing module manages the recycling center, documents the information of repair, disassembling, refurbishment, recycling, and disposal of electronics. Inventory is maintained in the Inventory Management module. The information system also includes accounting functionalities to process, analyze, and report and manage costs. The Logistics module collects, processes, and presents information to support the reversed supply chain through which producers are now recipients of recycled items.

Following the conceptual framework of the third party recycler information system presented in this section, a development team will analyze and design the proposed information system, to be completed by March 2010. The information system will first be prototyped and tested in mainland China. Evaluation of system tests will be used for future revision and improvements.

Conclusions

E-waste recycling has become an increasingly important issue globally. Instead of letting millions of tons of e-waste be dumped to landfills, governments and organizations around the world are now taking effective actions toward the proper disposal and recycling of e-waste. In this paper, we propose a third party recycler model as an alternative solution for e-waste recycling. The third party recycler serves as the intermediary between consumers (source of e-waste) and producers (recipients of recycled items). By reselling repaired, refurbished, and recycled electronics and parts to producers, the recycler is able to maintain profitability in order to be self-sustaining. The recycling service thus is provided free of charge to consumers including both individuals and corporate businesses.

References

Recycling E-Waste: a Solution through Third Party Recycler


MANAGING SUPPLY CHAIN RISK – ROLE OF IT/IS

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Abstract
Measures aimed at making supply chains more efficient and responsive have also made them more vulnerable and exposed to disruptions. These measures include increased off-shoring and outsourcing of manufacturing and product development activities, contract manufacturing, global sourcing, lean operations with reduced inventories, centralised distribution and warehousing, reduction of supplier base and tightly integrated supply chains. In addition to this increased sensitivity of supply chains, a significant increase in the frequency and number of events leading to major disruptions, and their magnitude is forcing organizations to take supply chain risk more seriously. This paper discusses the concept of supply chain risk, supply chain risk management, its dimensions and the role of information technologies in general, and enterprise systems in particular. It will discuss the challenges faced by business organizations in leveraging existing and future information technologies and systems and their double-edged role. While industry reference models have the potential to internalise supply chain risk management processes, their ability in identification and mitigation of the supply chain risk is limited and depends upon other IT-dependent factors, such as information visibility, trust, security of intellectual property information, ability to collect snapshots of demand, inventory and capacity at key nodes in the supply chain, and the sense and respond capability of the organization to deal with material flow disruptions.

Keywords: Supply chain risk, Information technologies, Enterprise systems, SCOR.

Introduction
In the past decade, supply chain management has become a key competitive weapon for organizations and many large and small organizations have developed and implemented strategies to improve their supply chain performance. While the majority of these efforts focused on the improvement of cost efficiencies, organizations have generally underplayed the risks from supply chain disruption and paid less attention to the effectiveness of their supply chains (Hendricks & Singhal 2005). Though classic solutions, such as excess capacities, built-in slack in delivery times, and excess margins to cover costs of returns, have been deployed for minimizing supply chain risk in the past, they are not considered reliable in an environment dominated by Just-In-Time (JIT), off-shoring and outsourcing of business processes and globalised supply chains. Information technologies in general have played a major role and complemented these traditional solutions. By facilitating improved visibility of information and integration of processes, information technologies in general, and the current suite of enterprise systems in particular, are expected to play an important role in managing the supply chain risk.

In addition, the industry standard process reference models, such as the SCOR (Supply Chain Operations Reference) model, have facilitated standardization of processes and information across the supply chain and contributed to improvements in supply chain performance. While the contribution of these information technologies and industry-standard process reference models to the efficiencies of the supply chains are well identified in the literature, their ability to contribute to the identification and mitigation of supply chain risks is not known. This paper reports on a study investigating the role of an enterprise systems-enabled environment and the implementation of a SCOR model in managing the supply chain risk. It presents a brief review of the literature on supply chain risk management and the role of information technologies in managing the risk and identifies gaps in the literature. It will then discuss the research model, the methodology adopted in the study and the preliminary findings and implications.

Literature Review and Context
Managers are increasingly challenged to address a variety of opportunities and risks at both operational and strategic levels. Risk is studied in various disciplines, such as accounting, finance, information technology and operations (Cucchiella & Gastaldi 2006). Risk is defined as the likelihood for an uncommon event to happen, and the negative effects this event will have on the organization (Khan & Burns 2007). Risk therefore depends on the probability of the event, the number of possible
outcomes, the significance of these outcomes (Mitchell 1995, Khan &Burnes 2007) and the pathway that leads to the event (Ritchie & Brandley 2007). It is debatable whether risk is subjective or objective and whether it is positive or negative. If it is subjective, it is dependent on the values and standings of the organization and managed on an individual basis; if it is objective it would be possible to develop general structured tools to measure and manage risk (Khan &Burnes 2007).

In general risk management literature, risk is almost always considered as something negative (Mitchell 1995, Harland et al 2003) and managing risk is considered equivalent to minimizing risk. In addition to the concept of its measurability, its relationship to uncertainty is also an issue.

Absence of precise meanings and interpretations in the general literature on risk and its application to the supply chain management area makes it hard to transfer the wide range of risk management tools available in the general literature to supply chain risk management (Khan &Burnes 2007). Suggesting that supply chain risks stem from variations in information, material and product flow, Gaonkar and Viswanadham (2007) defined risk in the supply chain as the distribution of the loss resulting from the variation in possible supply chain outcomes, their likelihood and their subjective value. Thus, the supply chain risk affects both upstream and downstream operations in the supply chain and can be expressed as a product of the probability of disruption and the impact of such disruption.

**Significance of supply chain risk**

Relatively unstable operating environment and increasingly sensitive supply chain means that modern supply chains are more vulnerable than ever. There has been an increase both in the potential for disruptions and in their magnitude (Elkins et al 2005). There has been a long-term upward trend in the number of catastrophic events and the amount of economic and insured losses since 1950 (Munich Re 2007). Thus, external environmental factors that are outside the control of the organization, as well as internal factors, have made the supply chains vulnerable and sensitive to disruptions.

Globalization of markets and increased competitive pressure has compelled firms in almost all industries to make their supply chains efficient and more responsive. By outsourcing and off-shoring manufacturing, and research and development activities, reducing inventories by Just-in-time strategies, reducing supplier base, single sourcing, and by collaborating more intensely with other partners in the supply chain, companies have achieved lean and efficient supply chain processes (Gaonkar & Viswanadham 2007, Fisher 1997, Lee 2002). Outsourcing manufacturing operations, focusing on reducing inventories and excess capacities and single sourcing, together with globalization and complexity in today’s interconnected supply chains, have made companies more vulnerable to disturbances in the supply chain (Harland et al 2003, Cousins et al 2004, Zsidisin 2003). Supply chain disruptions can also adversely affect the stock price and shareholder value of an organization (Hendricks & Singhal 2005). The leaner and more integrated a supply chain, the more vulnerable it is (Faisal et al 2006). In fact, today’s supply chains are more vulnerable than ever to major disruptions (Wagner & Bode 2008).

**Types of Supply chain risk**

To be able to evaluate and manage risk in supply chain, it is important to understand the different types of risks that can occur, where they stem from, which events make them occur and what drives them. Several authors have classified the risks in supply chains differently — while some have classified according to the sources of risk, others have used causes, or sources of uncertainty, as explained below.

Problems in supply chain result from a variety of incidents, such as natural disasters, labor disputes, economic instability in suppliers, actions from competing companies, instability in infrastructure, new technologies, etc. (Chopra & Sodhi 2004, Gaonkar & Viswanadham 2007, Kumar & Viswanadham 2007, Faisal et al 2006). Ritchie and Brandley (2007) define seven different sources of risk in supply chain – environment characteristics, industry characteristics, supply chain configuration, supply chain members, organization’s strategy, problem specific variables and decision making unit. Similarly, Wagner and Bode (2008) divide supply chain risk sources into five groups – supply side, demand side, regulatory, legal/bureaucratic, infrastructure and catastrophic. Chopra and Sodhi (2004) divide risks into nine different groups – disruptions, delays, systems, forecast, intellectual property, procurement, receivables, inventory and capacity. Cucchiella and Gastaldi (2006) classify risk according to sources of uncertainty – available capacity, manufacturing yield, supplier quality, internal organization, competitor action, information delays, stochastic cost, political environment, customs regulations and price fluctuations. Gaonkar and Viswanadham (2007) classify risk according to the events leading to risk – deviation, disruption and disaster. It is possible to design a robust supply chain that is protected against deviation and disruption, but it is impossible to be immune to disaster. Zsidisin (2003)
classify supply chain risk based on the characteristics on which it depends – item, market and supplier characteristics.

Several entities in a supply chain may have goals that are conflicting with each other and therefore may pose higher risk to the supply chain (Ritchie & Brindley 2007). Actions taken by individual members to protect themselves against disruptions in the chain may hide the problems until they become serious (Gaonkar & Viswanadham 2007). Poor communication across the supply chain makes it harder to manage problems at an early stage. Importantly, what could easily have been solved or avoided if discovered at an early stage may grow to a major disruption further down the chain. This can not only affect the processes, but also has a negative impact on the relations among the member entities in the supply chain. A well developed IT system is crucial to avoid these problems. Studies connecting supply chain risk to information technologies/systems are very limited (Finch 2004).

Risk in supply chain is a relatively new area of research and is not well understood (Khan & Burnes 2007). There are, however, some studies on supply chain risks. For example, Hendricks and Singhal (2005) have evaluated the impact of supply chain risk on company’s performance. Serious disruptions in supply chain resulted in 10% fall in share price and 40% fall in the general firm performance (Hendricks & Singhal 2005). A study by Wagner and Bode (2008), however, noted that disruption in the supply chain has a very low impact on overall performance. They argued that the impact on the supply chain is highly overestimated, especially the risk that stems from uncommon, catastrophic events, such as natural disasters and terrorism attacks. It is important to notice the difference in the dependent variable chosen by these two contrasting studies. While Hendricks and Singhal (2005) used company’s share market value as the dependent variable, Wagner and Bode (2008) measured the impact of supply chain disruptions on overall supply chain performance.

While Hendricks and Singhal (2005) base their study on companies already affected by disruption (therefore excluding the probability of disruption occurring), Wagner and Bode (2008) use a random sample of companies in Germany from which to collect data. Even though the disruption to the supply chain might be short in duration, the study observed that its effect is felt strongly on the company’s ability to recover (Wagner & Bode 2008). Wagner and Bode (2008) have operationalised the supply chain risk construct essentially from its sources – supply side, demand side, infrastructure, regulatory/legal and bureaucratic, and catastrophic risks. They observed that the demand side and supply side risks contribute to negative supply chain performance, while the other three risks (infrastructure, regulatory and catastrophic) have no clear negative impact on supply chain performance. Importantly, this study confirms previous research in supply chain management that stressed the importance of supply and demand coordination for achieving supply chain performance (Kleindorfer & van Wassenhove 2004). While some past studies discussed various types of risks (Johnson 2001, Cucchiella & Gastaldi 2006, Gaonkar & Viswanadham 2007, Ritchie & Brindley 2007, Kleindorfer & Saad 2005), others provided general guidelines for managing the supply chain risk (Chopra & Sodhi 2004, Craighead et al 2007, Zsidisin et al 2005). However, the influence of these mitigation strategies on the relationship between supply chain risk and supply chain performance were not studied in the past.

Managing supply chain risk

Even though risk in the supply chain has been discussed in the past, only recently have companies started taking action to manage risk. Deloitte and Touche (2004) and Tang (2006) defined supply chain risk management as the process that involves controlling, monitoring and evaluating supply chain risk and optimizing actions to prevent disruption and/or to quickly recover from disruption. The work with supply chain risk management is still in an early stage and is often driven by a few single enterprises; it would, however, be of benefit for all parts of the supply chain to mitigate risk (Ritchie & Brindley 2007).

There are many possibilities for managing risk. (Kumar & Viswanadham 2007) note that, even though each project is unique, the supply chain is often similar and built on a general basis. It is therefore possible and useful to develop a management system for managing risk in the supply chain. Some authors argue that supply chain risk management is a systematic approach that describes all the relevant disruptions along with appropriate actions and roles and responsibilities (Gaonkar & Viswanadham 2007). Risk management systems generally follow three basic steps – identification of the risks, estimation of their probabilities and significance. Based on this, a decision is made about the risks that are acceptable. Finch (2004) identified five major components in risk management – risk identification, analysis, reduction, transfer and acceptance, and monitoring. Faisal et al (2006) describes risk management as a process of understanding the risks and minimizing their impact on the company. Thus, risk management involves identification, assessment.
and quantification of potential supply chain disruption and developing strategies to eliminate, mitigate and/or transfer the risk and build resilience. The objective is to control the organization’s exposure to risk, reduce its negative impact and build the ability to recover.

There are two approaches to managing the supply chain risk – preventive and interceptive (Finch 2004) or proactive and reactive. In addition to these two, organizations also try to avoid, eliminate or transfer the risk. While preventive or proactive risk management strategies focus on reducing the company’s exposure to different types of risks and preventing the occurrence of risks, interceptive or reactive risk management strategies deal with the consequences of the disruption and involve developing actions to minimize the damage when a disruption has occurred and to quickly recover. Though preventive risk management is useful, it can never completely protect the company from risk (Gaonkar & Viswanadham 2007). Organizations try if possible to avoid or eliminate risk with the help of management strategies. Alternatively, companies may try to simply transfer the risk to other members in the supply chain. Though this strategy does not completely minimize the risk, it will at least shift the responsibility of mitigating that risk to another member in the supply chain, who may have better expertise to deal with those issues. For example, many organizations outsource some of the operations at the supply side and/or at the demand-side to a more competent external partner and thereby minimize their supply chain risk significantly.

Managing risk in the supply chain differs from general risk management. Risks in the supply chain often are interconnected, and actions to decrease one risk often lead to the increase of another risk (Chopra & Sodhi 2004). Management has to balance these actions so that the total risk is minimized, without affecting the company’s performance. Risks are also interconnected vertically through the supply chain, which means that risk management within one company might affect other companies in the chain. (Ritchie & Brindley 2007) argue that a risk in the supply chain affects all parts in the chain, upstream as well as downstream, and therefore should be managed through cooperative actions among the parts of the chain. Even though they find evidence for a trend towards more cooperative management responses in supply chains, this work is still in an early phase.

In the same way, Gaonkar and Viswanadham (2007) argue that the supply chain has to be managed at three different levels: strategic, tactical and operational, where operational refers to process-level, tactical is company level and strategic refers to management of external partners and parts of the supply chain. They also mean that risk can occur on different levels: single company level, network level, industrial level or environmental level, and that risks have to be managed at these levels as well.

To mitigate this risk the companies in the supply chain have to trust each other, share information frequently and have collaborative relationships. (Faisal et al 2006) find that this situation is rather rare in today's supply chains, especially among manufacturing small and medium sized companies. Furthermore Ritchie and Brindley (2007) suggest that agreement on common performance standards, effective communication and a close partnership are also important to mitigate this risk.

Disruptions are likely to occur, big or small, with higher or lower impact. Organizations need to be well prepared to meet frequent risks with lower impact. Typically organizations do not have any plans to deal with the less likely risks that may have a major impact on the company, while they are well prepared to meet frequent risks (Chopra & Sodhi 2004). The most significant ways companies protect themselves against supply chain disruptions today include systematized and controlled handling of orders and order status, maintaining excess capacities, inventories, and safety margins in time and capacities (Gaonkar & Viswanadham 2007, Chopra & Sodhi 2004). These are inefficient and resource consuming ways of managing risk and there are more effective tools and strategies for managing the supply chain risk that could be deployed.

Certain paths in the supply chain are of higher risk than others because of the higher likelihood of disruption and/or higher impact. It therefore makes sense to deploy resources where the risk is high. Faisal et al (2006) have identified trust among supply chain partners, collaborative relationships, information sharing and knowledge about risks as key variables that influence a company’s ability to manage supply chain risk. Strategic risk planning, corporate social responsibility and aligning incentives and revenue sharing policies are found to be other variables that are dependent upon the key variables mentioned earlier. In addition, agility in the supply chain, risk sharing and information security are other variables that are important, though with less influence (Faisal et al 2006). It is argued that supply chain agility not only allows firms to respond efficiently and effectively to unanticipated changes, but also works as a risk mitigation strategy in managing the unanticipated and actual disruptions in a supply chain (Kleindorfer & Saad 2005, Chopra & Sodhi 2004). Supply chain agility is considered an
important factor in risk mitigation as well as in response (Braunscheidel and Suresh 2009).

Different types of tools used to manage risk in the supply chain are mentioned in the literature. Many of them are general frameworks and need further development or specification to be useful tools for supply chain managers. For example, Gao and Viswanadham (2007) proposed a framework, based on mathematical models, for management of disruptions and another for management of deviations, both in a preventive way. Kumar and Viswanadham (2007) suggested a framework for an IT enabled case-based decision system to handle risks in the supply chain and Chopra and Sodhi (2004) offered a general approach for supply chain managers to work with risks. Kumar and Viswanadham (2007) suggested the use of IT to capture information from former cases with similar risks and make them available to managers to learn and apply.

Ritchie and Brindley (2007) proposed strategies for supply chain risk management that include risk insurance, information sharing, relationship development, agreed performance standards, regular joint reviews, joint training and development programs, joint pro-active assessment and planning exercises, developing risk management awareness and skills, joint strategies, inter-partnership structures, and relationship marketing initiatives. They have provided a framework to classify and manage risks and demonstrated with two case studies how their framework can help mitigate these risks.

Chopra and Sodhi (2004) suggest a strategy for companies to manage supply chain risks in two steps: “stress testing” and “tailoring”. Stress testing means identifying the company’s and its supply chain’s properties, such as key processes/suppliers/customers, logistics, inventory, capacity etc, and then presenting a number of “what if” scenarios, questioning what will happen and what actions could be taken in case of disturbance in the supply chain (Chopra & Sodhi 2004). This will help managers and other key personnel in the organization to identify critical risks, actions that could be taken to prevent these risks and how risks interfere with the company. In addition, they will help them to see which risks are not so crucial and not worth the cost of managing. It is then left to the manager to decide which preventive actions to take and how to prepare the company for risks.

**IT and supply chain risk - challenges**

Information technologies play a key role in managing the supply chain in this digital age. It is argued that a well developed information and logistics network (Gaonkar & Viswanadham 2007) and increased visibility throughout the supply chain (Christopher & Lee 2004) will help in mitigating supply chain risk. Information systems that deliver effective information sharing and compatibility among all partners, and monitoring of the supply chain processes are considered important requirements for managing supply chain risk (Rhee et al 2006). Unfortunately, the current crop of information systems, including the enterprise systems do not have adequate capability (Rhee et al 2006).

Managing the risk typically involves mapping the supply chain, measuring the risk of critical nodes in the supply chain network, identifying appropriate risk reduction mechanisms for high-risk nodes and deploying specific actions to mitigate the risk at these nodes, including initiating inventory visibility systems and deploying collaborative processes with key supply chain partners. Buffering the firm with excess inventories and resources is one of the easiest strategies companies adopt to mitigate supply chain risk. In addition, using two or more suppliers for critical inputs, providing additional resources that will offer greater flexibility to react to disruptions, and cushioning the planned lead times to allow a greater buffer for response are other strategies companies adopt for reducing the risk in their supply chains. Information technologies and systems such as enterprise systems and Radio Frequency identification (RFID) are used to manage risk in the supply chain.

ERP systems are packaged software solutions that are configurable information systems integrating information and information-based processes within and across functional areas in an organization. They were originally intended to replace a multitude of legacy systems. Even though the latest versions are now ‘web-enabled,’ the emphasis is still on the integrated architecture. This lack of open component based ERP system architecture in a dynamic supply chain management context may become its weakness. Concerted moves by almost all the major software vendors towards open integration technologies, acceptance of XML standards for document exchange and conversion have extended their capability. In addition, with a steady move towards web services standards and service-oriented architecture for technology, process and information integration, it now appears feasible to extend that capability further to deal with external partners and achieve supply chain efficiencies.

Technologies such as Web services would allow applications interactions across organizational boundaries economically and incrementally. With Service Oriented Architecture
(SOA) as its underlying philosophy, Web services are expected to transform the inter-organizational business transactions in future (Padmanabhu and al 2005). These Web services, designed to support application-to-application interaction without human assistance, can be accessed by disparate devices from handheld devices to large servers. In the supply chain management context, flexibility in business processes is critical. Web services that allow loose coupling of business processes mean that the organization can mix and match their offerings without making large investments in change management (Moitra and Ganesh 2005).

While information and process visibility is a key benefit of implementing an integrated information system such as an enterprise system, a lack of advanced decision support capabilities, lack of process flexibility in adapting to changing supply chain configurations, inadequacies of technology interfaces to extend the enterprise systems, and lack of trust between supply chain partners appear to be constraining the visibility and therefore the firm’s ability to mitigate and manage the supply chain risk.

ERP system is a strong backbone to an organization and delivers information ubiquity. If it is not fully exploited, it may become a strategic disadvantage in a network-based economy dominated by supply chains. Business organizations must manage the visibility, velocity and variability of information across the supply chain efficiently and effectively by the depth, quality and timeliness of information enabled by the ERP environment. While collaboration between various supply chain partners is the key requirement to achieve visibility, the efficiency of collaboration is restricted by non-integrative environments and the lack of process standards.

Moves by various industry groups and organizations towards development and acceptance of process management standards for different industries are expected to make process and information integration between partners in the supply chain easier. Some of the process activity standards popular in the industry are ‘SCOR’ (Supply Chain Operations Reference Model by Supply Chain Council) for manufacturing supply chains, DCOR/VCOR (Design Chain Operations Reference model for Design and Value Chain Operations Reference Model for Value Chains), eTOM for the telecom industry, ITIL (Information Technology Infrastructure Library) for information technology industry, and SEI (Software Engineering Implementation) capability maturity model for the software industry.

In the supply chain management context, in addition to the SCOR model, Supply Chain Management Institute’s SCM framework developed by the Global Supply Chain Forum, Supply Chain Consortium’s Best Practice framework and APQC (American Productivity and Quality Council) Process Classification framework (PCF) are some of the commonly used supply chain management frameworks. These frameworks are expected to establish a common language for communicating ideas, concepts, methodologies, measurement and practices and to document supply chain activities and thereby increase the visibility and understanding of the information.

These frameworks are expected to make process and information integration between the enterprises easier (Davenport 2005) and thereby enhance visibility. Recent developments of modern business process modelling and management tools, such as PetriNets, eBRL and several workflow modelling tools and languages, are also expected to improve process visibility compared to previous frameworks. Thus, increased visibility of the processes and information across the supply chain will help organizations to reduce risk and mitigate its effect. By quickly identifying the disruption and therefore being able to rapidly react and take action to prevent the disruption from impacting customers, increased visibility will help manage the supply chain risk better.

Research directions and conclusions

Existing information systems and technologies can be leveraged for identification, assessment and mitigation of supply chain risk. For example, standardization of business processes and information across supply chains will help in identifying the potential risk in the supply chain.

Information technologies play an important role in managing supply chains, both in delivering efficiencies as well as in managing the supply chain risk through improved visibility and information sharing and collaboration. The following research questions are therefore identified:

1. What is the importance of supply chain risk for supply chain managers and IT managers?
2. How is supply chain risk identified and managed in Australian organizations?
3. What is the role of information technologies such as enterprise systems in managing the supply chain risk?
4. What is the role of the Supply Chain Operations Reference (SCOR) model and/or other reference models in managing the supply chain risk?
5. What is the role of these emerging technologies such as Service oriented architecture and Web services?
6. What is the influence of traditional control
variables such as trust, information management practices, process management maturity, IT infrastructure management capability, change management, industry structure, competition, supply chain structure and organizational size? Despite the huge potential and significant benefits put forward by consultants and academics, business organizations are in a very early stage in developing and executing strategies for managing supply chain risk. Other than some large organizations, there are no significant organizations in the Australasian region that have integrated supply chain risk management into their strategic planning process.

The aim of this research study is exploratory; research and theory are at a formative stage and the phenomenon is not well understood. Even though literature on general risk management is abundant, it is predominantly based on mathematical modelling. By adopting multiple theoretical lenses and by applying the knowledge of managing risk in other areas, the proposed research is also aligned with Yin’s (2004) recommendation to explore and test alternative explanations in different contexts. A multi-case research design, based upon literal replication logic is necessary at the early stages. Recognizing the nascent stage of the research and the limited number of organizations contemplating and strategizing supply chain risk management, selection of cases could be purposeful (Huberman & Miles 2002) and must cover organizations and industry sectors that are active in implementing supply chain risk management strategies. A combination of qualitative and quantitative methodology is useful in answering the several research questions.

While information visibility and sharing of information are considered important in managing the supply chain risk, the risk to the firm’s intellectual property when information is shared in an extended enterprise with supply chain partners is a challenge. How can you minimize the supply chain risk without leaking strategic information through increased visibility? How do you differentiate the sharing of information about the production plans and products with the information about your new products and product development? With many information and process management aspects now outsourced, this risk may further jeopardize the company’s ability to maintain the security of its information.

For many firms, there is an ongoing tension between information security and information sharing in the supply chain context and it is a challenge to the ability of the firms to collaborate. Trust is another important challenge in managing the supply chain risk. Improved visibility of the processes and information across the supply chain is expected to improve trust among partners. Sharing information about the products, promotions, production plans, sales and operations plans, and transportation and distribution planning is important in building trust. Creating information visibility in terms of information sharing, enabled by information technology, may act like an enabler in building and improving trust. But if this is not supported by consistent execution, this high level of visibility may erode trust among partners and jeopardize their relationships and collaboration.

Supply chain risk management continues to be important to researchers in the supply chain management field as well as for information systems scholars. The double-edged role played by information technologies in identification and mitigation of the risk across the supply chain along with the traditional challenges such as trust, strategy execution, leveraging existing technologies and processes, and supply chain agility continue to throw new challenges to researchers and practitioners.

References


DEVELOPING MASS CUSTOMIZATION CAPABILITY THROUGH SUPPLY CHAIN INTEGRATION

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Abstract
Based on data collected from 292 manufacturing firms located in different countries, our results show that both internal and customer integration contribute positively to MCC. Positive interaction effects are also found between internal and customer integration, and between internal and supplier integration, on MCC. The results suggest that supplier integration play only a complementary role, supporting internal integration in the development of MCC. The findings demonstrate the pivotal role of internal integration in SCI. Whereas current research into SCI tends to view it as mainly “outward-facing” integration, our results strongly suggest that manufacturing firms should pursue internal integration as the foundation for successful SCI.

1. Introduction
Increasingly competitive markets and the decline of standardized, production-pushed products have forced many manufacturers to meet customer needs by offering more customized products and a greater variety of services on a large scale ([1]). Hence, manufacturers need to develop a key operational capability – mass customization capability (MCC), which is defined as the ability to offer a reliable, high volume of different products to better meet customer demands, without substantial tradeoffs in cost, delivery, or quality ([2]). For many manufacturers today, MCC has become a basic necessity, and the development of this capability among firms is of critical importance ([3],[4]).

As a new manufacturing paradigm, mass customization (MC) has led firms to refocus on their supply chain management (SCM) ([1], [5]). Researchers argue that building the MCC of a manufacturing firm is central to the effective and efficient management of an agile supply chain ([6],[7]). Many companies have implemented supply chain integration (SCI) to enhance their operational capability to meet changing customer requirements. There is a general recognition of the importance of external integration (i.e. with suppliers and customers) and internal integration among manufacturing firms. Over the last decade, researchers have started to examine the relationship between SCI and business performance and the mediating role of manufacturing capabilities.

Different types of integration might have mixed impacts or synergistic effects on different kinds of operational capabilities. MC requires the combination of several basic operational capabilities ([1],[2]) and SCI to facilitate production, assembly, logistics, and outsourcing decisions.

A number of researchers have observed that the transition to MC is difficult, and requires a comprehensive approach to product and process design, including the configuration of SCM systems ([1]). However, recent literature reviews reveal that previous research offers little insight into the development of MCC or how to make the transition to MC ([5]). The relationship between SCI and MCC is thus an important topic that deserves special attention ([3]). However, there is a lack of empirical research into this area. Hence, the current study investigates the roles of internal, customer, and supplier integration in the development of MCC. It addresses the following questions: What is the overall relationship between SCI and MCC, and what are the relative contributions of different types of integration to MCC? Are there synergistic effects between internal and external integration that a firm can exploit in developing MCC?

2. Literature review and research hypotheses

2.1. Customer integration and MCC
Customer integration refers to the degree to which a firm can strategically collaborate with its customers on managing interorganizational activities and build cooperative relationships. In MC operations, variety is not pushed by manufacturers but rather is driven by customers. Hence, understanding customer needs is a prerequisite for successful MC. Manufacturers need to analyze the heterogeneity of, and changes in, customer needs. This is considered one of major challenges faced by companies in implementing MC. Strategic customer integration builds long-term and collaborative relationships and direct involvement with customers. It allows manufacturers to access customer information, share knowledge, pursue joint development activities, speed up decision processes, reduce lead times, and improve process flexibility.
Therefore, strategic customer integration is critical in helping manufacturers not only to acquire information on customer requirements but also to gain a better understanding of customer preferences and needs, that is, what is preferred and why. Researchers emphasize the importance of providing customers with the opportunity to participate in order to incorporate their voice into the design and production process ([1],[2]). Therefore we propose the following hypothesis:

H1: Customer integration is positively related to MCC.

2.2. Supplier integration and MCC
Supplier integration refers to the degree to which a firm can strategically collaborate with its suppliers to manage interorganizational activities and build cooperative relationships. In MC operations, standardized modularization creates an expanded and greater role for suppliers because it increases the need for collaboration and a long-term commitment between suppliers and manufacturers. Both researchers and practitioners note that suppliers possess valuable knowledge and expertise that is invaluable for MC implementation. Manufacturers need to align what suppliers can deliver with the variety of products that customers want on a timely basis. This requires more information exchange and stronger relationships with suppliers.

Because of the multidimensional requirement for product variety, flexibility, cost, and delivery, mass customizers face a complex and dynamic operational environment. Whether or not they can respond to the changes in the environment and adjust operations is determined by the efficiency and effectiveness of the whole supply chain ([2],[3]). Where there is a long-term and cooperative relationship, information can flow freely across the supply chain to help manufacturers design better quality components that are more suited to customized demands, implement more cost-efficient production, minimize the possibility of errors, and facilitate initiatives for process improvements that can create added value ([1],[2]). Finally, supplier integration can help manufacturers gain critical knowledge that affects their core competence in MCC. Therefore, we propose the following hypothesis:

H2: Supplier integration is positively related to MCC.

2.3. Internal integration and MCC
Internal integration refers to the degree to which the different internal functions of firms are able to strategically collaborate and coordinate intraorganizational activities and decisions and build integral relationships with one another. MC demands quick and effective organizational responses in product development, production, and delivery in accordance with current customer needs. Internal integration facilitates the translation of customer demands into specific designs, processes, and physical goods, which leads to a connected and more coordinated response to marketplace changes and disruptions. It also requires the breaking down of the traditional functional “silo approach” and close coordination among the functional areas. Without effective internal integration, the complexity and variety of MC will cause many problems due to the conflicting interests of the different departments. For example, the marketing department might put too much emphasis on customer demands and overcommit to requirements without considering whether the products can be designed and manufactured efficiently and effectively. Design engineers might be interested in adding functions and features that are considered extraneous by customers. The manufacturing department might focus on cost reduction and efficiency and not care about customer needs, while the accounting department might not be able to estimate the variety-related portion of manufacturing overhead.

Internal integration provides the critical mechanisms inside the organization that strategically link up different functions and decision making. It plays a central role in the creation of manufacturing effectiveness, cost efficiency, process effectiveness, and product flexibility, which are essential for the development of MCC ([1],[3]). Researchers have consistently observed that cross-functional integration and knowledge sharing present one of the greatest challenges to the implementation of MC. Given the wealth of evidences of the importance of internal integration for MCC, we propose the following hypothesis:

H3: Internal integration is positively related to MCC.

2.4. Interaction effects among customer, supplier, and internal integration on MCC
Although it is widely recognized that effective supply chain integration involves customer, supplier, and internal integration, there is a surprising lack of research into the relationships among these different types of integration and whether their contributions to manufacturing capabilities are simply additive or synergistic. The few empirical studies that have investigated the relationships among the different types of integration tend to examine only specific aspects, and yield mixed results. We argue that the relationships among customer, internal, and supplier integration and their possible synergistic effects on MCC constitute an important issue that should be examined more carefully. The need to quickly provide products that are configured to customer requirements is becoming increasingly important in today’s competitive environment. In MC operations, the value of customer integration depends largely on whether the manufacturer can understand customer demands and
translate them into technical specifications and effective actions within the company; that is, both customer and internal integration are required. Customer integration can provide only the basic input about customer requirements, which are expressed in terms of product quantity, cost, functionality, quality, characteristics, aesthetics, and delivery ([1]). However, these requirements are not specified in terms of engineering, production, and material/component requirements that the internal company staff and workers can follow and develop into actions. Only through a process of information sharing, analyzing, interpreting, translating, and problem-solving interactions can ill-defined concepts and terms be translated into technical production specifications, plans, and schedules that can be easily understood and communicated inside the organization. This leads to a shared understanding of customer demands and a shared goal of how to fulfill such demands. However, this is often a complex and difficult process that requires the simultaneous integration of internal functions with external interfaces and strategic integration with customers and suppliers.

The linkage of customer with internal integration not only facilitates short-term operations but also has a strategic, long-term effect, building the organization’s core competence and competitive capabilities. By building a direct, business-to-business integrative channel between the customer and the manufacturer, customer needs, preferences, and constraints can be shared directly deep within the organization among the different functions. In a similar vein, we argue that supplier integration together with internal integration can optimize the efficiency and effectiveness of business operations, enhance knowledge sharing, promote organizational learning, and aid in building new capabilities among manufacturers. Supplier knowledge of innovations in component design, technologies, and equipment and experience of logistics networks will enrich the basic understanding of product, process, and supply chain activities and provide innovative improvements ([2]). Such external knowledge, if effectively shared throughout the organization, can also help to remedy inefficiencies in the existing operations. Moreover, the integration of external supplier knowledge into internal operations can also lead to strategic improvements in the organization’s MCC. For instance, knowledge about improvements in the functionality and characteristics of component production gives manufacturers vital knowledge for modular design of products and processes. Conversely, the production department may find a new way to aggregate parts production based on some innovation of the components, which can greatly increase the batch volume and decrease costs. However, if this knowledge is not shared with the design engineers in the company, then they will be unaware of the opportunity to use the same module to fulfill other demands, and the value of external supplier knowledge will be greatly reduced. When a manufacturer has an efficient internal integration infrastructure that enables the assimilation of supplier knowledge, it can more easily exploit the capabilities of its suppliers to find ways to improve the degree of customization, lower prices, or cut production lead times.

Finally, as full supply chain integration requires the linking of customer, internal, and supplier integration, we expect the widest arc of integration to have a holistic, synergistic impact on MCC. At the same time, because the effects of supply chain integration on MCC must work through internal integration, there is no reason to expect the interaction between supplier and customer integration to have an effect on MCC. Therefore, we propose the following hypotheses:

\[ H4a: \text{There is a significant interaction effect between customer integration and internal integration on MCC.} \]

\[ H4b: \text{There is a significant interaction effect between supplier integration and internal integration on MCC.} \]

\[ H4c: \text{There is a significant interaction effect among customer integration, supplier integration, and internal integration on MCC.} \]

3. Research methodology

3.1. The sample

The database used in this research is taken from the third round of the High Performance Manufacturing (HPM) project, which was conducted by a team of collaborative researchers in North America, Europe, and Asia. The database includes 292 mid- to large-size manufacturing plants (each with at least 100 employees) from nine countries (the U.S., Finland, Japan, South Korea, Australia, Italy, Germany, Sweden, and China). The sample includes plants in the electronics, machinery, and automobile supply industries in each of these countries. A stratified design was used to randomly select an approximately equal number of plants from each country and industry.

3.2. Measurement validation

We conducted exploratory factor analysis to assess the unidimensionality of the constructs. In each case, an eigenvalue greater than 1.00 was used to determine which factors would be retained, and a factor loading cutoff of 0.60 was used to ensure that each item or measure loaded on a common factor and contributed significantly to its score. The results of principal component factor analysis with varimax rotation, which show that all items met the cut-off criteria. Cronbach’s alpha was used to evaluate construct reliability. The
reliability of the scales met the threshold value of a Cronbach’s alpha greater than 0.70, as recommended by Flynn et al. (1990).

Content validity was established by a literature review of the key concepts and a series of plant visits, during which we conducted structured interviews with a number of managers. Then, we constructed a confirmatory factor analysis (CFA) model using the LISREL 8.54 program to assess convergent validity. In the model, each item was linked to its corresponding construct, and the covariances among those constructs were freely estimated. The resulting model fit indices are $\chi^2(113) = 255.91 \ (p < 0.001)$, non-normed fit index (NNFI) = 0.94, comparative fit index (CFI) = 0.95, standardized root mean square residual (RMR) = 0.058, and root mean square error of approximation (RMSEA) = 0.067, the values of which are all better than the threshold. The item loadings are all positive and greater than 0.50, and the critical ratio for each loading is significant, indicating the convergent validity of the items. Finally, we built a constrained CFA model for each possible pair of latent constructs in which the correlation between each paired construct was fixed to 1. We compared this model with the original unconstrained model in which the correlations among constructs were freely estimated. A significant difference in the chi-square statistics between the fixed and unconstrained models indicates high discriminant validity. In our study, the differences were significant at the 0.01 level, and thus discriminant validity was verified.

4. Analysis and results

We employed a hierarchical moderated regression approach to assess the effects of SCI on MCC. Model 1 included only the control variables, and Model 2 combined the control variables with the main effects of customer, supplier, and internal integration. Models 3 and 4 added the interaction terms, which were computed as the cross-products of the mean-centered scores for supplier and customer integration with internal integration, respectively. Model 5 considered the interaction between customer and supplier integration. Finally, Model 6 tested the complete three-way interaction effect of customer, supplier, and internal integration on MCC. The variables were mean centered to minimize potential multicollinearity problems associated with cross-product terms. Analysis of the variance inflation factors revealed no serious multicollinearity problems in any of the regression models. Residual analyses suggested that one case was an outlier. Therefore, we deleted it and report the regression results of the remaining cases. The sign and significance of the coefficients for the independent variables indicate support or non-support for the hypothesized effects. We also compared each model with its nested models to examine the incremental change in $R^2$ due to additional independent variables.

In Model 1, Australia is used as the base to control for country effects, and the auto supply industry is used as the base to control for industry effects. Model 1 is statistically significant, which indicates that country, industry, and plant size account for a small but marginally significant amount of the variance in MCC ($p < 0.05$). The base model shows that plant size is not associated with MCC. Few differences are found among countries in terms of MCC, and among industries, the electronics industry has much higher MCC than the auto supply industry. Model 2 reveals that SCI accounts for a significant amount of variance in MCC (an incremental $R^2$ of 0.158, $p < 0.01$). Specifically, both customer and internal integration have statistically significant and positive influences on MCC. Hence, Hypotheses 1 and 3 are supported. However, supplier integration does not have a statistically significant impact on MCC. Thus, Hypothesis 2 is rejected.

Comparing the results for Model 3 with those for Model 2, the positive and significant interaction between customer and internal integration reveals that customer integration not only improves MCC directly but also enhances the impact of internal integration. Therefore, Hypothesis 4a is supported. Model 4 reveals that the interaction between supplier and internal integration significantly affects MCC (an incremental $R^2$ of 0.013, $p < 0.05$). Thus, Hypothesis 4b is also supported. In addition, our results suggest that although supplier integration does not affect MCC directly, it has an indirect effect through enhancing the impact of internal integration.

The results of the hierarchical regressions support our argument that SCI works through internal integration and there is thus no reason to expect an interaction between customer and supplier integration (Model 5). In addition, we do not find a significant three-way interaction effect of customer, supplier, and internal integration on MCC (Model 6). Therefore, Hypothesis 4c is rejected.

5. Discussion and conclusions

This study investigates the effects of different types of integration on MCC. The results show that both internal and customer integration are positively associated with MCC. However, there is no direct relationship between supplier integration and MCC. In addition, there are significant interaction effects between internal integration and both types of external integration (customer and supplier) on MCC. These results show that different types of integration work interactively in the development of MCC, an important issue that researchers need to explore further.
Studies have also reported interaction effects between external and internal integration, but they do not distinguish between customer and supplier integration. In this study, we find that different types of integration have synergistic effects on MCC. Moreover, there is an interesting overall pattern in the emerging relationships, with internal integration playing the central role. In addition to its significant, direct effect on MCC, internal integration also has significant two-way interaction effects with customer integration and with supplier integration on MCC. Finally, unless internal integration plays a linking role, there is no reason to expect a significant interaction effect between customer and supplier integration, as shown by our results.

Our results support the general contention that SCI is important in building manufacturing capabilities. Whereas previous research has generally examined SCI at an overall macro level, this study provides a detailed investigation into how various types of integration might work together to contribute to MCC. We find that internal integration plays a pivotal role in helping to reap the overall benefits of SCI. We draw attention to this result because current SCI research tends to de-emphasize the role of internal integration, and considers SCI to constitute mainly “outward-facing” activities. Our results suggest, however, that internal integration should serve as the foundation of SCI.

Our results have practical implications for executives and managers of manufacturing firms. The development of MCC is a very important manufacturing strategy given today’s competitive environment, and requires consistency between internal and external integration. Our results indicate that managers interested in building MCC should start with internal integration. Without a good foundation characterized by strong internal integration mechanisms, other investments in supply integration might be wasted.

References
REVENUE SHARING WITH MULTIPLE AIRLINES AND AIRPORTS

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Abstract

This paper investigates the effects of concession revenue sharing between an airport and its airlines. It is found that the degree of revenue sharing will be affected by how carriers’ services are related (complements, independent, or substitutes). In particular, when carriers provide substitutable services, the sharing proportions might become negative if horizontal substitutability is sufficiently strong. In these situations, while revenue sharing improves profit, it reduces social welfare. It is further found that airport competition results in a higher degree of revenue sharing than would be had in the case of single airports. Nevertheless, the airport-airline chains may derive lower profits through this revenue-sharing rivalry, and the situation is similar to a classic Prisoners’ Dilemma. As the airport-airline chains move further away from their joint profit maximum, social welfare rises beyond the level achievable by single airports. Our analysis also shows that the (equilibrium) revenue-sharing proportion at an airport decreases in the number of its carriers, and increases in the number of carriers at the competing airports. Finally, the effects of the pure sharing contract are compared with those of the two-part sharing contract.

Keywords: Concession revenues; Revenue sharing; Airport competition; Airport-airline vertical cooperation; Non-atomistic carriers

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1. Introduction

An airport derives revenue from two facets of business: the traditional aeronautical operations and the commercial (concession) operations. The former refer to aviation activities associated with runways, aircraft parking and terminals, whereas the latter refer to non-aeronautical activities occurring within terminals and on airport land, including terminal concessions, and car parking and rental. For the last two decades, commercial revenues have grown faster than aeronautical revenues; as a result, they become the main income source of many airports. At medium to large US airports, for instance, commercial business represents 75-80% of the total airport revenue (Doganis, 1992). ATRS (2008) studied 142 airports worldwide and found a majority of these airports derived 40-75% of their total revenues from non-aviation services, a major part of which is revenue from concession services (with large hub airports relying, on average, even more on concession income). Furthermore, commercial operations tend to be more profitable than aeronautical operations (e.g., Jones et al., 1993; Starkie, 2001; Francis et al., 2004), owing partly to prevailing regulations and charging mechanisms (e.g., Starkie, 2001).

Paralleling the growth of concession revenues, revenue sharing between airports and airlines is getting popular in practice. As documented in Fu and Zhang (2009), there are cases, such as Tampa International Airport in the US and Ryanair in Europe, where airports and airlines share concession revenues. On the other hand, Ryanair has identified airport car parking as one of its business opportunities and cooperated with the leading airport parking company BCP. In its negotiations with some airports, Ryanair asked for parking revenue sharing as a condition to serve the airports (Fu and Zhang, 2009).
For the last several years, the effects of vertical relationships between airports and airlines have received growing attention from researchers. In addition to Fu and Zhang (2009), Auerbach and Koch (2007) and Barbot (2009a, 2009b) found that cooperation between an airport and its airlines can bring benefits to the alliance members in terms of increased traffic volume and operation efficiency. In this paper, we extend the previous work on airport-airline vertical cooperation, focusing on the effects of concession revenue sharing. More specifically, we consider that carriers may provide complementary, independent or substitutable services, and that the proportions of revenue sharing may be outside of the range of \([0, 1]\). The latter allows us to compare alternative sharing arrangements. Further, unlike the previous studies, our analysis is conducted with general demand and cost functional forms.

We find that the degree of sharing will be affected by how carriers’ services are related to each other. In particular, when carriers provide substitutable services, the sharing proportions might become negative if horizontal substitutability is sufficiently strong and the fixed (transfer) payments between the airport and carriers are feasible (referred to as the ‘two-part revenue sharing’). The negative sharing allows the airport to penalize the over-competing airlines so as to support prices in the output market and improve profit. In these situations, while revenue sharing improves the total airport-airlines channel profit, it reduces social welfare. If the fixed payments are not feasible, under the resulting ‘pure revenue sharing’ the airport will, for the cases of independent or complementary services, share less concession revenue with its carriers than would be under the two-part revenue sharing. For the substitutes case however, the sharing-proportions comparison between the two types is in general ambiguous. In the special case of negative sharing, the pure revenue sharing results in not only a higher sharing proportion, but also a higher welfare level if carriers are sufficiently symmetric, than the two-part revenue sharing.

Our second objective in this paper is to investigate revenue sharing for multiple, competing airports. In general, very few papers in the airport literature have examined the case of competing airports analytically. This is understandable given the local monopoly nature of an airport. The situation is changing, however. The world has experienced a rapid growth in air transport demand since the 1970s, and many airports have been built or expanded as a result. This has led to a number of multi-airport regions such as greater London in the UK and several metropolitan areas in the US (e.g., San Francisco, Chicago, New York, Washington, Dallas, Detroit, Huston, and Los Angeles) within which airports may compete with each other. At the same time, the dramatic growth of low-cost carriers (e.g., Southwest Airlines in the US and Ryanair in Europe) has enabled some smaller and peripheral airports to cut into the catchment areas of large airports. Starkie (2008) conducted an overview of UK airports from the perspective of a business enterprise. He concluded that effective competition between airports is possible and a competitive airport industry can be financially viable. Taken together, these observations suggest that it is important to investigate the effects of revenue sharing in the

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1 For example, Fu and Zhang (2009) examined revenue sharing only for a monopoly airport. The few exceptions include Gillen and Morrison (2003), who examined two competing airports in the context of a full-service carrier and a low-cost carrier. More recently, Basso and Zhang (2007) provided a general examination of airport competition with congestion and non-atomistic airlines at each airport, and Barbot (2009a) examined airport-airline interactions (collusion, in particular) using a spatial model similar to that of Basso and Zhang. The issues of concession revenues and revenue sharing were not considered in these papers.

2 Previous studies (e.g., FAA, 1999; GAO, 1997; Dresner et al., 2002; see also Hartmann, 2006, for a useful review on the topic) suggest that airline entry may be deterred if the dominant airline controls key airport facilities. Apparently, such a strategy by the dominant carrier would require at least implicit consent/cooperation from the airport. In the US, large and medium airports that meet a certain threshold of airline concentration are now required to submit competition plans as mandated by the ‘Wendell H. Ford Aviation Investment and Reform Act for the 21st Century’ legislated in 2000.
context of multiple, competing airports.

We find that airport competition will result in a higher degree of revenue sharing than would be had in the case of single airports. Nevertheless, the airport-airline chains may derive lower profits from this revenue-sharing rivalry; in effect, the airports are trapped by the incentive structure of the environment, and the situation is similar to a classic Prisoners’ Dilemma. As the airport-airline chains move further away from their joint profit maximum, social welfare rises beyond the level achievable by single airports. Our analysis also showed that airline market structure can have a bearing on revenue sharing arrangements at not only the airport in question, but also its competing airports.

The paper is organized as follows. Section 2 sets out the basic model and examines the revenue-sharing equilibrium for a single airport with multiple airlines. Section 3 examines revenue sharing for the general case of competing airports with each having an arbitrary number of carriers. Section 4 investigates the pure revenue sharing and compares its effects with those of the two-part arrangements at not only the airport in question, but also its competing airports.

2. Single Airport with Multiple Airlines

2.1 Basic model

Consider, in this section, that a single airport provides aeronautical service to airlines, for which it imposes a charge.\(^4\) In our modeling this charge is represented by a per-passenger fee \(w > 0\), and is regulated and cannot be changed unilaterally by either the airport or airlines.\(^5\) We have two carriers, labeled as \(i = 1, 2\), operating from the airport, although the analysis and results extend immediately to the \(n\)-carrier case (see, e.g., Section 3.2). They face inverse demands \(p'_i(q_1, q_2)\), which satisfy the usual properties of \(p'_i < 0\) and 

\[
p'_1 p^2 - p'_1 p^1 > 0
\]

with subscripts denoting partial derivatives.\(^6\) The airlines’ revenue from providing aviation service is then given by 

\[
R'_i(q_1, q_2) = p'_i(q_1, q_2)q_i > 0
\]

\[
R'_j(q_1, q_2) > 0,
\]

i.e., increasing carrier \(j\)’s output increases both the total and marginal revenues of carrier \(i\) (here, and below, if the indices \(i\) and \(j\) appear in the same expression, then it is to be understood that \(i \neq j\)).

In the present context, services provided by a trunk airline and a feeder airline – with their passengers connecting at the airport – may be considered as complements. Another example would be that two airlines engage in some form of strategic alliances or code-sharing arrangements (e.g., Brueckner, 2001; Brueckner and Whalen, 2000). i) \(\text{Independent services:}\)

\[
R'_i(q_1, q_2) = p'_i(q_1, q_2)q_i = 0,
\]

i.e., the airlines’ services are unrelated in demand. (Note, in this case, that \(R'_i(q_1, q_2) = 0\) implies \(R'_j(q_1, q_2) = 0\).) ii) \(\text{Substitutes:}\)

\[
R'_i(q_1, q_2) = p'_i(q_1, q_2)q_i < 0,
\]

\[
R'_j(q_1, q_2) < 0,
\]

i.e., increasing carrier \(j\)’s output reduces both the total and marginal revenues of carrier \(i\). For instance, two competing trunk carriers likely provide substitutes at an airport, so do two competing feeder carriers.

We consider that for each passenger going through the airport, a (net) concession revenue \(h(>0)\) is derived.\(^8\) How this revenue is shared

\(^4\) For example, at the Hong Kong airport this charge consists of runway charge, aircraft parking fee, and terminal building charge, with each component accounting for 68.7%, 6.6% and 24.7%, respectively (Zhang and Zhang, 2003).

\(^5\) Since price discrimination (on aeronautical charges) by an airport is prohibited by the International Air Transport Association (IATA) rules, all airlines serving the airport face the same \(w\).

\(^6\) While \(p'_i < 0\) indicates the usual property of downward-sloping demands, \(p'_1 p^2 - p'_1 p^1 > 0\) refers to the property of ‘own effects’ dominating ‘cross effects’ in demand functions. As noted by Dixit (1986, p. 108), the dominance of

own-effects over cross-effects is a standard assumption in models of oligopoly.

\(^7\) The first inequality in (1) shows (gross) complements between the airline services, whereas the second inequality implies ‘strategic complements’ (Bulow et al., 1985). That the former implies the latter holds for most (but not all) plausible demand structures; it certainly holds when demand functions are linear. In other words, the fact that services are complements is conducive to their strategic complementarity. Restricting attention to strategic complementarity is a standard practice in oligopoly models (Dixit, 1986; Tirole, 1988). Similar observations on ‘substitutes’ and ‘strategic substitutes’ hold for the substitutes case discussed next. We shall, as is common in the literature, refer to these two cases simply as ‘complements’ and ‘substitutes.’

\(^8\) This formulation of concession surplus has been used in, e.g. Zhang and Zhang (1997, 2003), Oum et al. (2004) and Fu and
between the airport and airlines is modeled as a two-stage game. In the first stage, the airport offers carrier \( i \) to share proportion \( r_i \) of the revenue \( hq_i \), in exchange for a fixed fee \( f_i \), subject to the carrier’s participation constraint.\(^9\) In this two-part sharing arrangement, no restriction is imposed on \( r_i \); consequently, \( r_i \) can be less than zero or greater than one. In the second stage, airlines interact with each other in Cournot fashion.\(^{10}\) The subgame perfect equilibrium of this two-stage game is referred to as the ‘revenue sharing equilibrium.’

2.2. Revenue-sharing equilibrium

The revenue-sharing equilibrium is solved in the standard backward fashion.

**Stage two:** Given sharing option \( (r_i, f_i) \), each carrier’s profit is:

\[
\pi_i(q_i, q_j) = R_i(q_i, q_j) - C_i(q_i) - wq_i + r_i h q_i - f_i, \tag{4}
\]

where \( C_i(q_i) \) denotes carrier \( i \)’s production cost.

Thus for carrier \( i \), the total operating cost net of fixed payment \( f_i \) equals \( C_i(q_i) + wq_i \). The Cournot-Nash equilibrium is characterized by the first-order conditions,

\[
\pi_i'(q_i, q_j) = R_i'(q_i, q_j) - C_i'(q_i) - w + r_i h = 0, \tag{5}
\]

and the second-order conditions

\[
\pi_i''(q_i, q_j) = R_i''(q_i, q_j) - C_i''(q_i) < 0. \tag{6}
\]

Both the second-order conditions and the stability condition, \( J \equiv \pi_{i1}^2 - \pi_{12}^1 \pi_{21}^2 > 0 \), are assumed to hold over the entire region of interest.\(^{11}\)

---

\(^9\) Thus we investigate the effect of a ‘two part’ revenue-sharing scheme under which fixed payments are possible. Such a model can be used to examine the incentive for vertical airport-airline cooperation – i.e., taking account of the profit for an airport-airline channel as a whole – and may also be consistent with situations in which airports and airlines can commit to medium-/long-term cooperation. Nonetheless, such fixed payments between airports and airlines might not be feasible in certain situations, owing to the difficulty in their agreeing to the right amount of payments, or to the preference for simpler revenue-sharing arrangements that do not involve any medium-/long-term commitment. We will, in Section 4, examine a ‘pure’ sharing contract that restricts fixed payments \( f_i \) to zero.

\(^{10}\) Recent studies on airport pricing and capacity investment that have incorporated imperfect competition of air carriers at an airport (e.g., Brueckner, 2002; Pels and Verhoef, 2004; Zhang and Zhang, 2006; Basso, 2008) have assumed Cournot behavior. Brander and Zhang (1990, 1993), for example, find some empirical evidence that rivalry between duopoly airlines is consistent with Cournot behavior.

\(^{11}\) This assumption implies that the Cournot equilibrium exists and is unique (e.g., Friedman, 1977). Note that if carriers face linear demands, then all these conditions will be satisfied.
Stage one: Revenue-sharing structures therefore influence subsequent airline quantities, which in turn will affect the airport’s profit. Assume, for simplicity, that the airport’s fixed cost is zero and its marginal cost is constant and normalized to zero. The airport’s profit, denoted by $\Pi$, is then given by:

$$\Pi = w \cdot (q_1^* + q_2^*) + [(1 - r_1)hq_1^* + (1 - r_2)hq_2^*] + f_1 + f_2, \quad (7)$$

where the second-stage equilibrium outputs are taken into account. There are three components in $\Pi$: i) the aeronautical revenue (profit) given by $w \cdot (q_1 + q_2)$; (ii) the residual concession revenue given by the bracketed term in (7); and (iii) the fixed payment collected from carriers, $f_1 + f_2$.

The airport chooses $(r_1, r_2)$ and $(f_1, f_2)$ to maximize $\Pi$. While $f_1$ won’t, as indicated earlier, affect the second-stage equilibrium outputs, $\partial \Pi / \partial f_1 = 1$ by (7). Consequently, the airport should, given its Stackelberg leader’s role, charge the airlines a fee as high as possible subject to their participation constraint $\pi^i \geq \pi_0^i$, with $\pi_0^i$ being carrier $i$’s reservation profit, $i = 1, 2$. Assume, without loss of generality, that each carrier receives its reservation profit. (Hence, all the benefits from improvements in performance go to the airport.) This participation constraint implies, using (4), that

$$f_i = R^i(q_1^*, q_2^*) - C_i(q_i^*) - wq_i^* + r_ihq_i^* - \pi_i^*, \quad i = 1, 2, \quad (8)$$

where equilibrium outputs $q_i^*$ are functions of $r_1$ and $r_2$. With (8), airport profit (7) becomes:

$$\Pi_{r_1, r_2} = \sum R(q_i^*, q_j^*) - C_i(q_i^*) + hq_i^* - \pi_i^* = \sum \theta_i^*(r_{ij}, q_j^*(r_{ij})) \quad (9)$$

Thus, the revenue-sharing equilibrium is characterized by the first-order conditions, $\partial \Pi / \partial r_i = v_i \cdot (\partial q_i^* / \partial r_i) + v_j \cdot (\partial q_j^* / \partial r_i) = 0$, $i = 1, 2$, \quad (10)

where

$$v_i = \frac{\partial \Pi}{\partial q_i} = R_i^i(q_1^*, q_2^*) - C_i(q_i^*) + h + R_i^i(q_i^*, q_2^*) \quad (11)$$

by (5), $v_i$ can be rewritten as:

$$v_i = w + (1 - r_i)h + R_i^i(q_1^*, q_2^*) \quad (11)$$

Consider first the case where carriers’ services are independent. It can be easily seen from (10), (11) and (2) that the equilibrium sharing proportions are given by (superscript $I$ for ‘independent services’):

$$r_i^I = 1 + (w / h), \quad i = 1, 2, \quad (12)$$

which are strictly positive. Revenue sharing therefore improves the airport’s profit – here, the profit gain is due to the internalization of a demand complementarity between the flights and concession consumption. Further, even if $r_i = 1$, the profit will rise with $r_i$ going beyond the ‘full’ share. Basically, the two-part revenue sharing resolves the well-known ‘double marginalization’ problem in a vertical structure (e.g., Tirole, 1988).

The independent-services case turns out to be a useful benchmark for the cases of substitutes and complements. By first-order conditions (10) it follows:

$$v_1 \cdot (\partial q_1^* / \partial r_1) + v_2 \cdot (\partial q_2^* / \partial r_1) = 0, \quad (13.1)$$

$$v_1 \cdot (\partial q_1^* / \partial r_2) + v_2 \cdot (\partial q_2^* / \partial r_2) = 0, \quad (13.2)$$

which give rise to

$$v_2 \cdot [(\partial q_1^* / \partial r_2)(\partial q_2^* / \partial r_1) - (\partial q_1^* / \partial r_1)(\partial q_2^* / \partial r_2)] = 0 \quad (13.3)$$

This equation, by (6), reduces further to $v_2 h^2(\pi_{12} - \pi_{11}) / J = 0 \Rightarrow v_2 = 0$. Plugging $v_2 = 0$ into (13.1) we immediately have $v_1 = 0$. It follows from (11) that

$$r_i = [1 + (w / h)] + (R_i / h), \quad i = 1, 2 \quad (14)$$

If airline services are complements, then $R_i > 0$; consequently (superscript $C$ for ‘complements’),

$$r_i^C > 1 + (w / h) = r_i^J, \quad i = 1, 2 \quad (15)$$

If airline services are substitutes, then $R_i < 0$ and so equation (14) yields (superscript $S$ for ‘substitutes’):

$$r_i^S < 1 + (w / h) = r_i^J, \quad i = 1, 2 \quad (16)$$

The above discussion leads therefore to:

**Proposition 1.** At the revenue-sharing equilibrium with a single airport, the sharing proportions are $r_i^J = 1 + (w / h)$ when carriers’ services are independent, $i = 1, 2$. The sharing proportions are greater (smaller, respectively) than $r_i^J$ when carriers produce complements (substitutes, respectively).
will lead to a failure of coordination between competing airlines, resulting in their producing too much with respect to what would be best for them as a whole. Anticipating this, the airport uses revenue sharing as a device to coordinate airline competition downstream. In particular, a smaller sharing proportion than the independent-services benchmark will, by Lemma 1, reduce industry output, thus lessening excessive production by carriers.

It is important to point out that for the substitutes case, the sharing proportions might become negative. This is because horizontal substitutability works in an opposite direction of the flights-concessions demand complementarity discussed above, in terms of the amount of production the airport would like to induce. The optimal level of revenue sharing, \( r^S \), is set to balance these two effects. Thus, \( r^S \) depends on the degree of substitutability between carriers’ services. Numerical examples are constructed at the end of this section, in which horizontal substitutability is so strong that \( r^S \) become negative.

2.3 Comparison with the no-sharing regime

Our concern now is to compare the revenue-sharing equilibrium with the situation where airport-airline revenue sharing is not allowed, characterized by \( r_i = f_i = 0 \). First, for the cases of complements and independent services, it is clear from Lemma 1 and Proposition 1 that revenue sharing will increase output and improve profit. Define social welfare as the sum of the airport-airline profit and consumer (passenger) surplus:

\[
W(r, c) = U(q_1, q_2) - C(q_1) - C(q_2) + h q_1^* + h q_2^* = \Phi(q_1^*, q_2^*) \tag{17}
\]

where \( U(q_1, q_2) \) is the consumer utility function in the usual industry (partial equilibrium) analysis, with \( \partial U / \partial q_i = p^i \). Although passengers may derive surplus also from their concession consumption, such surplus per passenger is assumed constant and further normalized to zero, thus giving rise to formulation (17). Differentiating \( W \) with respect to \( r_i \), yields:

\[
\partial W / \partial r_i = \partial U / \partial q_i + h \partial q_i^* / \partial r_i + \partial C(q_i^*) / \partial r_i \tag{18}
\]

Since \( p^i - C_i^o > 0 \) (positive markups in oligopoly), the output expansion identified above leads immediately to \( \partial W / \partial r_i > 0 \) and thus, revenue sharing improves welfare.

As for prices, it can be easily seen (from below) that they will fall if carriers’ services are independent. For the complements case, the effect is not as straightforward. Differentiating \( p^i(q_1^*, q_2^*) \) with respect to \( r_i \) and \( r_j \) yields

\[
\partial p^i / \partial r_i = p^i_j \cdot (\partial q_j^* / \partial r_i) + p^i_j \cdot (\partial q_j^* / \partial r_i) \tag{19.1}
\]

\[
\partial p^i / \partial r_j = p^i_j \cdot (\partial q_j^* / \partial r_i) + p^i_j \cdot (\partial q_j^* / \partial r_i) \tag{19.2}
\]

respectively. With carriers’ services being complementary, the first term on the right-hand side (RHS) of (19.1) is negative (recall \( p^i < 0 \) and Lemma 1) whilst the second term is positive. Similarly, the first term on the RHS of (19.2) is negative whilst the second term is positive. Under ‘symmetry’ however, the overall effects will be negative for both (19.1) and (19.2), as is shown below (Proposition 2). By ‘symmetry’ we mean (i) carriers have identical cost functions and face symmetric demands, and (ii) at the equilibrium, carriers have the same sharing contract (i.e., \( r_1 = r_2 \) and \( f_1 = f_2 \)). The symmetry condition will also be used in the comparison for the substitutes case (see Proposition 2).

Proposition 2. At the revenue-sharing equilibrium with a single airport,

1. when carriers provide independent or complementary services, (i) outputs and social welfare are greater and (ii) under symmetry, prices are lower than in the absence of revenue sharing;

2. when carriers provide substitutable services and are symmetric, (i) outputs and social welfare are greater (smaller, respectively) and (ii) prices are lower (higher, respectively), than in the absence of revenue sharing if \( r^S_i > 0 \) \( (r^S_i < 0 \), respectively).

Proof: 1. We only need to show the price effect for complementary services (the other parts have been shown in the text). Use \( \Delta \) to denote any difference of variables between the revenue-sharing regime and no-sharing regime. Applying the mean value theorem (MVT) to the function \( p^i(q_1^*, q_2^*) \) yields:

\[
\Delta p^i = p^i_j \cdot \Delta q_j^* + p^i_j \cdot \Delta q_j^*,
\]

where \( p^i_j \) and \( p^i_j \) are evaluated at some point between \( (q_1^o, q_2^o) \) and \( (q_1^c, q_2^c) \), with superscript \( O \) denoting variables associated with the no-sharing regime. Under symmetry, \( \Delta q_j^* = \Delta q_j^* > 0 \) from part (i). Consequently, \( \Delta p^i = (p^i_j + p^i_j) \Delta q_j^* < 0 \) with the inequality following from the condition \( p^i_1 p^2_1 - p^i_2 p^2_2 > 0 \) and symmetry: noting that symmetry implies
\[(p_i^1 + p_i^j)(p_i^1 + p_i^j) > 0\]
and hence
\[p_i^1 + p_i^j < 0.\]

2. (i) Applying MVT to \(q_i^j(r_1, r_2)\) yields
\[\Delta q_i^j = (\partial q_i^j / \partial r_i) \Delta r_i + (\partial q_i^j / \partial r_j) \Delta r_j,\]
with \(\partial q_i^j / \partial r_i\) and \(\partial q_i^j / \partial r_j\) evaluated at some point between \((r_1^0, r_2^0)\) and \((r_1^s, r_2^s)\). Under symmetry, \(\Delta r_i = \Delta r_j\) and \(\partial q_i^j / \partial r_i = \partial q_j^i / \partial r_j\); consequently,
\[\Delta q_i^j = \left[\partial(q_i^j + q_j^i) / \partial r_i\right] \Delta r_i = h \cdot (\pi_j^i - \pi_j^i) \Delta r_i.\]

Since \(\pi_j^i - \pi_j^j > 0\) under symmetry and the stability and second-order conditions, \(\Delta q_i^j\) must have the same sign as \(\Delta r_i \equiv r_i^s - r_i^o = r_i^s\) (recall \(r_i^o = 0\)).

For the welfare comparison, applying MVT to \(\varphi(q_i^j, q_j^i)\) in (17) yields \(\Delta \varphi = \varphi_i \Delta q_i^j + \varphi_j \Delta q_j^i,\) where \(\varphi_i\) and \(\varphi_j\) are evaluated at some point between \((q_1^0, q_2^0)\) and \((q_1^s, q_2^s)\). Under symmetry, \(\Delta q_i^j = \Delta q_j^i\). Consequently, \(\Delta \varphi = (\varphi_i + \varphi_j) \Delta q_i^j\) has the same sign as \(\Delta q_i^j\), because \(\varphi_i = p_i^j - C_i^j + h > 0\). The welfare result then follows from the above quantity comparison.

(ii) Applying MVT to \(p_i^j(q_i^j, q_j^i)\) yields \(\Delta p_i^j = p_i^j \Delta q_i^j + p_j^i \Delta q_j^i,\) where \(p_i^j\) and \(p_j^i\) are evaluated at some point between \((q_1^0, q_2^0)\) and \((q_1^s, q_2^s)\). With \(\Delta q_i^j = \Delta q_j^i\) under symmetry, \(\Delta p_i^j = (p_i^j + p_j^i) \Delta q_i^j\) has the opposite sign as \(\Delta q_i^j\), because \(p_i^j < 0\) and, by (3), \(p_j^i < 0\). The result then follows from the above quantity comparison. Q.E.D.

Although some of the comparisons in Proposition 2 are carried out under ‘perfect’ symmetry between the firms, a closer look at the above proof indicates that small asymmetries won’t undermine the results. Proposition 2 shows that when carriers offer complementary and unrelated services, revenue sharing between an airport and its airlines improves welfare. The welfare improvement arises because prices exceed marginal costs in the oligopolistic airline market and revenue sharing reduces prices (or equivalently, expands outputs).

When carriers provide substitutable services, revenue sharing may or may not improve welfare, depending on the sign of equilibrium sharing proportions \(r_i^s\). As indicated above, the sign of \(r_i^s\) will in turn depend on the degree of substitutability between carriers’ services. To capture such an impact, we need to impose more structures on the model. Specifically, a linear (inverse) demand is specified: \(p_i^j = 1 - b q_i^j - k q_j^i,\) with \(b > 0\) and \(k \in (-b, b)\), which ensure downward-sloping demands and the own price effects dominating the cross price effects. It is clear that carriers’ services are complements, independent and substitutes when \(k < 0\), \(= 0\) and \(> 0\), respectively. Carriers’ marginal costs \(c_1\) and \(c_2\) are constant and \(c_1 = c_2\). In the simulation, parameters are chosen to ensure positive outputs and marginal revenues.

Figure 1 reports the effects of airline service substitutability, where we define \(k = m \cdot b\) with \(m \in (-0.1, 1)\). Thus, negative \(m\) indicates horizontal complementarity, whilst for positive \(m\), larger \(m\)’s mean increasingly substitutable services. As expected, the airport shares a high percentage of concession revenue – \(r_i = r_2\) greater than 1 – with airlines when the latter produce complements (\(m < 0\)) so as to internalize horizontal complementarity. The (equilibrium) sharing proportions, \(r_i^s\), fall when airline services become increasingly substitutable. When horizontal substitutability becomes sufficiently strong, \(r_i^s\) turns into a negative value. Such a ‘negative revenue sharing’ allows the airport to penalize the over-competing airlines so as to support prices in the output market and improve profit for the whole airport-airlines channel. While carriers pay a higher price (than airport charge \(w\)) per unit of output, they are nevertheless compensated for with fixed payments from the airport – noticing in the figure that the fixed fee becoming negative. In such a

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13 Examining how equilibrium results change with substitutability (i.e., when airline services become more substitutable to each other) is also important, since there are situations in which airports or policy makers can ‘moderate’ such substitutability. For example, only a few Asian cities are served by multiple airports and as a result, low-cost carriers (LCC) are often forced to use the same airport as competing full-service carriers (FSC). Recently, airports in, e.g., Kuala Lumpur and Singapore chose to build separate LCC terminals which offer lower quality of airport service with less charge (Zhang et al., 2009). Such a measure would make LCCs’ services less substitutable to the services provided by FSCs.

14 The negative revenue sharing arrangement or its variants are also observed in practice. There are cases, for instance, where airports may make one-shot investments (for carriers) to offset circumstances.
case, the output and welfare (not shown in Figure 1) with revenue sharing (the solid line in the figure) are less than those in the no-sharing case (the dotted line), as predicted by Proposition 2. Here, while revenue sharing improves the total channel profit (see the figure), it might reduce social welfare.

- The horizontal axis corresponds to the substitutability parameter $m$, with $k = m \cdot b$, $m \in (-0.1, 1)$
- Solid Line: Results with share revenue
- Dotted Line: Results without revenue sharing.

3. Competing Airports

3.1 Strategic revenue sharing

We now consider two airports, represented by $i = 1, 2$, beginning with a situation of one carrier at each airport. (The case of multiple airlines will be considered in Section 3.2.) To save notation we continue to use $p^i(q_j, q_j)$ for the inverse demands faced by carriers, with $i$ denoting the $i$th airport’s carrier (and $q_i$ its output). The two airports compete with each other in the sense that their airlines’ services are substitutes in the eyes of passengers. More specifically, airline revenue functions $R^i(q_1, q_2) = p^i(q_1, q_2)q_i$ satisfy the substitutes condition (3).

Airport-airline behavior is modeled again as a two-stage game: In the first stage, each airport offers its carrier to share proportion $r_i$ of concession revenue $hq_i$, in exchange for fixed fee $f_i$, subject to the carrier’s participation constraint. In the second stage, airlines compete in Cournot fashion with their profits given by (4). Given this set-up, the second-stage equilibrium is characterized by (5), the first-order conditions, the equilibrium values. This revenue-sharing equilibrium with airport competition will be referred to as the ‘rivalry (revenue sharing) equilibrium.’ Without loss of generality the carriers are again assumed to receive their reservation profits $\pi^i_0$, $i = 1, 2$; consequently, each airport’s profit can be rewritten as:

$$\Pi^i = wq_i^* + (1 - r_i)hq_i^* + f_i, \quad i = 1, 2.$$  (20)

The subgame perfect equilibrium then arises when each airport chooses its sharing contract $(r_i, f_i)$ to maximize $\Pi^i$, taking its rival’s sharing contract at the equilibrium values. This revenue-sharing equilibrium with airport competition will be referred to as the ‘rivalry (revenue sharing) equilibrium.’ Without loss of generality the carriers are again assumed to receive their reservation profits $\pi^i_0$, $i = 1, 2$; consequently, each airport’s profit can be rewritten as:

$$\Pi^i = v^i_j \cdot (\partial q^*_i / \partial r_i) + v^j_i \cdot (\partial q^*_j / \partial r_j) = 0,$$

$$i = 1, 2,$$  (22)

where subscripts again denote partial derivatives (e.g., $\Pi^i_j \equiv \partial \Pi^i / \partial r_i$), $v^i_j \equiv \partial v^i / \partial q_j$ and $v^j_i \equiv \partial v^j / \partial q_i$.

From (21), $v^i_j = R^i_j(q^*_j, q^*_j) - C^i_j(q^*_j) + h$ which can by (5) be rewritten as:

$$v^i_j = w + (1 - r_i)h.$$  (23)

For the rivalry equilibrium, since $v^j_i = R^i_j < 0$, $\partial q^*_i / \partial r_i > 0$ and $\partial q^*_j / \partial r_j < 0$, it follows by (22) that $v^i_j < 0$. Thus by (23), the equilibrium sharing proportions satisfy (superscript $R$ for ‘rivalry equilibrium’),

$$r^R_i > 1 + (w / h), \quad i = 1, 2.$$  (24)

It is interesting to compare this rivalry equilibrium with the ‘non-rivalry (revenue sharing) solution,’ which is obtained when the two airports were perceived as independent in the sense that $p^j_j(q_1, q_2) = 0$. It can be easily seen from (22)-(23) that the non-rivalry sharing proportions are given by (superscript $N$ for ‘non-rivalry solution’):

$$r^N_i = 1 + (w / h), \quad i = 1, 2.$$  (25)

Comparing (25) with (24) leads to:

**Proposition 3.** The revenue-sharing proportions are greater at the rivalry revenue-sharing equilibrium than under the non-rivalry revenue-sharing solution, i.e., $r^R_i > r^N_i$ for $i = 1, 2$.

The non-rivalry regime is, from (25) and (12),
similar to the case of a single (monopoly) airport examined in Section 2, as expected: Like a monopoly airport, each airport in the non-rivalry regime shares positive proportion \( r_N \) of concession revenue with its carrier. While \( r_N \) internalizes the flights-concessions demand complementarity, the rivalry revenue sharing involves an additional term \( \delta_i \) – i.e., \( r_i = r_N + \delta_i \) – which is unique to the case of competing airports. Since this additional effect works by indirectly influencing the behavior of the rival airport-airline pair – which in turn will improve profit of the airport-airline pair in question – the rivalry revenue sharing may be referred to as the ‘strategic revenue sharing.’ Proposition 3 therefore shows that airport-revenue sharing arrangement. Here the situation is similar to a classic Prisoners’ Dilemma. As the airport-airline pairs move further away from their joint profit maximum through such a revenue-sharing rivalry, social welfare nevertheless rises beyond the level achievable by single airports.

Next, the rivalry equilibrium is compared to the non-rivalry solution in terms of output, price, profit and social welfare. Here, welfare is the sum of passenger surplus and profits of the two airport-airline pairs; hence, it takes the same form as (17). The comparison results are stated as follows:

**Proposition 4.** Under symmetry, at the rivalry revenue-sharing equilibrium, (i) outputs are greater; (ii) prices are lower; (iii) airport profits are lower; and (iv) social welfare is higher, than at the non-rivalry revenue-sharing solution.

**Proof:** Use \( \Delta \) to denote any difference of variables between the rivalry equilibrium and the non-rivalry solution. Here, we just show parts (i) and (iii); the proofs for parts (ii) and (iv) are similar to those of Proposition 2.

(i) Applying the mean value theorem (MVT) to \( q_i^* (r, r) \)
yields \( \Delta q_i^* = (\partial q_i^* / \partial r_i) \Delta r_i + (\partial q_i^* / \partial r_j) \Delta r_j \),
with \( \partial q_i^* / \partial r_i \) and \( \partial q_i^* / \partial r_j \) evaluated at some point between \( (r_1^N, r_2^N) \) and \( (r_1^R, r_2^R) \).
Under symmetry, \( \Delta r_i = \Delta r_j \) and \( \partial q_i^* / \partial r_j = \partial q_j^* / \partial r_i \);
consequently,
\[
\Delta q_i^* = (\partial(q_i^* + q_j^*) / \partial r_i) \Delta r_i = h \cdot (\pi_i - \pi_j) \Delta r_i
\]
Since \( \pi_i - \pi_j > 0 \) under symmetry and the stability and second-order conditions, \( \Delta q_i^* \equiv q_i^R - q_i^N \) must have the same sign as \( \Delta r_i \equiv r_i^R - r_i^N \).
By Proposition 3, \( r_i^R > r_i^N \) and hence \( q_i^R > q_i^N \).

(ii) Applying MVT to \( \Pi_i (r, r) \), given by
(21), yields \( \Delta \Pi_i = \Pi'_i (r, r) \Delta r_i + \Pi''_i (r, r) \Delta r_j \), where \( \Pi_i^* \) and \( \Pi_j^* \) are evaluated at \( (\bar{r}_i, \bar{r}_j) \) with \( r_i^N < \bar{r}_i < r_i^R \) (using Proposition 3). Since \( \Delta r_i = \Delta r_j \) under symmetry and
\[
\Delta r_i \equiv r_i^R - r_i^N > 0,
\]
it follows that
\[
\Delta \Pi_i = (\Pi_i^* + \Pi_j^*) (r_i^R - r_i^N)
\]
and hence \( \Delta \Pi_i < 0 \) if (and only if) \( \Pi_i^* + \Pi_j^* < 0 \). By (21) and symmetry, it follows that
\[
\Pi_i^* + \Pi_j^* = (\bar{v}_i^* + \bar{v}_j^*) [\partial(q_i^* + q_j^*) / \partial r_i],
\]
where \( \bar{v}_i^* \) and \( \bar{v}_j^* \) are evaluated at \( q_i^* (\bar{r}_i, \bar{r}_j) \). By (23), \( \bar{v}_i^* = w + (1 - \bar{r}) h \) which is negative given that \( \bar{r} > r_i^N = 1 + (w/h) \).
Furthermore, since \( \bar{v}_j^* = \bar{R}_j < 0 \) (substitutable airports) and
\[
\partial(q_i^* + q_j^*) / \partial r_i = h \cdot (\pi_i - \pi_j^*) > 0,
\]
it follows that \( \Pi_i^* + \Pi_j^* < 0 \).

Therefore, \( \Delta \Pi_i \equiv \Pi_i^R - \Pi_i^N < 0 \). Q.E.D.

Proposition 4 shows that both airport-airline pairs will derive lower profits through this revenue-sharing rivalry: the rivalry results in their producing too much, thereby depressing the prices and profits. In effect, the pairs are trapped by the incentive structure of the environment. If one airport-airline pair ignores the possibility of strategic use of revenue-sharing contracts while the other pair shares revenue strategically, the first pair loses while the second pair gains relative to the non-strategic sharing arrangement. Here the situation is similar to a classic Prisoners’ Dilemma. As the airport-airline pairs move further away from their joint profit maximum through such a revenue-sharing rivalry, social welfare nevertheless rises beyond the level achievable by single airports.

### 3.2. Multiple airlines

Section 3.1 studies the case of one carrier per airport. We now extend the analysis to a situation where there may be multiple competing airlines at each airport. Our second objective in this section is to show that the general demand structure used in Section 3.1 can be generated through explicit considerations of passenger behavior.

More specifically, our demand derivation follows Basso and Zhang (2007) by considering an
infinite linear city, where potential consumers are distributed uniformly with a density of one consumer per unit of length. Two competing airports are located at 0 (airport 1) and 1 (airport 2) and there are \( n_i \) carriers at airport \( i, i = 1, 2 \) (see Figure 2). At each airport, carriers produce homogeneous output, with total output \( Q_i = \sum_{k=1}^{n_i} q_{ik} \) and market price \( p^i \).

**catchment areas**
(adapted from Basso and Zhang, 2007)

The ‘full price’ faced by a consumer located at \( 0 \leq z \leq 1 \) and who goes to airport 1 is given by 
\[
p^1 = V - p^1 - (4t) \cdot z,
\]
where \( V \) denotes (gross) benefit from air travel.\(^{15}\)
Assuming everyone in the \([0, 1]\) interval consumes, then the indifferent passenger \( z \in (0, 1) \) is determined by setting \( U_1 = U_2 \), or
\[
\frac{1}{2} + \frac{p^2 - p^1}{8t} = \frac{V - p^1}{4t}.
\]
(27)

Given that airport 1 also captures consumers at its immediate left side, define \( z' \) as the last passenger on the left side of the city who goes to airport 1. Similarly, define \( z'' \) as the last passenger on the right side of the city who goes to airport 2. With the uniformity and unit density of consumers, \( z' \) and \( z'' \) are computed as:
\[
z' = -\frac{V - p^1}{4t}, \quad z'' = 1 + \frac{V - p^2}{4t}.
\]
(28)

The airports’ catchment areas are shown in Figure 2, and their demands are computed as:

\[
Q_i = z + |z'| = \frac{1}{2} + \frac{p^2 - p^1}{8t} + \frac{V - p^1}{4t}, \quad Q_i = (1-z) + (z'-1) = \frac{1}{2} \frac{p^2 - p^1}{8t} + \frac{V - p^2}{4t}.
\]
(29.1)  
(29.2)

From (29) the inverse demands are given by 
\[
p^i(Q_1, Q_2) = (2t + V) - 3tQ_i - tQ_j,
\]
\( i, j = 1, 2 \).
(30)

which take the linear functional forms. This demand system has the properties of
\[
p^1 = -3t < 0, \quad p_1^2 - p^1_2 = 8t^2 > 0,
\]
and substitutes condition (3).

To solve the two-stage airport competition game, we begin with an analysis of the second stage when airlines engage in intra- and inter-airport competition. Suppose for simplicity that carriers have linear costs \( C(q) = F + cq \). Consider first that the two airports have the same number of carriers, i.e., \( n_1 = n_2 = n \). Then airline profits can be written as:
\[
\pi^k(Q_1, Q_2, q_k) = p^i(Q_1, Q_2)q_k - F - cq_k - w_q + rh_q - f,
\]
(31)
The Cournot-Nash equilibrium is characterized by first-order conditions,
\[
\frac{\partial \pi^k}{\partial q_k} = p^i - 3tq_k - c - w + rh = 0,
\]
\( k = 1, \ldots, n, \quad i, j = 1, 2 \),
(32)

and the corresponding second-order conditions, which hold as \( \frac{\partial^2 \pi^k}{\partial q_k^2} = -6t < 0 \). Given the underlying symmetry of this set-up, the equilibrium quantities are easily obtained:
\[
q_k^* = \frac{3n+1}{2n+3}, \quad w = \frac{2t + V - c - w}{2n+3}, \quad u = \frac{4n+3}{(4n+3)^2},
\]
\( k = 1, \ldots, n, \quad i, j = 1, 2 \).
(33)

Back to the first stage of the game, each airport’s profit is:
\[
\Pi^i = wQ_i^* + (1-r)hQ_i^* + nf_i,
\]
\( i = 1, 2 \).
(34)

With the airline participation constraints, these profits can be rewritten as,
\[
\Pi^i(r_i, r_j) = [p^i(Q_1, Q_2) - c + hQ_i - n(F + r_i^2)].
\]
(35)

Hence the rivalry equilibrium is characterized by first-order conditions,
\[
\Pi^i = [w + (1-r)h - 3Q_i^* - (Q_1 - Q_i^*) + Q_i - (Q_i - Q_i^*) = 0],
\]
\( i = 1, 2 \).
(36)

From (36) the equilibrium sharing proportions are obtained as,

---

15 This is an ‘address model’ with positive linear transportation costs, and the differentiation of the two airports is captured by consumer transportation cost. Within a multi-airport region, for example, passengers may not necessarily choose an airport with cheaper airfare, but may go to a nearer airport – see the empirical studies by, e.g., Pels et al. (2001), Fournier et al. (2007) and Ishii et al. (2009). In addition to distance, other aspects of airport differentiation may be captured by extending the present formulation. For instance, Pels et al. (2000, 2001, 2003) have shown, using a hypothetical example and later the San Francisco Bay Area case study, that ground accessibility of an airport is the most important factor in affecting airport choices in a multi-airport market. Such differential ground access costs could be addressed by introducing a new parameter to the net-benefit functions (26).
Proposition 5. At the rivalry equilibrium with \( n_1 \) and \( n_2 \) carriers at airports 1 and 2 respectively, \( dr^R_i / dn_i < 0 \) and \( dr^R_j / dn_j > 0 \); i.e., the revenue-sharing proportion of an airport-airlines chain decreases in the number of carriers at its airport, and increases in the number of carriers at the competing airport. If \( n_1 = n_2 = n \), then \( dr^R_i / dn_i > 0 \), leading to:

\[
\begin{align*}
\text{Proposition 5.} & \quad \text{At the rivalry equilibrium with } n_1 \text{ and } n_2 \text{ carriers at airports 1 and 2 respectively, } \frac{dr^R_i}{dn_i} < 0 \text{ and } \frac{dr^R_j}{dn_j} > 0 \text{ : i.e., the revenue-sharing proportion of an airport-airlines chain decreases in the number of carriers at its airport, and increases in the number of carriers at the competing airport. If } n_1 = n_2 = n, \text{ then } \frac{dr^R_i}{dn_i} > 0 \text{, leading to:}
\end{align*}
\]

\[
r^R_i = 1 + \frac{w}{h} \left( \frac{8n^2 - 9}{2n(20n + 21)}h \right),
\]

\( i = 1, 2 \). \hspace{1cm} (37)

Notice from (37) that if \( n = 1 \) (each airport has one carrier) then \( r^R_i = 1 + \frac{w}{h} = r^N_i \), a result obtained in Section 3.1 (see Proposition 3).\(^6\) Further, it follows from (37) that \( \frac{dr^R_i}{dn} < 0 \), \( i = 1, 2 \); i.e., the sharing proportions decrease in the number of carriers serving the airports.

For the general case where airports 1 and 2 have \( n_1 \) and \( n_2 \) carriers respectively, the inverse demands are given by (30), where \( Q_i = \sum_{k=1}^{n_i} q_{ik} \) is the aggregate demand at airport \( i \). Solving the two-stage game yields:

\[
\begin{align*}
& \frac{dr^R_i}{dn_i} = 1 + \frac{w}{h} \frac{(8n_i - 29)(9n_i - 9)(10q + 15(2 + V) + h - c)}{n_i(28n_i - 29q + 31)}, \\
& \quad \ldots i = 1, 2.
\end{align*}
\]

(38)

Note that when \( n_1 = n_2 = n \), the above expression reduces to expression (37). From (38) it is straightforward to show that \( \frac{dr^R_i}{dn_i} < 0 \) and \( \frac{dr^R_j}{dn_j} > 0 \), leading to:

\[
\begin{align*}
\text{Proposition 5.} & \quad \text{At the rivalry equilibrium with } n_1 \text{ and } n_2 \text{ carriers at airports 1 and 2 respectively, } \frac{dr^R_i}{dn_i} < 0 \text{ and } \frac{dr^R_j}{dn_j} > 0 \text{ : i.e., the revenue-sharing proportion of an airport-airlines chain decreases in the number of carriers at its airport, and increases in the number of carriers at the competing airport. If } n_1 = n_2 = n, \text{ then } \frac{dr^R_i}{dn_i} > 0 \text{, leading to:}
\end{align*}
\]

\[
\begin{align*}
\frac{dr^R_i}{dn_i} = 1 + \frac{w}{h} \left( \frac{n_i - 1 - (2 + V) + h - c)}{2n_i h},
\end{align*}
\]

\( i = 1, 2, \) \hspace{1cm} (39)

Note, first, that if \( n_1 = 1 \), (39) reduces to (25) and so it extends the formula (25) to the case of multiple airlines. Second, using (39) we obtain:

\[
\begin{align*}
\frac{dr^N_i}{dn_i} < 0, \quad i = 1, 2, \quad (40)
\end{align*}
\]

that is, as the number of firms at a single airport increases and hence (uncoordinated) production gets increasingly excessive, the airport then has a greater incentive to curb production by using a smaller sharing proportion. This result is a clear extension of Proposition 1 which considers the effect of moving from one carrier to two carriers. Finally, comparing (39) with (38) yields that \( r^R_i > r^N_i \) for any \( n_i \) and \( n_j \) (\( n_i \) and \( n_j \) can take different values, \( i, j = 1, 2 \)): i.e., the revenue-sharing proportions are greater at the rivalry revenue-sharing equilibrium than under the non-rivalry revenue-sharing solution. This extends Proposition 3 of Section 3.1 to the general case of multiple airports with each having an arbitrary number of carriers.\(^19\)

---

\(^6\) This result can also be shown using demand functions (30) and the property of their associated revenue functions

\[
R'_j = p'_j q_j = -q'_j < 0.
\]

\(^7\) While the two results have similar intuitions, the present result is nevertheless obtained in an environment of competing airports.

---

\(^{18}\) This ‘number of competitors’ effect is related to a well-known result found by Salant et al. (1983): in a Cournot market, a merger of two firms into one entity reduces the merger partners’ profit (unless the merger leads to a monopoly). By internalizing part of the effect that a firm’s quantity decision has on the rivals’ profit, the merged entity sets its quantity too low, thereby yielding market share to the non-participating firms.

\(^{19}\) Similarly, Proposition 4 (including the Prisoners’ Dilemma result) can be extended to the \( n \)-carrier case. The derivation is
4. Pure Revenue-Sharing Contract

So far our approach to revenue sharing has focused on a ‘two part’ scheme under which an airport chooses both a sharing proportion and a lump-sum fee on its carriers for the right to share concession revenue. While desirable for the airport-airlines channel as a whole, such a fixed payment between the airport and airlines may not be feasible in practice, owing, e.g., to the difficulty in their agreeing to the right amount of payment.

In this section we consider a ‘pure’ sharing contract under which the fixed fee is constrained to zero, while keeping the rest part of the model unchanged. Using ‘hat’ to denote the pure revenue-sharing equilibrium – i.e., \((\hat{r}_i, \hat{r}_j)\) – these sharing proportions are constrained by the carriers’ participation constraints. Unlike the two-part sharing scheme, therefore, negative revenue sharing is not possible since these carriers cannot be compensated for with any fixed payments by the airport, indicating \(\hat{r}_i \geq 0\). Given these observations, the effects of the pure revenue-sharing contract will be compared to those of the two-part scheme as well as the no-sharing regime.

4.1 Single airport

Consider first a single airport served by two carriers, which provide complementary, independent or substitutable services. The airport offers carrier \(i\) a pure sharing contract with sharing proportion \(r_i\). Each carrier’s profit is given by

\[
\pi^i(q_i, q_2) = R^i(q_i, q_2) - C_i(q_i) - wq_i + r_ih_q^i, \quad i = 1, 2. \tag{41}
\]

The stage-2 equilibrium quantities are characterized by (5), and are expressed as \(q_i^*(r_i, r_j)\) with \(\partial q_i^*/\partial r_i\) and \(\partial q_i^*/\partial r_j\) given by (6). Then, the airport’s profit in stage 1 is

\[
\Pi(r_i, r_j) = w(q_i^* + q_2^*) + (1-r_i)h_q^i + (1-r_j)h_q^2. \tag{42}
\]

The pure revenue-sharing equilibrium is determined, implicitly, by first-order conditions,

\[
\begin{align*}
\partial \Pi / \partial r_i &= [w + (1-r_j)h] \cdot (\partial q_i^*/\partial r_i) \\
+ &\left[ w + (1-r_j)h \right] \cdot (\partial q_j^*/\partial r_j) - h_q^i = 0, \tag{43.1}
\end{align*}
\]

\[
\begin{align*}
\partial \Pi / \partial r_j &= [w + (1-r_i)h] \cdot (\partial q_i^*/\partial r_j) \\
+ &\left[ w + (1-r_i)h \right] \cdot (\partial q_j^*/\partial r_j) - h_q^j = 0. \tag{43.2}
\end{align*}
\]

Multiplying (43.1) by \(\partial q_i^*/\partial r_2\) and then subtracting (43.2) yields:

\[
[w + (1-r_j)h][\partial q_i^*/\partial r_2](\partial q_2^* / \partial r_1) - (\partial q_i^*/\partial r_1)(\partial q_2^* / \partial r_2) = h[q_i^*(\partial q_i^*/\partial r_2) - q_j^*(\partial q_j^*/\partial r_1)].
\]

Further, by (6) we have

\[
w + (1-r_j)h)[h^2(\pi_{12}^2 - \pi_{11}^2\pi_{22}^2) / J] = h[q_i^*(\partial q_i^*/\partial r_2) - q_j^*(\partial q_j^*/\partial r_1)].
\]

Since \(\pi_{12}^2 - \pi_{11}^2\pi_{22}^2 = -J\), it follows that

\[
[w + (1-r_j)h]h = -[q_i^*(\partial q_i^*/\partial r_2) - q_j^*(\partial q_j^*/\partial r_1)].
\]

By Lemma 1, \(\partial q_i^*/\partial r_1 > 0\) and \(\partial q_j^*/\partial r_2 = 0\) and \(< 0\) for independent and substitutable services respectively, we must have \(w + (1-r_j)h > 0\).

Similarly, it can be shown that \(w + (1-r_i)h > 0\) for independent and substitutable services. Therefore,

\[
\hat{r}_i^c < 1 + (w / h) \quad \text{and} \quad \hat{r}_j^c < 1 + (w / h), \quad i = 1, 2. \tag{44}
\]

For complements however, we need to assume the symmetry condition. Under symmetry, we have \(w + (1-r_i)h = w + (1-r_j)h\) in (43.1), which reduces to:

\[
[w + (1-r_i)h] \cdot (\partial q_i^*/\partial r_1 + \partial q_j^*/\partial r_1) = hq_j^i.
\]

Because \(\partial q_i^*/\partial r_1 > 0\), and \(\partial q_j^*/\partial r_2 > 0\) for complementary services, we must have \(w + (1-r_i)h > 0\), and so

\[
\hat{r}_i^c < 1 + (w / h), \quad i = 1, 2. \tag{45}
\]

**Proposition 6.** At the pure revenue-sharing equilibrium with a single airport,

1. when carriers provide independent and complementary services (assuming symmetric carriers in the case of complements), both the sharing proportions and social welfare are smaller than at the two-part revenue-sharing equilibrium;
2. when carriers provide substitutable services, both the sharing proportions and social welfare may be higher or smaller than at the two-part revenue-sharing equilibrium.

The proof is relatively straightforward and is available upon request from the authors. For the
cases of independent or complementary services, the airport, being unable to charge the fixed fee under the pure revenue sharing, shares less concession revenue with its carriers than would be under the two-part revenue sharing. This result follows directly from comparing (44)-(45) with the sharing proportions (12) and (15). This reduction in sharing will, by similar arguments used in the proof of Proposition 2, reduce social welfare.

For the substitutes case however, although the equilibrium sharing proportions are, by (44) and (16), less than $1 + (w/h)$ for both types of revenue sharing, the sharing-proportions comparison between the two types is in general ambiguous. In particular, as indicated, while negative sharing is ruled out under the pure revenue sharing, it is possible under the two-part revenue sharing. In such situations, it can be shown that the pure revenue sharing results in not only a higher sharing proportion, but also a higher welfare level if carriers are sufficiently symmetric, than the two-part revenue sharing.

When competing carriers are asymmetric, however, there is an interesting twist introduced in the sharing-proportions and welfare comparison between the pure and two-part sharing arrangement. To illustrate the effect, numerical simulations are called upon. More specifically, the demands are specified as linear: $p_i = 1 - b_i q_i - k q_j$ with the usual properties of $b_i > 0$ and $b_1, b_2 > k$. Carrier asymmetry is introduced via (i) $b_1 \neq b_2$ and/or (ii) $c_1 \neq c_2$. Without loss of generality, (i) we set $b_2 = (b_1 + k)/2$ and so $b_1 > b_2 (> k)$; and (ii) we fix $c_2$ and let $c_1$ vary. The results are given in Figure 3.
- The horizontal axis corresponds to airline 1’s marginal cost $c_1 \in [0.25, 0.7]$
- Solid Line: Results with the two-part revenue sharing
- Dotted Line: Results with the pure revenue sharing.

As shown in Figure 3, when firm 1 becomes more competitive (smaller $c_1$), an airport with the two-part revenue sharing will share more revenue with this carrier, while reducing the proportion shared with the other carrier (firm 2, not shown in Figure 3). By further strengthening the increasingly efficient carrier’s competitiveness with a higher revenue share, and hence greater profit could be generated in the airline market, the airport would capture greater profit via the fixed transfer payment. This is not the case for the pure revenue sharing.

Under the pure revenue sharing, an airport is more concerned with total traffic volume, which determines its profit margin, and wants to stimulate the traffic with minimum revenue shared (recall that the transfer-payment device is no longer available). This implies that price elasticities of demand play a very important role in the pure revenue sharing. In particular, increasing the sharing proportion for a carrier with large market share and output (as a result of its competitiveness) would likely be more costly than doing so with a fringe carrier. As can be seen from the figure, an airport under the pure revenue sharing shares less with firm 1 as it becomes more competitive. While carrier 1’s output may be higher or lower under the two-part revenue sharing than under the pure revenue sharing, total output and hence welfare are, at least for the parameter values used in Figure 3, higher under the former than the latter (note that here, the relevant range of comparison is for $\hat{r}_i > 0$). This is because, when competing carriers are asymmetric in costs and demands, an airport under the two-part revenue sharing has a tendency to influence the market equilibrium toward the efficient direction, which enhances social welfare.

Finally, the pure revenue sharing can also be compared to the no-sharing regime. It can be shown that at the pure revenue-sharing equilibrium, prices are lower, and both outputs and welfare are greater, than in the absence of revenue sharing. These results hold irrespective of the carriers’ producing complementary, unrelated or substitutable services. The proofs are analogous to the proofs of Proposition 2, with some of the results requiring that carriers be reasonably symmetric.

4.2 Competing airports
Next consider two competing airports, each served by one carrier. The stage-2 equilibrium quantities are again characterized by (5) and are given by $q_i^* (r_1, r_2)$, which have comparative-static property $\partial q_i^*/\partial r_i > 0$, $i = 1, 2$. Then each airport’s profit in stage 1 is $\Pi_i^* (r_1, r_2) = w q_i^* (r_1, r_2) + (1 - r_i) h q_i^* (r_1, r_2)$, and the pure revenue-sharing equilibrium is characterized by first-order conditions,

$$\Pi_i^* = [w + (1 - r_i) h] \cdot (\partial q_i^*/\partial r_i) - h q_i^* = 0, \quad i = 1, 2. \quad (46)$$

From (46) and $\partial q_i^*/\partial r_i > 0$, it follows that $w + (1 - r_i) h > 0$ and so

$$0 \leq \hat{r}_i < 1 + (w/h) = r_i^N < r_i^R, \quad i = 1, 2. \quad (47)$$
The following results are then obtained (part 2’s proof is analogous to Proposition 2’s):

**Proposition 7.** At the pure revenue-sharing equilibrium with competing airports,

1. the sharing proportions are smaller (greater, respectively) than at the two-part revenue-sharing equilibrium; and

2. under symmetry, (i) outputs and welfare are smaller (greater; respectively) and (ii) prices are higher (lower, respectively) than at the two-part revenue-sharing equilibrium (the no-sharing equilibrium, respectively).

Proposition 7 indicates that under airport competition, the pure revenue sharing improves social welfare relative to the no-sharing regime, albeit less effective than the two-part revenue sharing. In general, in terms of airfare, traffic volume and social welfare, the pure revenue sharing with competing airports lies in between the no-sharing and two-part revenue sharing regimes. It is also worth noting that unlike the ambiguous result for the single airport, the pure revenue sharing unambiguously entails a smaller sharing proportion than the two-part revenue sharing.

5. Concluding Remarks

This paper has investigated the implications of concession revenue sharing between an airport and its airlines. Earlier studies show that such sharing allows an airport to internalize the demand complementarity between flights and concessions, and may improve both the profit and social welfare. We found that the degree of sharing will be further affected by how carriers’ services are related (complements, independent, or substitutes). In particular, when carriers provide substitutable services, the sharing proportions might become negative if horizontal substitutability is sufficiently strong and the fixed (transfer) payments between the airport and carriers are feasible (the two-part revenue sharing). The negative sharing allows the airport to penalize the over-competing airlines so as to support prices in the output market and improve profit. In these situations, while revenue sharing improves the total airport-airlines channel profit, it reduces social welfare. If the fixed payments are not feasible, under the resulting pure revenue sharing the airport will, for the cases of independent or complementary services, share less concession revenue with its carriers than would be under the two-part revenue sharing. For the substitutes case however, the sharing-proportions comparison between the two types is in general ambiguous. In the special case of negative sharing, the pure revenue sharing results in not only a higher sharing proportion, but also a higher welfare level if carriers are sufficiently symmetric, than the two-part revenue sharing. We further found that carrier asymmetry tends to favor the two-part revenue sharing, in terms of enhancing welfare, over the pure revenue sharing.

Our second objective in writing this paper is to extend the existing literature on airport-airline vertical cooperation to the general case of multiple competing airports with each having an arbitrary number of carriers. We found that airport competition will result in a higher degree of revenue sharing than would be had in the case of single airports. Nevertheless, the airport-airline chains may derive lower profits through this revenue-sharing rivalry: in effect, the airports are trapped by the incentive structure of the environment, and the situation is similar to a classic Prisoners’ Dilemma. As the airport-airline chains move further away from their joint profit maximum, social welfare rises beyond the level achievable by single airports. Our analysis also showed that the (equilibrium) revenue-sharing proportion at an airport decreases in the number of its carriers, and increases in the number of carriers at the competing airport. Airline market structure will therefore influence revenue sharing arrangements not only at the airport in question, but also at the competing airports.

### References


Figure 1: Revenue sharing vs. no sharing: Single airport with two carriers
(Parameter values: \( b = 0.00001, c_1 = c_2 = 0.45, w = 0.05, h = 0.05 \))

Figure 2: Consumer distribution and airports’
Figure 3. Two-part revenue sharing vs. pure revenue sharing: Single airport with two carriers
(Parameter values: $b_1 = 0.00001$, $b_2 = 0.000085$, $k = 0.00007$, $c_2 = 0.55$, $w = 0.1$, $h = 0.3$)
EXAMINING THE ANTECEDENTS OF REPURCHASE INTENTION IN CONVENIENCE STORES: A PERSPECTIVE OF EXPECTATION-DISCONFIRMATION THEORY

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Abstract
The density of convenience stores in Taiwan is the highest in the world. In a convenience store context, this study attempts to examine the relationship between service quality, customer satisfaction and repurchase intention, as well as the impact of customer familiarity with employees on customer satisfaction and repurchase intention. The result indicated that expectation had direct effect on service quality. The result also showed that service quality was positively related to disconfirmation. As expected, there were interrelationships among service quality, satisfaction, and repurchase intention. Moreover, customer familiarity with employees had positive, direct influence on both satisfaction and repurchase intentions.

Keywords: Convenience store, service quality, expectation-disconfirmation theory, customer satisfaction, repurchase intention.

Introduction
In 2006, ACNielsen announced that more than 85% customers go to convenience store 3 to 4 times every one week. The Department of Statistics, Ministry of Economic Affairs also reported the gross rate of convenience stores in 2006 was 8.85% and the growth rate was higher than other industries. Since convenience stores were introduced to Taiwan in 1979 by Uni-President Company, they have been grown rapidly in Taiwan due to the convenience of distance, time, shopping, and service. According to the reports provided by Fair Trade Commission Executive Yuan, R.O.C, in 2006, every 2,700 people in Taiwan is served by a convenience store, but the average rate has been down to 2,500 people in 2009, making Taiwan’s density of convenience stores is the highest in the world. The amount of convenience stores in Taiwan has already exceeded 9,200. Among these convenience stores, 52.15% are 7-ELEVEN, which belong to Uni-President Company.

As 7-ELEVEN convenience stores are widespread in Taiwan, how customers expect and evaluate overall performance of 7-ELEVEN stores (i.e., customer expectation and perceived service quality) is an important issue in the Taiwanese retailing environment. More important, the mechanism of how customer expectations lead to repurchase intention and customer loyalty is also worth noting [35][36][40]. Therefore, the main objectives of this research are described as follow:

1. Identifying the key dimensions of service quality that customers take into account. This research will explore main dimensions that customers will concern when they evaluate the service quality of 7-ELEVEN convenience stores.
2. Exploring the gap between the expectations and the perceptions of service quality. This research uses the PZB’s model [40] to measure the expected service quality and perceived service quality. Measuring service quality in this way can get differences between these two constructs and specify which items and dimensions are the closest to customers’ expectations and which items and dimensions are the worst in order to provide remediation to 7-ELEVEN’s managers.
3. Examining the relationships among service quality, satisfaction, and repurchase intention. By integrating the expectation-disconfirmation theory (EDT) and the concept of PZB’s [41] Gap 5, this study attempts to analyze and estimate the direct or indirect relationship among service quality, satisfaction, and repurchase intention in a convenience store context.

Literature Review
Expectation-disconfirmation theory
Expectation-disconfirmation theory (EDT) is extensively used in consumer research and service marketing [2][20][35][40][46][51]. Due to its predictability, EDT has been applied to product and service repurchase contexts, including automobile [40], camcorder [50], photographic products [20], restaurant service [52], professional services [46], and so on.

EDT denotes that product/service performance will be compared to pre-use expectations, and this comparison process will result in the state of
disconfirmation. If actual performance outperforms expectations (positive disconfirmation), customers will feel satisfied. Contrarily, while actual performance fails to meet the expectations (negative disconfirmation), consumers will feel dissatisfied [35] [51]. Finally, the level of satisfaction will affect customers’ repurchase intention; the more satisfied customers’ feel, the higher they intend to repurchase.

EDT contains expectations, performance, disconfirmation, and satisfaction.

1) Expectations. Expectations are a determinant of satisfaction because it serves as the baseline or reference level for customers to form evaluative judgments about the focal product or service. Based on customers’ pre-purchase experiences, word-of-mouth communications, or product information and service promises provided by salespersons, customer expectations may represent expected product attributes in the future [50]. Oliver thinks of that customer expectations compose of two components, including a probability of occurrence and an evaluation of the occurrence, where customer judgments of these two components will affect their expectations [36]. According to these two components, expectations can be divided into “high expectations” (desirable events will occur or undesirable events will not occur) and “low expectations” (desirable events will not occur or undesirable events will occur).

2) Performance. Performance refers to the customers’ evaluations of recent consumption experiences. After purchasing, customers usually compare performance to their expectations in order to evaluate the level of confirmation/disconfirmation. Oliver and DeSarbo find out that product performance has a direct impact on customer satisfaction [38]. Other research also indicates the positive relationship between performance and satisfaction [2] [3].

3) Confirmation/Disconfirmation. Confirmation or disconfirmation is the main determinant of satisfaction. It represents the product of the difference between actual performance and expectations; that is, either confirmation or disconfirmation is the combination of expectations and performance [11]. Oliver suggests that confirmation or disconfirmation is a mental comparison, which may be lower than expectations (i.e., negative disconfirmation), higher than expectations (i.e., positive disconfirmation), or just the same as expectations (i.e., zero disconfirmation or confirmation) [35].

4) Satisfaction. Satisfaction is originally defined by Locke in the context of job performance as “a pleasurable or positive emotional state resulting from the estimate of one’s job” [30]. Oliver extends the definition to consumption context as “the summary psychological state resulting when the emotion surrounding disconfirmed expectations is coupled with the consumer’s prior feelings about the consumption experience [35] [36].” Westbrook notes that satisfaction is often treated as the mediator of post-purchase behavior. It connects the prior beliefs of alternatives, customers’ communication, and willingness to repurchase [60].

Parasuraman et al. propose a gap-based model of service quality based on the comparison with consumer expectations and perceived performance. It is similar to what EDT suggests and applied in numerous studies [16] [17] [44] [47] [55]. Rather than the performance-based measures of service quality, this study suggests that customers will use a variety of cues to infer the perceived quality of goods and services. As a result, we utilize the gap-based model to evaluate the expectations and perceptions pertaining to service quality in convenience stores. The next section will discuss the retail service quality.

Retail Service Quality
Compared with tangible products, the characteristics of service (include intangible, inseparability, variability, and perishability) lead to a variety of difficulties in measuring service quality. Parasuraman, Zeithaml, and Berry develop a scale to measure service quality [42]. It is well known as SERVQUAL, which contains five key dimensions, including tangible, reliability, responsiveness, assurance, and empathy [42]. SERVQUAL has been extensively used service quality in different contexts [43] [44] [64] [65].

However, several scholars suggest the dimensions of SERVQUAL need to be revised in order to meet the characteristics of different industries, countries and research contexts [4]. As for the retailing context, Dabholkar et al. develop a five-facet Retail Service Quality Scale (RSQS) for the retailing context, including physical aspect, reliability, personal interaction, problem solving, and policy [18]. Accordingly, Dabholkar et al.’s [18] service quality dimensions are further applied to the convenience store context in the current study.

Repurchase Intention
According to the attitudinal theory of consumer behavior, behavioral intention is the necessary process of any behavior performance. In other words, it determines the behavior performed [1]. Engel, Blackwell and Miniard suggest that a customer’s overall assessment to a certain object is determined by his/her perceptions and feelings toward the object [20]. The customer’s attitude toward the object will further affect his/her behavioral intention, and then in turn affect his/her actual behavior.

Zeithaml, Berry, and Parasuraman suggest that when customers perceived superior service quality,
they will have positive behavioral intention for the company, and can strengthen the relationships between customers and the company. If customers perceived poor service quality, they will result in negative behavioral intention toward the company [64]. Zeithaml et al. [65] suggest that favorable behavioral intention is associated with an company’s ability to make customers to (1) say positive things about the company,(2) recommend the company to other customers;(3) remain loyal to the company (i.e., repurchase from it),(4) spend more with the company, and (5) pay price premiums. Furthermore, they identify five factors of behavioral intention, including “loyalty”, “switch”, “pay more”, “external response”, and “internal response.” These constructs has been used in numerous past studies [65].

Research Framework and Hypotheses

According to research motivation and research objectives, this research attempts to identify the dimensions of service quality and evaluate the relationship among service quality, satisfaction, and repurchase intention in the convenience store context (i.e., 7-ELEVEN).

Figure 2 presents our research framework. Based on EDT, our model tested in this research describes that customer expectations will affect perceived service quality, and both have an impact on the disconfirmation construct. Then, disconfirmation will predict customer satisfaction, which in turn influences repurchase intention. In addition, the relationship between service quality and behavioral intention is mediated by customer satisfaction. Moreover, we suggest that customer familiarity with employees has an impact on satisfaction and repurchase intention.

Hypotheses

The customer’s expectations of product or service will affect the cognition of perceived service quality. When customer expectations are not met, his/her evaluation of the perceived service quality may be lower than those whose expectations are met or exceeded. On the contrary, while the customer expectations are met or exceeded, his evaluation of perceived service quality will be higher than those whose expectations aren’t met. Prior literature also suggests that customer expectations have a direct influence on perceived service quality [33] [50] [62]. When the expectations can’t be satisfied, the perceived service quality is “unacceptable quality”; when meeting the expectations, the perceived service quality is “satisfied quality”; when better than the expectations, the perceived service quality is “ideal quality” [41]. Hence, customer expectations of service quality will affect customer perceptions of service quality. Thus, we hypothesize:

H1. Expectations have a positive, direct influence on service quality.

According to EDT, expectations have a negative effect on disconfirmation. Therefore, when customer expectations are higher, perceived service quality will not be likely as high as the expectations, resulting in the negative disconfirmation. However, low expectations are more likely to be exceeded by perceived service quality, leading to the positive or zero disconfirmation. The negative effect of expectations on disconfirmation has been proven in a number of studies [40]. On the other hand, EDT also suggests that service quality has a positive effect on disconfirmation. Thus, superior service quality is more likely to be higher than the expectation level, resulting in the positive or zero disconfirmation. While poor service quality is more likely to be lower than the expectation level, leading to the negative disconfirmation. Thus, we hypothesize:

H2. Expectations have negative, direct influence on disconfirmation.

H3. Service quality has a positive, direct influence on disconfirmation.

Based on EDT, when service quality is better than what customers expected (positive disconfirmation), the satisfaction level will be higher than the levels while expectations are just or not met. That is, disconfirmation has a positive effect on satisfaction. Thus, we hypothesize:

H4. Disconfirmation has a positive, direct influence on satisfaction.

The service quality that customers perceived is an antecedent of satisfaction [23]. When customer perception of service quality is better, the probability that the customer will be satisfied seems higher. On the other hand, when service quality that customers perceived is poor, the probability that the customer will be satisfied appears low. Parasuraman et al. also suggest that superior service quality is more likely to increase customer satisfaction [58]. Moreover, positive perceptions of service quality can result in satisfaction, which in turn may lead to customer repurchase intention [16]. Thus, we hypothesize:

H5. Service quality has a positive, direct influence on satisfaction.

The positive effect of satisfaction on behavioral intention has been proven in numerous studies [2] [8] [17] [62]. That is, the higher level of satisfaction is more likely to lead to positive behavioral intention in the future. Hence, customer satisfaction will increase customer loyalty, such as customer’s willingness to repurchase and the frequencies or quantities of repurchase [46]. We utilized Zeithaml et al.’s [64] classification of behavioral intention in this study. Thus, we hypothesize:

H6. Satisfaction has a positive, direct influence on behavioral intention.
The service quality that customer perceived will affect his/her evaluation on overall satisfaction, and then in turn leads to future repurchase intention [9]. If the level of perceived service quality is higher, the customer will be satisfied and then he will be more likely to behave positively in the future. On the other hand, if the level of perceived service quality is lower, the customer will be dissatisfied and then he will be more likely to behave negatively in the future. Therefore, service quality and satisfaction have positive impacts on behavioral intention [54], for example, Cronin verified the relationship among service quality, satisfaction and repurchase intentions [17]. The mediation effect of customer satisfaction will be also tested in this study. Thus, we hypothesize:

**H7.** The relationship between service quality and repurchase intention is mediated by satisfaction.

The customer familiarity with employees has been shown as an important interpersonal element in the service context [13] [45]. If there is a good relationship between the customer and the employee, the employee may well know about the customer’s personality, habits or preferences and will provide more exact products or services that meet the customer’s needs. Hence, the customer who has a good relationship with the employee will be more satisfied with services that the employee provides, and the customer will probably have positive behavioral intentions toward the service provider, such as repurchase, willingness to recommend to his friends, or trust in the employee. In addition, several scholars also suggest that the interpersonal relationship between the employee and the customer can have a substantial impact on important relational outcomes for the company because it fosters customer satisfaction, commitment and trust in the staff, as well as customers’ repurchase intention, willingness to recommend the employee or the company to other potential customer, and to provide referrals [25] [28] [29] [31] [32] [57]. As such, customer familiarity with employees seems to be a positive effect on customer satisfaction and behavioral intention. Thus, we hypothesize:

**H8.** Customer familiarity with employees has a positive, direct influence on customer satisfaction.

**H9.** Customer familiarity with employees has a positive, direct influence on repurchase intentions.

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**Method**

**Operationalization of Variables**

In this study, we select customers who have shopping experiences in 7-ELEVENs as our research participants. Table 1 lists the operational definitions and sources of our research constructs. All constructs are modified to meet our research context, 7-ELEVEN.

**Table 1. Definition of research construct**

<table>
<thead>
<tr>
<th>Construct</th>
<th>Definition</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expectation</td>
<td>The customer’s anticipation of services before purchase.</td>
<td>[50]</td>
</tr>
<tr>
<td>Service quality</td>
<td>The service benefits which customer actually perceived.</td>
<td>[41] [18]</td>
</tr>
<tr>
<td>Disconfirmation</td>
<td>The customer evaluates the difference between expected and actually perceived service performance.</td>
<td>[11] [35]</td>
</tr>
<tr>
<td>Customer familiarity with employees</td>
<td>Customer perceptions of social closeness to employees.</td>
<td>[10]</td>
</tr>
<tr>
<td>Satisfaction</td>
<td>Overall customer satisfaction after experiencing the services.</td>
<td>[36] [63]</td>
</tr>
<tr>
<td>Repurchase intentions</td>
<td>Customer intention to perform favorable behavior toward buying.</td>
<td>[1] [64]</td>
</tr>
</tbody>
</table>

**Questionnaire Design**

The research questionnaire was generated through several times of group discussion with one professor, one doctoral student and five graduate students to meet the face validity. Most items are adapted from prior studies and modified to meet the objectives of this study. The expectations and perceptions of service quality were measured by items adapted from Dabholkar et al.’s retail service quality measurements [18]. The items to measure disconfirmation were modified from Oliver [35] and Westbrook and Reilly [60]. The items to measure overall satisfaction are used from Westbrook and Oliver [62]. Furthermore,
behavioral intentions were measured by items adapted from Zeithaml et al. [65].

All items of focal constructs are anchored at the six-point Likert-type scale, ranging from “1 = very disagree” to “6 = very agree.”

**Sample**

To collect data, first, we posted an announcement on BBS (telnet://ptt.cc) to ask for volunteers to participate in the study. Second, we invited those who usually go to 7-ELEVEN through interpersonal channels and asked them to fill out questionnaires.

We received a total of 310 returned questionnaires, in which 304 were valid. Out of 304 responses, 56.25% were male and 43.75% were female. The bulk of samples ranged in age from 21 to 30 years old (78.95%). Also, 96.38% had at least college degree and 69.41% students. In terms of average consumption frequency, 15.13% went to 7-ELEVEN one day per week, 18.09% for two days per week, 23.03% for three days per week, 12.5% for four days per week, 11.84% for five days per week, 3.29% for six days per week, and 16.12% for every day. Moreover, 87.5% of the samples have average expense amount under $100 N.T. dollars. 58.88% of the samples usually buy drinks and 29.93% usually buy food.

**Result**

**Analytic strategy for assessing the model**

The proposed model was evaluated using SEM, which is a powerful second-generation multivariate technique for analyzing causal models with an estimation of the two components of a causal model: measurement and structural models. The measurement model is estimated using confirmatory factor analysis (CFA) to test whether the constructs possess sufficient validation and reliability. The structural model is used to investigate the strength and direction of the relationship between the theoretical constructs. In this study, AMOS 7 was the software used to assess the measurement and the structural models.

**The measurement model**
The measurement model was tested using CFA. As shown in Table 3, factor loadings ranging from 0.62 to 0.93 exceeded the acceptable value of 0.50, as recommended by Fornell and Larcker [21]. The internal consistency of the measurement model was assessed by computing the composite reliability. As Bagozzi and Yi [6] suggest, all composite reliabilities were above the 0.70 benchmark. The average variance extracted for all constructs exceeded the threshold value of 0.50 recommended by Fornell and Larcker [21]. Since the values of reliability were above the thresholds, the scales for evaluating the constructs were deemed to exhibit convergence reliability.

**Table 3. Reliability**

<table>
<thead>
<tr>
<th>Construct</th>
<th>Item</th>
<th>Factor loading</th>
<th>Cronbach’s α</th>
<th>Composite reliability</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expectation-physical aspect (EPA)</td>
<td>EPA1</td>
<td>0.77</td>
<td>0.84</td>
<td>0.84</td>
<td>0.73</td>
</tr>
<tr>
<td></td>
<td>EAP2</td>
<td>0.93</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expectation-reliability (ERE)</td>
<td>ERE1</td>
<td>0.91</td>
<td>0.91</td>
<td>0.91</td>
<td>0.84</td>
</tr>
<tr>
<td></td>
<td>ERE2</td>
<td>0.91</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expectation-person interaction (EPI)</td>
<td>EPI1</td>
<td>0.85</td>
<td>0.84</td>
<td>0.91</td>
<td>0.72</td>
</tr>
<tr>
<td></td>
<td>EPI2</td>
<td>0.85</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expectation-problem solving (EPS)</td>
<td>EPS1</td>
<td>0.66</td>
<td>0.70</td>
<td>0.74</td>
<td>0.59</td>
</tr>
<tr>
<td></td>
<td>EPS2</td>
<td>0.85</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Service quality-physical aspect (PA)</td>
<td>PA1</td>
<td>0.81</td>
<td>0.76</td>
<td>0.76</td>
<td>0.61</td>
</tr>
<tr>
<td></td>
<td>PA2</td>
<td>0.76</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Service quality-reliability (RE)</td>
<td>RE1</td>
<td>0.93</td>
<td>0.90</td>
<td>0.90</td>
<td>0.81</td>
</tr>
<tr>
<td></td>
<td>RE2</td>
<td>0.88</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Service quality-person interaction (PI)</td>
<td>PI1</td>
<td>0.88</td>
<td>0.85</td>
<td>0.86</td>
<td>0.75</td>
</tr>
<tr>
<td></td>
<td>PI2</td>
<td>0.84</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Service quality-problem solving (PS)</td>
<td>PS1</td>
<td>0.77</td>
<td>0.87</td>
<td>0.80</td>
<td>0.66</td>
</tr>
<tr>
<td></td>
<td>PS2</td>
<td>0.89</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disconfirmation (DIS)</td>
<td>DIS1</td>
<td>0.77</td>
<td>0.83</td>
<td>0.86</td>
<td>0.67</td>
</tr>
<tr>
<td></td>
<td>DIS2</td>
<td>0.70</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>DIS3</td>
<td>0.89</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Customer familiarity with employees (FA)</td>
<td>FA1</td>
<td>0.87</td>
<td>0.84</td>
<td>0.82</td>
<td>0.61</td>
</tr>
<tr>
<td></td>
<td>FA2</td>
<td>0.79</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>FA3</td>
<td>0.68</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall satisfaction (SA)</td>
<td>SA1</td>
<td>0.86</td>
<td>0.91</td>
<td>0.90</td>
<td>0.75</td>
</tr>
<tr>
<td></td>
<td>SA2</td>
<td>0.91</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SA3</td>
<td>0.84</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Behavioral intentions (BI)</td>
<td>BI1</td>
<td>0.88</td>
<td>0.84</td>
<td>0.86</td>
<td>0.67</td>
</tr>
</tbody>
</table>

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The correlations among constructs were ranging from 0.03 to 0.86, and any squared values were smaller than the variances extracted by constructs (AVE); this implied that constructs were empirically distinct. In summary, our measurement model test supported both convergent and discriminant validity.

χ², GFI (goodness-of-fit index), NFI (normalized fit index), CFI (an incremental fit index of improved NFI) and RMSEA (root-mean-square error of approximation) were used to test the goodness of fit of the proposed model. The value of normed χ² was smaller than the threshold value of 3.00 recommended by Bentler and Bonett [7] (normed χ²=1.93). The value of GFI (GFI=0.88) exceeded the acceptable value of 0.85, as recommended by Hadjistavropoulos et al. [27]. As Bentler and Bonett [7] suggest, both NFI and CFI were above the 0.90 benchmark (NFI=0.90; CFI=0.95). Finally, as recommended by Hair et al. [26], the value of RMSEA was smaller than the acceptable value of 0.08 (RMSEA=0.06). Consequently, all the fitness measures in the study fell into acceptable ranges and the proposed model provided a suitable fit.

Tests of the structural model
We examined the structural equation model by testing the hypothesized relationships among the research variables (see Figure 3). The results showed that expectation had a significant effect on service quality (β=0.36, p<0.001) and service quality had a significant effect on disconfirmation (β=0.46, p<0.001), supporting hypotheses 1 and 3, respectively. Contrary to prediction, expectation had no direct influence on disconfirmation (0.09, p>0.05), hypothesis 2 was not supported. The results also showed that service quality had a significant, direct influence on overall satisfaction (β=0.15, p<0.05) and satisfaction had a significant, direct influence on repurchase intention (β=0.55, p<0.001). Hypothesis 5 and 6 were supported. This study used Sobel’s test [49] to verify the mediated relationship of service quality, satisfaction, and behavioral intention. The results indicated that service quality had a significant, indirect influence on repurchase intention through satisfaction (Z=2.35, p < 0.05). Hence, hypothesis 7 was supported. As expected, disconfirmation had a significant, positive influence on satisfaction (β=0.49, p<0.001), supporting hypotheses 4. Also the results showed that customer familiarity with employees significantly predicted both satisfaction and repurchase intention (satisfaction: β=0.39, p<0.001; repurchase intention: β=0.24, p<0.001), providing support for hypotheses 8 and 9. Moreover, the results showed that the dominant dimensions of service quality include physical aspect, reliability, person interaction, and problem solving.

Figure3. Results of structural modeling analysis
Discussion
This study presented and validated a multi-facet model to evaluate the relationship among 7-ELEVEN’s service quality, satisfaction, and repurchase intention. With empirical analysis, this research had found several implications as followings. First, expectation had positive, direct influence on
service quality in customer’s perception of. That is, dissatisfied customers due to the expected service quality higher than the perceived quality may have the lower expectation than those satisfied customer whose perceived service quality was equal or higher than the expectation. This study showed that service quality had a significant effect on disconfirmation. Thus, superior service quality provided by 7-ELEVENs is more likely to lead to the positive or zero disconfirmation. However, expectation was found to have no effect on disconfirmation. It could be that expectation should be measured by overall service performance or attributes of products/service instead of service quality, which has been argued in some previous studies (e.g. [34] [37] [39]).

Second, this research uses the PZB’s gap model [41] to measure the differences between expected service quality and perceived service quality. The results showed that the reliability of perceived service quality was the closest to customers’ expectations (-0.58), while problem solving is the lowest (-0.81) among the four dimensions. Additionally, the results were found that RE2 (This store provides its services at the time it promises to do so) was biggest but still negative among all items (-0.53). It means that customer perceived service qualities were lower than expectations in the 7-ELEVENs.

Third, just as expected, there have interrelationships among service quality, satisfaction, and repurchase intention. That is, the service quality that customer perceived will affect his/her satisfactions, and then in turn affects repurchase intentions in the future. When the level of perceived service quality is higher, the customer will be more likely to be satisfied and then he/she will probably have positive repurchase intentions in the future. Therefore, both service quality and satisfaction have positive impacts on repurchase intentions.

Finally, customer familiarity with employees had positive, direct influences on both satisfaction and repurchase intention. It means that when customer get the better service provided from the 7-ELEVEN’s employees according to the better acquaintance with customer, it would lead a higher and positive satisfaction and repurchase intentions in the future.

Implications for practice
This study generated some insights for 7-ELEVEN’s managers and customers:
(1) The results were found that four dimensions play dominant roles in service quality of convenience stores. That is, when customers evaluate the service quality of 7-ELEVEN, the dimensions they will concern include physical aspect, reliability, person interaction, and problem solving. Therefore, 7-ELEVEN’s managers should strive to improve the performances of these dimensions in order to increase service quality.
(2) Since service quality is so important to customer’s satisfaction and future repurchase intention, 7-ELEVEN’s managers should attempt to improve their service quality, in particular for the dimension of problem solving, which is the lowest dimension as compared to its expectation. Therefore, 7-ELEVEN’s managers and employees should struggle to improve their manners and show their sincere interest in solving problems and handling complaints in order to increase customers’ satisfaction and loyalty.
(3) The relationship between customers and employees has become increasingly important in the interpersonal element of services. The employee who has a good relationship with the customer will lead the customer more likely be satisfied with services and possibly have positive behavioral intentions in the future, such as willingness to recommend to his friends and repurchase from the store. Hence, the managers of 7-ELEVENs should encourage their employees to have rapport relationships with customers and know what their customers need.

References are available upon request.
MOVING AWAY FROM TRADITIONAL ELEMENTS TO BUILD TRUST IN E-COMMERCE

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Abstract
This paper investigates the evolution in variables that lead customers to trust an online shop or not. On the basis of samples taken in 2004 and in 2008 in Seoul (South Korea), it is shown that website visitors tend to trust online shops of generally well known companies. Certification marks granted by trusted third parties to online shops do not seem to induce trust, although a small positive trend seems noticeable. Offering accurate, easy to find product information on the website induced trust in 2004, but did no longer do so in 2008. All in all, the 2004 South Korean customer seemed to do business on the Internet like in the real world. However, by 2008 he seemed to be slowly moving away from that traditional way of buying things on the Internet to an Internet-specific way where other elements are considered to decide whether an online shop can be trusted.

Introduction
Sales over the Internet are increasing year after year but research shows that many people are still reluctant to buy on the Internet [1]. Reasons not to shop on-line are worries about payment security, worries about privacy, absence of confidence in e-retailers, the need to physically examine the product, worries about not receiving the goods or receiving them late and/or in bad condition [2].

Trust is an important factor in economic and social interactions where uncertainty exists [3]. From the psychological perspective trust is a concept of ‘generalized expectancy where there is a belief in another person or a group’s promise made in language or writing’ [4]. The economic perspective views trust as ‘an individual’s estimation or expectancy of an outcome in risky situations’. From the social perspective trust is understood as a characteristic of social relations and the formation of trust is a belief based on several conditions like social rules, norms, customs and history surrounding the actors’ relationship in exchanges [5]. Schur and Ozanne [6] defined trust as a belief that the other party’s words or speech is trustworthy and that the other party will do their best to fulfill the exchange relationship’s obligations. They discovered that the buyer’s trust and expectation in the negotiation influences his or her attitude and behavior toward the seller. Trust saves transaction costs by reducing uncertainty and induces cooperation. As seen from these various definitions, a consistent definition is necessary as research on trust is being carried out in diverse fields. In this paper, trust is defined as ‘a belief that the other party will commit to the obligations and responsibilities in exchange relationships where their words and behavior are trustworthy under uncertainty and risky situation.’ A consumer’s trust is then an effort to rely on the seller and reliance which ensures any action to be taken regardless of the conducive nature of the environment [7].

The formation of trust can be classified according to its different sources. Lewis and Weigert [8] pointed out that trust is built based on rationality and emotionality, and that there are different types of trust depending on the degree of rationality and emotionality. Shapiro, Sheppard and Cheraskim [9] made distinctions of the concept of trust into deterrence-based, knowledge-based and identification-based trust. In deterrence-based trust, reliability of behavior is guaranteed through the risk of punishment, and trust exists on the judgment that the behavior will be consistent because of considerable loss or punishment if the other party betrays. Knowledge-based trust is based on predictability derived from thorough knowledge on the other party which makes prediction possible. In other words, this trust is formed when predictability of the other party increases after accumulating information and experience through mutual relationships. The corresponding trust refers to trust and a sense of unity that is felt when both parties’ goals, values and norms coincide.

Literature on adoption of e-commerce shows that trust issues are important inhibitors of e-commerce adoption [13] [14] [15] [16]. Some researchers have tried to identify how trust can be established in online shops. Fogg et al. [17] for example found that web site elements that highlight the brick-and-mortar nature of the organization, such as listing a physical address and a contact phone number enhance web credibility. Feedback systems that allow market participants to provide information on their online experience were also said to enhance trust [51]. Field experiments conducted in Hong Kong by Tam and Ho [18] indicate that personalizing web sites plays a role in persuading customers to buy. Similarly, Fogg et al. [17] and Singh, Zhao, and Hu. [19] find that tailoring the website to the user...
experience as compared to information sources like

easily and quickly, it is able to offer excellent visual
information related to a purchase at almost zero costs
quantities of information. If the internet provides
product, the consumer will gather excessive
reduce this uncertainty derived from purchasing a
product satisfies their expectations, and so as to
Consumers perceive uncertainty on whether a
Product information quality
plays a positive role in forming consumer’s trust.
Hypotheses Development
Five hypotheses are put forward with respect to trust.
While some of these hypotheses concern elements
were typically known to induce trust in the real
world (such as having a sales person with much
knowledge about products), other hypotheses
specific for the virtual world (such as certification marks).
Shop well-known
A visitor’s past experience on the reputation and
awareness of websites has significant influence on
consumers’ will to purchase [20]. An effective search
leading to a well-known brand will heighten the level
of trust in the website [50]. As in traditional
transactions, the more conscious a consumer is of the
brand’s reputation and the store scale, the lower his
or her risk perception is and the higher the level of
trust [6]. Doney and Cannon [21] stated that a
company’s overall scale and market share play a role
in instilling trust that it will keep to its contract.
Privileges, risk perception, brand reputation, and
verbal recommendation related to online shopping
help to build trust and this trust again exerts positive
influence on the decision to buy through online
shopping [46]. Thus, ‘awareness’ of a specific shop
has been selected as a factor influencing trust.
Hypothesis 1: Awareness of an online shop
plays a positive role in forming consumer’s trust.
Product information quality
Consumers perceive uncertainty on whether a
product satisfies their expectations, and so as to
reduce this uncertainty derived from purchasing a
product, the consumer will gather excessive
quantities of information. If the internet provides
information related to a purchase at almost zero costs
easily and quickly, it is able to offer excellent visual
experience as compared to information sources like
catalogues although it may not match actual
observations. However, unlike conventional
distribution channels in which consumers purchase
after personally checking the product, concerns over
the product’s quality and distrust of seller are greater
in internet shops [43].
A consumer makes a decision through
sufficient and accurate information given to him to
make the decision process efficient It has been
shown that the quality of information displayed on
websites influences the trust in the company directly.
Similarly, Jarvenpaa and Todd [22] pointed out that
knowledge on the product, especially its price,
quality and diversity, affects the level of trust.
Because consumers cannot see the product
personally and are not able to be confident in the
quality, not only does information on the quality of a
product affect trust but the consumer’s perception on
the appropriateness of the information presented and
the ease of obtaining it also influences trust.
Hypothesis 2: The ease in finding and
understanding product information on an internet
shop plays a positive role in developing trust.
Certification Mark Presence
Providing information on which online shops are
trustworthy to consumers is important in helping
consumers make rational decisions when purchasing.
New businesses related to trust are emerging. In
order to encourage online transactions, it appears that
not only technological trust but also institutional trust
must be established [42]. The certification mark
system involves reputable third parties (such as
TRUSTe and BBBonline) granting marks that
acknowledge companies abide guidelines on online
transaction operations such as consumer protection,
personal information protection and system security.
Hence, from the consumers’ point of view, it
contributes to enhancing consumers’ trust in online
transactions by guiding business activities in online
transactions to the favorable direction. From the
companies’ view, it is significant in the sense that
they can expand their profitability by increasing
consumer loyalty because they are able to secure
consumers’ trust in their websites (Korea
Information Society Development Institute, 2000).
Lee Jung-woo [42] defined “trust services” in
electronic transactions as a general term to describe
businesses related to services regarding trust that
help consumers or firms to trust and utilize online
companies by evaluating a company’s technology
and both commercial and institutional trust, and then
approving it. The certification system related to
electronic transactions in Korea can be classified into
official electronic certifications and credit card
company’s private certification both based on
electronic signature law, and certification by a
credible third-party or other private certification [24].
Hypothesis 3: Presence of a certification mark affects consumer’s trust.

Transaction Clarity
Yoon Sung-jun [45] used safety of transactions to measure consumer’s risk perception. This was proven through guarantee assurance phrases, risk-free transactions, and user-friendly refund policies. Hence, clarity about the safety of transactions has been adopted as a factor affecting trust. This issue was tested by asking whether clarity of refund policies, customer support, insurance, etc would induce trust.

Hypothesis 4: The clarity of transaction safety in online shops positively influences consumer’s trust.

Research Setup
To test these hypotheses, surveys were conducted in South Korea in 2004 and 2008. In what follows we first shortly introduce the state of e-commerce in South Korea. Next we present the research methodology and the sample characteristics.

E-commerce in South Korea
In a Nielsen (2008) report [47], South Korea ranked first as the country with the highest online shopping experience as 99% of its internet users experienced online purchases. UK, Germany and Japan came in second at 97%, and US was eighth with 94%. Globally, the highest sales were in books (making up 41% in the last three months), followed by clothes, accessories and shoes (36%), videos, DVDs and games (24%), air tickets and bookings (24%), and electric home appliances (23%). Credit card is the most frequently used method of payment in online shopping, with more than 60% of shoppers using it. About 60% of online shoppers mainly purchase from a single store, what illustrates the existence of consumer lock-in. If shopping websites captivate first-time visitors and provide them with positive shopping experiences, they can earn their loyalty and future shopping experiences.

Research Methodology
A survey was conducted among people living in Seoul and its metropolitan area who had experienced online shopping. The survey consisted of 32 questions in total. Each question could be answered using a 7-point Likert scale (1 showing “strongly agree”; 7 showing “strongly disagree”).

Several questions were used to derive a value for independent and dependent variables. These questions were based on literature as shown in Table 1.

<table>
<thead>
<tr>
<th>Awareness of online shop</th>
<th>[7] [20] [32] [21] [33]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ease in understanding information of product</td>
<td>[43] [44]</td>
</tr>
<tr>
<td>Transaction safety clarity</td>
<td>[23]</td>
</tr>
<tr>
<td>Certification mark presence</td>
<td>[34] [35] [41] [42]</td>
</tr>
<tr>
<td>Trust (dependent variable)</td>
<td>[37] [38] [39] [40]</td>
</tr>
</tbody>
</table>

The appropriateness of the survey instrument was assessed separately for the 2004 and the 2008 sample using Cronbach’s alpha. That calculation result only differed for one question in the 2004 and 2008 sample. In order to enable a decent comparison of values across the years, the same questions were selected for both years (leading to only five questions being used to measure ‘online shop awareness’ instead of all six, while all six were appropriate for the 2004 sample).

All statistics were calculated using SPSS version 14.

Sample characteristics
228 surveys were collected in May 2004, of which 210 were useable for analysis. Table 2 shows the characteristics of the 2004 sample.

<table>
<thead>
<tr>
<th>Item</th>
<th>Division</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>gender</td>
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<td>29.2</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>70.8</td>
</tr>
<tr>
<td>age</td>
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<td>40’s</td>
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<td>33.8</td>
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<td></td>
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</tr>
<tr>
<td></td>
<td>College</td>
<td>60.0</td>
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<tr>
<td></td>
<td>Over Master etc</td>
<td>0.5</td>
</tr>
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<td>etc</td>
<td>0.5</td>
</tr>
<tr>
<td>occupation</td>
<td>students</td>
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</tr>
<tr>
<td></td>
<td>university students</td>
<td>13.3</td>
</tr>
<tr>
<td></td>
<td>service parts</td>
<td>11.0</td>
</tr>
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<td></td>
<td>sales</td>
<td>2.9</td>
</tr>
<tr>
<td></td>
<td>offices</td>
<td>16.2</td>
</tr>
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<td>professionals</td>
<td>18.1</td>
</tr>
<tr>
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<td>house-wives</td>
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<tr>
<td></td>
<td>self-employed</td>
<td>1.9</td>
</tr>
</tbody>
</table>
In October 2008, 167 surveys were collected, of which 148 were usable. Summary statistics of the 2008 sample are shown in Table 3.

Table 3: 2008 respondent characteristics

<table>
<thead>
<tr>
<th>Item</th>
<th>Division</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>gender</td>
<td>male</td>
<td>31.0</td>
</tr>
<tr>
<td></td>
<td>female</td>
<td>69.0</td>
</tr>
<tr>
<td>age</td>
<td>10’s</td>
<td>4.1</td>
</tr>
<tr>
<td></td>
<td>20’s</td>
<td>16.9</td>
</tr>
<tr>
<td></td>
<td>30’s</td>
<td>59.5</td>
</tr>
<tr>
<td></td>
<td>40’s</td>
<td>14.9</td>
</tr>
<tr>
<td></td>
<td>Over 40’s</td>
<td>4.7</td>
</tr>
<tr>
<td>education</td>
<td>under high school</td>
<td>4.7</td>
</tr>
<tr>
<td></td>
<td>high school</td>
<td>9.5</td>
</tr>
<tr>
<td></td>
<td>college</td>
<td>70.9</td>
</tr>
<tr>
<td></td>
<td>over master</td>
<td>10.1</td>
</tr>
<tr>
<td></td>
<td>etc</td>
<td>4.7</td>
</tr>
<tr>
<td>occupation</td>
<td>students</td>
<td>4.7</td>
</tr>
<tr>
<td></td>
<td>university students</td>
<td>15.5</td>
</tr>
<tr>
<td></td>
<td>service parts</td>
<td>1.4</td>
</tr>
<tr>
<td></td>
<td>sales</td>
<td>8.1</td>
</tr>
<tr>
<td></td>
<td>offices</td>
<td>25.0</td>
</tr>
<tr>
<td></td>
<td>professionals</td>
<td>3.4</td>
</tr>
<tr>
<td></td>
<td>house-wives</td>
<td>2.7</td>
</tr>
<tr>
<td></td>
<td>self-employed</td>
<td>6.1</td>
</tr>
<tr>
<td></td>
<td>etc</td>
<td>33.1</td>
</tr>
</tbody>
</table>

Research Results

A regression was run with trust as the dependent variable and five independent variables:
- online shop awareness,
- infoquality (product information quality),
- markpres (certification mark presence)
- markknow (certification mark knowledge),
- transafety (transaction safety clarity).

Table 4 and Table 5 show the test results of the regression on the 2004 and 2008 data respectively.

Table 4: Test results 2004 data (R² = 0.248)

<table>
<thead>
<tr>
<th>Beta</th>
<th>t</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>t</td>
<td></td>
<td></td>
</tr>
<tr>
<td>constant</td>
<td>1.771</td>
<td>7.170</td>
</tr>
<tr>
<td>awareness</td>
<td>0.267</td>
<td>2.417</td>
</tr>
<tr>
<td>infoquality</td>
<td>0.214</td>
<td>2.699</td>
</tr>
<tr>
<td>markpres</td>
<td>0.010</td>
<td>0.151</td>
</tr>
<tr>
<td>transafety</td>
<td>0.185</td>
<td>2.332</td>
</tr>
</tbody>
</table>

Table 5: Test results 2008 data (R² = 0.228)

<table>
<thead>
<tr>
<th>Beta</th>
<th>t</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>t</td>
<td></td>
<td></td>
</tr>
<tr>
<td>constant</td>
<td>1.619</td>
<td>5.215</td>
</tr>
<tr>
<td>awareness</td>
<td>0.258</td>
<td>3.290</td>
</tr>
<tr>
<td>infoquality</td>
<td>-0.023</td>
<td>-0.272</td>
</tr>
<tr>
<td>markpres</td>
<td>0.150</td>
<td>1.832</td>
</tr>
<tr>
<td>transafety</td>
<td>0.281</td>
<td>3.170</td>
</tr>
</tbody>
</table>

Discussion

The 2004 data show support for three hypotheses: the online shop awareness and the quality of the product information available on the website are positively related to the trust someone has in an online shop as well as clarity about the transaction (p<0.05). The significance of awareness shows that it is important for online shops to be perceived generally as a well known brand with a good reputation. This reputation can be established through various media (like newspapers) and can be based on recommendations by previous purchasers. The significance of infoquality shows that companies that wanted to sell products on the Internet in 2004 looked more trustworthy if they had appropriate product information online that was easy to access.

Knowledge about and presence of certification marks did not seem to play a statistically significant role in establishing trust in 2004. Clearly, certification marks were not really required in 2004 for customers to trust some website. This reflects the fact that customers in the ‘brick-and-mortar’ world do not rely on certification marks to build trust either. All in all, people going online did not really seem to have adapted to the online environment. They still trust sellers that are well-known and that can show they know something about the product. The fact that customers look for shops that are well-known shows in the insignificance of certification marks.

The 2008 data show an interesting change. Online shop awareness is still statistically significantly related to trust (p<0.05). Having a strong brand was thus still valuable in 2008. However, we notice an increase in the p-value for awareness. At the same time, we notice a big decrease in the p-value of certification mark presence. While it is still not possible to prove a statistically significant relationship between certification mark presence and the customer’s trust in online shops, the data seems to suggest that there is slowly growing an interest of customers to consider other suppliers than well-known brands. Risks of doing business with such companies are perceived as being bigger and variables related to certification marks and clarity about the presence seem to get lower p-values in the 2008 sample (but still remaining insignificant).
Interestingly, while infoquality was statistically significant in 2004, it turned insignificant (p=0.786) in 2008. Customers seem to acknowledge the fact that it is very easy for swindlers to copy paste information from reliable web sites and that the people behind websites may know nothing about the products that are offered on their website. That is, on the Internet, getting product information is very easy for people who want to (act as if they want to) sell something. In the real world, a person that wants to (act as if he wants to) sell something must invest considerable time and effort in getting the product information into his mind.

**Limitations and further Research**

Our research did investigate whether presence of product information entailed trust, but did not investigate whether absence of product information entailed distrust. While presence of product information does no longer seem to lead to trust anno 2008, it is possible that the absence of product information would lead to distrust. This is, however, not necessarily the case (as such an online shop may still be very capable of delivering the product) and thus needs to be investigated.

Our research was conducted in a single country. Important differences have been pointed out as regards uncertainty avoidance depending on the country and culture of individuals. Straub [25], for example, applies Hofstede’s dimensions [48] to compare the diffusion of e-mail in Japan and in the United-Sates, and puts forward the significant role of uncertainty avoidance in the adoption process of communication media. More recently, Bartikowski, Fassot and Singh [26] extended the TAM model to integrate a dimension entitled “cultural adaptation”. In a cross cultural empirical study, they identify the cultural aspect of consumers’ acceptance of international websites. Their study is very useful from a practical point of view insofar as it enables marketing managers to adapt their e-commerce websites to the profile of international consumers. Other authors apply Davis’ TAM model [27] to explain individual intentions to make purchases via the Internet and put forward the importance of risk aversion [28] [29]. Srite and Karahanna [30] identify “espoused national cultural values” as an important moderator of individual intention to use an information technology. South Korea scores 85 on Hofstede’s Uncertainty Avoidance Index, which is rather high (especially compared to countries such as Singapore with a score of 8). This implies that South Korean people don’t like uncertainty. This may be the reason that the data proved ‘online shop awareness’ to be of significant importance. People in South Korea, however, tend to minimize levels of uncertainty by implementing strict rules and policies. According to Hofstede [49], ‘the ultimate goal of this population is to control everything in order to eliminate or avoid the unexpected’. One could expect certification marks to fit in this scheme. However, uncertainty avoidance seems to be that deeply routed that certification marks currently are not sufficient to let consumers trust unknown online shops. Further research should investigate whether the same variables in our model are (in)significant in other countries. Further research could also investigate in what countries certification marks could be used to convey trust: while those marks are currently not valued in a risk averse country like South Korea, they may not be needed in countries with low uncertainty avoidance such as Singapore. It is quite possible that certification marks may become a success in some countries but not in others. Similarly, in some countries people may be more locked-in by existing suppliers than in other countries. At a higher level, this may have effects in terms of countries that do, or do not, get into globalization.

Clearly, it is important to continue the longitudinal study that was started in this paper to witness whether the evolution that slowly seems to be going on in South Korea (in terms of significance of certification marks and the like) is continuing.

**Conclusions**

Previous research had pointed out that trust is increased by adding elements to websites that stress the real world existence of the company (such as physical addresses and phone numbers). The paper at hand shows that customers (in our South Korean sample) back in 2004 also tried to identify a good seller like in the real world: by investigating whether he seemed able to provide accurate product information (on his website). By 2008, when the second sample in our study was taken, the customers seemed to have started to more fully understand the specifics of e-commerce and that availability of accurate product information does not guarantee that the people behind the website really know the product they sell and can be trusted.

Customers were and are showing trust in online shops that are generally well known and have a good reputation from media like newspapers. Certification marks which reveal trustworthiness and which should allow consumers to do business with companies they do not really know, do not seem to induce trust at this point in time but there is a small sign that they might be able to do so in the future.

All in all, the 2004 South Korean customer seemed to do business on the Internet like in the real world. However, by 2008 he seemed to be slowly moving away from that traditional way of buying things on the Internet to an Internet-specific way where other elements are considered to decide whether an online shop can be trusted.

This paper opens up several avenues for further
Moving Away from Traditional Elements to Build Trust in E-Commerce

References


TASTE VISUALIZATION TECHNIQUE FOR ONLINE FOOD SHOPPING MALLS: DEVELOPMENT AND APPLICATION

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Abstract
The main goal of this study is to visualize tastes of foods and agro-products to reduce the uncertainty of purchasing of them in online shopping malls. To accomplish the goal, we select two Korean traditional foods; Kimchi and Gochujang, develop the criteria for visualization of their tastes, choose about ten products for each food that are on sale in the online shopping malls, make visualization tables and apply them to the real shopping mall. And then, we contrast the customer satisfaction, purchasing pattern, and sales of both before and after applying the taste visualization tables.

Keywords: Taste Visualization; agro-product; e-commerce

Introduction
While the aggregate monetary amount of e-commerce transaction is continuously increasing, the proportion occupied by agro-product transaction is not very significant [1]. As the quality of agro-products may vary it is not easy for consumers to easily assess both the taste and the quality simply by looking at the agro-products in monitor display, which leads consumers to perceive high uncertainty.

While a plethora of research have investigated consumption pattern and purchase intention process associated with e-commerce environment [2], how the uncertainty associated with purchase of agro-products in e-commerce can be mitigated has received little attention. Also, no attempt approach has been made to analyze how the user’s visiting pattern or purchasing pattern changes when website information successfully fulfills user’s sense or curiosity that has not been fulfilled before.

To understand the changes, it is necessary to analyze changes in user behavior by performing click stream data analysis. As click stream analysis enables understanding of user migration path and stay length, it has been widely applied to help in understanding user decision making process or improving migration path within a website [3], [4], [5].

The purpose of this study is to conceive technique for visualization of taste and examine how the conceived technique mitigates uncertainty associated with online agro-product purchase.

Consequently, visualization models of Kimchi and Gochujang, two of the most frequently sold agro-products in Korean e-commerce environment, is developed and applied at actual e-commerce web pages to analyze how the application of visualization models affect consumer satisfaction and purchase intention.

Kimchi, one of the most popular Korean side dish, is a pickled dish made of vegetables (cabbage in most cases) with varied seasonings. Taste differs according to various factors such as vegetable and seasoning used, and period of fermentation. Gochujang is savory and pungent fermented Korean condiment made mainly of pepper. The word ‘Gochu’ means pepper and ‘Jang’ means condiment.

Based on the analysis, the study suggests strategies to apply visualization technique to increase the amount of e-commerce agro-product transaction and increase the overall size of domestic markets for agro-products and traditional food.

Theoretical Background
Uncertainty
Perceived uncertainty refers to “the degree to which the outcome of a transaction cannot be accurately predicted [6]”. As uncertain factors can rise in all types of transactions to negatively affect the predicted outcome, buyers cannot predicted whether a transaction will be successfully fulfilled or not [6]. Pavlo have developed a conceptual model, by integrating the principal-agent perspective with information systems, marketing, and sociological theories, to identify sources of perceived uncertainty and factors that mitigate the uncertainty sources in e-commerce environment. [7].

According to this model, ‘perceived information asymmetry’ and ‘fears of seller opportunism’ are the sources of perceived uncertainty. However, ‘fears of seller opportunism’ is not considered in our study as it is less relevant. If buyers are fully aware of a product quality before purchasing, there will be no information asymmetry [8]. However, as consumers in e-commerce environment cannot see or feel an actual product before a purchase is made and the product is delivered, information asymmetry arises and consumers perceive it.
‘Product diagnosticity’, ‘Informativeness’, and ‘trust’ are factors that mitigate perceived information asymmetry.

Product diagnosticity is defined as the extent to which a buyer believes that a particular shopping experience is helpful in terms of evaluating the quality of a product [9], [10]. Informativeness is defined as the extent to which information provided is resourceful and helpful to consumers [11]. Trust is defined as the intention of consumers to accept vulnerability of a transaction by believing that the seller will not act opportunistically [12].

When perceived uncertainty is decreased, purchase intention increased as a result. In the study of [16], Pavlou’s model was further developed and applied to analyze effectiveness of food traceability system. According to this study, decreased perceived uncertainty increases consumers’ willingness to pay price premium.

Relationships between variables are shown in Figure 1.

When e-commerce consumers purchase products, the quality of which can easily be judged on the web, they tend to select products with lower price regardless of information provided by sellers. De Figueiredo developed an e-commerce product continuum and examined four points on the continuum [13]. These products include oil, paper, clips, etc. However, when consumers intend to select products with variable quality, they want to “look and feel” the products. When e-commerce environment cannot satisfy consumers’ desire to look and feel, uncertainties tend to rise and consumers’ purchase intention changes [13]. [14] developed a conceptual model explaining how consumers’ preexisting motives and transient emotions affect purchasing process, and [15] developed a conceptual model after taking into consideration the existence of variable product quality. According to his model, variable quality of a product decreases motive and emotion, two factors boosting e-royalty. In other words, as quality variability increases, consumers perceive higher uncertainty and this can result in no purchase. This chain action negatively affecting purchase intention was tested by [2].

In a pilot study conducted by [16], it is found that when purchasing products with variable quality, consumers prefer sellers who decrease uncertainty by providing enough information on product to those who sell at lower price but provide not enough product information. In the study, consumers preferred CDs (product with invariable quality) sold at lower price, but preferred agro-products (product with variable quality) which provide more useful information although they are sold at higher price [16].

\[\text{Figure 1. Uncertainty Mitigation Model} \]
\(\text{(Partially adapted from [7] and [16])}\)

\[\text{Figure 2. Degree of product variability in e-commerce (Adapted from [13])}\]
Because of variable quality of agro-products, selecting agro-products requires looking and feeling. However, agro-products in current e-commerce transaction cannot satisfy consumers’ desire to look and feel. Consumers feel higher uncertainty associated with purchasing of food than with other products and this is why the size of agro-product transaction is relatively small [17]. Therefore it can be expected that when e-commerce sites can express visually quality or taste of agro-products they sell, consumer uncertainty will decrease and increase consumer satisfaction to result in larger size of total agro-products transaction amount.

Visualization of Taste

While several efforts are made to visualize taste of food, use of taste visualization technique in e-commerce environment is rare. Examples include curry, beer, coffee, and Kimchi. They are shown in <figure 3>, <figure 4>, <figure 5>, <figure 6>, and <figure 7>.

**Figure 3. Visualization of Curry Taste (Adapted from [26])**

<table>
<thead>
<tr>
<th>Pungency</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>mild</td>
<td>Soft and Mild</td>
</tr>
<tr>
<td>Moderate</td>
<td>Standard</td>
</tr>
<tr>
<td>1 hot</td>
<td>A little hot</td>
</tr>
<tr>
<td>2 hot</td>
<td>2 times</td>
</tr>
<tr>
<td>3 hot</td>
<td>3 times</td>
</tr>
<tr>
<td>4 hot</td>
<td>very hot</td>
</tr>
<tr>
<td>5 hot</td>
<td>Extremely very hot</td>
</tr>
<tr>
<td>6-10 hot</td>
<td>Unchallengeable</td>
</tr>
</tbody>
</table>

Projects to visualize taste of Kimchi, a traditional Korean food, are in progress. Diagram of <figure 7> set three stages of fermentation (non-fermented, moderate fermented, over-fermented) in continuum and provides fermentation date information to help consumers select Kimchi they want.

**Figure 6. Visualization of Coffee Taste (Adapted from [28])**

In 2007, Korean Ministry of Food, Agriculture, Forestry and Fishery (MIFAFF), as a part of its plan to standardize traditional food, has developed a standard for spiciness and fermentation rate of Kimchi. <Table 1> shows pungency information and <Table 2> shows fermentation stage (Ministry of Food 2007).

**Table 1. Pungency of Kimchi (Adapted from MIFAFF)**

<table>
<thead>
<tr>
<th>Pungency</th>
<th>Kimchi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capsaicinoids contents (mg %)</td>
<td>SHU (scoville heat unit)</td>
</tr>
<tr>
<td>mild</td>
<td>~0.3</td>
</tr>
<tr>
<td>slightly hot</td>
<td>0.3 - 1.5</td>
</tr>
<tr>
<td>moderate</td>
<td>1.5 - 3.0</td>
</tr>
<tr>
<td>very hot</td>
<td>3.0 - 4.5</td>
</tr>
<tr>
<td>extremely very hot</td>
<td>&gt;4.5</td>
</tr>
</tbody>
</table>
This standardization not only provides specific information on Kimchi to meet diverse consumer groups, but also contributes in the increment of Kimchi export and hence an overall improvement of Kimchi industry. MIFAFF plans to lead industry to voluntarily adopt the standardization, and then apply the standardization to quality certification.

A good example of food visualization technique usage is Wine.com. <Figure 8> is the visualization chart used at Wine.com.

Wine.com, an American website established in 2004, sells wine and appetizers served with wine to 50 states of the United Stated and Japan. Its visualization chart helps overcome inability to let consumers taste before purchase and the fact that wine-related information is difficult for some consumers to understand. This has helped in decreasing consumer uncertainty and also helped the company grow faster than its major competitors to enable it to acquire most of them.

### Research Design

This study develops taste visualization table, applies it to online shopping malls that sell agro-products, and investigate the difference in customer behavior before and after application of the table. Figure 9 is the conceptual research model. Kimchi and Gochujang, two traditional Korean agro-products, have been chosen because the size of their transaction in e-commerce is relatively higher and consumers have diverse preference towards distinguishable features an individual product has.

### Table 2. Fermentation Grade of Kimchi
(Adapted from MIFAFF)

<table>
<thead>
<tr>
<th>Fermentation grade</th>
<th>pH</th>
<th>Titratable acidity (lactic acid, %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>non-fermented</td>
<td>&gt;5.0</td>
<td>&lt;0.5</td>
</tr>
<tr>
<td>moderate fermented</td>
<td>4.2 - 5.0</td>
<td>1.0 - 0.6</td>
</tr>
<tr>
<td>over-fermented</td>
<td>&lt;4.0</td>
<td>&gt;1.0</td>
</tr>
</tbody>
</table>

### Figure 8. Visualization table of wine.com
(Adapted from [30])

<table>
<thead>
<tr>
<th>dry or sweet</th>
<th>bone dry</th>
<th>dessert</th>
</tr>
</thead>
<tbody>
<tr>
<td>body</td>
<td>light body</td>
<td>very full body</td>
</tr>
<tr>
<td>acidity</td>
<td>soft, gentle</td>
<td>very crisp</td>
</tr>
<tr>
<td>tannin</td>
<td>none</td>
<td>heavy tannins</td>
</tr>
<tr>
<td>oak</td>
<td>none</td>
<td>heavy oak</td>
</tr>
</tbody>
</table>

### Figure 9. Research Model

Elaboration Likelihood Model (ELM) is a model for analyzing factors that affect information process and changes in consumer attitude and behavior arising because of the factors [18], [19]. When awareness is happened by stimulus, it would lead to elaboration. And also it occurs behavior arising. Tam and Ho finds the similar model based on information procession for consumer decision and response like ELM [19]. According to the model, when a hypothesis is set, measured variables can be classified into awareness, recognition, decision and response, and feedback test the hypotheses by matching each variable to click stream measure items. Hypotheses are set according to the classification in <table 3>.

First, as visualization table can fulfill more senses, daily visit is expected to increase as a result of its inclusion. When a website visitor consecutively visits several pages in the website, one visit is recorded. When the same visitor visits the same website after certain amount of time, it is recorded as another visit. While there’s no standard for the time between visits, the time commonly ranges between 15 minutes and two hours and average is 30 minutes. Using visit as a variable instead of hit can prevent the problem of counting meaningless or accidental visits to a website [20].

H1a: If taste visualization table is applied to a webpage on an online shopping mall that sells agro-products, daily visit to the page increases.

H1b: A web page with visualization table has higher percentage of daily visit increase than a web page without visualization table has.

Also, number of search made on visualization related.
keywords is expected to increase. The increase can be interpreted as success in attracting consumer attention [20].

**H1c:** If taste visualization table is applied to a webpage on an online shopping mall, the number of search made on visualization related words increases.

Second, it is expected that average visit length of visitors might change after visualization table is applied.

**H2a:** If taste visualization table is applied to a webpage on an online shopping mall, average visit length of visitors will change.

**H2b:** A web page with visualization table has larger average visit length change than a web page without visualization table has.

Also the number of revisit is an important measurement item, which is related to recognition variable ‘Stickiness’.

**H2c:** If taste visualization table is applied to a webpage on an online shopping mall, the number of revisit increases.

**H2d:** A web page with visualization table has higher percentage of revisit increase than a web page without visualization table has.

Third, items that can be measured in decision making process include shopping card storage, transaction, and revenue. When more storage, more transaction, or higher revenue are found for a product with visualization table, this can be interpreted as the function of consumer decision making process [19].

**H3a:** If taste visualization table is applied to a webpage on an online shopping mall, the number of shopping cart storage increases.

**H3b:** A web page with visualization table has higher percentage of the number of shopping cart storage increase than a web page without visualization table has.

**H3c:** If taste visualization table is applied to a webpage on an online shopping mall, the number of transaction of the product increases.

**H3d:** A web page with visualization table has higher percentage of the number of transaction increase than a web page without visualization table has.

**H3e:** If taste visualization table is applied to a webpage on an online shopping mall, revenue increases.

**H3f:** A web page with visualization table has higher percentage of the revenue increase than a web page without visualization table has.

According to [16], if a product sold online has heterogeneity, consumers are willing to pay price premium for products which provide high quality information. Based on this result, it is expected that if visualization table helps in increasing the quality information of agro-products which are heterogeneous.

**H4a:** If taste visualization table is applied to a webpage on an online shopping mall, customer satisfaction increases.

**H4b:** A web page with visualization table has higher percentage of the customer satisfaction increase than a web page without visualization table has.

### Research Method

#### Click Stream Data

Click Stream data is a data on a path a user follows to visit a webpage and is used to understand

<table>
<thead>
<tr>
<th>Measuring Variable</th>
<th>Measurement Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Awareness (H1)</td>
<td>Visit</td>
<td>Number of visits to items with visualization table</td>
</tr>
<tr>
<td></td>
<td>Search Keywords</td>
<td>Number of search keywords related to visualization</td>
</tr>
<tr>
<td>Recognition (H2)</td>
<td>Visit Length</td>
<td>Time spent in a page where visualization table is inserted</td>
</tr>
<tr>
<td></td>
<td>Revisit</td>
<td>Number of revisit to page where visualization table is inserted</td>
</tr>
<tr>
<td>Decision and Response (H3)</td>
<td>Shopping Cart Storage</td>
<td>Number of items with visualization table stored in shopping carts</td>
</tr>
<tr>
<td></td>
<td>Transaction</td>
<td>Number of items with visualization table included in actual transaction</td>
</tr>
<tr>
<td></td>
<td>Revenue</td>
<td>Sales revenue on items with visualization table</td>
</tr>
<tr>
<td>Feedback (H4)</td>
<td>Customer Satisfaction</td>
<td>Relative customer satisfaction</td>
</tr>
</tbody>
</table>

**Table 3 – Measurement Items of visualization table**
relationship between the paths. The data can be obtained from the log on the server of web server or an institution that collects Internet surfing data sent by panels. Information that can be obtained from click stream data include address of visited webpage, address of previous webpage, browser used, duration of stay, etc. Data obtained from panels also contain demographic information [20].

Click stream data has been widely used in purpose of analyzing decision making on Internet. It has been used to understand path analysis and prediction within a website [5]. and identify purpose of website visit [22]. Visualization systems that help clearly understand the result of click stream data analysis has been developed [23] and whether a user will purchase a product in his/her subsequent visit has been analyzed [4]. Research on suggesting a product to a user after analyzing his/her path has been conducted [24], [25] and further research has been conducted to find out how effective the product suggestion is in affecting subsequent migration path and product visit pattern [20]. In this study, changes in user behavior will be analyzed after a taste visualization table has been included to provide more information on food.

Data Collection

An online shopping mall that sells agro-products, ‘KGFarm’, is selected to examine the effect of adding visualization table. KGFarm is designed and maintained by the local government of Kyungkido, the largest province in Korea in terms of population. Sellers including large corporate, SMEs, and individual farmers place their product on KGFarm. Therefore for a customer, there are several sellers to choose among, based on price, product information and other preferences, when they want to buy a certain product. Visualization tables will be placed on selected product pages and categorization pages will indicated which products have visualization table. For analysis, collection period, number of users, pages per a session, sessions per a user, and page visits per a user are collected. Number of users refers to the number of IPs which visited the web page and this excludes the IP of KGFarm employee and product seller. Session refers to a sequence of process of a user between initial visit and leave of the website. Page visits refers to the number of visited URL.

An example of collected raw click stream data processed into meaningful data is shown in <table 4>.

<table>
<thead>
<tr>
<th>ID</th>
<th>Session ID</th>
<th>IP Address</th>
<th>Page Visited</th>
<th>Product Info.</th>
<th>Visit Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>210.10.1.1</td>
<td>Home</td>
<td></td>
<td>30</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>210.10.1.1</td>
<td>Category</td>
<td></td>
<td>26</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>210.10.1.1</td>
<td>Product G-08-110-01</td>
<td></td>
<td>81</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>210.10.1.1</td>
<td>Account</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>210.10.1.1</td>
<td>Cart</td>
<td></td>
<td>(25)</td>
</tr>
</tbody>
</table>

<Table 4 – Example of processed click stream data>

Future Plan

The taste visualization charts of Kimchi and Gochujang are in development process based on preceding studies. After analyzing factors that determine the taste of Kimchi and Gochujang, evaluation criteria will be selected, and sensory evaluation by panels will be conducted. The process will take several months to complete.

Taste visualization tables will be inserted and the change of sales and customers’ satisfaction in KGFarm will be investigated to prove the hypotheses. The existing sales and satisfaction of customers before implementation of the table in the same sites should also be measured. The customer satisfaction will be investigated through simple surveys with approval of KGFarm. Collected click stream data will be analyzed to test hypotheses.

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[29] http://www.gmarket.co.kr


THE ROLE OF KNOWLEDGE SHARING IN SUPPLY CHAIN INTEGRATION PROCESSES

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Abstract
Current issues in supply chain management focus increasingly on the interdependence between value forming and supply chain integration. This interdependence is interesting, especially in an environment with variable and heterogeneous demand, posing challenges and opportunities for the management of supply chain integration. The purpose of our conceptual paper is to introduce the drivers and the benefits of the supply chain integration process and to introduce the role of knowledge sharing in this context. In the pursuit of this goal, the concepts of supply chain integration and value forming are defined as the research context. The preliminary results propose that the essential integration elements can be identified and a more distinct supply chain integration process as well as knowledge sharing in this process can be defined.

Keywords: Knowledge sharing, Supply chain integration, Value forming

Introduction
Supply chain management (SCM) seeks to enhance competitive performance by integrating the internal functions within a company and effectively linking them with the external operations of suppliers, customers and other supply chain members. As Tan et al. [49] state, “supply chain management is the simultaneous integration of customer requirements, internal processes and upstream supplier performance”. Jahre et al. [21] suggest that logistics and SCM search for more integration (adaptation) for increased efficiency as well as more flexibility (adaptability) in order to preserve the capacity to cope with changes. Generally, the entire concept of supply chain management is predicated on integration [36][47]. Integrated SCM has been found to offer benefits such as reduced cost, superior customer service levels and improved responsiveness to changes in the marketplace [45][39]. As Van der Vaart et al. [51] state, many authors do indeed agree that integrative practices and a high level of integration have positive impacts on corporate and supply chain performance [10][25][54]. Power [39] concludes among others that the requirement for integration of supply chains is inherently strategic, and a potential source of competitive advantage. Recent work [17][52][54] has also provided convincing empirical evidence for the relationship between integration and performance. These definitions of supply chain management and the benefits of integration mentioned above have encouraged authors to define the concept of supply chain integration (SCI) in many ways. Fawcett et al. [16] propose four types of integration being a) internal cross-functional process integration, b) backward integration with valued first-tier suppliers leading to integration with second-tier, c) forward integration with valued first-tier customers and d) complete forward and backward integration. The description by Frohlich et al. [17] is based on the concept of “arcs of integration”. To represent an activity’s strategic position they illustrate them graphically as an arc, with the direction of the segment showing whether the firm is supplier or customer inclined, and the degree of the arc indicating the extent of integration. Five arcs are defined representing the integration strategies: inward-facing, periphery-facing, supplier-facing, customer-facing and outward-facing. [46] Similarly, Narasimhan et al. [34] propose three components of supply chain integration, namely customer integration, strategic integration and supplier integration. Kim [25] names three levels of integration being a) company’s external integration with suppliers, b) internal cross-functional integration within a company and c) company’s external integration with customers. Kim [25] also mentions stages of SCI being independent operation stage, internal SCI stage and external SCI stage.

According to Fabbe-Costes et al. [14] the SCI framework includes three overall dimensions: layers, scopes and degree. The established layers of integration are a) integration of physical, information and financial flows, b) integration of processes and activities, c) integration of technologies and systems and d) integration of actors. The scope of integration, that is the nature and number of organizations or participants included in the integrated supply chain, may vary including phases such as a) limited dyadic downstream, meaning integration between the focal company and its customers, b) limited dyadic upstream, meaning integration between the focal company and its suppliers, c) limited dyadic, meaning integration between the focal company and
Integration process has also been defined many ways. Some references like Harland [19] and Stonebraker et al. [48] propose characteristics in supply chain integration processes as having four sequential phases: a) internal flow of materials and information, b) dyadic relationships with immediate suppliers and customers, c) extended relationships with the supplier’s supplier and the customer’s customer and d) networks of inter-connected businesses involved in the delivery of product and service packages. The process of supply chain integration should progress from the integration of internal logistics processes to external integration with suppliers and customers [25]. Bagchi et al. [6] for their part propose two modes of categorization of integration, Information Integration and Organizational Integration, and three stages of integration within each mode, namely low, medium and high. They have also defined two stages of supply chain integration: low integration and high integration. [46] Integration has also been argued to be more difficult in practice than in theory; integration should be differentiated [7]; and integration is more rhetoric than reality [16]. Bask et al. [7] have recommended a change from holistic integration towards semi-integrated supply chains. They perceive the pressure in contemporary SCM to be towards the disintegration, divergence and differentiation [21]. Bagchi et al. [5][6] also challenge the argument that “high integration fits all”. They emphasize that the degree of integration depends on a number of situational factors. In other words, they propose a contingency approach to supply chain integration arguing that factors such as dominance versus balanced power in the supply chain, the degree of competition in the industry, the maturity of the industry, and the nature of products may determine the desired level of integration in a supply chain.

However, the process of integration is not a simple one, as Cousins et al. [10] state. Integration of supply chain activities requires consistent involvement of both the buyer and the supplier and investing in socialization - the level of interaction and communication between various actors within and between the firms - is critical to success. [19] Frohlich et al. [17] state that closer coordination helps eliminate many non-value adding activities from internal and external production processes including overproduction, waiting, transportation, unnecessary processing steps, stockpiling, and defects. In other words, better coordination translates directly into reduced variability, which, in turn, leads to greater efficiency along with faster delivery of finished goods. Coordination among functions is a critical precondition for effective supply chain integration and, together with shared information, improves the ability of supply chains to react to sudden changes in volatile demand environments [16][30]. Johnston et al. [22] also state that success for individual firms depends on how well the supply chain functions as a whole. Furthermore, the success depends largely on the openness and extent of sharing of the outcomes of the new relationship. Coordination becomes possible when information is transparently shared among supply chain partners [5][6]. According to the study by Sezen [43], flexibility and output performances of supply chains can be improved by emphasizing integration and information sharing. There are also many other studies showing that cooperative information sharing among supply chain members improves the effectiveness of supply chains and influences supply chain performance in terms of total cost and service level [32][41][55].

The formula for integration includes several strands. Power [39] emphasizes that organizations aiming to become part of an extended, integrated supply network can also expect that this will require an infrastructure enabling effective information flows and streamlined logistics. The most effective of these networks will be those succeeding in achieving the right mix of information requirements, physical logistics and collaboration, thus providing shared benefits to the majority of partner organizations. According to Kemppainen et al. [24], supply chains are undergoing considerable change and companies are repositioning themselves by assuming new roles and abandoning old ones. On the one hand, there will be dominant companies that coordinate and integrate the value offerings of supply chains. On the other hand, supply chains and networks are too large and complex to be controlled by only one company. Integration should vary from link to link since the focal company may not have the ability or the inclination to manage all the relations similarly. Altogether, the literature fails to provide an unambiguous definition of the concept of supply chain integration [14]. Managers from various functional areas define SCM in unprecedented and varied ways and they also view the integrative nature of SCM differently [16]. Therefore it is difficult to provide decision-makers with normative advice as to how and what to integrate, the cost of integration, and its possible negative consequences for example, for innovation and flexibility. For researchers, too, it
is a problem if the same concepts are interpreted in different ways, and if different concepts are used with the same meaning. Hence, a better understanding of the concept of integration, its dimensions and implications, is of managerial relevance as well as academic importance, and contributes to theory-building in business logistics and supply chain management [14].

We argue that observing the supply chain integration process is insufficient; integration processes are not well defined and the objectives of the integration process are not sufficiently connected to decision-making processes. The reasons are the inconsistency of the terminology as well as difficulties in defining what kind of stages the integration processes contain and how the value of integration is added to the members of supply chain. Therefore, the goal of this conceptual paper is to examine supply chain integration as a continuous process in which the decision-maker easily estimates the potential and advantages of integration. Due to the complexities of the integration process the paper is written from the knowledge sharing point of view. In the pursuit of this goal, the following discussion first describes the background factors forming the theoretical framework of supply chain integration. The discussion then goes on to a brief epistemic consideration of the concept of knowledge in order to gain a better understanding of knowledge transfer in integration process. Then the schema for the integration process will be formed, with the help of which knowledge sharing in the integration process will be described.

Knowledge-based elements in supply chain integration

Perceiving the benefits of supply chain integration

Bagchi et al. [5] define supply chain integration as a comprehensive collaboration among supply chain network members in strategic, tactical and operational decision-making. Integration can also be defined as follows [29][23]: “Integration is a process of interaction and collaboration in which different operations work together in a cooperative manner to arrive at mutually acceptable outcomes for their organization.” The definitions of integration emphasize interaction and collaboration between different members of supply chains and supply networks. The definitions also stress the importance of common objectives and cooperation to achieve the expected outcomes. Trkman et al. [50] state that successful implementation of supply chain integration projects is not so much a technological problem. As Cousins et al. [10] emphasize, the concept of socialization is an important process that underpins the development of collaboration and supply chain integration. In other words, if the firms want to enjoy the benefits of collaboration, they have to invest in socialization as well. Anderson et al. [2] found that cooperation is built by the interaction of both the supplier’s and the buyer’s beliefs and actions, leading to the commitment of resources. Commitment requires investment and takes time to build. The reward is a lasting business alliance capable of combining the coordination advantages of vertical integration with the entrepreneurial benefits of separate ownership. Akkermans et al. [1] also characterize the basis of integration as cooperation, collaboration, information sharing, trust, partnerships, shared technology, and a fundamental shift away from managing individual functional processes, to managing integrated chains of processes.

The meaning of supply chain integration is optimizing value activities between the focal firm’s value chain and the value chains upstream and downstream. As Vickery et al. [52] state, the theoretical foundation for supply chain integration can be traced to Porter’s [38] value chain model and its notion of linkages. A linkage is the relationship between the way in which one value activity is performed and the cost or performance of another. Porter argued for the identification and strategic exploitation of linkages within a firm’s value chain (horizontal linkages) and between the firm’s value chain and the value chains of its suppliers and customers (vertical linkages). Optimizing linkages among value activities and especially optimizing vertical linkages between suppliers, manufacturers and customers is the core purpose of supply chain integration. Such integration should also create superior performance and enable the achievement of financial and growth objectives [17][49]. In other words, value forming in the supply chain requires integration. Without fit and appropriate integration there will be value gaps in the supply chain. Unfortunately, value forming is not unambiguous between the supply chain parties because it is difficult for the company’s customer to utilize and recognize added value, and the members of supply chain also understand value adding in different ways. [26][37][8] We argue that during the integration process and as a result of it, supply chain members should be aware of value adding. In a case where added value is difficult to prove to other supply chain members, a holistic understanding of the advantages of integration process is harder to achieve.

Relationship formation during the integration process

Relationships between supply chain members also affect the integration process. Generally speaking, the relationships in the supply chain management context are seen as relationships between the company and its customers and suppliers. Different relationships can be described, for example, by the power matrix, which relates power attributes between
the parties. [11] In other words, with the matrix it is
possible to analyse the level of influence one person
or firm has over another person or firm. Then it is
possible to judge the degree to which one party is
dependent upon the other party for their custom or
services. A number of other attributes, such as
switching costs and the number of suppliers or
customers are also presented in the power matrix of
Cox [11]. In the supply chain integration context, it is
important that the participants work together in a
collaborative relationship due to their
interdependence. Although it is not easy to redress
any imbalance in power levels (e.g. the dominant
party does not want to forfeit its position), we
suggest that by supply chain members’ commitment
and trust the imbalance in power level can be
reduced. This also means that participants or actors
should have common interests or goals in their
supply chain management activities. Therefore, we
suggest that a better balance in power levels
increases the options in supply chain integration.

Bagchi et al. [6] state that it should become
easier to generate trust among partners in an
integrated supply chain. Trust can be defined in the
activities that are inherent in high-trust relationships
such as communication, informal agreement, absence
of surveillance, and task-coordination [12]. Trust
should promote collaboration and decision
realignment, reduce irrational behaviour and “second
guessing” among supply chain members thereby
reducing the need for safety stocks. However, trust is
not simply an input to a relationship, as Johnston et
al. [22] put it. Instead, it is both a pre-condition and
an outcome of relationship development. Trust may
arise from frequent face-to-face contact, sharing of
vital information and exposure of opportunistic
behaviour. In other words, cooperative arrangements
lead to successful intentions that build trust, but most
firms would not undertake these activities without a
sufficient initial level of trust. As mentioned above,
trust between the members of the supply chain is
conducive to integration. Trust is based on
expectations which, in turn, are based on a
perception of the motives and abilities of the person
to be trusted. That is, identity will be shaped by the
perceived motives and abilities. In marketing, the
ability to achieve promised outcomes has been
consistently suggested to be crucial for the
development of trust [40][20]. Understanding is a
basis of trust helping people to comprehend their
partners’ behaviour, state of mind and motives. The
development of relationships directs the process.
When a feeling of trust is established it affects the
perceptions of a partner’s commitment more than
behaviour does. Trust in relation to the organisational
mind and collective action is an important issue,
because it ties together a complex and attentive
system which forms the collective mindset required
for reliable performance. According to Weick and
Roberts [53], co-operation is imperative for the
development of the mind, and trust is imperative for
cooperação. Interpersonal skills enable people to
represent and subordinate themselves to
organisations. This means that trust without a
behavioural content is a non-complete trust [31][33].
According to Nonaka and Takeuchi [35], building
trust requires the use of face-to-face dialogue that
provides reassurance about points of doubt and leads
to willingness to respect the others’ sincerity. Thus,
we conclude that trust has an indirect effect on the
options in the process of supply chain integration.

One integration element is transparently
shared information, which is related to commitment
and trust and which also enables coordination
between chain members. We can thus state that
supply chain integration is apparently achieved by
socialization and cooperative information sharing
among supply chain members. These elements imply
that there are various needs regarding quality and
quantity of knowledge between the supply chain
members making the decisions about integration.
These needs concerning knowledge are related to a
decision-maker’s situation and background, i.e. how
complex the decision-maker perceives the integration
decisions to be. Badaracco [3] claims that a human
being cannot take advantage of new information
unless he or she has some kind of earlier “social
software” connected to that information. Cohen and
Levinthal [9], who introduced the “absorptive
capacity” concept, also claim that an individual’s
capability to utilize new information in solving
problems largely depends on his or her earlier
knowledge. Thus, we can say that integration
decisions depend on the decision-maker herself. The
type of product delivered likewise affects the need
for integration. For example, Lampel and Mintzberg’s [28] product classification - dividing a
product into categories such as pure standardization,
segmented standardization, customized
standardization, tailored customization and pure
customization - defines different needs for
integration. This, in turn, implies that the situations
in supply chain integration processes also vary and
deepen on decision-maker’s background and the
products and services supplied.

Commitment implies that people are
working for the integration of the supply chain.
People can be committed to tasks by many means,
such as money, promotion, travel, etc. However,
many researchers [42][35] believe that genuine
bonding and commitment derive from the interesting
content of the work and from the significance of the
that practitioners believe that people are committed
through self-interest and the pursuit of power and
wealth. However, in the opinion of Senge [42], if
people are only interested in themselves, then the organisation inevitably develops an atmosphere where people are no longer interested in common organisational objectives. In Senge’s [42] opinion, an alternative model could be one where people want to be a part of activities that are greater, more significant than their personal and selfish goals. They want to contribute toward building something important, and they appreciate doing it with others. Then, according to the discussion above, we draw the conclusion that the acquisition and sharing of knowledge within the supply chain context is enhanced by a person's or firm’s strong commitment to the goals of integration process and the common goals of the supply chain.

### Focusing on knowledge sharing in the supply chain integration process

Relying on the theoretical review, we can summarize that the central themes in integration are interaction, collaboration, information sharing, trust, partnerships, shared technology, managing integrated chains of processes and cooperation to achieve the common objectives. Cooperation, for its part, is built by the interaction of buyer’s and supplier’s beliefs and actions leading to commitment of resources. These different integration elements and their relative position and meaning during the integration process are at least partially unclear. Therefore it is useful to recognize different stages during the integration process to categorize and re-form the integration elements mentioned above.

These central themes and bases of integration lead to the idea of achieving more precise supply chain integration by using the following elements: common goals, common information and knowledge sharing, and commitment and trust. These three elements form the objective level of the proposed supply chain integration process. The response level in this process consists of the confirmed relevance of common goals, identified value forming via information and knowledge sharing, and feedback mechanisms formed (see Figure 1). In this proposed model of the supply chain integration (SCI) process, the integrating companies’ common goals are first observed against supply chain level objectives. The objectives may concern quality and quantity factors, which are related to issues like time, costs and quality. Common goals can be compared to individual members’ own objectives and the same kind of comparison will also be conducted on the supply chain level. If the goals are relevant for both supply chain members separately and the whole supply chain collectively, the process of integration will continue to the next step. In this Common Goals – Relevance phase knowledge sharing is essential, because at the response level the relevance of common goals is discovered both at the company level and at the supply chain level. The relevance may also be concerned with the problem of quality and quantity factors, which are related, for example, to the relative position of the industry. Therefore it is important that awareness of the company’s objectives and the expected advantages are ensured by the company’s internal knowledge sharing.

If the relevancy of the common goals is ensured by the parties, in the next step the parties begin to share common information and knowledge between organisations. This can be called external knowledge sharing. The objective of external knowledge sharing is to make sure that the integration process will form real value to the parties and to the supply chain as a whole. At the response level the value of the integration process resulting from information and knowledge sharing is identified. The value added from supply chain integration may, for example, be improved customer service, reduced inventories and costs, reduced overproduction and variability, reduced waiting and faster deliveries. Such information and knowledge sharing is more related to the utilizing of common information and
communication systems. The utilization is based on the parties’ interaction as well as information and knowledge sharing in different relationships and the objective is moreover to contribute to achieving common objectives.

If value formation takes place, members’ commitment and trust are bound to increase. The effect of trust and commitment on people’s awareness of the importance and meaning of their activities should be emphasized [42][35]. Trust enables communication, informal agreement, the absence of surveillance, and task coordination. Trust is both a pre-condition and an outcome, which means that a sufficient level of trust is needed in the first place. Therefore it can be argued that without knowledge sharing between the parties, commitment and trust cannot increase. At the response level, the feedback mechanisms ensure that the integration process is a continuum. At this phase, the openness and sharing of outcomes is vital for companies to be able to compare value added and the outcomes achieved with the outcomes anticipated. Therefore feedback mechanisms have an important role when knowledge is shared and collected during the integration process.

From the conceptualized schema above (Figure 1) we can identify the highlighted role of knowledge and knowledge sharing in supporting the whole process of SCI as well as in being a focal element of the integration process. Figure 1 also illustrates that knowledge sharing itself is not enough to sustain the integration process. In the integration process the process management is also needed, with the help of which knowledge sharing is sustained, coordinated, and controlled. The process management element controls the whole integration process and connects the integration process with the company’s operations.

Conclusions and Discussion
In a modern dynamic business environment a static position or unclear defining of supply chain integration do not form a sufficient basis for an efficient and effective process of supply chain integration. Furthermore, supply chain integration is a major challenge to companies striving towards superior performance and added value. Therefore, supply chain member relationships have been examined in light of the theoretical classification of the factors behind the concept of supply chain integration and the actors behind the processes of supply chain integration. The purpose of this paper was to discuss and introduce the role of knowledge sharing in supply chain integration and to introduce a schema for this integration process. Thus, six essential integration elements were identified: a) common goals, b) relevance, c) common information and knowledge sharing, d) value forming, e) commitment and trust and f) feedback mechanism. These elements form the basis of SCI process and their content is determined by the company’s supply chain objectives and expected advantages of supply chain integration. By defining the integration process it was possible to reveal the various roles of knowledge sharing behind the integration process.

Although we need more theoretical research and empirical tests, we can still argue that the first step toward an observable integration continuum has now been taken. When evaluating the need for integration and creating the statements and measures for observing the relationship between knowledge sharing and value adding in supply chain integration, the proposed model could be a useful starting point.

References


THE CONE OF LEARNING: A TERTIARY LEVEL EMPIRICAL STUDY ACROSS TRADITIONAL, BLENDED, AND FLEXIBLE LEARNING MODES

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Abstract
Tertiary institutions are moving towards more flexible teaching and learning environments. Relationships between tertiary teaching and learning modes, student outcomes, and learning perceptions have engaged partial studies. This article employs a holistic view. It develops and tests a tertiary teaching and learning environment from a value enhancement approach. Here student-preferred teaching and learning modes are assessed. The tertiary institution teaching and learning offerings or modes are mapped against student learning outcomes, as defined by the tertiary institution ‘business enhancement measurement model’. This research shows tertiary institutions can more closely align their educational teaching and learning solutions towards their student’s perceived learning requirements, whilst also enhancing its student’s skills.

Keywords: Learning modes, tertiary, education, flexible, blended, traditional, student outcomes, student perception

Introduction
Tertiary institutions educate and proactively instruct learners to acquire high levels of knowledge and skills. They up-skill and train students deploying: (1) enhancement, implementation and impact measures; (2) learning assimilation enhancement processes; and (3) diagnosing impediments successful learning enhancements [2][3] and deliver learning enhanced student solutions [29]. These learning improvement cycles operate in a similar manner to business ‘plan-do-check-act’ quality cycles [41][14][16]. Thus, both the product and/or quality of the service are engaged, student knowledge application solutions are continually revamped, and best student learning options are sought for each student cohort [46][48][18].

Closely aligned, tertiary institution knowledge-application solutions [22][23][24] may capture combinations of traditional, blended or flexible learning modes [13][20]. These in-turn, may affect performance outcomes of the students. These measures (capturing teaching and learning effectiveness) are related to the student learning processes. Quality tertiary teaching and learning institutions aim to balance their tight budgets, meet student expectations and deliver targeted, business-acceptable graduate solutions [39].

Tertiary teaching and learning modes remain an issue for tertiary education institutions and for their engaging students [15]. They are also an issue for tertiary staff grappling with the demands of workload, research, and administration whilst also targeting their lecturing delivery of high quality programs [42] and are often executed within the confines of tight departmental funding, institutional streamlining and budgetary constraints [39].

Tertiary students outcomes are built on: (1) their acquired skills and outcomes – captured as their: interpersonal, informational, analytical and behavioural components [8]; (2) their perceived learning like: satisfaction, experiences, value and quality [43][31]; and (3) their student perceived satisfaction transitions towards their employment future and/or perceived business related workplace successes. Students see their potential tertiary outcomes as both workplace performance services and acquired value-adding services for their chosen future workplace destinations [32]. Students expect to emerge from tertiary institutions with skills sets: capable of reasoned thought; reliable and critically appraised research; ideas transposition, skills and knowledge adaptation, strong interpersonal skills [12][33]. They expect the tertiary institution to equip them with skills relevant to their future agile and flexible workplace environments [5][9][11].

In the global workplace, flexibility offers a pathway towards delivering appropriate responses to customer generated requests [50]. Pine, Bart & Boynton [3] suggest a business with customised offerings can better target its customer’s need and preferences (and at customer acceptable price settings). Zipkin [50], adds that technology-enhanced, customer-integrated business solutions jointly capturing combined effects from: (1) customer connection; (2) process flexibility; and (3) logistics, can add value to the customer generated solution – and do so in a cost efficient manner. Ansari and Mela [1] add that visually pleasing web-based solutions, built on intelligently-tapped digital sources, and downstream business network capabilities, can be
selectively programmed towards specific customized solutions. Such selectively programmed, web-connected processes, can deliver, in near real-time, a chosen customised business solution to the customer Murthi and Sarkar [38]. The capturing of individual customer, web-connected data, in near real time, may enable the delivery of targeted customer solutions. This customer-specific process is termed ‘personalization’ [38]. But, personalisation may also be more complex, and may require special networked technologies. Hamilton and Selen [27] show technology-networked solutions, built stepwise, from the customer engaging front-end into the business’s networked back-end systems, and tapped intelligently to track customer shifts, can even more closely align the business and it is offerings towards each customer’s specific requirements. They term this arrangement ‘customisation’ – where one business ideally provides a solution to just one customer each time. Tam and Ho [45], and Jackson [30] suggest digital content and knowledge-requested services when targeted to individual customers, move the customisation processes closer to reality. Thirumalai and Sinha [47] show customisation (or customerisation) may be split into stages as a customer three step process. They suggest there is: (1) a decision to engage stage, then: (2) a service and/or product selection stage, and finally: (3) a transaction stage, completes the process. Thus, to better engage with the customer, the business may adopt a ‘more flexible’ approach towards its delivery modes.

Today, intelligently-networked, changeable, business-delivery modes, along with their generated customer engagement perceptions, can intelligently programmed into business front-end business-customer interface solutions [23]. These approaches mean the modern business can trend towards offering greater flexibility and value adding in its attempts to best answer each customer’s enquiry. Hence, a tertiary education business (with students as its customers) may follow similar customising pathways, as it seeks to more closely emulate such emerging flexible and agile business approaches.

Tertiary Teaching and Learning Modes

In the tertiary education environments, Collis and Moonen [11] map degrees of flexibility, and the goal of learning activities into four quadrants. Quadrant one resembles traditional teaching and learning. It typically occurs in a teacher-directed environment, with instructor-to-student(s) interactions occurring in live, synchronous-rich, face-to-face learning environments [36][34][3][7][19].

Quadrant two captures a form of blended learning termed blended enhanced learning. Blended enhanced learning encapsulates ‘the what’, ‘the where’, and ‘the when’ of learning [28], and may be defined as ’a combination of instructional media or learning systems that combine face-to-face instructions with computer assisted learning management systems’ [4][7][9][20][49]. Blended enabled learning is primarily focused on delivering additional flexibility to the students, whilst providing similar, but different learning components or learning opportunities more in line with agreed student desired and educator accepted outcomes. Thus, personal and/or team-based, student-centered, real-world learning materials, relevant to the learning focus, may be added to the learning offerings, but they are still tied to aspects of teacher-lead traditional learning mode frameworks. Here, a traditional learning environment is typically supplemented by on-line, or computer-mediated, learning elements and/or technology-equipped virtual classrooms engaging the student with learning experience extensions like discussion boards, social networks, gaming environments, personal blogs, and virtual teams. Quadrant three approaches may involve contributions to the professional tertiary learning environment from both the students and the various instructor teams. Overall, more personally engaging activities are experienced by each student. A range of student-centered learning activities are engaged to increase the richness of learning. For example, (1) role plays; (2) case studies presentations; (3) problem solving activities; (4) instructor podcasts and simulations; and (5) web-located teaching support materials may be included.

Quadrant four portrays a flexible learning environment. Here, instructors are directly involved in the planning, monitoring and setting of each individual student’s learning quality, value, skills, controls, and satisfaction issues. This one-on-one style curriculum between the provider and the learner has been termed a ‘customerised’ service provision [22]. This often unique, negotiated and pre-agreed unique learning framework allows for a radical transformation of pedagogies. Flexible learning moves the learning dimension from a model where learners are just receivers of information, to a model where learners actively construct learning and knowledge. The dynamic interactions within this learning environment enable intellectual activities which may be transformed through technology [7]. For example, students engaging in intellectual discussions through collaborative learning modes like

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discussion boards and wikis may transform individual ideas and research into shared knowledge.

Biggs [6], Bonk and Graham [7], Cybinski and Selvananthan [13], Michinov and Michinov [35], Georgouli, Skalkidis & Guerreiro [20], Hamilton and Tee [25][26] have shown the four teaching and learning modes (face-to-face, blended-enabled, blended-enhanced or flexible) established above, show differences in their learning and engagement approaches, and these relate to student learning forming a ‘Cone of Learning’ continuum [26]. This ‘Cone of Learning’ continuum, built on the student learning areas of the Biggs [6] 3P teaching and learning model, is shown as Figure 1.

**Figure 1: The Cone of Learning, Hamilton and Tee [26].**

It portrays increasing complexity in the resultant learning mode offerings options - as more activities (like participation in and the level of learning experiences required) are engaged in conjunction with inherent student factors (like the personal learning skills set brought by the student), and whilst delivering optimal student learning outcomes options (like acquired student learning skills and optimal acquired quality of student learning). Thus, as one progresses from the face-to-face base level (or traditional learning mode approaches) towards the more complex flexible learning mode approaches, far greater total student learning outcomes effects are projected shown to be delivered [26].

At the flexible learning end of the ‘Cone of Learning’ complex mixes of timing and flexibility; content and flexibility; entry requirements; instructional and resources deployment approaches, and delivery and logistics [11] , along with the delivery of: the ‘what’, the ‘where’, the ‘when’, the ‘how’ and aspects of the ‘why’ associated with the learning processes may be engaged as potential contributors to the student learning processes [25].

The ‘Cone of Learning’ also displays blurred boundaries between different teaching and learning modes. Michinov and Michinov [35] support the blurring of boundaries between the face-to-face and blended teaching and learning modes, and Georgouli, Skalkidis, and Guerreiro [20] indicate a similar situation between blended and flexible teaching and learning modes. This paper adds another dimension to Hamilton and Tee’s [26] ‘Cone of Learning’ continuum by expanding the blended section into a lower-level or blended-enabled mode and a higher-level or blended-enhanced mode, again with blurred boundaries. This reconstruction of the ‘Cone of Learning’ is portrayed as Figure 2.

**Figure 2: The Cone of Learning Reconstruction, adapted from Hamilton and Tee [26].**

**Research Study**

We now test the model above using the four teaching and learning modes outlined above against 224 first year business students, with constructs developed from a literature and focus group based, seven point Likert scale teaching and learning modes questionnaire, built under normal survey instrument validation and development approaches [21]. We engage a structural equation modelling approach, investigating possible paths and path strengths, and observing the levels of total learning effects generated under each model. We follow the structural equation modeling procedures of Hamilton and Tee [26], and apply this research against the well established Biggs [6] 3P teaching and learning approach. We rearrange this approach using the teaching mode as the independent construct, and use this teaching-generated learning experience setter approach to generate the Biggs four construct blocks for each of the traditional, blended-enhanced, blended-enabled and flexible teaching and learning mode delivery systems. We model our study as shown in Figure 3.

**Experience Setter**

To fully investigate possible pathways we also test for an additional pathway to that used by Biggs [6], and test for a path between student factors and learning outcomes. Factor reduction of potential construct measures (all measure residuals below 0.05 and with no cross-loading measures above 0.3) delivered reliable, internally consistent, single indicator constructs for each teaching and...
learning mode learning block. Using each resultant factor reduction construct, along with corresponding Cronbach alpha (each was above 0.75 indicating composite reliability), and its associated standard deviation, the relevant construct load and associated error are determined [37]. The structural equation models, built in AMOS 16, are then developed, exposing all the relevant significant paths for each teaching and learning mode. No significant bi-directional pathways were found. Bootstrapping successfully checked sample invariance and the Bollen-Stine p was above 0.05 - as required for each model. Model fit measures for each teaching and learning mode are displayed in Table 1.

Table 1: Learning Experience Setter Teaching Model Goodness of Fit Measures

<table>
<thead>
<tr>
<th>Teaching Context</th>
<th>Traditional Learning Mode Parameter Estimates Generated</th>
<th>Blended Enhanced Learning Mode Parameter Estimates Generated</th>
<th>Flexible Learning Mode Parameter Estimates Generated</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Chi Sq 0.0145</td>
<td>df 11</td>
<td>Bollen-Stine p 0.0828</td>
</tr>
<tr>
<td></td>
<td>RMSEA 0.045</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CFI 0.992</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bollen-Stine p 0.828</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>GFI 0.981</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>AGFI 0.951</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 3: Biggs 3P Model used as Learning

Discussion

Our four teaching and learning mode models, with their key measures shown in Table 1, in each case, display excellent ‘goodness-of-fit’ across all parameters. Our net-learning pathways effects into each learning block (shown in Table 2) also demonstrate that blended learning delivery mode systems may be further split into two distinct blocks, with blended enabled learning delivering higher degrees of net-learning-effects. This study also indicates that as the student factors like personal skills and ability, and motivation increase the student’s capacity to operate in a more flexible environment, and to draw in higher levels of learning increase. This in-turn also impacts on increased levels of student perceived learning achievements or outcomes.

This study also lends support to the ‘Cone of Learning’, with more complexity in learning offerings and challenges, also driving greater student perceived learning outcomes. Traditional teaching and learning (as the simpler learning structure) is seen by students as a low net-learning environment. The blended-enhanced teaching and learning mode, with components of negotiated work in combination with traditional mode activities, is seen as the next strongest learning deliverer. The blended-enabled teaching and learning mode also capturing traditional and blended-enhancing offerings is perceived by students as offering the next highest overall net-learning-effects solution. The flexible teaching and learning modes delivery system where: anytime, anywhere, anyhow, individually-negotiated learning, is recognised by tertiary institutions and by participating students as legitimate, is seen as the learning system capturing aspects of the other modes where appropriate, whilst also delivering highest net-learning outcomes.

Table 2: Net-Learning-Effect Measures Delivered from Different Teaching Mode Approaches

<table>
<thead>
<tr>
<th>CONSTRUCTS</th>
<th>Traditional Learning Mode</th>
<th>Blended Enhanced Learning Mode</th>
<th>Blended Enabled Learning Mode</th>
<th>Flexible Learning Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student Factors</td>
<td>0.34</td>
<td>0.41</td>
<td>0.62</td>
<td>0.74</td>
</tr>
<tr>
<td>Learning Experiences</td>
<td>0.43</td>
<td>0.42</td>
<td>0.52</td>
<td>0.60</td>
</tr>
<tr>
<td>Learning Outcomes</td>
<td>0.30</td>
<td>0.40</td>
<td>0.48</td>
<td>0.51</td>
</tr>
<tr>
<td>Average</td>
<td>0.38</td>
<td>0.41</td>
<td>0.54</td>
<td>0.62</td>
</tr>
</tbody>
</table>

Finally, this study also supports the existence of an increasingly complex learning continuum as proposed by Bonk and Graham [7], and Georgouli, Skalkidis, and Guerreiro [20]. Here, higher levels of student factor, learning experience and learning outcomes all suggest movement in the same positive net-learning-effects direction - as teaching and learning modes move from traditional towards flexible learning approaches, As such, this work suggests the static four quadrant view of teaching and learning previously presented by Collis and
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Monen [11], should be shown as a learning
continuum, with no clear boundaries between
learning modes as shown in our Cone of Learning.

[2]

[3]

Conclusions
Tertiary teaching and learning modes, built on
teaching context constructs outlined herein, show
differences in net student learning effects and these
can be ‘fitted’ into a ‘Cone of Learning’ continuum.
Here, four zones of increasing complexity in
teaching and learning mode (traditional, to
blended-enhanced, to blended-enabled, through to
flexible) offerings may be engaged, with each
mode housing a different set of net student learning
options. This results in different levels of perceived
student learning outcomes being achieved.
The ‘Cone of Learning’ continuum, arising as
one moves from the base level (or traditional
teaching and learning mode) through to more
complex teaching and learning mode approaches,
indicates students perceive that differing degrees of
teaching modes and approaches, deliver different
net-learning outcomes, and that these may be
explained as a single teaching and learning mode,
or under more complex learning approaches as
some combination of selected teaching and
learning mode components as suggested by this
research. If developed and used wisely the ‘Cone of
Learning’ may be used to build a powerful tertiary
institution teaching and learning positional and
benchmarking tool.
This research is not able to capture the exact
transition borders between the teaching and
learning mode levels within the ‘Cone of Learning’
and it is seen as a continuum with blurred
boundaries, and showing various degrees of
overlap across modes and across transitions.
Further, we cannot prove there are only three
dimensions to the ‘Cone of Learning’ continuum,
nor can we definitely conclude the three
dimensions of Biggs 3P model used herein
definitely act at ninety degrees to each other.
Finally, it is likely that a fourth dimension – time
exists and that the model is even more complex
than that shown. We suggest this because we
suspect,
multi-level,
hierarchical
model
development options may exist, and further these
may also require the capture additional
dichotomous (or even ordered categorical)
outcomes constructs. Hence, new longitudinal
surveys, along with structural equation modeling
and Mplus analysis toolkits may be required to
research such situations.

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EXTENDING THE BIGGS 3P TEACHING AND LEARNING MODEL: A STRUCTURAL EQUATION MODELING APPROACH

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Abstract
A structural equation modeling approach is used to build understanding of the Biggs 3P model of teaching and learning within the tertiary institution sector. A learning quality dependent construct is used to show the Biggs 3P construct blocks do display significant two way interactions between each and every construct, and so act as an interlinked system.

Keywords: Learning modes, tertiary, education, flexible, blended, traditional, student outcomes, student perception

Introduction
Tertiary institutions typically deploy unique combinations of unique learning offerings and learning activities as engagement tools for their student cohorts. This research builds on the Biggs 3P model of teaching and learning. The three P’s are tools Biggs engages to relate: (1) presage as the learning characteristics existing prior to the learning engagement; (2) process as the student learning experiences capture tool, and product as the overall student learning outcomes capture toolkit. The Biggs 3P model is shown as Figure 1.

Biggs suggests that learning outcomes that result are complex, and that they operate in interaction with each other. He suggests the general direction of effects may be represented by heavy arrows as shown in Figure 1, and that both student factors and the teaching context jointly drive the system towards a common set of learning outcomes. Biggs also explains that no two classes, or any teacher-student engagements are exactly the same, and Biggs believes the teacher and the individual student engaging in the teaching and learning processes will likely achieve quite different results. Biggs also indicates that each specific institution has impact on the teaching and learning process. Thus, with many complex variable intertwining any change in one area likely shows as an affect in another. Thus the 3P model delivers a teaching and learning system.

Biggs 3P model shows each pathway between construct blocks as bi-directional teaching and learning pathways, with bold arrows representing key directional resultants that ultimately influence student learning outcomes [9][30][56].

The student factors construct block captures the measures of Boyatzis and Kolb [12], Caladine [15], Allen, Bourhis, Burrell and Mabry [1], Collins and Moonen [19], Duke [28], Biggs [9], Kretovics [44], and Delielioglu and Yildirim [24][25].

The teaching context construct block captures three areas traditional, blended and flexible teaching are captured by works by Chickering, Gamson, and Barsi [16], Moore [52][53], Nikolova and Collins [57], Caladine [15], Beattie and James [6], Miller and Groccia [51], Johnson and Johnson [39][40], Novak [58], McCarthy and Anderson [49], Navarro and Shoemaker [55], Nunan, George, and McCausland [59], Smith [60], Collins and Moonen [19], Baugher, Varanelli, and Weisbord [5], Biggs [9], Moore and Kearsley [54], Theroux [63], Dabbagh and Bannan-Ritland [22], Gamliel and Davidovitz [31], Hill [36], Delielioglu and Yildirim, [24][25], Bluc, Goodyear, and Ellis [10], and Hughes [38], Brew [13], Georgouli, Skalkidis, and Guerreiro [32], Hamilton and Tee [35], and Yudko, Hirokawa and Chi .

The learning focused activities construct block captures learning experience related areas, and is built from works by: Wade, Hodgkinson, Smith, and Arfield [64], Miller and Groccia [51], Arbaugh, [4], Dill and Soo, [26], Marks, Sibley, and Arbaugh [48], Davis and Wong [23], Finch [29], Douglas, McClelland, and Davies [27], and Sun, Tsai, Finger, and Chen [61].

The learning outcomes construct block captures both learning skills deployed and learning quality aspects as outlined by: Wade, Hodgkinson, Smith, and Arfield [64], Collis and Moonen [18][19], Smith [60], Chiu, Hsu, Sun, Lim, and Sun [17], Holsapple & Lee-Post [37], Lee [45], Alves and Raposo [2], McFarland and Hamilton [50], Johnson, Hornik, and Salas [41], Lowry, Molloy, and McGlennon [47]; and Sun, Tsai, Finger, and Chen [61].

The learning outcomes construct block captures the measures built from the works outlined above, we reconstruct the constructs and relationship blocks from Figure 1 into our four independent construct test approaches of Biggs 3P model. This approach is portrayed as Figure 2.
In Figure 2 the teaching contexts interact with the student learning processes of student factors, the student learning focused experiences and the student learning outcomes blocks. These four Biggs 3P construct blocks are mapped using structural equation modelling against one additional outcomes construct block (that captures aspects of traditional blended and flexible learning quality). This additional outcomes block is used to test whether the four construct blocks of Biggs 3P do indeed show two-way path interactions. We test this approach using a blended learning mode teaching environment via a multiple campus first year tertiary student study. Here, both a face-to-face and value adding on-line and/or simulation learning mix is used to suitably engage students. If the Biggs 3P construct blocks show significant covariance, and paths to the outcomes block are all sufficiently strong, and the model fit is suitably strong, then these observed construct blocks may be used to further extended the Biggs 3P model into an initial observed variable set. This has application for studies like Hamilton and Tee’s (2008) business ‘value enhancement approach to tertiary institution learning modes, graduate attributes and business enhancement’, and may then show how overall teaching and learning mode systems can better align with graduate employer desires.

**Research Study**

The Biggs 3P model was tested using a structural equation modeling approach. First year business undergraduate students in weeks five and six of their first semester at university, across the campuses of a regional Australian university were the subjects of this study. Data capture of three hundred and seventy three students occurred during March 2009. To ensure measurement suitability a seven-point Likert scale was used across all student survey measures except for those concerning demographics. The survey measures tabulated in Appendix 1 were used to build the structural equation model shown in Figure 3. The added learning quality construct driver block was developed under maximum likelihood in AMOS 16, and via a factor reduction processes. This learning quality construct was used as the dependent variable and as the driver to enable the testing of interactions effects between Biggs’s 3P teaching and learning constructs.
**Results**

The independent construct test approach of Biggs 3P model when tested under Amos 16 showed some case (or potential construct) items when examined within the theoretical context of each scale necessitated removal during factor reduction – either for substantive or statistical reasons [3].

Unidimensionality, reliability and convergent and discriminant validity were evaluated for the remaining acceptable construct items. Modification indices above 4, standard residuals were above two, and standard parameter estimates under 0.50 were all removed. The composite reliability for each construct was 0.75 or greater.

Structural equation modeling outputs is displayed in Figure 3 along with a relevant 'goodness-of-fit' data table. The construct validity was excellent across the model, with a chi squared to degrees of freedom ratio around the value ‘two’. The RMSEA, RMR, CFI, GFI, AGFI, and TLI values all indicate a sound but not excellent model fit. This is because the output variable learning quality is not capturing the full learning driver block. Satisfaction, value, service and communication construct blocks also need to be included here, but this was beyond the data collection of this study. The GFI minus AGFI ratio remained under 0.06, and supported a degree of fit. The Bollen-Stine p (2000 bootstraps), for the structural equation modeling approach used for the blended teaching mode model remained under but near 0.05, and further validated the model fit [8][46][7][42][14][43][21][11][33]. This pathways model delivers sound quality results, and bootstrapping (2000 bootstraps), supported by near normal ML charts, is used to indicate the avoidance of possible calculation misspecification errors, and to further validate model fit [33].

All paths shown in Tables 1 and 2 are significant at p < 0.05 and all have reasonable loadings. All covariance paths shown in Tables 3 and 4 are significant at p < 0.05, and all have moderate loadings. Thus, the four construct blocks of Biggs 3P model each display different, but strongly moderated interactions, when mapped against the learning quality construct block. This supports Biggs 3P model where significant interactions between the construct blocks are expected. The moderate covariance levels indicate the constructs are different, but do show interaction effects.

### Table 1: Regression Pathways

<table>
<thead>
<tr>
<th>Path (Reg Wts)</th>
<th>Estimate</th>
<th>S.E.</th>
<th>CR</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEARNING QUALITY ← STUDENT FACTOR</td>
<td>.260</td>
<td>.074</td>
<td>3.540</td>
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</tr>
<tr>
<td>LEARNING QUALITY ← LEARNING EXPERIENCE</td>
<td>.096</td>
<td>.137</td>
<td>0.727</td>
<td>***</td>
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<tr>
<td>LEARNING QUALITY ← LEARNING SKILLS</td>
<td>.218</td>
<td>.082</td>
<td>2.645</td>
<td>0.08</td>
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<tr>
<td>LEARNING QUALITY ← BLENDED MODE</td>
<td>.138</td>
<td>.055</td>
<td>2.485</td>
<td>0.017</td>
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</table>

### Table 2: Regression Path Value Between Constructs

<table>
<thead>
<tr>
<th>Path Loadings (Standardized Reg Wts)</th>
<th>Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEARNING QUALITY ← STUDENT FACTOR</td>
<td>.202</td>
</tr>
<tr>
<td>LEARNING QUALITY ← LEARNING EXPERIENCE</td>
<td>.469</td>
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<tr>
<td>LEARNING QUALITY ← LEARNING SKILLS</td>
<td>.393</td>
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<tr>
<td>LEARNING QUALITY ← BLENDED MODE</td>
<td>.688</td>
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</table>

### Table 3: Covariance Pathways

<table>
<thead>
<tr>
<th>Covariance Pathways</th>
<th>Estimate</th>
<th>S.E.</th>
<th>CR</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEARNING QUALITY ← LEARNING EXPERIENCE</td>
<td>.211</td>
<td>.060</td>
<td>4.596</td>
<td>***</td>
</tr>
<tr>
<td>LEARNING QUALITY ← LEARNING SKILLS</td>
<td>.288</td>
<td>.086</td>
<td>4.553</td>
<td>***</td>
</tr>
<tr>
<td>STUDENT FACTOR ← LEARNING QUALITY</td>
<td>.287</td>
<td>.065</td>
<td>4.508</td>
<td>***</td>
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<tr>
<td>LEARNING QUALITY ← LEARNING EXPERIENCE</td>
<td>.308</td>
<td>.062</td>
<td>5.064</td>
<td>***</td>
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<tr>
<td>STUDENT FACTOR ← LEARNING QUALITY</td>
<td>.306</td>
<td>.057</td>
<td>5.303</td>
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<tr>
<td>LEARNING QUALITY ← LEARNING EXPERIENCE</td>
<td>.266</td>
<td>.064</td>
<td>5.302</td>
<td>***</td>
</tr>
</tbody>
</table>

### Table 4: Biggs Construct Covariance Pathways

<table>
<thead>
<tr>
<th>Covariance Paths (Standardized Coeffs)</th>
<th>Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEARNING EXPERIENCE ← LEARNING SKILLS</td>
<td>.624</td>
</tr>
<tr>
<td>BLENDED MODE ← LEARNING SKILLS</td>
<td>.481</td>
</tr>
<tr>
<td>STUDENT FACTOR ← LEARNING SKILLS</td>
<td>.489</td>
</tr>
<tr>
<td>BLENDED MODE ← LEARNING EXPERIENCE</td>
<td>.605</td>
</tr>
<tr>
<td>STUDENT FACTOR ← LEARNING EXPERIENCE</td>
<td>.609</td>
</tr>
<tr>
<td>BLENDED MODE ← STUDENT FACTOR</td>
<td>.489</td>
</tr>
</tbody>
</table>

### Conclusions

The structural equation modeling approach used shows that the Biggs 3P model of teaching and learning for first year tertiary institution students does display interaction between each of the construct blocks. These two way interactions each of differing path strength as suggested by Biggs, constitute an interlinked system, and these may be used in structural equation modeling studies to further investigate the linkages between tertiary institution learning modes, graduate attributes and business enhancement [35]. To improve this study the outcomes driver set should capture satisfaction, value, service, quality and communication constructs.

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Extending the Biggs 3p Teaching and Learning Model


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Appendices

Appendix 1: Construct Items

<table>
<thead>
<tr>
<th>Code</th>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF1</td>
<td>The ability to understand the practical implications of course-acquired new knowledge</td>
</tr>
<tr>
<td>SF2</td>
<td>Ideas and solutions processes</td>
</tr>
<tr>
<td>SF3</td>
<td>Enhanced knowledge suitable for a student’s planned future career</td>
</tr>
<tr>
<td>SF4</td>
<td>Added value to the student’s skills portfolio</td>
</tr>
<tr>
<td>LE1</td>
<td>My quality learning experiences are best delivered by face-to-face individual instruction from the</td>
</tr>
<tr>
<td>LE2</td>
<td>Each of my tertiary teachers should engage with me by pre-defined project tasks</td>
</tr>
<tr>
<td>LE3</td>
<td>Tertiary learning should offer the mix of theory and practice that I can negotiate to best suit my</td>
</tr>
<tr>
<td>LE4</td>
<td>Tertiary learning should offer a sequencing of topics that I can negotiate to best suit my needs</td>
</tr>
<tr>
<td>LS1</td>
<td>Student-teacher, individually-agreed, course delivery is the best way to improve my behavioural skills</td>
</tr>
<tr>
<td>LS2</td>
<td>Face-to-face learning is the best way to improve my information skills</td>
</tr>
<tr>
<td>LS3</td>
<td>Face-to-face learning is the best way to improve my analytical skills</td>
</tr>
<tr>
<td>LS4</td>
<td>A mix of face-to-face and on-line learning is the best way to improve my behavioural skills</td>
</tr>
<tr>
<td>BM1</td>
<td>It is absolutely important for students to access tertiary learning materials as library resources (on-line and/or off-line)</td>
</tr>
<tr>
<td>BM2</td>
<td>It is absolutely important for students to access tertiary learning materials as library books and borrowable resources</td>
</tr>
<tr>
<td>BM3</td>
<td>It is absolutely important for students to access tertiary learning materials as texts and course websites</td>
</tr>
<tr>
<td>BM4</td>
<td>Highest value learning is best provided by a mix of face-to-face and technology enhanced on-line interactive websites and discussion boards</td>
</tr>
<tr>
<td>LQ1</td>
<td>Tertiary learning environment face-to-face learning makes students master knowledge by drills and</td>
</tr>
<tr>
<td>LQ2</td>
<td>Tertiary learning environment face-to-face learning makes students always learn content that is linked by the teacher to its most appropriate context</td>
</tr>
<tr>
<td>LQ3</td>
<td>It is absolutely important for students to access tertiary learning materials as face-to-face discussions with the teacher, lecturer, instructor and/or mentor</td>
</tr>
<tr>
<td>LQ4</td>
<td>Tertiary student learning environment interactions should develop customer (student) satisfaction</td>
</tr>
<tr>
<td>LQ5</td>
<td>Tertiary learning should offer suitable learning resources that may be varied to best suit my needs</td>
</tr>
<tr>
<td>LQ6</td>
<td>My quality learning experiences are best delivered by allowing me to select my preferred assessment items and grading systems</td>
</tr>
</tbody>
</table>

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HEARTTHROB IN CYBERSPACE - THE CHARACTERISTICS OF THE POPULAR ONLINE DATERS

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Abstract
Online dating websites are currently popular application for Internet users to make new friends and find their partners. An interesting observation is that some people are more popular than others in online dating websites. The current study focus on the personal profile characteristics which make one a popular dater. By two field surveys, this study discusses the relationship between online daters' personal profiles and their popularity.

Keywords: Online Dating, Online Relationship, Dating Websites, Social Websites.

Introduction
Online dating is current a popular activities in the cyberspace. People make new friends and find their partners through online dating websites. Some Internet users had experience in meeting new friends on the internet. For some Internet users, one goal to use Internet is to build and maintain online relationship. Some users develop the online relationships into friendships. Some of them even turned into romantic relationships [9].

More and more people make new friends and find their partners through online dating websites. Some of them used online dating websites to developed romantic relationships. However, there is an interesting observation that some people are more popular than others in online dating websites. These popular users attract others' attention and may be ideal partners for other users.

Previous studies on mate preference had indicated that people would choose romantic partner by their personal characteristics of demographic, personality, social economic status, etc. It is a reasonable inference that online dating participants would also hold some preferences for ideal date partners. The online date partner preferences determine who are popular daters in cyberspace.

The current study focused on the personal profile characteristics which made one a popular dater. By observation of popularity of online daters, this study tried to find characteristics which were associated with popularity of online daters. Then, this study conducted another observation to confirm these characteristics to make sure that online daters with these characteristics were also popular daters.

Literature Review
Previous studies indicated that personality, education, occupation, social economic status, physical appearance, intelligence quality, and emotion quality were factors influencing mate selection. Followings are mate preferences mentioned in previous studies.

Mate preferences in personality, intelligent and emotion
Personality, intelligent and emotion are important issues for friendship and romantic relationship. Buss and Barnes [1] revealed that good companion, considerate, honest, affectionate, dependable, intelligent, kind, understanding, interesting to talk to, and loyal were characteristics which made people popular mates. Sanderson, Keite, Miles, and Yopyk [15] indicated that people who focused on intimacy in their relationships preferred dating partner with characteristics in warm and open and similar personality attributes. Goodwin [7] indicated that kindness, consideration, honest, and humor were important personality characteristics in cross-sex preference for potential mates. Hoyt and Hudson [8] found that people would like to select mates who consisted of intelligent. Buunk, Dijkstra, Fetchenhauer, and Kenrick [2] indicated that both men and women liked mates who were self-confidence and dominance. McGee and Shevlin [10] revealed that humor people were with high level of attractiveness and amiable personality and good relation capacities were preferred in mate selection. Doosje, Rojahn, and Fischer [5] indicated that both males and females felt autonomy, intelligence, and emotionality were desired characteristics for their preferred partners.

Previous studies had discussed the gender difference in mate preferences in personality, intelligent and emotion. For males, they preferred their spouse with frugal personality [1]. According to Todosijević, Ljubinković, Snežana, and Arančić [21], males desired mates with aggressiveness, self-pity, fearfulness, fragility personality, seriousness, independence, enterprising, and sincerity than females. Clark, Dover, Geher, and Presson [3]
pointed out that males wanted to meet romantic partners who were humor, patience, emotional stability, and with communication and social skills. Gazioglu [6] indicated that males reported that chastity and dependable character as more important than females.

For females, they preferred spouses were with characteristics of considerate, honest, dependable, kind, understanding, fond of children, and well-liked by others [1]. Buunk et al. [2] revealed that females significantly preferred mates who had high level of dominance than others. In Gazioglu [6]'s study, females were more concerned than males with physical stability and maturity, mutual attraction-love, and intelligence. In intelligence, females felt more importance than males. Females felt less importance in kind and understanding than males in mate preference [6].

O'reilly, Knox, and Zusman [11] revealed that females would like to a marital partner who were considerate, dependable, and intelligent as essential traits in a future spouse. Besides, females did not seek caring nature and hygiene and cleanliness romantic partners, as Clark et al. [3] indicated. In McGee and Shevlin [10]'s study, gender with humor on level of attractiveness was not significant.

People are with different major concerns for different kinds of relationship. Regan and Joshi [13] showed that intellect had higher significant on long-term romantic partner than short-term sexual partner. Sanderson et al. [15] indicated that people cared the security feeling when building a long-term relationship. Regan and Joshi [13] showed that people for romantic relationships were interested in mental characteristics, such as humor, intellect, and intelligence. On the other hand, people for sexual relationships were concerned with attractiveness and sexy appearance. In addition, Regan, Levin, Sprecher, Christopher and Cate [12] divided mate preference criteria into internal and external characteristics. Internal characteristics included personality and intelligence, while external characteristics included physical attractiveness. People preferred internal characteristics more than external characteristics in selecting mates.

Mate preferences in occupation, social status, family and background
Income and economic status are important for everyone for their daily life. People usually do not like to marry someone without stable jobs. They wanted to marry someone who was earning more than themselves [18]. Social status, family and background are also important in mate selection. Buss and Barnes [1] revealed that a large family was unpopular characteristics for people in a mate.

Previous studies indicated gender differences in mate preferences in occupation, social economic status, and relative. Doosje et al. [5] indicated males tended to value socio-economic status as more important than females. For marriage mates, males were less concerned with social pressure and economical necessity and felt less importance in good earning capacity than females [6]. However, females were more unwilling than males to marry someone whose income was lower, and who did not have stable jobs [18]. Females were fond of income and social position mates [2]. Females cared more about social status than males in mate preference [12] [17]. For females, they preferred spouse characteristics in a mate who included good earning capacity, ambitious and career-oriented, and good family background. Females more preferred than males in good earning capacity [1]. For characteristics in mate preferences, females were more concerned with sociability, good financial prospect, favorable social status or rating, ambition and industrious, and similar political background than males.

People were with different concerns for different kinds of relationship. For a speed-date, females cared more than males in earnings prospects of the potential romantic partner [4].

Mate preferences in education
There were gender differences in mate preference in education. Some studies indicated that females were more concerned with similar education status than males [6] [16]. However, some studies revealed that people wanted to marry ones with more education than themselves [8] [18]. South [18] revealed that males would like to marry females with lower education was lower than themselves. Males felt less importance of college degree in mate selection than females [6]. Females were fond of higher level of education [2] [16] and preferred more than males in college degree [1].

Mate preferences in physical appearance
In general, males care physically attractive much more than females in mate selection [1] [2] [5] [7] [17] [21]. Previous studies had discussed the gender difference in mate preferences in physical appearance. Males are attracted much by body type and looking than females [1] [2] [7]. For males, they preferred their spouse were with characteristics of physically attractive and good cook [1]. According to Todosijević et al. [21], males prefer thinness mates. Clark et al. [3] pointed out that males wanted to meet romantic partners with attractive appearances. In Gazioglu [6], empirical survey results indicated that for preferences potential mates, females felt less importance in physical attractiveness than males.

For a speed-date, males showed that physically attractive were more important than females in an ideal romantic partner [4]. For females, they
preferred tall spouses [14]. Todosijević et al. [21] found that males desire more in beauty than females. And males were also more desirable in good looks. For marriage mates, males reported that good looks were more importance than females [6]. For males, they preferred their spouse were with characteristics of good looking [1].

**Types of relationships in cyberspace**

Thelwall [20] divided expending online relationships objectives into four types: friendship, dating, networking and serious relationships. In his research, results revealed that females were fond of friendship, but males preferred to dating or serious relationships. And the younger people had less interest in networking. In online friendship, females had more friends than males. Both males and females liked to know female friends.

**Study 1**

**Method**

The current study focus on the personal profile characteristics which make one a popular dater. To reach this purpose, the study collected data of popularity and personal profiles from online dating websites. Online date websites usually assign a unique membership number to each user. The current study used a random sampling process to determine the subject list. The study collects all personal profiles and popularity of the users in the sampled subject list.

The current study collects data from Taiwan Yahoo Dating website. In Taiwan Yahoo dating website, each online dating account has a friendship score and a good feeling score. Both friendship score and good feeling score of an online dater are decided by other users. If individuals want to make friends with one in online dating website, they need to send a request to and add one into their good friend list. This request would bring one point of friendship score to her or him [19]. Individuals with high friendship scores in Taiwan Yahoo Dating website means that many people admire or like them.

Good feeling score is another function provided by Taiwan Yahoo Dating website. This function allows users to give a good feeling score to others. Each day one user can only give one good feeling point to the same user. However, in the other day this limitation will re-count and individual can give another one good feeling point to the same user. This good feeling point reflects others' intention to make friend with and is collected as a record in ones' personal profiles [19]. This study adopted both friendship and good feeling scores as index for online dates' popularity. Both the friendship and good feeling scores range from zero to hundreds or thousands. Some famous online dating participants are with extreme high value in friendship and good feeling scores. To avoid the bias from by the outlets, the study used the log values of friendship and good feeling score for data analysis purpose.

Personal profiles in online dating websites include several parts: demographics, background, interests, match preference, and autobiography. The demographics part includes gender, age, residence, constellation, blood, marriage, height, weight and type. The part of background includes the degree of education, occupation, smoking habit, drinking or not, belief, personality, and languages spoken. The part of interests composes of interest, pet, movie, travel experience, music, food, and prefer leisure place. The part of match preference contains mate preference in gender, age, marriage, belief, height, weight, the degree of education, body type, and relationships. The autobiography part includes self introduction of online dating user. Some fields in the personal profiles are in the format of multiple responses, include personality, languages spoken, interest, pet, movie, travel experience, music, food, prefer leisure place, matching type, and matching relationships, while the other fields in the format of multiple-choice.

**Table 1 Demographic profiles of the sample**

<table>
<thead>
<tr>
<th>Demographic variables</th>
<th>Cases</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>498</td>
<td>64.26</td>
</tr>
<tr>
<td>Female</td>
<td>277</td>
<td>35.74</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under 20 years old</td>
<td>44</td>
<td>5.68</td>
</tr>
<tr>
<td>21 to 25 years old</td>
<td>181</td>
<td>23.35</td>
</tr>
<tr>
<td>26 to 30 years old</td>
<td>224</td>
<td>28.90</td>
</tr>
<tr>
<td>31 to 35 years old</td>
<td>144</td>
<td>18.58</td>
</tr>
<tr>
<td>36 to 40 years old</td>
<td>64</td>
<td>8.26</td>
</tr>
<tr>
<td>41 to 45 years old</td>
<td>48</td>
<td>6.19</td>
</tr>
<tr>
<td>46 to 50 years old</td>
<td>21</td>
<td>2.71</td>
</tr>
<tr>
<td>Up 50 years old</td>
<td>16</td>
<td>2.19</td>
</tr>
<tr>
<td>Marriage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unmarried</td>
<td>582</td>
<td>75.10</td>
</tr>
<tr>
<td>Married</td>
<td>42</td>
<td>5.42</td>
</tr>
<tr>
<td>Separation</td>
<td>7</td>
<td>0.90</td>
</tr>
<tr>
<td>Divorce</td>
<td>39</td>
<td>5.03</td>
</tr>
<tr>
<td>Widowed</td>
<td>7</td>
<td>0.90</td>
</tr>
<tr>
<td>Not married</td>
<td>57</td>
<td>7.35</td>
</tr>
</tbody>
</table>

**Subjects**

This research randomly collected 800 personal profiles from Taiwan Yahoo online dating website. Among them, 25 subjects were deleted due to missing and unreasonable personal profiles, remaining 775 (96.88%) personal profiles were included to analyze. The subjects consisted of 498 (64.26%) males and 277 (35.74%) females. The age of subjects were ranged from 18 to 63 years old (M = 30.10, SD = 7.84). Of the subjects, 28.90% were 26
to 30 years old. Over three fourths subjects were unmarried, as Table 1 indicated.

Data Analysis
In term of table 2, the average number in friendship score was 105.45 (SD = 884.54) for all subjects, 93.291 (SD = 1044.28) for male, and 127.30 (SD = 479.24) for female. In the case of good feeling score, the average number was 4031.69 (SD = 20844.08) for all subjects, 3326.88 (SD = 20344.30) for male, and 5298.82 (SD = 21693.57) for female. Since that some famous online daters were with extremely high value in friendship and good feeling scores, the study used the log values of friendship and good feeling score for data analysis.

Table 2 Popularity for all subjects

<table>
<thead>
<tr>
<th></th>
<th>All subjects (n=775)</th>
<th>Male (n=498)</th>
<th>Female (n=277)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Friendship score</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>105.45</td>
<td>93.291</td>
<td>127.30</td>
</tr>
<tr>
<td>s.d.</td>
<td>884.54</td>
<td>1044.28</td>
<td>479.24</td>
</tr>
<tr>
<td>Good feeling score</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>4031.69</td>
<td>3326.88</td>
<td>5298.82</td>
</tr>
<tr>
<td>s.d.</td>
<td>20844.08</td>
<td>20344.30</td>
<td>21693.57</td>
</tr>
</tbody>
</table>

Personality traits and popularity
In online dating websites, users present their personality traits by dichotomous field. The study conducted t-test to explore the difference in popularity for online daters with different personality traits. Averagely male had higher friendship score when with personality traits of romantic ($t=-3.76; p<.001$), simple and straightforward ($t=3.03; p<.001$), humorous ($t=-2.02; p<.05$), stubborn ($t=-3.14; p<.01$), and smart and capable ($t=-2.31; p<.05$). Males with personality traits of romantic, simple and straightforward, humorous, stubborn, and smart and capable were more popular than ones without when evaluating popular by friendship score. Nevertheless, males were less popular if ones were with personality traits of friendly and easygoing ($t=3.11; p<.01$) and shy ($t=2.11; p<.05$).

Males had averagely significant higher good feeling score when ones were with personality traits of romantic ($t=-2.86; p<.01$), positive ($t=-2.88; p<.01$), sincere ($t=-2.11; p<.05$), and enthusiastic ($t=-2.31; p<.05$) and significant lower good feeling score when with friendly and easygoing ($t=2.05; p<.05$) and shy ($t=2.42; p<.05$) personality traits.

Female had significant higher friendship score when ones were with personality traits of humorous ($t=-2.43; p<.05$) and careful and consideration ($t=-2.16; p<.05$), and lower friendship score when with friendly and easygoing ($t=-2.41; p<.05$) and free and unrestricted ($t=2.88; p<.01$) personality traits. Averagely female had higher good feeling score when with personality traits of embraced careful and consideration ($t=2.00; p<.05$), and lower good feeling score when with taciturn ($t=2.17; p<.05$) personality trait.

Interest and popularity
In online dating websites, users present their interests by dichotomous field. The study conducted t-test to explore the difference in popularity for online daters with different interests. The popularity composed of friendship and good feeling scores in the current study. The t-test results revealed that males were with higher friendship score when having personal interests in reading and writing ($t=-2.85; p<.01$), finance and investment ($t=-2.12; p<.05$), and keeping pets ($t=-2.07; p<.05$) and with significant lower friendship scores when having personal interests in playing computers and network ($t=-2.88; p<.01$) and sleeping ($t=2.06; p<.05$). The results also indicated that male with higher good feeling score when having personal interests of reading and writing ($t=-2.06; p<.05$) and finance and investment ($t=-3.32; p<.001$) and significant lower score when having personal interests in playing computers and network ($t=-2.73; p<.01$) and rides ($t=2.18; p<.05$) and sleeping ($t=2.10; p<.05$).

Female were with significant higher friendship scores when with personal interests of shopping ($t=-1.98; p<.05$) and keeping body slim and beauty ($t=-2.80; p<.001$), and with significant lower friendship score when with interests of chat with others ($t=2.55 p<.05$). Besides, female were with significant higher good feeling score when ones with personal interests in travel ($t=-2.71; p<.01$), and significant lower good feeling score when with interesting in astrology and fortune ($t=2.06; p<.05$).

There was no significant difference in friendship score for females with different movie preference. However, males were with significantly higher good feeling scores when preferring sci-fi movie ($t=-2.34; p<.05$), and with lower good feeling score when preferring animation movie ($t=2.05; p<.05$). Females were with significantly higher friendship scores when preferring drama ($t=-3.01; p<.01$) and comedy ($t=2.52; p<.05$) movies, and were with no significant difference in good feeling score for different movie preference.

Male were with higher friendship scores when ones preferred Japanese food ($t=-3.11; p<.01$), western food ($t=-2.18; p<.05$), and Italian food ($t=-2.09; p<.05$), and significant difference was found in preference in Japanese food ($t=-4.01; p<.001$) in male. For females, significant differences in friendship scores were found in food preference. Female averagely had higher friendship scores when ones preferred Japanese food ($t=2.68; p<.01$),

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Nevertheless, no significant difference was found in good feeling scores for different food preference.

**Spoken Languages**
Males had significant higher friendship scores when they spoke English ($t=5.27; p<.001$), Cantonese ($t=-3.66; p<.001$), Japanese ($t=-3.65; p<.001$), and Korean ($t=-4.02; p<.001$). Besides, males had averagely higher good feeling score when they spoke English ($t=4.35; p<.001$), Cantonese ($t=-2.18; p<.05$), Japanese ($t=-2.20; p<.05$), and Korean ($t=-3.30; p<.01$).

For females, popularity was also relative with spoken languages. Female had significant higher friendship score when they spoke English ($t=-2.48; p<.05$) and Korean ($t=-1.99; p<.05$). Good feeling scores were not significant difference with different spoken languages.

**Relationship preferences and popularity**
Males were with higher friendship scores when they preferred to build pen pal ($t=-2.14; p<.05$) relationship online. Nevertheless, females were with less friendship scores when they indicated that they hoped to build romantic relationship ($t=2.22 p<.05$), innocent encounter ($t=2.15 p<.05$), and intimate relationships ($t=2.13 p<.05$). Besides, males were with higher good feeling scores when their preferred relationship types was marriage ($t=-2.12 p<.05$), and with less good feeling scores when preferring romantic scores.

Females were with higher friendship scores when they preferred intimate relationships ($t=-3.16; p<.01$), and were with less friendship scores when they preferred pen pal relationship ($t=2.14; p<.05$).

**Body type and popularity**
In online dating websites, users present their body type by selecting one description from several predetermined statements. The study conducted ANOVA analysis to reveal the difference in popularity among people with different body types.

<table>
<thead>
<tr>
<th>Table 3 Characteristics make online daters popular and unpopular - friendship score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Popular characteristics</strong></td>
</tr>
<tr>
<td><strong>Male</strong></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

ANOVA analysis results revealed that significant differences in both friendship scores ($F(4,405) = 4.98, p<.001$) and good feeling scores ($F(4,405) = 4.30, p<.001$) were found among different body types. Handsome and Tall, handsome, and strong and sunshine type males were with significant higher friendship scores. On the contrary, males were with less friendship score when with body types of fat and plump, strong and tall, thin and tall, and medium build. Handsome and tall and strong and sunshine males were with higher good feeling scores, while polite, strong and tall, thin and
tall, and medium build body type males were with lower good feeling scores.

There were significant difference in friendship scores ($F(9,204) = 5.88$, $p<.001$) and good feeling scores ($F(9,204) = 3.41$, $p<.001$) among different body types. Females with body type of slender, thin, good body sharp, noble and elegant, sexy and charming, and strong and sunshine were with significant higher friendship scores, while fat and plump and medium build body type females were with lower friendship scores. Noble and elegant and strong and sunshine body type females were with significant higher good feeling scores, and cute and petite, fat and plump and medium build body type were with significant lower good feeling scores.

**Education and popularity**

The results in ANOVA analysis pointed out that for males there were significant difference in both friendship scores ($F(2,465) = 8.19$, $p<.001$) and good feeling scores ($F(2,465) = 12.93$, $p<.001$) among different education levels. Males with higher education degree were with higher friendship scores and good feeling scores than others.

The ANOVA analysis results indicated that there was significant different among different education level in friendship scores ($F(1,245) = 5.25$, $p=.02$) for female. Females with college degree were with higher friendship score. No significant difference was found in good feeling scores among different education levels.

**Occupation and popularity**

ANOVA analysis results revealed that males with different occupations were with significant difference scores in friendship ($F(4,352) = 4.40$, $p<.01$) and good feeling ($F(4,352) = 8.89$, $p<.001$) scores. Males with entertainer and owner occupations were with higher friendship scores. Males with occupation of civil service, employee, entertainer, and business owner were with higher good feeling scores. Besides, students were with lower friendship and good feeling scores.

For female there were significant difference among different occupations in both scores of friendship ($F(4,201) = 3.18$, $p=.01$) and good feeling ($F(4,201) = 3.86$, $p<.01$). Females with occupations of employee, entertainer, and unemployed were with higher scores of both friendship and good feeling. Females with occupation of civil services and students were had with lower scores of both friendship and good feeling.

<table>
<thead>
<tr>
<th>characteristics</th>
<th>characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Male</strong></td>
<td><strong>Female</strong></td>
</tr>
<tr>
<td>Personality Traits</td>
<td>Personality Traits</td>
</tr>
<tr>
<td>romantic, positive, sincere, enthusiastic</td>
<td>friendly and easygoing, shy</td>
</tr>
<tr>
<td>Interests</td>
<td>Interests</td>
</tr>
<tr>
<td>reading and writing, finance and investment</td>
<td>playing computers and network, rides, sleeping</td>
</tr>
<tr>
<td>sci-fi film</td>
<td>animation movie</td>
</tr>
<tr>
<td>Japanese food</td>
<td>Spoken languages</td>
</tr>
<tr>
<td>Spoken languages</td>
<td>Chinese</td>
</tr>
<tr>
<td>English, Cantonese, Japanese, Korean</td>
<td>Body types</td>
</tr>
<tr>
<td>Body types</td>
<td>fat and plump, strong and tall, thin and tall, medium build</td>
</tr>
<tr>
<td>handsome and tall, handsome, strong and sunshine</td>
<td>Education</td>
</tr>
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<td>Education</td>
<td>high school</td>
</tr>
<tr>
<td>master</td>
<td>Occupation</td>
</tr>
<tr>
<td>Occupation</td>
<td>student</td>
</tr>
<tr>
<td>entertainer, business owner</td>
<td></td>
</tr>
</tbody>
</table>

### Study 2

**Method**

The first study summarized characteristics which made the online daters popular or unpopular. The current study employed the characteristics found in the first study to collect personal profiles of online daters to test and verify if these characteristics were relative with popularity of online daters. To avoid the bias from by the outlets, the study used the log values of friendship and good feeling score for data analysis purpose.

The current study used popular and unpopular characteristics listed in table 3 and table 4 to search from Taiwan Yahoo online dating website to collect the online daters which with these popular and unpopular characteristics.

| Table 4 Characteristics make online daters popular and unpopular – good feeling score |
|----------------------------------|-----------------|
| Popular | Unpopular |
| Study 2 Procedure | |
| The first study summarized characteristics which made the online daters popular or unpopular. The current study employed the characteristics found in the first study to collect personal profiles of online daters to test and verify if these characteristics were relative with popularity of online daters. To avoid the bias from by the outlets, the study used the log values of friendship and good feeling score for data analysis purpose. |

**Subjects**

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After search the online dating website, this current study in friendship score gathered 59 male online daters with popularity characters and 632 ones with unpopular characteristics. For females, the current study collected 96 online daters with popular characteristics and 173 ones with unpopular characteristics. In good feeling score, this study assembled 15 male online daters with popularity characters and 136 ones with unpopular characteristics. For females, the current study got together 201 online daters with popular characteristics and 1 ones with unpopular characteristics. New online dating users with zero friendship score were excluded in this study.

### Table 5 Popular and unpopular dater – friendship score

<table>
<thead>
<tr>
<th>Item</th>
<th>Friendship score</th>
<th>n</th>
<th>M</th>
<th>s.d</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Male</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With popular</td>
<td></td>
<td>59</td>
<td>0.73</td>
<td>0.62</td>
<td>t=20.37**;</td>
</tr>
<tr>
<td>characteristics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With Unpopular</td>
<td></td>
<td>632</td>
<td>0.05</td>
<td>0.17</td>
<td>p&lt;.001</td>
</tr>
<tr>
<td>characteristics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With popular</td>
<td></td>
<td>96</td>
<td>1.21</td>
<td>0.67</td>
<td>t=11.98**;</td>
</tr>
<tr>
<td>characteristics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With Unpopular</td>
<td></td>
<td>173</td>
<td>0.42</td>
<td>0.41</td>
<td>p&lt;.001</td>
</tr>
<tr>
<td>characteristics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Data Analysis**

As table 5 indicated, the results displayed significant differences in friendship scores between daters with popular characteristics and ones with unpopular characteristics for both male (t=20.37; p<.001) and female (t=11.98; p<.001). The average friendship score in log of male daters with popular characteristics was 0.73 (SD = 0.62), and with unpopular characteristics was 0.05 (SD = 0.17). For female, the average number in log was 1.21 (SD = 0.67) for ones with popular characteristics and 0.42 (SD = 0.41) for ones with unpopular characteristics.

The results in good feeling score found significantly different in popular and unpopular characteristics for male (t=4.33; p<.001) and female (t=2.63; p<.01), as table 6 indicated. The good feeling score in log of male daters with popular characteristics was averagely 1.46 (SD = 0.61), and with unpopular characteristics was 0.76 (SD = 0.59). For female, the number in log was averagely 2.90 (SD = 0.76) for ones with popular characteristics and 0.90 (SD = 0.00) for ones with unpopular characteristics.

### Table 6 Popular and unpopular dater – good feeling score

<table>
<thead>
<tr>
<th>Item</th>
<th>Good feeling score</th>
<th>n</th>
<th>M</th>
<th>s.d</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Male</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With popular</td>
<td></td>
<td>15</td>
<td>1.46</td>
<td>0.61</td>
<td>t=4.33**;</td>
</tr>
<tr>
<td>characteristics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With Unpopular</td>
<td></td>
<td>136</td>
<td>0.76</td>
<td>0.59</td>
<td>p&lt;.001</td>
</tr>
<tr>
<td>characteristics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With popular</td>
<td></td>
<td>201</td>
<td>2.90</td>
<td>0.76</td>
<td>t=2.63*;</td>
</tr>
<tr>
<td>characteristics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With Unpopular</td>
<td></td>
<td>1</td>
<td>0.90</td>
<td>0.00</td>
<td>p&lt;.01</td>
</tr>
<tr>
<td>characteristics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Discussion**

By two field studies, this article discusses the relationship between online daters' personal profiles and their popularity. The first study investigated 775 online daters' profiles from an dating websites. The second study searched for the online daters with profiles of popular and unpopular characteristics. By observation the popularity of these online daters, it was found that online daters with the "popular" characteristics were also the popular daters and those with "unpopular" characteristics were also the unpopular daters. These may served as evidences that the found personal profile characteristics were indeed factors influencing the popularity of the online daters.

The statistic analysis results indicated that in physical body type and looking, education level, occupation, personality, and interesting were characteristics which influenced the popularity of online daters, while significant gender differences were found in the characteristics which were relative with popularity of online daters.

In personality, both males and females who were humorous personality would become popular daters in online dating websites. Making friends and living with humorous people let people's life become funny and entertaining. These results supported the findings of previous studies [7] [10], in which humorous people had higher level of attractiveness and humorous was an important characteristic in mate preference.

For males, romantic, straightforward, stubborn, and smart were popular characteristics. Females wanted to have a romantic boyfriend or partner. It could let them live in romantic atmosphere. In addition, smart or intellect males had more wisdom than others. They would have much greater work or earning capacity. These finding supported Hoyt and Hudson [8] and Regan and Joshi [13], which revealed that people would like to select mates who
consisted of intelligent. In the case of females, consideration personality traits made them the popular daters. In traditional thinking in Taiwan as well as some other countries, females are expected to have consideration personality traits to take good care of their husband and children and even their family. These results supported the findings of Goodwin [7], in which consideration was an important characteristic for potential mates.

In interest, males with interested in reading and writing, finance and investment, and pets were more popularity than others in online dating websites. Males who liked to reading and writing had more literature temperament and gave people gifted image. Moreover, interesting in finance and investment males may give others a signal of wealth and fortune which is important for the future life. In addition, males who interested in pets revealed that they are benevolent and patient partners.

Females who loved to go shopping and improve body and face beauty were more popular than others in online dating websites. In the aesthetic, people were fond of sexy and thin females. If females who loved to improve body and face beauty, they would have perfect body type. Therefore, they would become popular online daters.

In spoken languages, the study collected data from Taiwan Yahoo dating website. In Taiwan, most people can speak Chinese and Taiwanese. So both males and females did not consider Chinese and Taiwanese as important characteristics for mate preference. Nevertheless, foreign languages such as English, Cantonese, Japanese, and Korean may be characteristics in online dating websites. People who could say multilingual were more popular in online dating websites for males and females. Online daters who spoke more foreign languages may have much more ability in future career development and in earning money. So people in online relationships were fond of meeting multilingual people.

In match relationships, it represented that relationships were desirable in online dating websites by users. Males who preferred pen pal and innocent encounter in relationships and females who preferred intimate relationships were more popular in online dating websites. Some of males probably looked for sexual and intimate relationships in developing online relationships. On the contrary, some of females expanded online relationships in order to seek friendships or innocent relationships. Therefore, males who wanted to romantic and intimate relationships and females who wanted to friend relationships were both unpopular in online dating websites. These finding supported Thelwall [20], which found that females were fond of friendships, but males were fond of dating or serious relationships in online relationships.

In body type, handsome and Tall, handsome, and strong and sunshine male daters were more popular in online dating websites than others. But fat and plump, strong and tall, thin and tall, and medium build daters were unpopular in online dating websites. For females, the popular body types were slender, thin, good body sharp, noble and elegant, sexy and charming, and strong and sunshine in online dating websites. Nevertheless, fat and plump and medium build body types for females were undesirable. Because of social values in aesthetic, people thought that males must be stronger and taller in body type and females must be with thin and sexy body. Moreover, males who had much stronger and taller type may make sense of security. In online dating websites, everybody wanted to know males and females with good body type. Therefore, males and females who were fat or medium body would have lower popularity in online dating websites.

In education, males with higher education were more popular in online dating websites. These results supported the findings of previous studies [2] [16], in which females would like to males who had higher level of education than themselves. However, females with college degree of university were higher popularity. People may think that males with higher education could get not only better jobs but also earn higher income. Females would like to meet males with higher social status or economic capacity. The high education level may bring reliable and dependable feeling to females when developing romantic relationship. Nevertheless, a gender stereotype and gender discriminate advocated that females would not need to have “too many” education. So females with college degree were more popular in online dating websites, than ones with master degree or with high school education.

In occupation, males who were entertainer and business owner had more popular, and females who were unemployed, entertainer, and employee were popular in online dating websites. Both males and females who were popular were entertainer in occupation. The possible explanations are that entertainer let someone feel more artistic temperaments and accomplishments, and business owner could gain much more money today. By contraries, males who were students and females who were civil service and students were unpopular in online dating websites. Males and females who were students were both undesirable in occupation. It may probably show that they did not have economical ability in independent and stable jobs. However, civil service such as polices let someone feel solemn and strict in gender stereotype. This gender stereotype might make the females in occupation of civil service unpopular.
The current study observed that some people are more popular than others in online dating websites and focused on the personal profile characteristics which made one a popular dater. The resulted revealed that personality, interesting, language, physical body type and looking, education level, and occupation were characteristics which significantly influenced the popularity of online daters with gender differences. Based on the above, if males and females in online dating websites had these popular characteristics, they would become more and more popular daters even heartthrob in cyberspace.

References
COMPARING THE BEHAVIORAL MODELS IN CYBER-WORLD USING SOCIAL ROLES

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Abstract
Cyber-world is a typical form of social syndication. Although the future of cyber-world seems bright, not all efforts have succeeded. Therefore, knowing how to motivate users and keep them continually visiting is an important challenge for creating successful cyber-world Web sites. Since that human behaviour varies according to people’s different social roles, this study investigated four social roles (habitual, active, personal, and lurker) in the cyber-worlds. 729 users of i-Partment were used to test the research model. This study empirically confirms the existence of different behavioural models, and revealed the implications for theory and practice.

Keywords: Social role, Social presence, Interactive quality

Introduction
The interactive nature of Web 2.0 has resulted in proliferation of users to cyber-worlds and has brought huge profits to the successful cyber-world Web site providers. The number of users of the world’s largest cyber-world Web site—Second Life, soared from 1.5 million in 2006 to 3 million in 2008 [1], the average of 1 million residents log in monthly [2], and the transaction volume reached US$350 million in 2008 [3]. Habbo, a cyber-world Web site built on the hotel model, had more than 120 million characters registered by the end of 2008, and more than 40% of its users are returning visitors [4]. Habbo earned US$74 million revenue in 2008, US$60 million of which came from the sale of virtual goods [5]. i-Partment, the most successful cyber-world Web site in the greater China area boasted nearly 20 million residents in China and Taiwan by March 2009, and its 2008 revenue exceeded the equivalent of US$295 million, 50% of which came from avatar services and 50% from advertising income. Observing the development and potential of cyber-world Web sites, Gartner [6] estimated that 80% of active Internet users would be participating in virtual world Web sites by 2011. Furthermore, Liew [7] has indicated that US$1 to US$2 in monthly average revenue per user (ARPU) for cyber-world Web sites such as Second Life, Habbo Hotel, Club Penguin, and Runescape. The booming population of cyber-world users and the providers’ revenue forecasts show that cyber-worlds clearly have great marketing and business potential.

Despite cyber-worlds’ bright prospects, many virtual projects do not succeed. Gartner [8] indicated that 90% of corporate virtual world projects fail and shutdown within 18 months because they are unable to attract large numbers of people to join and use their sites. Therefore, understanding users’ motivations for joining and continuing to visit certain cyber-world Web site is critical to manage a virtual world Web site successfully. As cyber-worlds are recreational applications operated on Web 2.0 internet platform, this study has emphasized the interactive features of Web 2.0 and constructed users’ behavioral models from three dimensions: technology, sociability, and quality, as according to Social presence Theory, TAM, and IS successful model. In addition, many scholars have argued that human behaviors differ according to what people’s distinct social roles are [9] [10], few studies have analyzed and compared behavioral models for different social roles. Since there are various characters or avatars in cyber-worlds, this study have divided cyber-world users into four types – habitual, active, personal, lurker [11] – according to their interaction levels and has analyzed whether their behavioral models differ of their different roles. This study proposes some overall administrative strategies for cyber-world Web site managers.

Research Model and Hypotheses
Cyber-worlds such as i-Partment are interactive communities built on the World Wide Web technology. Thus, it is reasonable to consider the users’ acceptance behaviors from a system perspective. Davis et al. [26] regarded that perceived ease of use and usefulness would affect users’ intentions to use an information system, and perceived ease of use would affect users’ intentions
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to use via perceived usefulness. Many researches have adopted TAM as a basic framework for investigating users' acceptance of various technological applications [17] [20]. Subsequent studies have also suggested that perceived ease of use can have a positive impact on users' intentions to use certain systems [27]. From the intrinsic motivation perspective, many studies have indicated that users tend to prefer using enjoyable platforms, such as portal Web site [18] [19] [28], Internet-based learning media [29], and instant messaging [17]. Therefore, this study proposed the following hypotheses.

**H1a** Perceived ease of use is positively related to perceived usefulness in i-Partment.

**H1b** Perceived ease of use is positively related to intention to use i-Partment.

**H1c** Perceived usefulness is positively related to intention to use i-Partment.

**H1d** Perceived enjoyment is positively related to intention to use i-Partment.

Social presence is the critical factor that keeps people interacting in social activities [12]. Since i-Partment is a kind of cyber-world instinct with social interaction, this study has regarded social presence is indispensable for promoting people’s activities. Hassanein and Head [20] confirmed that users' social presence has a positive effect on perceived usefulness in the on-line shopping environment. In addition, users’ enjoyable experiences can be increased by improving users’ social presence in online environment [13] [15] [20]. Moreover, users’ perceptions of social presence positively affect customers’ intention to visit e-commerce Web sites [31]. Hence, this study proposed the following hypotheses.

**H2a** Social presence is positively related to perceived usefulness in i-Partment.

**H2b** Social presence is positively related to perceived enjoyment in i-Partment.

**H2c** Social presence is positively related to intention to use i-Partment.

TAM was widely applied in the studies related to users’ acceptance of new information systems. However, Davis [16] suggested that users’ perceptions may also be influenced by other external variables. In prior studies, researchers investigated related antecedents of users’ perceptions in system usage [32] [33] [34] [35]. In addition, information quality, response time and system accessibility were important factors affecting users’ perceptions on Web sites [17] [23]. This study has summarized related studies of the TAM and found that system and information characteristics are important factors in affecting users’ perceptions [24][36]. Furthermore, Hwang & Kim [37] considered that perceived web quality was the antecedent of affective reactions, such as enjoyment and anxiety. Accordingly, this study proposed the following hypotheses.

**H3a** System quality is positively related to perceived ease of use in i-Partment.

**H3b** System quality is positively related to perceived usefulness in i-Partment.

**H3c** Information quality is positively related to perceived ease of use in i-Partment.

**H3d** Information quality is positively related to perceived usefulness in i-Partment.

**H3e** Information quality is positively related to perceived enjoyment in i-Partment.

In cyber-worlds, people value platform-based and sociability-based interactive qualities. Huang et al. [22] regarded that individuals’ personal interactions positively affect perceived enjoyment and perceived usefulness in instant message systems. Open channels with two-way communication functions, such as interactive Web sites or advertisements [38] enable human-computer and interpersonal interactions and strengthen users’ social presence [39]. Since prior studies have primarily investigated applications of interactive quality according to their technical and social dimensions [25] [40], this research has divided interactive quality into two dimensions – platform-based and sociability-based, and proposed the following hypotheses.

**H4a** Platform-based interactive quality is positively related to perceived usefulness in i-Partment.

**H4b** Platform-based interactive quality is positively related to social presence in i-Partment.

**H4c** Platform-based interactive quality is positively related to perceived enjoyment in i-Partment.

**H4d** Sociability-based interactive quality is positively related to perceived usefulness in i-Partment.

**H4e** Sociability-based interactive quality is positively related to social presence in i-Partment.

**H4f** Sociability-based interactive quality is positively related to perceived enjoyment in i-Partment.

**Methodology**

**Measurement Development**

This study used an online questionnaire to examine the research model and test the proposed hypotheses. The items were based on the TAM [20], the IS success model [24] [41] [42], and social
psychology literatures and contents [14] [40] were slightly modified to fit the context of the Web 2.0 interactive environment. Since different social role leads to different social behaviors, this study has adopted Ip & Wagner’s [11] role categorization (i.e. habitual, active, personal, and lurker), and investigated the difference in behavioral models of different roles in cyber-worlds.

In this study, the respondents selected one type of social roles based on their habits of using i-Partment. A pilot test of 50 samples was conducted to examine the reliability and validity of the measurements, and the results showed that the measurement has acceptable reliability and validity.

Subjects
We invited i-Partment members to participate in our survey. Over a one-month period, we had 729 valid subjects, of which, 152 (20.9%) considered themselves habitual participants, 236 (32.4%) felt they active members, 233 participated mainly to satisfy personal needs, and 108 were lurkers. Partial least squares (PLS) was used to analyze the data.

Results
The Measurement Model
The individual item reliability of measurement was measured by Cronbach’s α. In this study the Cronbach’s α values of all constructs, ranging from 0.81 to 0.96, exceeded the threshold of 0.7 [43] and thus captured a high degree of variance in each construct. The internal consistency of measurement model was measured by composite reliabilities (CRs). In this study, all composite reliabilities were above the benchmark of 0.8 [44], showing a high internal consistency of scales. In addition, the average variance extracted (AVE) for all constructs exceeded the threshold value of 0.5 [44] [45]. Therefore, all constructs in the model had satisfactory construct reliability.

Content validity is concerned the representations of the items of a specific construct [46]. All constructs in our study were derived from prior studies and related literature, thus, addressing strong content validity. As for the construct validity of the measurement model, the convergent validity was measured by a factor loading analysis. In this study, all loadings of measurement items corresponded to their constructs, and all loadings were above the threshold value of 0.6 [47] and larger than the items loadings on other constructs. As shown in Table 1, the correlations between any two constructs were lower than the square root of the AVEs within the construct, satisfying Fornell and Larker’s [45] criterion for good discriminant validity. Consequently, all constructs in the model had satisfactory validity.

Table 1 Discriminant validity (N=729)

<table>
<thead>
<tr>
<th>Construct</th>
<th>INT</th>
<th>IQ</th>
<th>PIQ</th>
<th>SIQ</th>
<th>PE</th>
<th>PEN</th>
<th>PU</th>
<th>SP</th>
<th>SQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>INT</td>
<td>0.81</td>
<td>0.90</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IQ</td>
<td>0.70</td>
<td>0.61</td>
<td>0.84</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>PIQ</td>
<td>0.65</td>
<td>0.64</td>
<td>0.70</td>
<td>0.81</td>
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<td></td>
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</tr>
<tr>
<td>SIQ</td>
<td>0.73</td>
<td>0.69</td>
<td>0.67</td>
<td>0.77</td>
<td>0.85</td>
<td></td>
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<tr>
<td>PE</td>
<td>0.72</td>
<td>0.65</td>
<td>0.60</td>
<td>0.70</td>
<td>0.69</td>
<td>0.85</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PEN</td>
<td>0.94</td>
<td>0.77</td>
<td>0.60</td>
<td>0.63</td>
<td>0.71</td>
<td>0.63</td>
<td>0.97</td>
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</tr>
<tr>
<td>PU</td>
<td>0.82</td>
<td>0.69</td>
<td>0.64</td>
<td>0.67</td>
<td>0.76</td>
<td>0.69</td>
<td>0.72</td>
<td>0.91</td>
<td></td>
</tr>
<tr>
<td>SP</td>
<td>0.76</td>
<td>0.73</td>
<td>0.61</td>
<td>0.66</td>
<td>0.75</td>
<td>0.67</td>
<td>0.76</td>
<td>0.80</td>
<td>0.87</td>
</tr>
<tr>
<td>SQ</td>
<td>0.68</td>
<td>0.64</td>
<td>0.77</td>
<td>0.71</td>
<td>0.70</td>
<td>0.67</td>
<td>0.60</td>
<td>0.63</td>
<td>0.61</td>
</tr>
</tbody>
</table>

* The diagonal values represent the square root of AVEs

The Structural Model—Path Analysis Results of Full Sample
A test of the structural model was performed using the PLS procedure, and the results for all subjects (n = 729) are indicated in Fig. 2. The structural model showed that SQ (β = 0.50, p < 0.001) and IQ (β = 0.22, p < 0.001) significantly affected PE (R²=0.47). Additionally, PE (β = 0.16, p < 0.001), IQ (β = 0.13, p < 0.01), SIQ (β = 0.24, p < 0.001), and SP (β = 0.43, p < 0.001) had a significant direct effect on PU (R²=0.72). Likewise, PIQ (β = 0.20, p < 0.001) and SIQ (β = 0.60, p < 0.001) significantly affected SP (R²=0.58). Whereas IQ (β = 0.10, p < 0.05), SP (β = 0.49, p < 0.001) and SIQ (β = 0.23, p < 0.001, H4f supported) had strong effects on PEN (R²=0.63), the effects of PIQ were weak in this study. As expected, PE (β = 0.17, p < 0.001, H1b supported), PU (β = 0.10, p < 0.05, H1c supported), SP (β = 0.20, p < 0.001, H2c supported), and PEN (β = 0.44, p < 0.001, H1d supported) significantly affected INT (R²=0.66). Unexpectedly, SQ and PIQ had no direct influence on PU, and PIQ had no direct influence on PEN. Therefore, H3b, H4a, and H4c were not supported.

The Structural Model—Path Analysis Results of Split Sample
This study compared the variances of characteristics between four subgroups—habitual users, active users, personal users, and lurkers—using an one-way ANOVA analysis for all constructs. The results show that the four subgroups’ attributes have significant differences in all constructs. We analyzed the PLS path analysis of split samples to understand the different adoption behavior of four social roles. Table 2 showed the path analysis results for habitual, active, personal, and lurker members.

Table 2 Path analysis of four subgroups (habitual /active / personal / lurker)

<table>
<thead>
<tr>
<th>Subgroup</th>
<th>Habitual(N=152)</th>
<th>Active</th>
</tr>
</thead>
</table>

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As to the influence of users’ perceptions on the intention to use, PE was a significant determinant for active, personal, and lurker users. By contrast, only habitual users weighted PU significantly in determining INT. Moreover, SP was a significant factor influencing INT for active and personal users, and PEN significantly affected INT in general. In this study, the last dependent construct (INT) was explained by \( R^2 \) value of 0.75 for habitual users, 0.59 for active users, 0.68 for personal users, and 0.63 for lurkers. Overall, the determinants that this study proposed had good explanatory powers of INT in four subgroups.

As to the influence of users’ perceptions on the intention to use, PE was a significant determinant for active, personal, and lurker users. By contrast, only habitual users weighted PU significantly in determining INT. Moreover, SP was a significant factor influencing INT for active and personal users, and PEN significantly affected INT in general. In this study, the last dependent construct (INT) was explained by \( R^2 \) value of 0.75 for habitual users, 0.59 for active users, 0.68 for personal users, and 0.63 for lurkers. Overall, the determinants that this study proposed had good explanatory powers of INT in four subgroups.

Conclusions

Discussion

This study has investigated users’ adoption intentions, users’ perceptions, and the antecedents affecting users’ perceptions in one kind of Web 2.0 applications: cyber communities. The results of this study have revealed the importance of perceived ease of use, perceived usefulness, perceived enjoyment, and social presence in shaping adoption intention. Findings are in line with prior research related to online shopping, virtual community, and weblogs [10] [31]. Moreover, this study has verified that different social roles result in different users’ behaviors. The result is consistent with prior
Differences of the Determinants of Users’ Intention to Use Virtual World Websites

First, perceived enjoyment was the only one factor that significantly affected all users’ intentions to use in all four split samples. The reason may be that virtual worlds are entertaining applications; therefore, being able to enjoy it is a basic requirement. Second, perceived ease of use significantly affected the intention to use in four subgroups except the habitual members (H1b supported). The result indicates that perceived ease of use is an essential factor for influencing most users’ intention to use. However, habitual member was the social role participating virtual world websites most actively, therefore, most of habitual members less emphasized on regarding for ease of using a system. Even though the interface or functions of a website are not easy to use, habitual members may get over the barrier and use the website with some extent of enthusiasm. Third, perceived usefulness significantly affected users’ intention to use just in habitual samples (H1c supported). This result reveals that habitual members particularly emphasize the usefulness of cyber-world Web sites for improving the ability and efficiency of interpersonal interaction on the interactive platforms. Fourth, social presence had a significant direct effect on the active and personal subgroups’ intention to use (H2c supported). The result indicates that active and personal members especially value their social presence and may keep stay with cyber-world Web sites primarily for the social interactions these sites offer. By contrast, habitual members have an enthusiastic intention to use and actively visit cyber-world Web sites, where as lurkers mainly focus on operating their own virtual space or visiting others’ virtual spaces, they demonstrate less interest in interacting with other members. Therefore, social presence has less importance for habitual and lurker members than it does for active and personal members.

Differences of the Relationships between Users’ Perceptions

As for the differences among the relationships of users’ perceptions, two findings are discussed as follows. First, perceived ease of use had a significant and direct influence on perceived usefulness for four subgroups except for active members (H1a supported). Only in the habitual subgroup did perceived usefulness significantly affect the intention to use. The result indicates that perceived ease of use has an indirect effect on intention to use via perceived usefulness. Second, social presence significantly affected perceived usefulness and perceived enjoyment in all four samples (H2a and H2b supported). The result is consistent with prior research [20][30] and reveals that even though social presence is not significant in increasing users’ intention to use a virtual world Web site, it has an indirect effect on users’ intention to use via perceived enjoyment in all four subgroups and perceived usefulness in the habitual subgroup.

Differences of the Antecedents of Users’ perceptions

This study investigated the antecedents affecting users’ perceptions of Web 2.0 applications by considering the system quality, information quality and interactivity quality. Some findings are exhibited as follows. First, perceived ease of use was significantly affected by system quality and information quality in all four subgroups (H3a and H3b supported). This result implies that a high level of quality in system and information may enable users to feel that a specific cyber-world Web site is easy to use. Second, perceived usefulness had different antecedents in the four subgroups. System quality was more important for habitual and personal members, and information quality was more significant for active and personal subgroups. As for interactivity quality, the platform function was significant in affecting perceived usefulness for the active and lurker members, and all but the lurkers emphasized the sociability function’s effect on perceived usefulness. Third, platform-based and sociability-based functions had significant effects on social presence in all four subgroups, possibly because platform-based and sociability-based functions are essential for establishing social relationships in online environments, and members’ social presence increases by using platform-based and sociability-based functions of cyber-world Web sites. Fourth, platform-based and sociability-based functions had significant effects on perceived enjoyment. The result indicates that both platform-based and sociability-based functions have features that create and enrich users’ enjoyable experience. Furthermore, the relationship between information quality and perceived enjoyment were significant in habitual, personal and lurker members. Even so, each social role appeared to emphasize different information content.

Implications for Theory

The current research demonstrates that users’ intentions to use cyber-world Web sites are...
determined by technical and social factors. Although the TAM has been widely adopted in various applications [16], it has had limited value for explaining specific systems. Since the recreational characteristics of cyber-world Web sites, perceived enjoyment was regarded as an important factor affecting users’ adoption of innovative technology [21] and has also integrated social presence into the TAM by considering the social elements of cyber-world Web sites. For all samples, users’ intentions to use were significantly determined by perceived ease of use, perceived usefulness, social presence, and perceived enjoyment. In which, perceived enjoyment was the strongest factor influenced on intention, followed by social presence. This result reveals that our proposed research model can explain users’ acceptance behaviors of new technology more completely than TAM in the context of cyber-world Web sites.

Implications for Practice
The current research also has important practical implications for administrators managing cyber-world Web sites. The insightful findings of this study can help us better understand how different social roles accept new technologies. Practitioners should make use of this finding and provide flexible services to fulfill users’ special needs. For example, habitual members place great emphasis on the usefulness of the platform for social interaction. Thus, practitioners should ensure that the platform is reliable, convenient to access, and the response time is acceptable, and provides sociable functions that enable users to make contact with others and develop good relationships. In response to the importance that active and personal members place on social presence, practitioners should enhance platform and sociability-based interactive qualities by providing controllable interactive functions (i.e. information choice, functions or services based on users’ requirements) and enable users to create a sense of place (i.e. providing functions to conduct users’ ways to establish cyber-lives or cyber-spaces, such as gardens or farms, that they can share with others). In addition, practitioners should ensure that their cyber-world Web sites are easy to use and enjoyable to keep lurkers interested and entertained.

Limitations
Although this research has revealed interesting findings, the results of this study should be cautious with some limitations. First, the target of this study is one of the outstanding cyber-world Web sites in the greater China area in Asia — i-Partment. Therefore, the results might not overlook “cultural diversity” of other countries’ users who may display the same acceptance behavioral models. Second, this study categorized the samples into four social roles, a slight bias concealed from the reason that users may play multi-social roles on cyber-world Web sites. Finally this research model has focused on cyber-worlds, the only one type of Web 2.0 applications. In the future, the users’ acceptance behavioral model may be extended by considering other factors, or by applying it in different contexts to search for general conclusions.

Acknowledgement. The authors acknowledge the participation of i-Partment users, and would like to thank the editor and reviewers for remarkable comments. This study was founded by National Science Council, Taiwan, R.O.C. under Grant Number [NSC 97-2410-H-031-033-MY2].

References


Comparing the Behavioral Models in Cyber-World Using Social Roles


THE ROLE OF PERCEIVED CRITICAL MASS IN EXPLAINING WE-INTENTION TO USE INSTANT MESSAGING FOR TEAM COLLABORATION

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Abstract
Today, instant messaging has been becoming a major communication technology in business environment. One important causal factor related to the use of instant messaging is critical mass. Specifically, the use of instant messaging requires collective efforts and interdependence among two or more people, and thus is conceptualized as intentional social action in the current study. Drawing on prior studies of social influence and critical mass, we propose a research model and empirically evaluate it using survey data collected from 227 respondents. The results indicate that perceived critical mass impacts usage we-intention both directly and indirectly through attitude and social influence factors. We believe the findings of this study will provide important implications to both researchers and practitioners.

Keywords: We-Intention, Perceived Critical Mass, Instant Messaging, Theory of Reasoned Action, Social Influence

Introduction
With the rapid growth and expansion of Internet, instant messaging has been becoming a major communication technology. The adoption of instant messaging in organizations makes collaborative teams more efficient through reducing delays in decision-making and enabling rapid response to the dynamic and volatile business environment. A recent report indicated that instant messaging is the most valuable web 2.0 technology for enterprise [40]. Compared to the conventional business communication tools, such as email, instant messaging has several unique features that are especially suitable for team collaboration. For example, it can notify users when their buddies are online and available to receive messages, facilitate real-time online communication, allow users to create a private chat room for group project discussion or even for desktop video-conferencing, permit team members to work on office software together, and enable quick transfer of files, documents, images, and the like.

A large number of Information Systems (IS) research has been devoted to investigating the adoption and diffusion of interactive communication technologies [23] [25] [26]. Communication technologies “require multiple users and cannot be used successfully by one person acting alone” [34]. It has two distinct characteristics: universal access and reciprocal interdependence. Universal access requires almost everyone agree to use the media on a regular basis and reciprocal interdependence indicates early and later adopters are mutually influenced [26]. It is the social processes surrounding the use of the technology that determine the communication patterns [25]. Lou et al. [23] and Li et al. [22] further demonstrated that communication technology is different from traditional information technology in that the former is designed for collaboration and cooperation, therefore the benefits of using a communication technology can be achieved only when the majority of the users accept and use the system. The interactive and interdependent nature of interactive communication technology raises several interesting issues. For example, does the collective acceptance of communication technology demand a re-conceptualization of employees’ usage intention? What conditions under which communication technology become self-sustaining? Which processes of social influence may affect the use of communication media? With an attempt to address these questions, we regard the use of instant messaging as intentional social action in the current study and examine the impact of perceived critical mass on usage we-intention through a theoretically-derived research model.

The remainder of this study is organized as follows. We first review the theoretical background of this study in Section 2. We then present the research model and discuss the proposed hypotheses derived from the model in Section 3. We describe the research method and report the results of data analysis in Section 4 and 5 respectively. We finally discuss the research findings and the implications for both researchers and practitioners in Section 6.

Theoretical Background
In this section, prior studies on the use of instant
Therefore, an individual may be privately committed and shared authority over the joint action. In contrast, a given behavior is privately commitment and shared authority over the joint accordingly, all participants have collective content is collectively accepted by each participant the circumstance of we-intention, the intention who functions as a member of the group and for an individual in the I-intention situation. Therefore, an individual may be privately committed to performing the behavior and have full control over his/her own action. Third, there is a difference in reasons for acting. Participants with we-intention are motivated by group reasons such as community-oriented motivational factors, whereas individuals with I-intention are primarily motivated by personal reasons. In addition, another central difference between I-intention and we-intention lies in the satisfaction condition. The collectivity condition for the satisfaction of we-intention supposes that if the intention content is satisfying for one member of a group, it is satisfying for all the members in this group. In contrast, the intention content is just satisfying for an individual in the I-intention context.

We-intention has initially been concerned by philosophers [5] [36] [37], who primarily focused on conceptual and logical aspects. Only recently, some studies concentrated on the measurement and hypothesis testing concerns, and started to employ this concept to explain virtual community participation and communication technology adoption behavior [1] [7] [11] [32]. These empirical studies on we-intention have demonstrated that both individual reasons (e.g., attitude, perceived behavioral control, emotions, etc.) and social factors (e.g., group norms, social identity, social presence, etc.) are significant predictors of participation we-intention. The importance of we-intention in ensuring the success of a communication technology is underscored by the fact that people have to take into account others’ responses to this use [6]. The use of a communication technology thus requires collective efforts and interdependence between two or more people [22]. In this sense, we-intention may be a more appropriate construct in investigating the collective acceptance of communication technology in the current study.

Instant Messaging for Team Collaboration
Previous studies have demonstrated that instant messaging increase participation, cooperation, and collaboration among geographically dispersed co-workers [6]. For example, Nardi et al. [27] distinguished between the inter-action and outer-action processes in the use of instant messaging in the workplace. They found that people use instant messaging both for information exchange and for social connectedness. Isaacs et al. [19] further reported two distinct styles of instant messaging usage in the workplace. Heavy IM users mainly use it to work together, whereas light users mainly use it to coordinate. Herbsleb et al. [16] have found that the perception regarding the utility of instant messaging in the workplace depends on the users’ views of the importance of information communication and the perceptions of the nature of communication issues. Quan-Haase et al. [30] later examined the use of instant messaging among knowledge workers in a high-tech firm and found that instant messaging creates higher connectivity and leads to a new form of collaboration. Similarly, Cho et al. [8] demonstrated that instant messaging improve employees' working relationships with co-workers both within and across organizational boundaries.

We-Intention
We-intention is often considered as the intention to participate in a group and perform a group activity in which the participants perceive themselves as members of the group (for a review, see [3]). There are several unique characteristics that distinguish we-intention from the traditional individual intention (I-intention) [36] [37]. First, the main target is different. For I-intention, the intended target is a singular subject, whereas for we-intention, the focus is plural target. It is a group of people instead of an individual that acts or experiences an event. Therefore, the behavior is perceived as a group-referent intentional social action. Second, there is a difference in goal achievement process. In the circumstance of we-intention, the intention content is collectively accepted by each participant who functions as a member of the group and accordingly, all participants have collective commitment and shared authority over the joint action. In contrast, a given behavior is privately accepted by an individual in the I-intention situation. Therefore, an individual may be privately committed to performing the behavior and have full control over his/her own action. Third, there is a difference in reasons for acting. Participants with we-intention are motivated by group reasons such as community-oriented motivational factors, whereas individuals with I-intention are primarily motivated by personal reasons. In addition, another central difference between I-intention and we-intention lies in the satisfaction condition. The collectivity condition for the satisfaction of we-intention supposes that if the intention content is satisfying for one member of a group, it is satisfying for all the members in this group. In contrast, the intention content is just satisfying for an individual in the I-intention context.

Theoretical Foundation
The theoretical foundation of this study is then reviewed. Specifically, the concept of we-intention, theory of reasoned action, critical mass theory and Kelman’s social influence framework are discussed.

The Role of Perceived Critical Mass in Explaining We-Intention
The 9th International Conference on Electronic Business, Macau, November 30 - December 4, 2009
use of instant messaging in team collaboration is mostly voluntary. People often use public instant messaging services at work and therefore subjective norms may not be essential in predicting the acceptance and use of instant messaging. To better understand the acceptance of instant messaging, we take ideas from critical mass theory and Kelman's social influence framework to capture the underlying social processes.

Critical Mass Theory
Critical mass theory has been developed to predict the probability, extent and effectiveness of collective action. Critical mass was originally defined as "a small segment of the population that chooses to make big contributions to the collective action" [28]. It is assumed to provide the necessary conditions for reciprocal behavior to get started and become self-sustaining [26]. The concept of critical mass was later introduced into innovation diffusion research and was defined as "the point at which enough individuals have adopted an innovation so that the innovation's further rate of adoption becomes self-sustaining" [31]. Critical mass theory is particularly important in explaining the adoption and diffusion of communication technologies because the value of the technology increases with the number of its users [23]. Therefore, if there is a critical mass of users who communicate via the technology on a regular basis, the use of this technology will spread rapidly and users can communicate to others with the least efforts [6] [26] [33]. Although the actual critical mass is difficult to measure, an individual may have a perception of whether an innovation reaches the threshold of critical mass and such perception is termed "perceived critical mass" in prior studies [23].

Prior studies have extensively examined the role of perceived critical mass in behavioral intention to use instant messaging. For example, a case study investigating the use of instant messaging in organizations suggested that critical mass represents an important factor for instant messaging success in the workplace [6]. Ilie et al. [18] further demonstrated that perceived critical mass will influence intention to use instant messaging more strongly for men than for women. In addition to the direct effect on usage intention, perceived critical mass also affects intention to use instant messaging indirectly through users’ perception concerning this innovation. For example, Li et al. [22] found that perceived critical mass influences behavioral intention to continue using instant messaging both directly and indirectly through perceived usefulness and perceived enjoyment. Slyke et al. [33] further demonstrated that perceived critical mass relates to instant messaging usage intentions both directly and indirectly through perceived innovation characteristics.

Social Influence Framework
Previous studies have suggested that social influence is especially important in determining the successful adoption and use of communication technology [7] [32], especially “social influence in the form of coercion or collective adoption decision” is believed to be necessary for attracting the earliest users [26]. Social influence often consists of informational and normative influence [10] and operates through three different processes – compliance, internalization and identification [21]. Informational influence is often considered as an internalization process through which an individual accepts information obtained from others as evidence about reality. Normative influence is a combination of compliance and identification. Compliance occurs when an individual conforms to the expectations of significant others to receive support or avoid punishment. Identification occurs when an individual accepts the influence in order to establish and maintain a positive self-defining relationship with another person or a focal group [2] [17] [21].

Research Model and Hypotheses
The research model, as shown in Figure 1, is based on theory of reasoned action and incorporates perceived critical mass and social influence processes to explain users’ we-intention to adopt instant messaging for team collaboration. To better determine the role of perceived critical mass in intentional social acceptance, we also propose that perceived critical mass impacts usage we-intention both directly and indirectly through attitude and social influence factors. The constructs and their relationships are discussed in detail in the following sections.

The Role of Users’ Attitude
As we noted early, the values of instant messaging can be achieved only when most of the peers agree to use it on a regular basis [26]. In this regard, instant messaging requires collective efforts and interdependence among all participants [22]. Therefore, we conceptualize the use of instant messaging as an intentional social action and replace individual intention with we-intention in the current...
study. According to TRA, attitude reflects a person’s consideration of the extent to which performing a behavior is advantageous or disadvantageous and it further leads to behavioral intention [13]. Consistent with this view, the first hypothesis is: 

H1: Attitude toward the use of instant messaging will have a positive impact on we-intention to use instant messaging for team collaboration.

The Role of Social Influence
The social influence underlying the compliance process is represented by subjective norm in this study. As we discussed before, subjective norm functions only under conditions of mandatory use and for users with limited experience. In the current investigation context, people often use public instant messaging services for team collaboration and the usage behavior is mostly voluntary. Therefore, 

H2: Subjective norm will NOT have any significant impact on we-intention to use instant messaging for team collaboration.

The internalization process is represented in the current study through the effect of group norm. Social influence underlying this process is captured by the congruence of the information obtained from others and one’s own value system. In the current study, if users believe that they have similar goals or values with other participants, they will be more likely to develop a we-intention to use instant messaging together. Therefore, 

H3: Group norm will have a positive impact on we-intention to use instant messaging for team collaboration.

The third social influence process is identification, which is characterized by social identity in this study. Identification refers to one’s conception of self in terms of the relationship with a focal group. Social identity has been used to explain the development of participation we-intention in some prior studies [1] [11]. The rationale is that social identities “prescribe and instigate behaviors for the benefit of group members” [4]. In this study, social identity will induce group-oriented behaviors, such as using instant messaging for team collaboration, because users are motivated to distinguish their own group from out-groups. Therefore, 

H4: Social identity will have a positive impact on we-intention to use instant messaging for team collaboration.

The Role of Perceived Critical Mass
In this study, perceived critical mass is defined as “the degree to which a person believes that most of his or her peers are using the system” [23, p. 95]. Lou et al. [23] have suggested that critical mass is the basis for sustained collective action. Without securing a critical mass of users, communication technology cannot be successfully implemented due to a lack of active participants [24]. The direct effect of perceived critical mass on behavioral intention has been empirically examined and found to be significant in several studies (e.g., [22] [23] [33]). In the current study, if an individual believes that most of his or her peers are using instant messaging for collaborative work, he or she will be more likely to use instant messaging together with others. Therefore, 

H5: Perceived critical mass will have a positive impact on we-intention to use instant messaging for team collaboration.

Perceived critical mass reflects an individual’s perception of the number of current users [22] [23]. This perception can be developed through interaction with others [23] and people will develop their own attitudes toward the innovation via the perceived number of users [17]. In the current study, if people perceive that most of their peers are using instant messaging for team collaboration, they may have a favorable attitude toward the use of instant messaging. Therefore, 

H6: Perceived critical mass will have a positive impact on attitude toward the use of instant messaging.

Prior studies have suggested that perceived critical mass affects the acceptance of communication technologies through both informational influence and normative influence [23]. Since the use of instant messaging is mostly voluntary, the usage behavior thus is unlikely to be rewarded or punished. Therefore, we believe that perceived critical mass will not significantly relate to subjective norm. In the current study, informational influence is reflected through internalization process (group norm) and normative influence is reflected through identification process (social identity) [17]. Group norm captures “an understanding of, and a commitment by, the individual member to a set of goals, values, beliefs, and conventions shared with other group members” [11, p. 245]. It is often considered as the most readily accessible or inferable group-related information. In this study, if there is a critical mass of users, potential adopters may gradually understand the group norm through direct and indirect interaction with previous adopters or announcement made about the use of instant messaging [11]. In addition, the information exchange and the perception that most of their peers are using instant messaging for team collaboration may lead the potential users to believe that this technology can meet their own goals [23]. The perceived overlap with the group norm will make the norm to be more influential [29]. Therefore, 

H7: Perceived critical mass will NOT have any significant impact on subjective norm concerning the use of instant messaging for team collaboration.
H8: Perceived critical mass will have a positive impact on group norm regarding the use of instant messaging for team collaboration.

Social identity captures an individual’s identification with a social group and can be achieved through self-awareness of one's membership, as well as emotional and evaluative significance of this membership [12] [35]. Identifying with a virtual community is believed to stem from an understanding of the benefits of the membership [11]. A critical mass of users will help to convey such benefits. Prior studies have also demonstrated that digital environment may be socially rich for social identity to develop [29]. In the current study, if an individual perceives that most of their peers are using instant messaging for team collaboration, he or she will be more likely to realize the benefits of the membership and feel an obligation to participate in the group activities with other peers. Otherwise, he or she will be out of the communication loop and be viewed as an outsider by others [23]. In this case, he/she will develop a shared identity with the group. Therefore, H9: Perceived critical mass will have a positive impact on social identity with the collaborative group.

Research Method

The purpose of this study is to examine the role of perceived critical mass in the development of we-intention. Data collection method, measures, and survey response are reported in this section.

Data Collection Method

A convenient sampling approach is adopted to test the hypotheses. The main data collection was conducted in a local university in Mainland China. Students from six randomly selected classes were invited to participate in. A screening question was employed to ensure that all respondents have used instant messaging for group project discussion. A pencil-and-paper survey was used for data collection.

Before the survey was administered, a short briefing was given to explain the purpose and the scenario of this research and the respondents were asked to imagine in their mind the group members they often discussed with. These instructions were designed to capture the groups with which the respondents develop we-intentions to use instant messaging together. All participation in this study was completely voluntary yet motivated by a lucky draw among successful respondents.

Measures

As shown in Table 1, all measures used in this study have been validated in prior studies. Minor changes in the wording were made so as to fit into the current investigation context. In addition, a backward translation method was used to ensure the consistency between the Chinese and the original English version of the questionnaire.

Table 1. Summary of Psychometric Properties of the Measures

<table>
<thead>
<tr>
<th>Construct</th>
<th>List of items</th>
<th>Loading</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitude (ATT) α=0.895 β=0.680</td>
<td>Using instant messaging for team collaboration during the next two weeks would be: (7-point semantic scales) ATT1: foolish/wise ATT2: harmful/beneficial ATT3: bad/good ATT4: unpleasant/pleasant</td>
<td>0.838 0.789 0.870 0.801</td>
<td>[2]</td>
</tr>
<tr>
<td>Subjective Norm (SN) α=0.942 β=0.891</td>
<td>SN1: Most people who are important to me think that I should/should not use instant messaging for team collaboration during the next two weeks. (7-point “should-should not” scale) SN2: Most people who are important to me would approve/disapprove of me using instant messaging for team collaboration during the next two weeks (7-point “approve-disapprove” scale)</td>
<td>0.953 0.935</td>
<td>[2]</td>
</tr>
<tr>
<td>Group Norm (GN) α=0.917 β=0.847</td>
<td>Using instant messaging for team collaboration sometime during the next two weeks with the group members you often collaborated with can be considered as a goal. For each member in your group, please estimate the strength to which each holds the goal. (7-point “weak-strong” scale) GN1: Strength of the shared goal by the self. GN2: Average of the strength of the shared goal for other members.</td>
<td>0.931 0.909</td>
<td>[2]</td>
</tr>
<tr>
<td>Social Identity (SI) α=0.908 β=0.624</td>
<td>SI1: How would you express the degree of overlapping between your own personal identity and the identity of the group you collaborate with through instant messaging when you are actually part of the group and engaging in group activities? (8-point “far apart-complete overlap” scale) SI2: Please indicate to what degree your self-image overlaps with the</td>
<td>0.694</td>
<td>[2]</td>
</tr>
</tbody>
</table>
Survey Responses
A total of 246 questionnaires were distributed, out of which 227 usable questionnaires were returned. Of the respondents, 149 were male and 78 were female. A large majority (55.1%) of the respondents aged between 21 and 25. On the whole, the respondents were relatively experienced in using instant messaging and spent more than one hour on instant messaging per day. Table 2 provides the overall sample characteristics.

Table 2. Sample Characteristics

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Number (N=227)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;21</td>
<td>68</td>
<td>30.0%</td>
</tr>
<tr>
<td>21-25</td>
<td>125</td>
<td>55.1%</td>
</tr>
<tr>
<td>&gt;25</td>
<td>34</td>
<td>14.9%</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>149</td>
<td>65.6%</td>
</tr>
<tr>
<td>Female</td>
<td>78</td>
<td>34.4%</td>
</tr>
<tr>
<td>Experience with Instant Messaging</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;2 Years</td>
<td>12</td>
<td>5.3%</td>
</tr>
<tr>
<td>2-5 Years</td>
<td>139</td>
<td>61.2%</td>
</tr>
<tr>
<td>&gt;5 Years</td>
<td>76</td>
<td>33.5%</td>
</tr>
<tr>
<td>Time spent on Instant Messaging per day</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;1 Hour</td>
<td>51</td>
<td>22.5%</td>
</tr>
<tr>
<td>1-2 Hours</td>
<td>101</td>
<td>44.5%</td>
</tr>
<tr>
<td>&gt;2 Hours</td>
<td>75</td>
<td>33.0%</td>
</tr>
</tbody>
</table>

Results
Partial Least Squares (PLS) was used to test the proposed research model. The PLS procedure [39] is a second-generation multivariate technique which can assess the measurement model and the structural model simultaneously in one operation. In addition, PLS has the ability to model latent constructs under condition of non-normality and makes minimal demands in term of the sample size to validate a model. Following the two-step analytical procedures [15], the measurement model was first examined and then the structural model was assessed.

Measurement Model
Convergent validity was assessed by examining the composite reliability and the average variance extracted [15]. Composite reliability is the measurement for internal consistency. Average variance extracted indicates the amount of variance captured by a construct as compared to the variance caused by the measurement error. A composite reliability of 0.70 or above and an average variance extracted of more than 0.50 are deemed acceptable [14]. As shown in Table 1, all the measurement exceed the recommended thresholds, with composite reliability ($\alpha$) ranged from 0.895 to 0.942 and average variance extracted ($\beta$) ranged from 0.624 to 0.891.

Discriminant validity indicates the extent to which a given construct differs from other constructs. It can be verified by comparing the shared variances between constructs with the average variance extracted for each construct [14]. To demonstrate the adequate discriminate validity of the constructs, the square root of the average variance extracted for each construct should be greater than the correlations between that construct and all other constructs. Table 3 presents the correlation matrix of the constructs and the square roots of the average variance extracted. The results suggest an adequate level of discriminant validity of the measurements.
Table 3. Correlation Matrix of the Constructs

<table>
<thead>
<tr>
<th></th>
<th>ATT</th>
<th>SN</th>
<th>GN</th>
<th>SI</th>
<th>PCM</th>
<th>WE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATT</td>
<td>0.825</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SN</td>
<td>0.177</td>
<td>0.944</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GN</td>
<td>0.296</td>
<td>0.044</td>
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<tr>
<td>PCM</td>
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<tr>
<td>WE</td>
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<td>0.909</td>
<td>0.417</td>
<td>0.469</td>
<td>0.441</td>
<td>0.906</td>
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</tbody>
</table>

* The bold numbers in the diagonal row are square roots of average variance extracted

Structural Model

The results of the analysis are depicted in Figure 2, which presents the overall explanatory power, the estimated path coefficients (all significant paths are indicated with asterisks), and the associated t-value of the paths. Test of significance of all paths were performed using the bootstrap re-sampling procedure. The model accounts for 35.6% of the variance in we-intention to use instant messaging for team collaboration. The results show that perceived critical mass has the strongest impact on we-intention, with a path coefficient at 0.263, followed by group norm, social identity and attitude, with path coefficients at 0.225, 0.171 and 0.160 respectively. In addition, perceived critical mass exerts statistically significant effects on social identity, attitude and group norm, with path coefficients at 0.412, 0.318 and 0.247 respectively. As we hypothesized, subjective norm does not play any role in our current investigation context.

Discussion and Conclusion

Instant messaging becomes a basic communication tool in today’s business environment, allowing for real-time group discussion and rapid file transfer. This study tries to investigate the motivations of using instant messaging for team collaboration, with particular emphasis on the role of perceived critical mass in we-intention formation. In this section, we first discuss the key findings, followed by limitations of this study and the implications for both research and practice.

Discussion of Key Findings

In this study, we conceptualize the use of instant messaging as an intentional social action and integrate critical mass theory and social influence framework with theory of reasoned action. The measurement model is confirmed with adequate convergent and discriminant validity of all the measures and the structural model explains 35.5% of the variance in we-intention. The results support all the relationships proposed in the research model. Consistent with theory of reasoned action, attitude toward the use of instant messaging exerts a statistically significant effect on usage we-intention. In addition, social influence factors, except for subjective norms, are significant factors predicting we-intention to use instant messaging for team collaboration. Users who have similar goals with others or categorize themselves as group members are more likely to have we-intentions to use instant messaging together. This finding is also consistent with prior studies investigating social influence processes in virtual communities [7] [32]. The insignificance of subjective norm in our current investigation context may be due to the fact that compliance acts only under conditions of mandatory use and for users with limited experience [20]. Perceived critical mass plays significantly in our research model. It influences we-intention both directly and indirectly through users’ attitude and social influence processes. These findings echo with prior literature demonstrating that perceived critical mass may influence the adoption and diffusion of communication technologies through both informational influence and normative influence [23].

Limitations

Before highlighting the implications for research and practice, we first discuss the limitations of this study. First, the data was collected from a student sample with high experience in using instant messaging. We-intention is formed when they use instant messaging for group project discussion, which is different in nature from the tasks conducted in other social or business contexts. Although university students are the major users of instant messaging and they also represent the future workforce, generalization of the findings of this study should be made with caution. Treating employees in the non-laboratory workplace as survey subjects is strongly recommended in future research. Second, we have not examined the actual instant messaging usage behavior in this study. A longitudinal study is highly recommended for future research on this topic. Third, our research model only explains 35.5% of the variance in we-intention. Future research should extend this line of inquiry and incorporate additional factors investigating collective action in our research model to improve the quality of the model and thus its predictive ability.
Implications for Research
This study contributes to existing research on the adoption and use of communication technologies in two important ways. First of all, previous studies concerned with communication technologies acceptance primarily focused on the individual intention approach, which refers to an individual makes his/her own decision to adopt or use a technology. However, communication technology requires collective efforts and shared responsibility, and in this situation the decisions to adopt are interdependent. In the implementation of communication technology, people will be influenced by their own perceptions about the technology, as well as the actions taken by their peers [23]. In the current study, we present an attempt to regard we-intention, instead of an individual intention, as the dependent variable in our research model and empirically examined the possible antecedents of we-intention to use instant messaging for team collaboration. We believe that this study has the potential to contribute to the IT adoption literature, especially communication technology adoption. This study thus provides an opportunity for future research to develop knowledge in the area of collective acceptance of information technologies. In particular, future research should examine we-intention in the use and deployment of social computing technologies (e.g., wiki, weblogs, discussion forums, youtube, etc).

Second, this study also advances theoretical discourse on the role of perceived critical mass in explaining information systems usage intention. While prior studies emphasized the role of users’ perception from the innovation itself, such as perceived usefulness, perceived ease of use [23], perceived innovation characteristics [18] and perceived enjoyment [22], in mediating the relationship between perceived critical mass and usage intention, the empirical results of this study further suggested that internalization and identification are two most important social influence processes through which perceived critical mass predicts we-intention to use instant messaging. Future research thus should continue this line of research and further investigate the mechanisms (such as internalization and identification) through which perceived critical mass may lead to collective acceptance of communication technologies.

Implications for Practice
The results of this study also provide useful insights to practitioners. This issue is managerially important because the use of instant messaging in the workplace continues to grow at a steady pace. Based on the findings of this study, here are some guidelines for managers who are using instant messaging for team collaboration.
First, group norm and social identity play important roles in determining we-intention to use instant messaging for team collaboration. In this sense, people with common goals or shared identity will be more likely use instant messaging together. Business managers thus should help employees promote their understanding toward the group norm and their belongingness to the collaborative team. Some practical recommendations include making the group norm explicit through public files such as FAQ or bulletin, providing regular opportunities for group discussion, and building a satisfying relationship among the group members. In addition, managers should take into account some special features of instant messaging in the development of the shared goals and in facilitating employees’ identification with the working team. To achieve this, for example, managers could apply chat room or IM group provided by instant messaging services in a flexible way.

Second, the significance of perceived critical mass also provides some important practical implications for business managers. It is necessary to recognize that a critical mass of users is essential for the successful implementation of communication technologies. Managers thus should encourage the use of instant messaging in the initial implementation stage to achieve a perception of critical mass. Some possible strategies include targeting groups whose members have close working relationships with each other, encouraging word-of-mouth communication among early users and potential users, and making the early adopters more visible to the majority. In addition, the perception of critical mass is heavily influenced by the acceptance of this technology within the visible and relevant sub-networks. Managers thus could promote the use of communication technology in a visible sub-group first, this will further convey an overall impression to employees and other sub-networks that critical mass has been achieved.

Acknowledgment
The work described in this article was partially supported by a grant from the Research Grant Council of the Hong Kong Special Administrative Region, China (Project No. CityU 145907). The authors acknowledge with gratitude the generous support of the Hong Kong Baptist University for the project (FRG/08-09/II-58) without which the timely production of the current report/publication would not have been feasible.

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TRUST-BUILDING MECHANISMS AND KNOWLEDGE SHARING IN VIRTUAL COMMUNITIES

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Abstract

Although trust has received much attention in the virtual communities (VCs) literature, few studies have been conducted to examine how trust develops in VCs. Drawing from prior literature on trust and knowledge sharing, a research model for understanding the antecedents of trust and the role of trust in VCs is presented. Data was collected from 324 members of a technical virtual community to test the model. The results help in identifying how the factors fall into three trust-building mechanisms build trust in the context of VCs. The study discusses the theoretical and managerial implications of this study and proposes several future research directions.

Keywords: Virtual Communities, Knowledge Sharing, Trust, Trust-Building Mechanisms

Introduction

Supported by information technologies, virtual communities (VCs) provide an attractive place for individuals to exchange knowledge with others [40]. Previous literature suggests that success of VCs requires that their members be willing to share their knowledge with other members [8]. However, contributing knowledge in VCs seems difficult [47]. Some researchers argue that contributing knowledge to VCs could cause knowledge contributors to loss their benefits derived from knowledge [47]. Others posit that the rationale action for members in VCs is to use knowledge regardless of its provision [46]. In fact, more than 90% of members in VCs are regarded as lurkers—individuals who visit VCs on a regular basis but not posting frequently [41]. Thus, it is important to understand what encourages members to contribute their knowledge and makes VCs more vibrant [8][40].

Previous literature indicates that trust, an implicit set of beliefs that the other party will behave in a dependent manner and will not take advantage of the situation [14], plays an important role in helping members overcome the problems regarding motivation to share knowledge [40]. The trust perspective has been increasingly adopted in recent study [8] [19] [40] [41], yet little research has been conducted to understand what promotes trust in VCs.

This study seeks to examine the factors leading to trust development and the importance of trust to knowledge sharing in the context of VCs. An empirical investigation is conducted using a research model of trust antecedents, trusting beliefs, knowledge sharing intention and actual knowledge sharing behavior. Seven antecedents of trust derived from three trust-building mechanisms (calculus-based mechanism, relationship-based mechanism and system-based mechanism) are assessed as well, including knowledge growth, perceived responsiveness, social interaction ties, shared vision, system quality, service quality and knowledge quality. The model is tested with data collected from members of a technical virtual community in Taiwan. The results of this study shed light upon the importance of trust-building mechanisms in the context of VCs. The findings may help both academics and practitioners gain insights into how to stimulate knowledge sharing in VCs.

Theoretical Background

Introduction to Trust in VCs

Recent advances in information and communication technologies have enabled many people to participate in VCs [4] [19]. In the VCs, people can discuss a common hobby and share personal experience and opinion with others [40]. People can get knowledge from and give knowledge to other people as well [40]. More specially, people come to VCs to find emotional support, instrumental aid and encouragement [41]. Building upon Ridings et al. [40] and Wasko and Faraj [47], we define VCs as the self-organizing and open activity systems in which a group of people with common interests and practices can communicate with others regularly in an organized way over the Internet through a common location.
Trust-Building Mechanisms and Knowledge Sharing In Virtual Communities

Trust-Building Mechanisms in VCs

Researchers have suggested that there are four mechanisms that can build trust, including calculation-based mechanism, process-based mechanism, characteristic-based mechanism and institution-based mechanism [1] [3] [13] [23]. The calculation-based mechanism stresses that trust is based on one’s subjective assessment of the costs and benefits derived from creating and sustaining a relationship [3]. Trust will emerge when one believes that other party will perform action that is beneficial to him/her [43]. In the setting of VCs, Hsu et al. [19] suggest that decreased costs and increased benefits in time and knowledge build members’ trust. Accordingly, calculation-based mechanism should arguably apply in the case of VCs.

Process-based mechanism posits that trust grows primarily over repeated interactions [1] [3]. The repeated interactions in turn increase understanding of what, why and when others do what they should do. This may provide a framework to predict other’s future actions and help people build their trust [15]. The characteristic-based mechanism stresses that trust could be driven by the similarity between people [15] [27]. That is, trust is created because similarity enables people to create a felling of shared ethical and moral habits that allows people to believe that others’ behaviors are appropriate and ethically [13]. In fact, the arguments of process-based mechanism and characteristic-based mechanism are similar to the key assertion of social capital theory literature, which suggests that frequent social interaction and shared vision promote trust [45]. Some researchers have addressed the importance of social capital in VCs [8] [47]. Consequently, this study integrates the two trust-building mechanisms and proposes the term “relationship-based mechanism” to capture the link between social relations and trust.

The institution-based mechanism states that an institutional structures and norms within an organization provide a sense of security that may encourage one’s confidence in other party’s trustworthy behavior and goodwill [1] [4] [36]. Similarly, previous research indicates that institutional factors such as guarantees, safety nets,
revaluation, and legal resource provide essential supports for trust development [43]. Some researchers, on the other hand, describe that trust in an organization may arise due to sound privacy and technological mechanisms [19] [39]. As noted above, VCs are cyberspaces supported by information technologies and there are not explicit regulations, external guarantors and legal laws to rule members’ behavior [47]. In the study, we argue that trust in VCs may emerge because of technical infrastructure rather than norms. As such, we propose the term “system-base mechanism” to capture the subset of institution-based mechanism and suggest that members’ trust may arise due to the adherence to the technical competence, system reliability, protective mechanism, and managerial policies and procedure. Such standpoint is in line with Ratnasingam [39].

Research Model and Hypothesis
Figure 1 portrays the research model of this study. In the model, trust is positioned as mediated variables which are affected by factors belong to three types of trust-building mechanisms (calculus-based relationship-based mechanism, and system-based mechanism). Then trust is proposed to have positive impact on knowledge sharing intention, in turn, leads to an increase in actual knowledge sharing behavior (quantity of knowledge sharing and quality of knowledge sharing). Each construct and hypotheses are discussed in the rest of this section.

Knowledge Sharing Intention and Knowledge Sharing Behavior
The research done in the framework of TRA, TPB, and TAM has shown that behavioral intention is a strong predictor of actual behavior [18]. For instance, Hsu and Chiu [18] find that a user’s behavioral intention to use e-service is a significant determinant of his/her actual use of e-service. Similarly, Wu and Chen [48] indicate that a user’s WAP service use intention has positive influence on actual use of service. Therefore, H1a. Members’ intention to share knowledge is positively associated with quantity of knowledge sharing.

H1b. Members’ intention to share knowledge is positively associated with quality of knowledge sharing.

Trust in VCs and Knowledge Sharing Intention
Trust is the one’s belief that other party will not act opportunistically by taking advantage of situation [15] and will behave in dependable and social appropriate manner [38]. Trust has been recognized as a central aspect in interpersonal relationships [14]. Some researchers indicate that people are more likely to help others they trust [5]. Others note that people are more willing to take part in joint activities such as knowledge sharing if trust exists in the environment they are in [40] [45]. Ridings et al. [40] have provided empirical evidence suggesting that trust has positive influence on one’s desire to share knowledge. Therefore,

H2. Members’ trust in VCs is positively associated with their intention to share knowledge.

Knowledge Growth and Trust in VCs
Past research suggests that members in VCs may increase their expertise by learning others’ experience and skills [6] [46]. Knowledge growth is thus treated as the benefits of gaining expertise from participating VCs [6]. From the view of calculation mechanism, trust can be created when benefits arising from using knowledge shared by others. Moreover, perceived knowledge growth implies that members in VCs have the skill, expertise and willingness to contribute useful knowledge, thereby creating one’s belief in others’ credibility and benevolence. Based on above discussion, this study may reasonably assume that perceived knowledge growth may lead to the development of trust positively.

H3. Member’s perception of knowledge growth is positively associated with trust in VCs.

Perceived Responsiveness and Trust in VCs
The existing of VCs depends on members’ postings and responsiveness [40]. Generally, members often expect some type of response from others [40] [46]. The responsiveness from others has been viewed as a type of benefit motivating people to participate in VCs [40]. From the perspective of calculation-based mechanism, members can build their trust toward VCs when they receive responsiveness from others. Ridings et al. [40] suggest that trust will not develop if an individual posts a message and there are no responses [40]. Their study has provided empirical evidence to support the link between perceived responsiveness and trust as well. Therefore,

H4 Perceived responsiveness is positively associated with trust in VCs.

Social Interaction Ties and Trust in VCs
Prior literature states that trust is the product of repeated social interactions [40] [43] [45]. The assertion of social capital theory posits that ongoing social interactions strengthen network density and closure and thus promote trust [31]. Tsai and Ghoshal [45] further note that frequent interactions allow individuals to know one another and create a common opinion, thereby are more
likely to perceive others as trustworthy. Ridings et al. [40] address that repeated interactions allow individuals to perceive others’ reliability and dependability that are need for trust development. Based on above arguments, social interaction ties are believed to have positive impact on trust development. The study of Tsai and Ghoshal [45] provided empirical evidence to support the relationship between social interaction ties and trust.

**H5 Members’ social interaction ties are positively associated with trust in VCs.**

**Shared Vision and Trust in VCs**

As noted by Tsai and Ghoshal [45], a shared vision embodies “the collective goals and aspiration of the members of an organization” (p. 467). The shared vision could be viewed as a bonding mechanism that may bring and keep members within an organization together [45]. In general, people with similar interests or attitudes may be more likely to build relationships with each other [29]. Trust will arise among individuals who think they share a common objective and value [24]. Gefen et al. [16] postulate that people may tend to believe and rely on members of the group they identify and treat their behaviors in a favorable and acceptable manner. Empirical evidence supporting the link between a shared vision and trust has been provided by prior studies [16] [45].

**H6 Members’ shared vision is positively associated with trust in VCs.**

**System Quality and Trust in VCs**

System quality refers to the desired characteristics of information systems, such as reliability [11], ease of use, stability [11] [25], and security [11] [32]. Several studies have shown that the system quality determines the development of trust [9] [39]. For instance, McKnight et al. [33] suggest that using information systems could result in the perception of system quality, which in turn forms the trusting beliefs. Corbitt et al. [9] report that the characteristics of information systems influence trust significantly. Thus, it is reasonable to assume that system quality may affect members’ trust in VCs. Therefore, **H7. System quality is positively associated with trust in VCs.**

**Service Quality and Trust in VCs**

Service quality can be defined as a global judgment or attitude relating to the superiority of service [35]. Service quality is concerned with the overall service or support delivered by VCs [11]. Some researchers suggest that service quality could be assessed by several constructs such as responsiveness, reliability, empathy, and assurance [35]. In this study, the focus of service quality is assurance, indicating that VCs provide some regulation procedures or policies to make their members believe that VCs are in proper order and safe [32]. Researchers suggest that when a situation falls safe, one may believes that this situation possesses some kind of trustworthy attributes [32]. Based on above discussion, this study may reasonably propose that service quality is related to trust. Therefore, **H8. Service quality is positively associated with trust in VCs.**

**Knowledge Quality and Trust in VCs**

Knowledge quality refers to quality of VCs’ knowledge, such as relevance, timeless, comprehensibility and completeness [25]. Previous

**Figure 1. Research Model**

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literature indicates that if people perceive that knowledge quality is of high quality, they are more likely to have high trust beliefs as to Web site [26]. In contrast, if members feel suspicious about the knowledge quality, they may doubt the ability of VCs and tend to distrust the knowledge they are unfamiliar [28]. The study of Song and Zahedi [44] and Liao et al. [26] provide empirical evidence to support the relationship between knowledge quality and trusting beliefs. Therefore, 

H9. Knowledge quality is positively associated with trust in VCs.

Research Methodology

Measurement development

Items in the questionnaire was developed by either adapting measures had been validated by prior literature, or by converting the definition of items developed based on the relevant theory and prior studies into questionnaire format [7]. A pretest of the questionnaire is performed using three experts in the IS area to assess logical consistencies, ease of understanding, question item sequence adequacy, and context fitness. Following the pretest, an online pilot test involving 20 master students who have been members of virtual communities was carried out to test the feasibility of this study. For all measures, a seven-point scale was used with anchors ranging from strongly disagree (1) to strongly agree (7). The questionnaire items are listed in Appendix A.

Survey administration

The research model was tested using data collected from members of BlueShop. BlueShop is selected because it is a well-known community dedicated to sharing knowledge about database, programming, IT security, and operation system and many other domains in Taiwan [8]. In order to target respondents, a banner with a hyperlink connecting to the Web survey was posted on the homepage of BlueShop. Thirty randomly selected respondents were offered an incentive in the form of gift certificate amounting to NT$ 500 to increase the response rate. The returned questionnaires were initially screened for usability and reliability; 324 responses were found to be complete and valid for data analysis.

Data Analysis and Results

The model was tested using structural equation modeling (SEM) as implemented in LISREL. We began with assessing measurement model to ensure the reliability, convergent validity, and discriminant validity of the model. The reliability was examined using the composite reliability values. As shown in Table 1, the values of composite reliability ranged from 0.86 to 0.95, well above the common acceptance level of 0.70 [17]. Previous literature stresses that convergent validity is adequate when factor loading higher than 0.7 and constructs have an average variance extracted (AVE) of at least 0.5 [12]. Table 1 also shows that all AVEs are greater than 0.5 and all items exhibited a factor loading higher than 0.7 on their respective constructs. The results suggest that convergent validity is acceptable. In addition, Table 2 shows that all the square roots of AVE values exceed the correlation between the construct and other constructs in the model, indicating the adequate discriminant validity of constructs in the model [12].

Once the measurement was adequate we tested the hypotheses by reviewing the parameters in the structural model. For models with good fit, the ratio of chi-square to the degree of freedom ($\chi^2$/d.f.) should be less than 5. The non-normed fit index (NNFI), and comparative fit index (CFI), should exceed 0.9. The commonly accepted value of root mean square error of approximation (RMSEA) should not exceed 0.08 [8]. For the current structural model, $\chi^2$/d.f. is 2.51 ($\chi^2$= 1202.69, df= 464), NNFI is 0.97, CFI is 0.98, and RMSEA is 0.07. The results demonstrate the model fit indices are within accepted thresholds.

Figure 2 illustrates the estimated coefficients and their significance in the structural model. Most paths are significant, except for those between social interaction ties and trust in VCs ($\beta$=-0.01, $t$=-0.12), system quality and trust in VCs ($\beta$=-0.04, $t$=-0.47), and knowledge quality and trust in VCs ($\beta$=0.09, $t$=1.09), meaning that hypotheses 5, 7, and 9 are not supported. As expected, intention to share knowledge is significantly associated with quantity of knowledge sharing ($\beta$= 0.48, $t$=9.01) and quality of knowledge sharing ($\beta$= 0.60, $t$=10.3), supporting hypotheses 1a and 1b. Trust in VCs exhibits a strong effect on intention to share knowledge ($\beta$=0.68, $t$=13.02) so that hypothesis 2 is supported. Furthermore, knowledge growth and perceived responsiveness have significant effects on trust in VCs ($\beta$= 0.16, 0.22; $t$=2.77; 3.71, respectively). The results support hypotheses 3 and 4. Finally, as expected, trust in VCs is predicted by share vision and service quality ($\beta$= 0.33, 0.29; $t$=4.78, 2.94, respectively). Thus, hypotheses 6 and 8 are supported.

Conclusions

In this study, we propose a theoretical model to investigate what factors may affect a members’ trust toward VCs, which in turn influences their knowledge sharing behavior in the context of VC. Using data collected from 324 members of a technical virtual community, we empirically demonstrate that trust in VCs is significantly
related to knowledge sharing behavior. Trust in VCs, in turn, is affected by knowledge growth, perceived responsibility, shared vision, and service quality. The results provide important implications for research and practice. First, we have empirically expanded past studies on trust and VCs by proposing three trust-building mechanisms, such as calculus-based mechanism, relationship-based mechanism, and system-based mechanism, that can apply to the context of VCs. The three mechanisms are important because they may advance our understanding of what and how the factors derived from these mechanisms build trust, which in turn leads to better knowledge sharing behavior. Second, the results of this study indicate that the influence of shared vision on the formation of trust is stronger than factors fall into system-based mechanism. However, prior study [36] argues that institution-based trust is the most important determinant of trust in the environment without prior interaction history. As a result, further study should employ longitudinal view to verify that whether the importance of institution-base mechanism may decline when the relationship among people develops as time. Third, the results report that social interaction ties do not have significant effect on trust in VCs. The result seems to provide additional support for the argument that social capital may not develop in the virtual setting because of the lack of shared history, interdependence, and co-presence [47]. Finally, the results show that an individual’s intrinsic benefit (i.e., knowledge growth) and extrinsic benefit (i.e., perceived responsiveness) may affect the establishment of trust in VCs. According to the theory of motivation crowding effect [34], extrinsic motivation often undermines the effect of intrinsic motivation [20]. Hence, further study is needed to examine the interaction effect between intrinsic and extrinsic benefits on trust formation.

<table>
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<th>Factor Loading</th>
<th>Composite Reliability</th>
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<td></td>
<td>PKG2=0.97</td>
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<td></td>
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<td></td>
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<tr>
<td></td>
<td>POR3=0.86</td>
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<tr>
<td>3. Social Interaction Ties (SIT)</td>
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<td>0.90</td>
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<tr>
<td></td>
<td>KSAQ2=0.8</td>
<td></td>
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<tr>
<td></td>
<td>KSAQ3=0.8</td>
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<td></td>
<td>KSAQ4=0.8</td>
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Table 2 Correlations of Latent Variables

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<tr>
<td>2</td>
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<tr>
<td>3</td>
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<td>4</td>
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<td>5</td>
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<td>0.33</td>
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<td>0.81</td>
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<td>7</td>
<td>0.62</td>
<td>0.48</td>
<td>0.36</td>
<td>0.56</td>
<td>0.61</td>
<td>0.69</td>
<td>0.81</td>
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<td>0.33</td>
<td>0.67</td>
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<td>0.62</td>
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<td>0.86</td>
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<tr>
<td>9</td>
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<td>0.51</td>
<td>0.40</td>
<td>0.56</td>
<td>0.27</td>
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<td>0.50</td>
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<td>0.27</td>
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<td>0.54</td>
<td>0.49</td>
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</tr>
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</table>

Legend:
This study also provides several interesting implications for practitioners who are interested in encouraging knowledge sharing within VCs. First, the results indicate that knowledge growth is a significant determinant of trust in VCs. This suggests that management of VCs should provide directions, such as yellow pages of knowledge possessors, to help members to locate people who possess knowledge they need [2]. Second, the results also report that perceived responsiveness has significant effect on trust in members of VCs. From the practice of human-machine interface design, management of VCs should improve VCs’ online communication capability to provide some flexible and convenient tools for members to post and response questions easily. Third, the results also reveal that shared vision is positively associated with trust in members of VCs. Panteli and Sockalingam [37] posit that the interaction may enhance the development of shared values, goal and mutual understanding among people. Therefore, management of VCs should develop strategies or mechanisms that can facilitate the interaction among members. Finally, results of this study also report that service quality is an important motivator for nurturing members’ trust. Thus, management of VCs should enhance members’ perception of the benevolence of VCs. This may be done by disclosing information about the principles and guidelines of privacy protection and regulatory policies on the Web site.

Although the results of this study provide several interesting and useful findings, the resent study still has some limitations. First, using members in a virtual community as subjects may limit the generalizability of the findings to other types of VCs, since knowledge sharing in global virtual communities may be different from the ones within organizations [8]. Further study is needed to examine the extent to which the findings of this study can be applicable in various types of VCs. Second, many researchers agree that trust is a dynamic phenomenon [19] [22] [37] that will change with time Therefore, an idea research design is that researchers should employ longitudinal perspective to validate the influence of trust development on individuals’ knowledge sharing intention and behavior and identity what factors may impact the trust development over time. Finally, since the focus of this study is active participants and this study did not investigate members who had ceased to participate in VCs, and members who do not log onto the VCs, the results of this study may also suffer from self-selection bias, similar to Chiu et al. [8] and Wasko and Faraj [47].

In conclusion, this study develops and tests a theoretical model to examine the antecedents of trust using three distinct trust-building mechanisms in VCs. The results show that knowledge growth, perceived responsiveness, shared vision service quality may determine the development of trust in VCs. By providing empirical evidence regarding the significant influence of these factors on trust building, this study believes that the findings of this study have contributed to the development of a
richer understanding of what factors may create members’ trusting beliefs in VCs. Given the importance of knowledge sharing in VCs, this study also hopes that the findings may offer useful implications to VCs practitioners.

References


[47] Wasko, M.M., Faraj, S. Why should I share? Examining social capital and knowledge contribution in electronic networks of...
Appendix A. Questionnaire Items

Knowledge Growth (KG)
1. The members in the BlueShop community help me learn new things.
2. The members in the BlueShop community help me master new skills.
3. The members in the BlueShop community help me acquire innovative ideas.

Perceived Responsiveness (PR)
1. The members in the BlueShop community are very responsive to my posts.
2. I can always count on getting a lot of responses to my posts.
3. I can always count on getting responses to my posts fairly quickly.

Shared Vision (SV)
1. The members in the BlueShop share the vision of helping others solve their professional problems.
2. The members in the BlueShop share the same goal of learning from each other.
3. The members in the BlueShop think cooperation is important.

System Quality (SYSQ)
1. I feel that the BlueShop community is easy to use.
2. I feel that the BlueShop community is stable.

Service Quality (SVRQ)
1. The BlueShop community never modifies or losses the content members shared.
2. The BlueShop community has better procedures to make sure that members of this community will obey its policies and rules.
3. The BlueShop community does not use personal information for any purpose unless it has been authorized by members.

Knowledge Quality (KQ)
1. The BlueShop community provides up-to-date knowledge.
2. The BlueShop community provides sufficient knowledge.
3. The knowledge provided by BlueShop is meaningful and understandable.
4. The knowledge or information provided by BlueShop is important and helpful for my work.

Trust in VCs (TVC)
1. I feel that the BlueShop community is reliable.
2. I felt that the BlueShop community is likely to care for members’ welfare.
3. I feel that the BlueShop community is competent to help members enhance their knowledge.

Intention to Share Knowledge (ISK)
1. I will come to the BlueShop community to share knowledge I know about a particular subject with other members.
2. I will come to the BlueShop community to share my skills and abilities with other members.

Quantity of Knowledge Sharing (KSQN)
1. I frequently contribute my knowledge to other members in the BlueShop community.
2. I usually involve myself in discussions of various topics rather than specific topics in the BlueShop community.
3. I usually spend a lot of time conducting knowledge sharing activities in BlueShop community.

Quality of Knowledge Sharing (KSQA)
1. The knowledge shared by me is relevant to the topics.
2. The knowledge shared by me is easy to understand.
3. The knowledge shared by me is complete.
4. The knowledge shared by me is reliable.
FACEBOOK USAGE AMONG ARABIC COLLEGE STUDENTS: PRELIMINARY FINDINGS ON GENDER DIFFERENCES

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Abstract
With immense popularity and candid participation, Facebook shows a greater potential in developing customer communities, promoting online presence, advertising, and customizing services/products. Despite its popularity, research on Facebook in particular and social networking sites in general is far behind the practice. Particularly, research outside the western countries is very limited. With the young generation of Arabic world embarking on Internet, social networking sites, e.g., Facebook, have been used as a main arena for their identity construction, and relationship development, playing a vital role in shaping future society. Thus, the purpose of this study is to provide descriptive information about the use of Facebook by Arabic college students with a focus on gender differences in motivations and perceived consequences of Facebook usage.

Keywords: Social Networking Sites; Adolescents; IT Usage; Trust

Introduction
According to Boyd and Ellison [1], social networking sites are “web-based services that allow individuals to 1) construct a public or semi-public profile within a bounded system, 2) articulate a list of other users with whom they share a connection, and 3) view and traverse their list of connections and those made by others within the system.” In the past couple of years alone, social networking sites such as Friendster, MySpace, and Facebook have become immensely popular among adolescents and emerging adults. Among various social networking sites, Facebook is currently considered as a rich site for researchers interested in social networks due to its heavy usage patterns and technological capacities that bridge online and offline connections. Particularly as the statistics by Jan. 2009, Facebook, originally created for college students, has attracted more than 150 million active users with more than half of them are outside of college. The fastest growing demographic is those 30 years old and older. Facebook has become an integral part of daily life. On average, each user has 100 friends on the site, spends more than 3 billion minutes on Facebook each day (worldwide). More than 13 million users update their statuses at least once each day and more than 3 million users track certain pages on a daily base. More than that, Facebook is also increasingly leveraged by politicians, protesters, social activists, companies and etc. to achieve a wide range of objectives. A good example is Obama’s campaign in 2008.

Compared to traditional online communities, the strict policy enforced in Facebook against the use of pseudonyms help cultivate a culture of honesty that is not always found in other online communities. With immense popularity and candid participation, Facebook shows a greater potential in developing customer communities, promoting online presence, advertising, and customizing services/products. For instance, several libraries have setup their Facebook profile to provide customize the service for college students. Facebook is also embarking e-commerce by partnering with Amazon.com. Although many business models are still in the experimental stage, no one would ignore Facebook’s potential in e-commerce.

Despite its popularity, research on Facebook in particular and social networking sites in general is far behind the practice. Particularly, research outside the western countries is almost empty. With the young generation of Arabic world embarking on Internet, social networking sites, e.g., Facebook, have been used as a main arena for their identity construction, and relationship development, playing a vital role in shaping future society [2]. For instance, Ayed [3], in his field study, demonstrated that Internet plays an important role in shaping the political attitudes and culture among the youth. The young generation in the Arab world are influenced by both Islamic and modern cultures [4], which may not stay in harmony. Therefore, it is important to gain the insights on how the young generation interacts with social networking sites in general and Facebook in particular. Moreover, prior research has observed that, despite opportunities of hiding identities online [5], users’ online behavior is still subject to their offline identities [6]. Research on refined understandings of the digital divide has found that equal access to Internet resources does not guarantee homogeneity among users’ online pursuits [7, 8]. Among various offline identities, gender has been demonstrated to influence a wide array of user-technology interaction [9, 10]. Given strong cultural notions of gender in Arabic world, there is
no reason to assume equal adoption, pursuit and perception of social networking sites between the male and female users. Thus, the purpose of this study is to provide descriptive information about the use of Facebook by Arabic college students with a focus on gender differences in motivations and perceived consequences of Facebook usage. Crucial questions for understanding the use of such applications address self-perception in Facebook, frequent activates, influential others in Facebook adoption, perceived trust and perceived consequences of using Facebook.

Internet Usage and Facebook Adoption in UAE

The Internet is a global phenomenon, but with distinct regional profile [11]. As indicated in prior research (e.g., Straub et al., 2001), culture and social norms play an important role in shaping Internet usage. We choose The United Arab Emirates (UAE) as our research site due to its relatively high Internet penetration among Middle East countries. UAE was established in 1971 as a federation of seven emirates. Within 30 years, this country has undergone significant social, economic, and cultural changes. ETISALAT has been providing Internet services to UAE since August 1995. The country now has one of the highest rates of Internet usage in the Middle East and its telecommunications sector is the most highly developed in the region. According to Emirates Internet and Multimedia (EMI) [12], there are 2.3 million Internet users by March 2008, accounting for 49.8% of the total population. Nowadays the Internet has become an integral part of life for the young generation in UAE. The penetration of Internet also brings massive opportunities for electronic commerce. A new Arab Advisors Group major survey of Internet users in UAE reveals that 51.2 per cent of Internet users in UAE reported purchasing products and services online and through their mobile handsets in 2007. Particularly, Facebook has become very popular among young people in UAE. Although the exact statistics is missing, its popularity is signaled through some discussions about Facebook in various venues, and recent event of “ Blocking Facebook” in UAE. The author’s casual survey with students in the classroom also reported about 60% of Facebook adoption.

Meanwhile, UAE has promoted the gender empowerment by encouraging women to receive education, and take an active part in economic and political life. According to UN report, UAE ranks 24th out of 108 countries in the gender empowerment measure, with a value of 0.698. This also indicates that compared to other Arabic countries, UAE offers more opportunities for women to access Internet resources. All evidence indicates that Facebook has emerged to be a significant social phenomenon worth much attention in UAE.

UAE nationals, being the minority (15-20%) in their own country, have kept firm ties to their cultural tradition. Particularly to our interest are those traditions or social norms enforced to the female. Although recently the government encourages Emirate females to join the workforce and take leadership roles in running the country, strong social norms remain applicable for the female. For instance, a female cannot show her face except to close family members, a female is not allowed to interact with others, particularly male, without permission from her family, and a female is not allowed to touch or be touched by males (e.g., a handshake with a work colleague is not permitted).

Hence, using Facebook creates a great controversy with respect to the traditional Islamic/Arabic culture, since Facebook empowers the female with more possibilities in extending their social network, and provides more sources for identity exploration and development. Saudi preacher Ali al-Maliki, a leading critic of Facebook, claims the network is corrupting the youth of the nation, “Facebook is a door to lust, and young women and men are spending more on their mobile phones and the Internet than they are spending on food.”v The conflict brought by the usage of Facebook and exposure to western culture, is expected to be stronger among women than men in UAE, which implies significant gender differences in Facebook usage and perception.

How do people perceive themselves in Facebook?

According to Erikson [12], identity is the main developmental task of adolescence. Research in developmental psychology has demonstrated that as Internet becomes a main social environment for most people, it becomes an essential arena for identity experimentation and exploration, playing an important role in adolescent development [13]. Same theories are also applicable to Arab youth. For instance, Ayed [3], in his field study, demonstrated that Internet plays an important role in shaping the political attitudes and culture among the youth. The young generation in the Arab world are influenced by both Islamic and modern cultures [4], which may not stay in harmony. The conflict brought by the usage of Internet and exposure to western culture, fundamentally shapes the self-perception of young generation and understanding of their self-perception in Facebook would be the first step.

What do they do with Facebook?

Facebook was originally designed to be a social networking site for connecting college students, but now extends to high schools and other organizations. When people join Facebook, they start by creating a
profile which can be used to identify connections to those who share the similar characteristics. Members can also connect to those they meet through the site. Built upon this basic networking function is the rich communication and relationships among members, fulfilling a number of purposes. Despite equal access to Facebook, different users may have their own online pursuits [7, 8]. Particularly, we are interesting in gender differences in Facebook activities. Since women are subject to more limitations in physical life than men, Facebook, providing an alternative online playground, may be perceived to be more important among women than men. Therefore, in this study, we try to provide some preliminary results regarding the specific pursuits for Facebook among Arabic young students, and gender differences in Facebook activities.

Who are the most influential others for Facebook usage?
According to theory of planned behavior [14], one of the determinants of behavior intention is subjective norms, defined as “a person’s perception that most people who are important to him think he should or should not perform the behavior in question”. Such perceived pressure from important others exerts its influences through three major mechanisms: compliance, internalization and identification [15]. Compliance means the person is motivated by the need for approval from significant others. Internalization refers to the adoption of a decision based on the congruence of one’s values with the values of another. Identification suggests that the person defines him/herself in terms of features of social category that renders the self stereotypically “interchangeable” with other group members, and stereotypically distinct from outsiders [16]. Subjective norms are particularly relevant in understanding Arab students’ Facebook usage due to the fact that the traditional Islamic values remain influential, especially for female students. The initial attempt in this study would be identification of influential, especially for female students. The initial attempt in this study would be identification of influential, especially for female students.

What are the perceived consequences of using Facebook?
Perceived consequences are derived from Triandis’ model [24]. According to this model, each act or behavior is perceived as having a potential outcome that can be either positive or negative. An individual’s choice of behavior is based on the probability that an action will provoke a specific consequence. Identifying the consequences of using Facebook would shed lights on the determinants of Facebook usage.

Method
In order to understand the gender differences in Facebook usage among UAE college students, a survey was conducted in a private university in UAE during the Spring 2008 semester. In the survey, we mainly focused on the following subjects, i.e., self-perception in Facebook, frequent activates, influential others in Facebook adoption, perceived trust and perceived consequences of using Facebook. While adopting scales validated in prior research, e.g., trust [25], subjective norms [26], prior to the survey, we also organized a focus group discussion with 20 students who did not attend the survey study in order to identify the measures for frequent activities with Facebook, perceived consequences, and influential others in measuring subjective norms. For instance, many students expressed their concern about the negative impacts of Facebook on their family relationship and culture, which was later articulated into the survey.

The survey was distributed to 128 students taught by one of the authors and a total of 70 students returned the valid response, with 35 female and 35 male. Participation was completed voluntarily without any motivation. Table 1 summarizes the demographic information of the participants. The majority of participants are undergraduate students ranging between 19-30 years old. The distribution of the nationality was consistent with the general ethnic distribution in this university. Despite the diversity, almost all students are Muslims and comply with the traditional Islamic culture. A subsequent test indicated insignificant national difference.

More than half of participants had more than 5 years’ experience with Internet, which confirmed that using Internet has become their daily routine. More particularly, 84.3% of participants had at least 6 months’ experience with Facebook and 54.3% of them logged in on a daily base. Consistent with our early survey results, Facebook was very
popular among young generation of UAE. Moreover, ANOVA test did not report a significant gender difference in the experience with Internet and Facebook, and frequency of Facebook usage. This may suggest that both female and male enjoy similar Internet access.

**Table 1: Demographic Information**

<table>
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<tr>
<th>Age</th>
<th>Count (%)</th>
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<tbody>
<tr>
<td>19-30</td>
<td>65 (92.9%)</td>
</tr>
<tr>
<td>31-45</td>
<td>5 (7.1%)</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Frequency of Login</th>
<th>Count (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily</td>
<td>38 (54.3%)</td>
</tr>
<tr>
<td>Weekly</td>
<td>17 (24.3%)</td>
</tr>
<tr>
<td>Monthly</td>
<td>15 (21.4%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Experience with Internet</th>
<th>Count (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 5 years</td>
<td>40 (57.1%)</td>
</tr>
<tr>
<td>2-5 years</td>
<td>26 (37.1%)</td>
</tr>
<tr>
<td>&lt; 1 year</td>
<td>4 (5.7%)</td>
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<table>
<thead>
<tr>
<th>Experience with Facebook</th>
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<tbody>
<tr>
<td>&gt; 12 months</td>
<td>37 (52.9%)</td>
</tr>
<tr>
<td>6-12 months</td>
<td>22 (31.4%)</td>
</tr>
<tr>
<td>&lt; 6 months</td>
<td>11 (15.7%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Membership with Facebook</th>
<th>Count (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 6 months</td>
<td>18 (25.7%)</td>
</tr>
<tr>
<td>6-12 months</td>
<td>20 (28.6%)</td>
</tr>
<tr>
<td>1-2 years</td>
<td>23 (32.9%)</td>
</tr>
<tr>
<td>2-5 years</td>
<td>9 (12.9%)</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Nationality</th>
<th>Count (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syrian</td>
<td>15 (21.4%)</td>
</tr>
<tr>
<td>UAE</td>
<td>17 (24.2%)</td>
</tr>
<tr>
<td>Palestinian</td>
<td>11 (15.7%)</td>
</tr>
<tr>
<td>Egyptian</td>
<td>7 (10%)</td>
</tr>
<tr>
<td>Indian</td>
<td>7 (10%)</td>
</tr>
<tr>
<td>Lebanese</td>
<td>7 (10%)</td>
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<tr>
<td>Pakistani</td>
<td>6 (8.6%)</td>
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<thead>
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<th>Education</th>
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<tr>
<td>Undergraduate</td>
<td>61 (87.1%)</td>
</tr>
<tr>
<td>Masters</td>
<td>9 (12.9%)</td>
</tr>
</tbody>
</table>

**Data Analysis and Results**

ANOVA was conducted to examine the gender difference in terms of purposes of self-perception in Facebook, frequent activities with Facebook, subjective norm, perceived trust, and perceived consequences of using Facebook.

**Self-perception in Facebook**

A key task in adolescent development is the formation of identity. How do people in Facebook perceive themselves? In this survey, we tapped three self-perceptions, i.e., sociable-unsociable, conservative-outgoing; independent-dependent. Selection of these items was based on the gender stereotype in UAE. As one respondent put, “As a UAE guy, I find something that doesn’t meet our cultural or religion morale. For instance, a girl can come to me account and say how sexy I am. This is not allowed in our culture.” Table 2 reports the gender difference in self-perception in Facebook. Different from the general stereotype, both female and male students reported similar level of sociability and conservativeness, higher than what has been perceived in the physical life. Moreover, although both groups reported a relatively high level of independence, significant difference was found between the female and male students. It seems that the female students who live in Facebook feel more independent. However, this explanation warrants further examination as it might be the result of selection bias.

**Table 2: Gender Differences in Self-perception in Facebook**

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std.</th>
<th>Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>In Facebook, I am very sociable 1 - unsociable 8 **</td>
<td>female 3.31</td>
<td>2.529</td>
<td>428</td>
</tr>
<tr>
<td></td>
<td>male 2.77</td>
<td>2.079</td>
<td>380</td>
</tr>
<tr>
<td>In Facebook, I am very conservative 1 - outgoing 8 **</td>
<td>female 5.11</td>
<td>2.125</td>
<td>359</td>
</tr>
<tr>
<td></td>
<td>male 5.10</td>
<td>1.768</td>
<td>323</td>
</tr>
<tr>
<td>In Facebook, I am very dependent 1 - independent 8 *</td>
<td>female 6.23</td>
<td>2.157</td>
<td>365</td>
</tr>
<tr>
<td></td>
<td>male 5.13</td>
<td>1.852</td>
<td>338</td>
</tr>
</tbody>
</table>

**Frequent Activities with Facebook**

Social networking sites are designed to foster social interaction. Enhanced social network also provides rich information source and fulfill different pursuits of users. Table 3 reports the frequent activities with Facebook identified in focus group discussion, which generally covers most needs of social networking site users, e.g., information needs (Item 1-5), social needs (Item 6-8), entertainment needs (Item 9-10), and development needs (Item 11). The survey results also indicated significant difference in all activities between the male and female students. Specifically, the female students reported more frequency in all activities, indicating that Facebook plays a more important role in the female students’ life than their counterpart.
First, the female students were reported to be more active in information seeking and contributing activities. Like what one student mentioned in the focus group discussion, “Since I am a woman, I found that it as the only way [online] I could express my opinions and ideas freely.” This confirms the claim that Internet in general and Facebook in particular are playing a very important role in empowering women in Arabic world. Secondly, both male and female students consider Facebook as a social venue for networking and seeking social support, although such demands seem more salient among the female students. Thirdly, Facebook is also considered more as a playground for female students than for male students. This may also related to the fact that male students enjoy more freedom and choices for entertainment. Finally, Facebook was found to be an important venue for the female students in experimenting different roles; while such role was not salient among the male students. This result might be related to the difference in enforced limitations between the female and male in the real life. As we mentioned before, despite the economic and social progress, UAE remains close-tied with the Islamic/Arabic traditions, and women are subject to more restrictions. Overall, the usage of Facebook for male students is consistent with its basic function, social networking; while for female students, Facebook seems fulfill various roles and constitutes as an important complement for limitations in their physical social life.

Subjective Norms

Based on the focus group discussion, we identified four important others in influencing students’ decision, i.e., relatives (family members), friends, professors, and classmates. While the peer influence is same across two groups, female students were reported to be more influenced by their relatives and professors than male students. Getting approval from certain authorize seems important for female students’ Facebook usage.

Table 4: Gender Difference in Social Norms (1=Strongly Disagree; 8=Strong Agree)

<table>
<thead>
<tr>
<th>Subjective Norms</th>
<th>Male Mean</th>
<th>Std. Error</th>
<th>Female Mean</th>
<th>Std. Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>My relatives think that I should use Facebook</td>
<td>3.73</td>
<td>.38</td>
<td>2.03</td>
<td>.21</td>
</tr>
<tr>
<td>My friends think that I should use Facebook</td>
<td>4.56</td>
<td>.29</td>
<td>3.37</td>
<td>.26</td>
</tr>
<tr>
<td>My professors think that I should use Facebook</td>
<td>4.91</td>
<td>.24</td>
<td>3.46</td>
<td>.21</td>
</tr>
<tr>
<td>My classmates at university think that I should use Facebook</td>
<td>4.67</td>
<td>.22</td>
<td>4.04</td>
<td>.18</td>
</tr>
</tbody>
</table>

Perceived Trust

Overall, our survey results did not indicate a high level of trust with people in Facebook, except for the dimension of integrity. First, the belief in the integrity of people in Facebook would convince the members of Facebook that their information would not be used inappropriately and their expected results from social interaction would be fulfilled. Our results showed significant difference in the belief in integrity between male and female students. Female students tended to believe that people in Facebook were honest and reliable; while the male students...
seemed opposite. As one male respondent put, “In fact, when I first set up my profile…I was afraid to add my real personal details and my profile stayed empty for more than three weeks because of my doubt with that website. I was afraid even to add friends to my profile when they send me invitations.”

Table 5: Gender Difference in Perceived Trust in Facebook

<table>
<thead>
<tr>
<th></th>
<th>Male Mean</th>
<th>Male Std. Error</th>
<th>Female Mean</th>
<th>Female Std. Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integrity**</td>
<td>3.87</td>
<td>.386</td>
<td>5.31</td>
<td>.228</td>
</tr>
<tr>
<td>Benevolence*</td>
<td>2.55</td>
<td>.361</td>
<td>2.74</td>
<td>.356</td>
</tr>
<tr>
<td>Ability**</td>
<td>4.52</td>
<td>.421</td>
<td>4.61</td>
<td>.470</td>
</tr>
<tr>
<td>Predictability</td>
<td>3.71</td>
<td>.516</td>
<td>3.74</td>
<td>.322</td>
</tr>
</tbody>
</table>

Second, benevolence deals with the belief that the trusted party actually cares about the trusting party. Our results reported that generally all respondents did not hold a strong belief of benevolence of the members in Facebook. We also found that female students were reported to be more cautious than male students, as indicated by the significant lower rating on benevolence from female students.

Third, the trust dimension of ability is the assessment that the trusted party knows the subject in question and that this knowledge enhances the certainty of the trusting party obtaining its expected outcomes from the relationship. Our results showed that female students had significant lower trust in the others’ ability than male students.

Finally, the trust dimension of predictability means the trusted party behaves as expected by the trusting party. Compared to the rating for the trust dimensions of benevolence and ability, the rating for the dimension of predictability are a little bit higher and no significant difference was found between two gender groups.

Perceived Consequences of Facebook Usage

Based on the focus group discussion, we identified the following four consequences tapping the potential impacts of Facebook in individuality (item1), time management (item2), social relationships (item3) and cultural conflict (item4). In the survey, except for item 3 (Using Facebook makes me away from real life friends and family), ratings for the other three items were significantly below 4.5. Moreover, the significant gender difference was only reported for item 2 (Using Facebook makes me lose precious time). Particularly, our results showed that using Facebook is not necessarily associated with being unique, which may confirm the popularity of Facebook among the young generation in UAE. Second, due to the multiple pursuits that Facebook can fulfill, using Facebook is not considered as wasting time, which is particularly true among female students. Moreover, all participants were neutral regarding the potential impact of Facebook on physical social life. Finally, participants in our study did not think that using Facebook is against the culture. Instead of following the old generations’ opinions about Facebook, the young generation in UAE tries to fit the new technologies and changes into their existing culture system. As one participant put, “His [Imaam] opinion upset me, and I often thought to myself that he was leader suitable for my grandfather’s generation, not mine!”

Table 6: Gender Difference in Perceived Consequences of Facebook Usage

<table>
<thead>
<tr>
<th></th>
<th>Male Mean</th>
<th>Male Std. Error</th>
<th>Female Mean</th>
<th>Female Std. Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Using Facebook makes me different from the others***</td>
<td>3.94</td>
<td>.399</td>
<td>2.94</td>
<td>.360</td>
</tr>
<tr>
<td>Using Facebook makes me lose precious time**</td>
<td>1.94</td>
<td>.188</td>
<td>3.35</td>
<td>.505</td>
</tr>
<tr>
<td>Using Facebook keeps me away from real life friends and family***</td>
<td>4.06</td>
<td>.449</td>
<td>4.54</td>
<td>.508</td>
</tr>
<tr>
<td>Using Facebook may be against our culture, e.g., putting up other people's pictures online***</td>
<td>3.71</td>
<td>.450</td>
<td>3.83</td>
<td>.516</td>
</tr>
</tbody>
</table>

Implications and Future Research

This research provided an exploratory investigation of Facebook use among university students in UAE with a focus on gender differences. Seventy university students participated in the survey. Before we draw any conclusion, we would like to highlight some limitation of this study that should be considered in externalizing the conclusions to general population. Given the limited exposure, our sample size was small, compared to the population that we tried to study. With specific institutional design, i.e., gender segregation, the surveyed university, compared to the other mixed-gender institutions, attracts many students who are relatively more conservative and more subject to the traditional
social norms. So our results may reflect more about the Internet usage and its impacts among conservative adolescents in UAE. Despite the above limitations, our results contribute to the existing literature that is dominant with western evidence by providing the preliminary understanding about the Facebook usage among the young generation in the Arabic region and by revealing significant differences between male and female students. The results of this study suggest further work is warranted to examine the following issues. First, with social networking sites increasingly integrated into young people’s daily life, it will be important to examine the impact of such sites on the young’s development. Compared to their parental generation, the young generation in UAE has more channels for social interaction, information activities and identity experiment. Particularly, Facebook seems more important for female students in UAE to extend their social network, get information, and experiment different identities. In this study, we identified a wide range of activities with Facebook and also found the female students were reported to be significantly more active than male students. However we only tapped the issue about identity development by indicating their self-perception in Facebook. Particularly the response from the female students showed great difference from the stereotype, e.g., conservative, as requested by traditional culture. In stead the female students, similar to their counterpart, were ready to welcome new friends and new ideas. As one student commented after the survey, “Facebook makes me more open to different perspectives”, we expect social networking sites such as Facebook may play an important role in transforming the young generation in Arab world. Second, as one important indicator of local culture, gender role should be considered in the future research on IT adoption/usage in Arabic world. Our results, despite the descriptive nature, have revealed very interesting and significant gender differences. It would be interesting and promising to examine the moderating role of gender in influencing users’ behavior in social networking sites.

References


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Endnote:


FORMATION AND OPERATION OF A BLOGGING COMMUNITY: A STRUCTURATIONAL PERSPECTIVE

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Abstract
Blogging is popular. It has emerged as a formidable phenomenon that not only draws massive daily following but also shifts the paradigm of human interaction. As a new communication genre, blogging has no specific governing bodies to manage the entity. This raises interesting questions on how is a blogging community being formed and how does it function. Founded on Structuration Theory, this paper applies the concepts of structure and agency as well as signification, legitimation, and domination to explain the formation and operation of a blogging community. The framework is valuable in serving as the basis for understanding how rules and practices are produced and reproduced to govern smooth functioning and operation of a virtual blogging community.

Keywords: Blogging, Structuration Theory, Structure, Duality, Social Networking

Introduction
Blogging is popular. It has emerged as a formidable global phenomenon that draws massive daily following. According to technorati.com, a search engine that tracks blogs, since 2002, it has indexed 133 million blog records. About one million blogs are being created everyday in 81 different languages [13]. Blogpulse.com [7], another blog tracker, identified over 107 million blogs as of October 12, 2009 and reported that 70,663 new blogs were added within the last 24 hours.

With blogs, sharing and publishing of ideas, opinions, and thoughts become almost effortless. Everyone seems willing to assume the role of writers or journalists as well as that of listeners, freely expressing, communicating, sharing, collaborating, debating, analyzing, and reflecting ideas, opinions, emotions, and thoughts online. From the teenager next door to the grandmother down the road, from the hairstylist at the corner shop to the professor in a university, from an ordinary citizen to the premier in office, all are riding the wave of writing and reading blogs. Apparently, blogging is becoming a mainstream communication and interaction medium that permeates every inch of our society and defies limitations of gender, age, and professions.

With virtually no designated governing authority on blogs, questions many are interested in knowing are how is a blogging community being formed, how does it function, how are rules and practices being enforced, etc. This paper uses Structuration Theory as the theoretical framework to explore the questions above. Specifically, it applies the concepts of structure and agency as well as signification, legitimation, and domination to the formation and operation of a blogging community.

Structuration Theory
Introduced by Anthony Giddens [4], Structuration Theory is a meta-theory that focuses on understanding the relationship between individuals (i.e., human agency) and society (i.e., structure). According to this theory, human agency and structure do not constitute separate realities. Rather, they form a “mutually constitutive duality”[8, p. 129] where human agents constantly draw on structure when they act, and at the same time, human actions will help to produce and reproduce the structure. This interplay between human agency and structure enables dynamic evolvement of both entities.

Structure
Structures are rules and resources that human agents draw on to direct their formation of meanings and beliefs, and guide their interpretations and actions. Giddens [4] differentiates between rule of social life and formulated rule. The former refers to “techniques or generalizable procedures applied in the enactment/reproduction of social practices” while the latter is “codified interpretations of rules rather than rules as such” [4, pp. 17-23]. As for resources, Giddens distinguishes between allocative and authoritative resources. Allocative resources are “transformative capacity generating commands over objects” while authoritative resources are “transformative capacity generating commands over persons or actors” [4, p. 33].

Since structure is made up of rules and resources, it may enable one’s actions. At the same time, it may also constrain one’s activities. When
functioning in a social setting, human agents draw on three types of structure: signification, domination, and legitimation. These three structures mediate three types of interaction (i.e., communication, power, and sanction) via three modalities (i.e., interpretive scheme, facility, and norm). Figure 1 depicts the relationships between structure and human interaction through the mediation of modality.

![Figure 1: Duality of Structure (adapted from [4, p. 29])](image)

Structure of signification informs human agents about the role of each individual in a social setting. It consists of rules, assumptions, and knowledge that define human interaction and assist human agents in making sense of on-going activities around them. The extent to which structure enables and constrains human interaction is exercised through interpretive schemes. In daily interaction, human agents draw on share meanings from the structure of signification. At the same time, their interaction will produce and reproduce the structure of signification.

Structure of domination conveys message about the power a human agent holds in a social setting. During interactions, human agents draw on the structure of domination to exercise their power. This is possible through the use of facility that provides power over the control of material products and people. Since power is mobilizable and transformable, in the process of interaction, human agents will produce and reproduce the structure of domination.

Structure of legitimation defines appropriate behavior in a social setting. It consists of norms that human agents draw upon during interaction to sanction their own and others’ conducts. Hence, norms are made up of rules or standards of morality that govern legitimate conducts. In the process of sanctioning their actions, human agents produce and reproduce the structure of legitimation.

The separation of structure into three dimensions of signification, domination, and legitimation is only for analytical purposes [4]. In practice, these dimensions are highly interdependent. Every time human agents interact with one another, they draw on existing understanding, resources available, and norms to help them define and shape their current instance of interaction. These processes constantly produce new structure and modify existing structure.

**Human Agents**

According to Giddens [4], human agents are knowledgeable beings. When interacting with others, they constantly watch their own actions and monitor the behaviors of others. They will also reflect on instances of interaction with others to make necessary changes to their subsequent actions. Even though human agents act with certain intended outcomes, their actions may bring about unintended consequences. Therefore, the production and reproduction of an accepted behavior by human agents in a social setting may uphold desirable manners. At the same instant, the process may also promote unwanted behaviors.

**A Structurational Framework of Blogging Community**

The following applies the concepts of human agents and structure to the blogging phenomenon. It describes different groups of human agents that exist in a blogging environment. It also discusses the structure of the blogging environment.

**Human Agents in a Blogging Environment**

In the blogging environment, the primary role human agents hold is that of a blogger. Bloggers, in general, can be categorized into three groups based...
on the level of activity in reading and writing blogs, (see Figure 2). The first group is “active players”. Active players regularly read and write blogs. They often write their own thoughts and opinions online. At the same time, they frequently provide commentary on others’ blogs. Even though active players may write and read individual blogs, their focus leans towards community blogs where there is high level of interaction among bloggers.

The second group is “passive on-lookers”. Passive on-lookers frequently read blogs. However, they neither write their own blogs nor comment on others’ blogs. Their goal of reading blogs is to extract and gather information. At times, passive on-lookers may treat blog reading as an entertaining activity and do so for the fun of reading what has been written by others.

The third group of bloggers is “passive players”. Passive players treat blogging as an electronic replacement of traditional diary writing. With diary writing as an agenda, the content produced by this group of bloggers is mostly personal in nature where they document their life, opinions, and thoughts [1, 9]. Even though passive players always detail their activities online, they seldom or never read others’ blogs. As such, they focus almost exclusively on their own blog sites (i.e., individual blogs).

As shown in Figure 2, there is an additional group of individuals called “non-players” who neither read nor write blogs. The categorization of bloggers into three main groups, plus an additional group of non-players meets Gidden’s view of human agents. According to Structuration Theory, human agents are strongly voluntaristic and “always have the possibility of doing otherwise” [5, p. 258]. This means every individual can choose whether they want to engage in the activity of blogging and how they want to participate in the activity. Non-players choose not to engage in blogging while active players take part vigorously in reading and writing blogs. Passive players and passive on-lookers choose different approaches to participate in blogging activities.

Since human agents are constantly evolving as a result of the production and reproduction of the structure of blogging, it is possible for bloggers to adjust the intensity at which they read and write blogs. For example, a passive on-looker may feel the need to express his/her disagreement when reading a comment that contrasts his/her belief. Similarly, the on-looker may feel the urge to support a position that coincides with his/her principle. As passive on-lookers begin to provide commentary on others’ blogs, they slowly move into the category of active players. Similar scenario may happen to passive players when they are attracted to read and comment on others’ blogs.

Another very interesting evolvement is when non-players start to move into any of the three blogger groups (see Figure 2). Such shift is evident from statistics reported by blog trackers such as technorati.com and blogpulse.com that show an increasing number of blog sites in recent years.

As more individuals join the blogging community and as more human agents become active players, there might be a need for third-party monitoring agents – i.e., the hosts of blog sites. These hosts play important roles in maintaining standards, ethics, and quality of their blog sites. For example, when a controversial topic with
undesirable consequences is being discussed or when a blogger repeatedly broken the policies of ethical posting, blog site hosts will intervene by removing those undesirable postings and by blocking future participation of the particular blogger. When comparing community blogs and individual blogs, blog site hosts seem to play a more prominent role in the former blog type.

Structuration Theory also contends that human agents are knowledgeable, therefore “every member of a society must know...a great deal about the workings of that society by virtue of his or her participation in it” [3, p. 250]. This means by being a member of the blogging community, bloggers know the modus operandi of blogs. They understand their role as bloggers. They know the topic focus of a particular blog site and they are aware of what an acceptable post is and what is not.

As knowledgeable agents, bloggers will reflectively monitor their own actions as well as others’ blogging activities. This monitoring effort is evident from activities such as bloggers updating their blog sites, reflecting on others’ write-ups, commenting on others’ blogs, and changing their opinion after reading others’ posts. Even though bloggers often write their blogs with certain intended outcomes, their articles may create unintended consequences. For example, an innocent expression of personal viewpoint may create uproar within the blogging community as well as to the structure external to the blogging community.

The Structure of a Blogging Environment

A blogging environment, bounded by its rules and resources, constitutes the structure in which the community operates. This structure is distinct from most other social structures in two ways. First, the interaction in a blogging community takes place only via texts (i.e., information posted on blog sites). This is different from traditional social structures such as that of an office setting where a group of employees work or a family setting where relatives live. In traditional structure, interaction among human agents takes place mostly face-to-face. In blogging, action and meaning are accorded primacy only through texts. This interacting method requires bloggers to have the ability to clearly and skillfully script the content of their posts in order to convey their intended messages. It may also require bloggers to read between lines in order to grasp the meaning of the writers.

Even when comparing blogging with other online text interacting media such as webpages or chat rooms, the style of interacting in blogs still constitutes a unique communication genre [2, 6, 10, 11, 12]. Specifically, the communication acts of blogs are asynchronous and asymmetrical [6, 12]. They are asynchronous because communications do not occur in real time and they are asymmetrical because communications do not occur in dyads [6, 12].

Second, the blogging community does not have any designated governing authority to formulate and impose rules and regulations. It adopts a self-regulated operating mode with very minimal if not non-existent intervention from blog site hosts. This is true especially for individual blogs. Together, the unique communication method of blogging along with its lack of governing authority shapes the three structures of signification, domination, and legitimation in the blogging community.

In a self-regulated blogging environment, members understand their own role as well as the role of other players. They recognize the responsibilities of blog site hosts, blog owners, writers, and readers. They also know the topics and contents that are appropriate for a particular blog site based on its objectives. Accordingly, bloggers will publish only suitable write-ups on the site. The knowledge bloggers have toward blogging and blog sites forms the structure of signification. This structure will evolve over time. For example, the contents of a blog site may shift from one topic area to another. Similarly, the ideology of a blog site may change from a conservative position to a liberal stance.

Structure of domination conveys message about the power of different parties in a blogging environment. The most evident one being blog site hosts who have the power to remove an inappropriate post and stop an undesirable blogger from continue participating in their blog sites. Among bloggers, opinion leaders are able to draw on their persuasive writing power to gain reader approval. They are the authoritative figure in content discussion. When they promote a message, it diffuses faster compared to the one promoted by a non-leader [9]. Thus, opinion leaders are able to draw on the structure of domination to champion their course and strengthen their position. Since power is mobilizable, it is possible for another opinion leader to emerge and replace the existing blog leader.

Structure of legitimation defines appropriate and ethical blogging behavior. It informs bloggers what is expected of blog contents and what type of language is acceptable. Whenever a blogger violates this expectation, the members will react. For example, they may express their disapproval with the blogger. In a worse case, they may censure the blogger.

As bloggers interaction, existing structures of
signification, domination, and legitimation will be produce and reproduce over time. At any point in time, the structure available represents the most up-to-date system recognized and abided by the community of bloggers.

Conclusions
Blogging is an emerging phenomenon that draws massive followings. Considering the popularity and the pervasiveness of blogging activities, it is essential for us to understand how the community is being formed and operated despite the lack of specific governing bodies to formulate and impose rules and practices. As a widely cited theory in information systems research, Structuration Theory serves as a useful framework to understand the formation and functioning of a blogging community. The theory also explains how a blogging community evolves over time in terms of its structure and content.

Such an understanding is valuable to organizations. Specifically, organizations can ride on the popularity of blogging to establish dialogues between management and employees so as to improve the relationships between both parties. They can also use blogs to educate and garner employee supports toward organizational policy change and implementation.

References
Cross-Entropy of Uncertain Variables

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Abstract
In order to deal with the divergence of uncertain variables from a prior one, this paper is devoted to introduce the concept of cross-entropy for uncertain variables and study the minimum cross-entropy principle. 

Keywords: Uncertain variable, cross-entropy, minimum cross-entropy principle.

1 Introduction

Entropy is used to provide a quantitative measurement of the degree of uncertainty. Inspired by Shannon, the entropy of random variables (Shannon [21]), fuzzy entropy was first initialized by Zadeh [24] to quantify the fuzziness, who defined the entropy of a fuzzy event as a weighted Shannon entropy. Up to now, fuzzy entropy has been studied by many researchers such as De Luca and Termini [4], Kaufmann [7], Yager [22], Kosko [8], Pal and Pal [18], Pal and Bezdek [19]. However, the above definitions of entropy describe the uncertainty resulting from the difficulty in deciding whether or not an element belongs to a set, i.e., they characterize the uncertainty resulting from linguistic vagueness rather than information deficiency, and vanishes when the fuzzy variable is an equipossible one. Liu [12] proposed that an entropy should meet the following three requirements. Minimum: the entropy of a crisp number is minimum, i.e., 0. Maximum: the entropy of an equipossible fuzzy variable is maximum. Universality: the entropy is applicable not only to finite and infinite cases but also to discrete and continuous cases. Based on these requirements, Li and Liu [9] provided a new definition of fuzzy entropy to characterize the uncertainty resulting from information deficiency.

In order to study the uncertainty in human systems, Liu [13] founded uncertainty theory, which is a branch of mathematics based on normality, monotonicity, self-duality, countable subadditivity, and product measure axioms. Up to today, uncertainty theory have been widely applied to uncertain programming(Liu [16]), uncertain logic (Li and Liu [10]), uncertain entailment (Liu [11]), uncertain inference (Liu [15]), uncertain process (Liu [14]), uncertain differential equation and uncertain optimal control and so on. Based on the uncertain measure, Liu [15] provided the definition of uncertain entropy to characterize the uncertainty of uncertain variables resulting from information deficiency. In many real cases, only partial information about uncertain variable such as expected value and variance is available. However, there are infinite number of uncertainty distributions consistent with the given information. For random variables, Jaynes [6] suggested to choose the distribution which has the maximum entropy, which is the maximum entropy principle. Chen and Dai [2] investigate the maximum entropy principle of uncertainty distribution for uncertain variables. In order to compute the entropy more conveniently, Dai and Chen [3] proves some formulas of entropy of function of uncertain variables with regular uncertain distributions.

Based on the De Luca and Termini’s fuzzy entropy, Bhandari and Pal [1] defined a cross-entropy for fuzzy set via membership function. In order to deal with the divergence of uncertain variables from a prior one, this paper will introduce the concept of cross-entropy of uncertainty distributions for uncertain variables and study the minimum cross-entropy principle. The rest of the paper is organized as follows. Some preliminary concepts of uncertainty theory are recalled in section 2. The concept of entropy for uncertain variables is introduced in section 3, and some useful examples are calculated. Maximum entropy principle theorem for uncertain variables is proved in Section 4. The definition of cross-entropy is proposed in section 5. The minimum cross-entropy principle is investigated in section 6. At last, a brief summary is given in Section 7.

2 Preliminary

Let Ω be a nonempty set, and ℒ a σ-algebra over Ω. Each element Λ ∈ ℒ is assigned a number ℳ{Λ}.

Definition 1 (Liu[13]) The set function ℳ is called an uncertain measure if it satisfies the following four axioms:

Axiom 1. (Normality) ℳ{Ω} = 1;
Axiom 2. (Monotonicity) ℳ{Λ₁} ≤ ℳ{Λ₂} whenever Λ₁ ⊆ Λ₂;
Axiom 3. (Self-Duality) ℳ{Λ} + ℳ{Λᶜ} = 1 for any event Λ;
Axiom 4. (Countable Subadditivity) For every countable
sequence of events \( \{ A_i \} \), we have
\[
\mathcal{M} \left\{ \bigcup_{i=1}^{\infty} A_i \right\} \leq \sum_{i=1}^{\infty} \mathcal{M} \{ A_i \}.
\]

Some properties of uncertain measure have been studied by You [23] and Gao [5]. An uncertain variable is a measurable function from an uncertainty space \((\Gamma, \mathcal{L}, \mathcal{M})\) to the set of real numbers. The uncertainty distribution function \( \Phi : \mathbb{R} \to [0,1] \) of an uncertain variable \( \xi \) is defined as \( \Phi(x) = \mathcal{M} \{ \xi \leq x \} \). It has been proved by Peng and Iwamura [20] that a function is an uncertainty distribution function if and only if it is an increasing function except \( \Phi(x) = 0 \) and \( \Phi(x) = 1 \). The expected value of an uncertain variable was defined by Liu as
\[
E[\xi] = \int_0^{+\infty} \mathcal{M} \{ \xi \geq r \} dr - \int_{-\infty}^{0} \mathcal{M} \{ \xi \leq r \} dr
\]
provided that at least one of the two integrals is finite. Furthermore, the variance is defined as \( E[(\xi - E[\xi])^2] \). Some useful examples of uncertainty distribution functions are recalled following.

**Example 1** An uncertain variable \( \xi \) is called linear if it has a linear uncertainty distribution.
\[
\Phi(x) = \begin{cases} 0, & \text{if } x < a \\ (x-a)/(b-a), & \text{if } a \leq x \leq b \\ 1, & \text{if } x > b \end{cases}
\]
denoted by \( \mathcal{L}(a,b) \) where \( a \) and \( b \) are real numbers with \( a < b \). The expected value of \( \xi \) is \( (b-a)/2 \) and the variance \( (b-a)^2/12 \).

**Example 2** An uncertain variable \( \xi \) is called zigzag if it has a zigzag uncertainty distribution.
\[
\Phi(x) = \begin{cases} 0, & \text{if } x < a \\ (x-a)/(2(b-a)), & \text{if } a \leq x < b \\ (x+c-2b)/(2(c-b)), & \text{if } b \leq x \leq c \\ 1, & \text{if } x > c \end{cases}
\]
denoted by \( \mathcal{Z}(a,b,c) \) where \( a \), \( b \) and \( c \) are real numbers with \( a < b < c \). The expected value of \( \xi \) is \( (a+2b+c)/4 \).

**Definition 2** (Liu [15]) The uncertain variables \( \xi_1, \xi_2, \ldots, \xi_m \) are said to be independent if
\[
\mathcal{M} \left\{ \bigcap_{i=1}^{m} \xi_i \in B_i \right\} = \min_{1 \leq i \leq m} \mathcal{M} \{ \xi_i \in B_i \} \quad (1)
\]
for any Borel sets \( B_1, B_2, \ldots, B_m \) of real numbers.

**Example 3** Let \( \xi \) be an uncertain variable with uncertainty distribution function
\[
\Phi(x) = \left( 1 + \exp \left( \frac{\pi(e-x)}{\sqrt{3}\sigma} \right) \right), \quad -\infty < x < +\infty, \ \sigma > 0.
\]
Then the expected value of \( \xi \) \( E[\xi] = e \) and variance \( V[\xi] = \sigma^2 \).

**Remark 1** Let \( \xi \) and \( \eta \) be independent normal uncertain variables with expected values \( e_1 \) and \( e_2 \), variances \( \sigma_1^2 \) and \( \sigma_2^2 \), respectively. Then the uncertain variable \( a_1\xi + a_2\eta \) is also normal with expected value \( a_1e_1 + a_2e_2 \) and \( (\|a_1\|\sigma_1 + |a_2|\sigma_2)^2 \) for any real numbers \( a_1 \) and \( a_2 \).

For the up-to-date uncertainty theory, the readers may consult Liu [17]

**Definition 3** (Liu [15]) Let \( \xi \) be an uncertain variable with uncertainty distribution \( \Phi(x) \). Then its entropy is defined by
\[
H[\xi] = \int_{-\infty}^{+\infty} S(\Phi(x)) dx
\]
where \( S(t) = -t \ln t - (1-t) \ln(1-t) \).
Note that \( S(t) = -t \ln t - (1-t) \ln(1-t) \) is strictly concave on \([0, 1]\) and symmetrical about \( t = 0.5 \). Then \( H[\xi] \geq 0 \) for all the uncertain variables.

**Theorem 1** (Chen and Dai[2]) Let \( \xi \) be a continuous uncertain variable with finite expected value \( e \) and variance \( \sigma^2 \). Then
\[
H[\xi] \leq \frac{\pi\sigma}{\sqrt{3}}
\]
and the equality holds if \( \xi \) is a normal uncertain variable with expected value \( e \) and variance \( \sigma^2 \), i.e., \( \mathcal{N}(e, \sigma) \).

## 3 Cross-Entropy for Uncertain Variables

In this section, we will introduce the concept of cross-entropy for uncertain variables by uncertain measure. For convenience, we denote
\[
T(s, t) = s \ln \left( \frac{s}{t} \right) + (1-s) \ln \left( \frac{1-s}{1-t} \right),
\]
with convention \( 0 \cdot \ln 0 = 0 \). It is obvious that \( T(s, t) = T(1-s, 1-t) \) for any \( 0 \leq s \leq 1 \) and \( 0 \leq t \leq 1 \). Note that
\[
\frac{\partial T}{\partial s} = \ln \left \frac{s}{t} \right \frac{1-s}{1-t} \ \frac{\partial T}{\partial t} = \frac{1}{t(1-t)}
\]
\[
\frac{\partial^2 T}{\partial s^2} = \frac{1}{s(1-s)} \ \frac{\partial^2 T}{\partial t^2} = \frac{1}{(1-t)^2}
\]
Then \( T(s, t) \) is a strictly convex function with respect to \( (s, t) \) and reaches its minimum value 0 when \( s = t \).

**Definition 4** Let \( \xi \) and \( \eta \) be two continuous uncertain variables. Then the cross-entropy of \( \xi \) from \( \eta \) is defined as
\[
D[\xi; \eta] = \int_{-\infty}^{+\infty} T(\mathcal{M} \{ \xi \leq x \}, \mathcal{M} \{ \eta \leq x \}) dx
\]
where \( T(s, t) = s \ln \left( \frac{s}{t} \right) + (1-s) \ln \left( \frac{1-s}{1-t} \right) \).

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It is obvious that \(D[\xi; \eta]\) is permutationally symmetric, i.e., the value does not change if the outcomes are labeled differently. Let \(\Phi_\xi\) and \(\Phi_\eta\) be the distribution functions of continuous uncertain variables \(\xi\) and \(\eta\), respectively. The cross-entropy of \(\xi\) from \(\eta\) can be written as

\[
D[\xi; \eta] = \int_{-\infty}^{+\infty} \left( \Phi_\xi(x) \ln \left( \frac{\Phi_\xi(x)}{\Phi_\eta(x)} \right) + (1 - \Phi_\xi(x)) \ln \left( \frac{1 - \Phi_\xi(x)}{1 - \Phi_\eta(x)} \right) \right) dx.
\]

The cross-entropy depends only on the number of values and their uncertainties and does not depend on the actual values that the uncertain variables that \(\xi\) and \(\eta\) take.

**Lemma 1** For any uncertain variables \(\xi\) and \(\eta\), we have \(D[\xi; \eta] \geq 0\) and the equality holds if and only if \(\xi\) and \(\eta\) have the same uncertainty distribution.

**Proof:** Let \(\Phi_\xi(x)\) and \(\Phi_\eta(x)\) be the uncertainty distribution functions of \(\xi\) and \(\eta\), respectively. Since \(T(s, t)\) is strictly convex on \([0, 1] \times [0, 1]\) and reaches its minimum value when \(s = t\). Therefore

\[
T(\Phi_\xi(x); \Phi_\eta(x)) \geq 0
\]

for almost all the points \(x \in \mathbb{R}\). Then

\[
D[\xi; \eta] = \int_{-\infty}^{+\infty} T(\Phi_\xi(x); \Phi_\eta(x)) dx \geq 0.
\]

For each \(s \in [0, 1]\), there is only a unique point \(t = s\) making \(T(s, t) = 0\). Thus, \(D[\xi, \eta] = 0\) if and only if \(T(\Phi_\xi(x), \Phi_\eta(x)) = 0\) for almost all the \(x \in \mathbb{R}\), that is \(\mathcal{M}\{\xi \leq x\} = \mathcal{M}\{\eta \leq x\}\).

**4 Minimum Cross-Entropy Principle**

In the real problems, the distribution function of an uncertain variable is unavailable except partial information, for example, prior distribution function, which may be based on intuition or experience with the problem. If the moment constraints and the prior distribution function are given, since the distribution function must be consistent with the given information and our experiences, therefore we will use the minimum cross-entropy principle to choose the one that is closest to the given prior distribution function out of all the distributions satisfying the given moment constraints.

**Theorem 2** Let \(\xi\) be a continuous uncertain variable with finite second moment \(m^2\). If the prior distribution function has the form

\[
\Psi(x) = (1 + \exp(ax))^{-1}, \quad a < 0.
\]

Then the minimum cross-entropy distribution function is the normal uncertain distribution with second moment \(m^2\).

**5 Conclusion**

This paper introduces the concept of cross-entropy of uncertainty distribution for uncertain variables to deal with the divergence of uncertain variables from a prior one, and studies the minimum cross-entropy principle.

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**References**

Abstract

This paper discusses random fuzzy queueing systems with finite capacity, where the interarrival times and service times are characterized as random fuzzy variables. Fuzzy simulation techniques are designed to estimate the membership degree, the expected value of system length, and the credibility measure that the system length does not exceed a predetermined level. Furthermore, the rough figures of the membership function and credibility distribution function of the system length can be obtained. Finally, an example is given to illustrate the effectiveness of the presented techniques.

Keywords: Queueing systems; Fuzzy variable; Random fuzzy variable; Fuzzy simulation; Credibility distribution

1 Introduction

The finite-capacity queueing systems have been widely studied by many researchers such as Gouweleeuw and Tijms [4], Brethauer and Cote [1], Wagner [16], and Gross and Harris [5]. In the traditional queueing theory, the interarrival times and service times are characterized as random variables. It means that statistical data are needed to determine the distribution functions of interarrival times and service times. However, in many practical queueing systems, it is difficult or impossible to obtain the statistical data needed. In fact, in modelling queueing systems, one would describe the interarrival times and service times by linguistic terms such as very fast, fast, moderate or slow rather than by random variables. Thus, fuzzy queueing systems are much more realistic than the traditional queueing systems [2].

To handle fuzzy phenomena, Zadeh [17] initiated the concept of fuzzy set via membership function. In order to measure a fuzzy event, Zadeh [18] proposed the concepts of possibility measure and possibility space, which have been well developed by many researchers such as Nahmias [14], Dubois and Prade [3], Klir [7], Liu [8–11], and Liu and Liu [12]. Nowadays, the issue of applying the possibility theory to queueing systems with finite capacity has attracted a lot of researchers such as Li and Lee [13], Negi and Lee [15], Kao et al [6], and Chen [2].

More precisely, Li and Lee [13] proposed a general approach for analyzing fuzzy queueing systems. However, as commented by Negi and Lee [15], this approach is very complicated and generally unsuitable for computational purposes. Negi and Lee [15] proposed an approach by using the α-level sets and two-variable simulation to analyze fuzzy queueing systems. Kao et al [6] adopted parametric programming to construct the membership functions of the performance measures for fuzzy queueing systems, and this approach was successfully applied to four simple fuzzy queueing systems with one or two fuzzy variables. Chen [2] developed a method that could construct the membership functions of the performance measures in finite-capacity queueing systems with fuzzified exponential arrival rate and service rate.

However, the possibility measure is not self-dual while a self-dual measure is very necessary in both theory and practical applications. This property of possibility measure will result in the phenomenon that an event may not occur even if its possibility is 1. This is the greatest shortcoming for possibility measure since it is very hard for a decision maker to make decision based on possibility measure. In order to overcome the drawback of possibility measure, Liu and Liu [12] proposed the concept of credibility measure of a fuzzy event, and introduced the concept of expected value of fuzzy variable based on the credibility measure. Liu [8] presented the concept of credibility distribution of a fuzzy variable. Furthermore, to handle the phenomena combined with randomness and fuzziness, Liu [8, 9] introduced the concept of random fuzzy variables. This paper discusses random fuzzy queueing systems with finite capacity, where the arrival rate and service rate are fuzzy variables with arbitrary membership functions, then presents fuzzy simulation techniques to analyze the queueing system performance.

The rest of this paper is organized as follows. Some concepts and results on fuzzy variables and random fuzzy variables are introduced in Section 2. The queueing systems with finite capacity containing random fuzzy variables are discussed in Section 3. The fuzzy simulation techniques are designed to analyze the queueing system performance in Section 4. Finally, an example is given to illustrate the effectiveness of the presented techniques.
2 Fuzzy variables and random fuzzy variables

In this section, we review some basic concepts and results on fuzzy variables and random fuzzy variables, which are used throughout the paper.

Definition 1 (Zadeh [18]) Let $\Theta$ be a nonempty set, $\mathcal{P}(\Theta)$ the power set of $\Theta$, and Pos a function from $\mathcal{P}(\Theta)$ to the set of real numbers. Then Pos is called a possibility measure if it satisfies the following three axioms:

1) $\text{Pos}\{\emptyset\} = 1$;
2) $\text{Pos}\{\emptyset\} = 0$;
3) $\text{Pos}\left(\bigcup A_i\right) = \sup\{\text{Pos}\{A_i\} : \text{for any set } A_i \in \mathcal{P}(\Theta)\}$. Furthermore, the triplet $(\Theta, \mathcal{P}(\Theta), \text{Pos})$ is called a possibility space.

Definition 2 (Nahmias [14]) A fuzzy variable is defined as a function from the possibility space $(\Theta, \mathcal{P}(\Theta), \text{Pos})$ to the set of real numbers.

Definition 3 Let $\xi$ be a fuzzy variable on the possibility space $(\Theta, \mathcal{P}(\Theta), \text{Pos})$. Then its membership function is derived from the possibility measure by

\[
\mu(x) = \text{Pos}\{\theta \in \Theta \mid \xi(\theta) = x\}, \quad x \in \mathbb{R}.
\]

Example 1 Let $\xi = (a, b, c)$ be a triangular fuzzy variable with $a < b < c$. Then its membership function is

\[
\mu(x) = \begin{cases} 
\frac{x-a}{b-a}, & \text{if } a \leq x \leq b \\
\frac{x-c}{b-c}, & \text{if } b < x \leq c \\
0, & \text{otherwise}.
\end{cases}
\]

Definition 4 (Zadeh [19]) Let $(\Theta, \mathcal{P}(\Theta), \text{Pos})$ be a possibility space, and $A$ a set in $\mathcal{P}(\Theta)$. Then the necessity measure of $A$ is defined by

\[
\text{Nec}\{A\} = 1 - \text{Pos}\{A^c\}
\]

where $A^c$ is the complementary set of $A$.

Remark 1 (Liu and Liu [12]) It is obvious that neither the possibility measure nor the necessity measure is self-dual, i.e., the possibility (necessity) of a fuzzy event plus the possibility (necessity) of its opposite event is not equal to 1.

Based on possibility measure and necessity measure, Liu and Liu [12] proposed the concept of credibility measure.

Definition 5 (Liu and Liu [12]) Let $(\Theta, \mathcal{P}(\Theta), \text{Pos})$ be a possibility space, and $A$ a set in $\mathcal{P}(\Theta)$. Then the credibility measure of $A$ is defined by

\[
\text{Cr}\{A\} = \frac{1}{2}\{\text{Pos}\{A\} + \text{Nec}\{A\}\}.
\]

Remark 2 (Liu and Liu [12]) The credibility measure is self-dual, i.e.,

\[
\text{Cr}\{A\} + \text{Cr}\{A^c\} = 1.
\]

Example 2 Let $\xi = (1, 2, 3)$ be a triangular fuzzy variable. It is easy to obtain that $\text{Pos}\{\xi \leq 2\} = 1$, $\text{Nec}\{\xi \leq 2\} = 0$, and $\text{Cr}\{\xi \leq 2\} = 0.5$, while $\text{Pos}\{\xi > 2\} = 1$, $\text{Nec}\{\xi > 2\} = 0$, and $\text{Cr}\{\xi > 2\} = 0.5$.

Proposition 1 (Liu [10]) Suppose that $(\Theta_i, \mathcal{P}(\Theta_i), \text{Pos}_i)$ are possibility spaces, $i = 1, 2, \ldots, n$. Let $\Theta = \Theta_1 \times \Theta_2 \times \cdots \times \Theta_n$ and $\text{Pos} = \text{Pos}_1 \wedge \text{Pos}_2 \wedge \cdots \wedge \text{Pos}_n$. Then the set function Pos is a possibility measure, and $(\Theta, \mathcal{P}(\Theta), \text{Pos})$ is a possibility space. Furthermore, $(\Theta, \mathcal{P}(\Theta), \text{Pos})$ is called the product possibility space.

Definition 6 (Liu and Liu [12]) Let $\xi$ be a fuzzy variable on the possibility space $(\Theta, \mathcal{P}(\Theta), \text{Pos})$. Then the expected value $E[\xi]$ is defined as

\[
E[\xi] = \int_{-\infty}^{+\infty} \text{Cr}\{\xi \geq r\}dr - \int_{-\infty}^{0} \text{Cr}\{\xi \leq r\}dr
\]

provided that at least one of the two integrals is finite. Especially, if $\xi$ is a nonnegative fuzzy variable, then

\[
E[\xi] = \int_{0}^{+\infty} \text{Cr}\{\xi \geq r\}dr.
\]

Example 3 (Liu and Liu [12]) The triangular fuzzy variable $\xi = (a, b, c)$ has an expected value

\[
E[\xi] = \frac{1}{4}(a + 2b + c).
\]

Definition 7 (Liu [8]) The credibility distribution $\Phi$: $\mathcal{R} \rightarrow [0, 1]$ of a fuzzy variable $\xi$ is defined by

\[
\Phi(x) = \text{Cr}\{\theta \in \Theta \mid \xi(\theta) \leq x\}.
\]

That is, $\Phi(x)$ is the credibility that the fuzzy variable $\xi$ takes a value less than or equal to $x$.

Definition 8 (Liu [8]) A random fuzzy variable is defined as a function from the possibility space $(\Theta, \mathcal{P}(\Theta), \text{Pos})$ to the set $\mathcal{F}$ of random variables.

Example 4 In a queueing system, let $\xi$ be the interarrival time of customer arrivals. Usually, the probability distribution of $\xi$ is assumed to be known completely except for the values of one or more parameters. For example, the interarrival time $\xi$ might be known as an exponentially distributed random variable with an unknown mean $\lambda$, whose probability density function is

\[
\phi(x) = \begin{cases} 
\lambda e^{-\lambda x}, & \text{if } 0 \leq x < +\infty \\
0, & \text{otherwise}.
\end{cases}
\]

If $\lambda$ is characterized as a fuzzy variable defined on the possibility space $(\Theta, \mathcal{P}(\Theta), \text{Pos})$, then $\xi$ is just a random fuzzy variable denoted by

\[
\xi(\lambda(\theta)) \sim \mathcal{E}(\lambda(\theta)).
\]
Remark 3 (Liu [8]) Roughly speaking, if \( \Theta \) consists of one single element only, then the random fuzzy variable degenerates to a random variable. If \( \mathcal{F} \) is a collection of real numbers (rather than random variables), then the random fuzzy variable degenerates to a fuzzy variable.

3 Random fuzzy queueing systems with finite capacity

Consider a stochastic queueing system with finite capacity \( \text{M/M/1/FCFS/K/\infty} \), in which there is one server. Customers arrive at the single server as a Poisson process with an arrival rate \( \lambda \), and all service times are independent and identically distributed exponential random variables with service rate \( v \). The queue discipline is first come, first served (FCFS). There is a limit \( K \) placed on the number allowed in the system at any time, and the size of source population is infinite.

In statistics, the values of \( \lambda \) and \( v \) are estimated by the interval estimate or point estimate method. However, in many practical queueing systems, the data needed in these methods can not be obtained. Therefore, it is very difficult or impossible to obtain the exact values of \( \lambda \) and \( v \). In such a case, it is reasonable that \( \lambda \) and \( v \) are characterized as fuzzy variables according to experts’ experiences. By Definition 8, the interarrival times and service times are all random fuzzy variables. Such queueing systems are called random fuzzy queueing systems with finite capacity, which is denoted by \( \text{RF/RF/1/FCFS/K/\infty} \), where \( \text{RF} \) denotes that interarrival times and service times are random fuzzy variables. The following example explains the concept of random fuzzy queueing systems with finite capacity.

Example 5 There is a new petrol station with a single pump and finite space for no more than 10 cars (9 waiting, 1 being served), i.e., \( K = 10 \). Cars arrive at the petrol station according to a Poisson process, and service time has an exponential distribution. Due to lack of historical data on arrivals and service time, the arrival rate \( \lambda \) and service rate \( v \) can not be determined exactly. In such a case, by some relevant experts’ experiences, \( \lambda \) and \( v \) are characterized as the fuzzy variables with the membership functions

\[
\mu_1(x) = \left[ 1 - (x - 1)^2 \right] \lor 0 \quad \text{and} \quad \mu_2(x) = e^{-(x-2)^2},
\]

respectively. Then the queueing system is just a random fuzzy queueing system with finite capacity.

Remark 4 If \( \lambda \) and \( v \) degenerate to crisp numbers, then the random fuzzy queueing system \( \text{RF/RF/1/FCFS/K/\infty} \) is just the traditional queueing system \( \text{M/M/1/FCFS/K/\infty} \).

Remark 5 If we ignore the fuzziness of the arrival rate and service rate when they can not be obtained exactly, it is reasonable for us to employ their expected values to denote them. Such a case is very similar to the case of using a deterministic value instead of a random variable in stochastic environments. Therefore, it is much more realistic that the arrival rate and service rate are characterized as fuzzy variables when they can not be obtained exactly.

4 Analysis on random fuzzy queueing systems with finite capacity

There are many indices to measure the queueing system performance, such as system length, queue length, waiting time, etc. Without loss of generality, we take system length as the performance measure of queueing systems. In stochastic environments, the expected value of system length of the queueing system \( \text{M/M/1/FCFS/K/\infty} \) is

\[
L(\lambda, v) = \frac{\lambda [K\lambda^{K+1} - v(K + 1)\lambda^K + v^{K+1}]}{(\lambda - v)(\lambda^{K+1} - v^{K+1})},
\]

where \( \lambda < v \) (see [5]).

In the random fuzzy queueing system \( \text{RF/RF/1/FCFS/K/\infty} \), \( \lambda \) and \( v \) are characterized as fuzzy variables on the possibility spaces \( \Theta_1, P(\Theta_1), P_0 \) and \( \Theta_2, P(\Theta_2), P_0 \), respectively. Therefore, \( L(\lambda, v) \) is a fuzzy variable defined on the product possibility space \( \Theta \times P(\Theta), P_0 \), where \( \Theta = \Theta_1 \times \Theta_2 \) and \( P_0 = P_0 \). Apparently, \( L(\lambda, v) \) is a nonnegative fuzzy variable. By Definition 6, the expected value of \( L(\lambda, v) \) can be written as

\[
E[L(\lambda, v)] = \int_0^{+\infty} \text{Cr} \{ L(\lambda, v) \geq r \} \, dr.
\]

The credibility distribution \( \Phi : \mathcal{R} \rightarrow [0,1] \) of the system length \( L(\lambda, v) \), by Definition 7, is

\[
\Phi(x) = \text{Cr} \{ L(\lambda, v) \leq x \}.
\]

That is, \( \Phi(x) \) is the credibility measure that the system length \( L(\lambda, v) \) does not exceed \( x \).

In many real queueing systems, it is very hard to compute the membership degree \( \mu_\lambda(x) \), the expected value \( E[L(\lambda, v)] \) and the credibility measure \( \text{Cr} \{ L(\lambda, v) \leq x \} \). Therefore, it is necessary to design fuzzy simulation techniques to estimate these values. For more details on fuzzy simulation techniques, see [12].

4.1 Fuzzy simulation for the membership degree \( \mu_\lambda(x) \)

The fuzzy simulation technique for estimating the membership degree \( \mu_\lambda(x) \) is described as follows.

1) Set \( k = 1 \).
2) Let \( x_k = \frac{K_k}{M} \), and \( \mu_k = 0 \), where \( M \) is a sufficiently large integer.
3) Uniformly generate a number \( \lambda_1 \) from the support of \( \lambda \), then calculate the membership degree of \( \lambda_1 \) according to the membership function of \( \lambda \), written as \( v_1 \).

4) Replace \( L(\lambda, v) \), \( \lambda \) and \( v \) in Eq. (3) with \( x_k, \lambda_1 \) and \( y \), respectively, then Eq. (3) becomes the following polynomial equation

\[
x_ky^{K+2} - (\lambda_1 + x_k\lambda_1)y^{K+1} + (K + 1 - x_k)\lambda_1^{K+1}y + (x_k - K)\lambda_1^{K+2} = 0.
\]

Solve Eq. (5) by the dichotomy method, and calculate the membership degree of the solution according to the membership function of \( v \), written as \( v_2 \).

5) Set \( \text{temp} = v_1 \wedge v_2 \).

6) If \( \mu_k < \text{temp} \), then set \( \mu_k = \text{temp} \).

7) Repeat Steps 3 to 6 \( N \) times, where \( N \) is a sufficiently large integer.

8) Set \( k = k + 1 \). If \( k \leq M \), return to Step 2. Otherwise, output \( (x_i, \mu_i) \), where \( i = 1, 2, \ldots, M \).

**Example 6** Let us continue to discuss the random fuzzy queueing system in Example 5. It is easy to obtain that

\[
L(\lambda, v) = \frac{10\lambda^{12} - 11v\lambda^{11} + 2v^{11}}{(\lambda - v)(\lambda^{11} - v^{11})},
\]

where \( \lambda \) and \( v \) are the fuzzy variables with the membership functions \( \mu_1(x) = [1 - (x - 1)^2] \vee 0 \) and \( \mu_2(x) = e^{-(x-2)^2} \), respectively. The rough figure of the membership function of \( L(\lambda, v) \) is shown in Figure 1.

![Figure 1: Rough Shape of \( \mu_L(x) \) in Example 6](image)

4.2 Fuzzy simulation for the expected value \( E[L(\lambda, v)] \)

The fuzzy simulation technique for estimating \( E[L(\lambda, v)] \) is summarized as follows.

1) Set \( e = 0 \).

2) Uniformly generate \( (\theta_{k1}, \theta_{k2}) \) from \( \Theta_1 \times \Theta_2 \) such that \( p_k \geq \varepsilon \) for \( k = 1, 2, \ldots, N \), where \( p_k = \text{Pos}(\theta_{k1}) \wedge \text{Pos}(\theta_{k2}) \), \( \varepsilon \) is a sufficiently small positive number, and \( N \) is a sufficiently large integer.

3) Set

\[
a = L(\lambda(\theta_{11}), v(\theta_{12})) \land \cdots \land L(\lambda(\theta_{N1}), v(\theta_{N2})),
b = L(\lambda(\theta_{11}), v(\theta_{12})) \lor \cdots \lor L(\lambda(\theta_{N1}), v(\theta_{N2})).
\]

4) Uniformly generate \( r \) from \([a, b]\). Set \( e = e + \text{Cr}\{L(\lambda, v) \geq r\} \), where

\[
\text{Cr}\{L(\lambda, v) \geq r\} = \frac{1}{2} \left( \max_{1 \leq k \leq N} \{ p_k \mid L(\lambda(\theta_{k1}), v(\theta_{k2})) \geq r \} \right)
+ \min_{1 \leq k \leq N} \{ 1 - p_k \mid L(\lambda(\theta_{k1}), v(\theta_{k2})) < r \}.
\]

5) Repeat the fourth step for \( N \) times.

6) Compute \( E = a \lor 0 + b \land 0 + e \cdot (b - a) / N \), then output \( E \).

**Example 7** Let us continue to discuss the random fuzzy queueing system in Example 5. After 5000 cycles, the estimate of \( E[L(\lambda, v)] \) is reported by fuzzy simulation technique as 3.5201. The variations of the estimate with different numbers of cycles are shown in Figure 2, where the straight line represents the real value of \( E[L(\lambda, v)] \), and the curve represents the variations of the estimates with different numbers of cycles. It is easy to see that the estimates approach the real value when the number of cycles is larger than 2000.

![Figure 2: Variations of the Estimates of \( E[L(\lambda, v)] \) in Example 7](image)
4.3 Fuzzy simulation for the credibility measure 

\[ \text{Cr}\{L(\lambda, v) \leq x\} \]

The fuzzy simulation technique for estimating \( \text{Cr}\{L(\lambda, v) \leq x\} \) is summarized as follows.

1) Uniformly generate \((\theta_{k1}, \theta_{k2})\) from \(\Theta_1 \times \Theta_2\) such that \(p_k \geq \varepsilon\) for \(k = 1, 2, \ldots, N\), where \(p_k = \text{Pos}(\theta_{k1}) \land \text{Pos}(\theta_{k2})\). \(\varepsilon\) is a sufficiently small positive number, and \(N\) is a sufficiently large integer.

2) Compute

\[ M = \frac{1}{2} \left( \max_{1 \leq k \leq N} \{p_k \mid L(\lambda(\theta_{k1}), v(\theta_{k2})) \leq x\} \right) \]

\[ + \min_{1 \leq k \leq N} \{1 - p_k \mid L(\lambda(\theta_{k1}), v(\theta_{k2})) > x\}, \]

then output \(M\).

**Example 8** Let us continue to discuss the random fuzzy queueing system in Example 5. We use the fuzzy simulation technique proposed to estimate the credibility measure \(\text{Cr}\{L(\lambda, v) \leq 5\}\). After 5000 cycles, the estimate of \(\text{Cr}\{L(\lambda, v) \leq 5\}\) is 0.6305. The variations of the estimates with different numbers of cycles are shown in Figure 3, where the straight line represents the real value of \(\text{Cr}\{L(\lambda, v) \leq 5\}\), and the curve represents the variations of the estimates. It is easy to see that the estimates approach the real value when the number of cycles is larger than 2000.

![Figure 3](image3.png)

**Figure 3**: Variations of the Estimates of \(\text{Cr}\{L(\lambda, v) \leq 5\}\) in Example 8

By using the fuzzy simulation technique proposed to estimate \(\text{Cr}\{L(\lambda, v) \leq x\}\), where \(x \in (0, 10)\), the rough figure of the credibility distribution function \(\Phi(x)\) of the system length \(L(\lambda, v)\) can be seen, which is depicted in Figure 4 (5000 cycles in fuzzy simulation for every credibility measure \(\text{Cr}\{L(\lambda, v) \leq x\}\)).

![Figure 4](image4.png)

**Figure 4**: The Credibility Distribution Function \(\Phi(x)\) in Example 8

5 Numerical example

**Example 9** Consider a random fuzzy queueing system \(RF/RF/I/FCFS/K/\infty\). Let the arrival rate be the fuzzy variable \(\lambda\) with the membership function

\[ \mu_\lambda(x) = \begin{cases} 
1 - (x - 1)^2, & \text{if } 0 \leq x \leq 2 \\
1 - (x - 3)^2, & \text{if } 2 < x \leq 4 \\
0, & \text{otherwise},
\end{cases} \]

the service rate be the triangular fuzzy variable \(v = (3, 5, 7)\), and the system capacity \(K = 100\).

It is easy to obtain that

\[ L(\lambda, v) = \frac{100\lambda^{102} - 101v\lambda^{101} + \lambda^{101}}{(\lambda - v)(\lambda^{101} - v^{101})}. \]

Apparently, since the membership function of arrival rate \(\lambda\) is multimodal, the methods presented in [2] and [6] cannot apply to this queueing system. The fuzzy simulation techniques proposed in Section 4 can be used to estimate the membership degree \(\mu_L(x)\), the expected value \(E[L(\lambda, v)]\), and the credibility measure \(\text{Cr}\{L(\lambda, v) \leq x\}\).

The rough figure of the membership function of \(L(\lambda, v)\) is shown in Figure 5.

![Figure 5](image5.png)

**Figure 5**: Rough Figure of \(\mu_L(x)\) in Example 9

After 5000 cycles, the estimate of \(E[L(\lambda, v)]\) is reported by fuzzy simulation technique as 49.8414. The variations of the estimate of \(E[L(\lambda, v)]\) with different numbers of cycles are shown in Figure 6, where the straight line represents the real value of \(E[L(\lambda, v)]\), and the curve represents the variations of the estimate of
$E[L(\lambda, v)]$. It is easy to see that the estimates approach the real value when the number of cycles is larger than 2000.

![Figure 6: Variations of the Estimates of $E[L(\lambda, v)]$ in Example 9](image)

After 5000 cycles, the estimate of $C_r\{L(\lambda, v) \leq 50\}$ is 0.5001. The variations of the estimate with different numbers of cycles are shown in Figure 7, where the straight line represents the real value of the credibility measure $C_r\{L(\lambda, v) \leq 50\}$, and the curve represents the variations of the estimates obtained by the fuzzy simulation technique. It is easy to see that the estimates approach the real value when the number of cycles is larger than 2000.

By using fuzzy simulation technique to estimate $C_r\{L(\lambda, v) \leq x\}$, where $x \in (0, 100)$, the rough figure of the credibility distribution function $\Phi(x)$ of the system length $L(\lambda, v)$ can be seen, which is depicted in Figure 8 (5000 cycles in fuzzy simulation for every credibility measure $C_r\{L(\lambda, v) \leq x\}$).

![Figure 7: Variations of the Estimates of $C_r\{L(\lambda, v) \leq 50\}$ in Example 9](image)

6 Conclusion

This paper discussed random fuzzy queueing systems with finite capacity. Fuzzy simulation techniques were designed to estimate the membership degree, the expected value of the system length, and the credibility measure that the system length was less than or equal to a predetermined level. Finally, an example was given to illustrate the effectiveness of the proposed techniques. The methods can be easily employed to analyze the other performance measures such as waiting time, queue length, and so on. Similarly, the proposed methods can be employed to analyze the other random fuzzy queueing systems.

Acknowledgments

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REPORT ON THE $L^p$ NON-LOCAL FLOW AND ITS APPLICATION TO POPULATION MODEL

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Abstract

In this paper, we propose a new non-local population model, which is of logistic type equation on a bounded Lipschitz domain in the whole Euclidean space. This model preserves the $L^2$ norm, which is called mass, of the solution on the domain. We show that this model has the global existence, stability and asymptotic behavior at time infinity.

Keywords: Population model, Non-local flow, Norm preservation, Global existence, Stability

1 Introduction

In this work, we discuss a new population model with non-local term proposed in [11]. This model contains a non-local term and this non-local term helps the flow to keep the mass, the integral of square of the population density, constant for all time. Let’s first review some previous study of population modelings.

After a critical study of Malthus’s population model, people begin to believe that a good population model should have good behavior like the stability depending on the initial data. So people come to the logistic model, which is a slight modification of Malthus’s model. Let us discuss this model first. The logistic model is a population model such that it describes the changes over time of a population occupying a single small region. In mathematical language, the logistic model can be stated as below. Let $P$ be the population quantity. Then the change rate of $P$ is the difference between the birth rate $\frac{dB}{dt}$ and the death rate $\frac{dD}{dt}$, i.e.,

$$\frac{dP}{dt} = \frac{dB}{dt} - \frac{dD}{dt}.$$ 

From the experimental observation, we put

$$\frac{dB}{dt} = aP + bP^2$$

and

$$\frac{dD}{dt} = cP + dP^2,$$

where $a, b, c, d$ are constants such that $a > c$ and $d > b$. Hence we obtain

$$\frac{dP}{dt} = (a - c)P - (d - b)P^2.$$

Let

$$r = a - c$$

and

$$K = \frac{a - c}{d - b}.$$

Then we get the logistic model

$$\frac{dP}{dt} = rP(1 - \frac{P}{K}).$$

Here the growth rate $r$ represents the change at which the population may grow if it were unencumbered by environmental degradation, and the parameter $K$ represents the carrying capacity of the system considered. To be precise, the carrying capacity is the population level at which the birth and death rates of a species exactly match, resulting in a stable population over time. Hence in some modeling, one may assume that $K = K(t)$ is a periodic function in time variable. Considering the season variations, the reasonable model is

$$\frac{dP}{dt} = r(t)P(1 - \frac{P}{K}),$$

where $r(t)$ is no more a constant, but is a T-periodic function of the time variable $t$. When a total quantity, a memory term is considered, the model may take the form

$$\frac{dP}{dt} = r(t)P(1 - \frac{P}{K}) + \int_{0}^{t} Q(u(s))ds.$$ 

Here $Q(u) = u'$. For more models and the history of population modeling, we refer to the work [17], and the books [7] and [14].

The drawback of the model above is that it ignores the impact of the environmental condition to the population. That is to say, one need to consider the space restriction to population. When the environmental condition on the region $D$, a bounded Lipschitz domain in $\mathbb{R}^n$, is considered, one encounters the following diffusion model of logistic type on $D$

$$u_t = \Delta u + ru(1 - \frac{u}{K}),$$

(1)

where $u = u(t, x)$ is the population quantity such that $u = u(t, x) > 0$ for $x \in D$ and $u(t, x) = 0$ on $\partial D$, $t > 0$. (1) will be also called the Logistic equation as considered in [3]. Note that the equation (1) is a local model such that the value $u(x, t)$ at $(x, t)$ depends only on its immediate
surroundings. We refer to [3], [6], and [16] for related models. The model (1) has a lot modification. A famous one is the T-periodic Fisher’s equation

$$u_t = \Delta u + r(x, t)u \left(1 - \frac{u}{K}\right)$$

where $r(x, t)$ is a T-periodic function in $t$. In this model, both the time and space restriction to population is considered. Later on, people add a global perturbation to the model above to get

$$u_t = \Delta u + r(x, t)u \left(1 - \frac{u}{K}\right) - q(u)/u$$

where $q : (0, K) \to (0, K)$ is a continuous increasing mapping. There is a good description in the book of P.Hess [15] of the models above.

We now discuss our new population model. In [11], we propose a new non-local population model in logistic equation type. We modify (2) to the following non-local logistic equation

$$\begin{align*}
\begin{cases}
\partial_t u = \Delta u + \lambda(t)u + a(x)(u - u^p) & \text{in } D \times \mathbb{R}_+,
\quad u(x, 0) = g(x) & \text{in } D,
\quad u(x, t) = 0 & \text{on } \partial D,
\end{cases}
\end{align*}$$

where $p > 1$ and $a(x) > 0$ is a non-trivial Lipschitz function on the closure of the domain $D$, which has the positive solution and preserves the $L^2$ norm. By definition, we call the integral quantity of $u(x, t)$, $\int_D u^2 dx$, the mass of the population model. Likewise,

$$\frac{1}{2} \frac{d}{dt} \int_D u^2 dx = \int_D u u_t dx$$

$$= -\int_D |\nabla u|^2 dx + \lambda(t) \int_D u^2 dx + \int_D a(u^2 - u^{p+1}) dx.$$ 

Thus, one must have $\lambda(t) = \frac{\int_D (|\nabla u|^2 a(u^{p+1} - u^2)) dx}{\int_D g^2 dx}$ to preserve the $L^2$ norm. Without loss of generality we assume $\int_D g^2 dx = 1$. Then we consider the following problem on the bounded domain $D$

$$\begin{align*}
\begin{cases}
\partial_t u = \Delta u + \lambda(t)u + a(u - u^p) & \text{in } D \times \mathbb{R}_+,
\quad u(x, 0) = g(x) & \text{in } D,
\quad u(x, t) = 0 & \text{on } \partial D,
\end{cases}
\end{align*}$$

where $p > 1$, $\lambda(t) = \frac{\int_D (|\nabla u|^2 + a(u^{p+1} - u^2)) dx}{\int_D g^2 dx}$, $g(x) \geq 0$ in $D$, $\int_D g^2 dx = 1$ and $g \in C^1(D)$.

The advantage of the new model (2) is that it has global solution, which depends continuously on the initial data in a Hilbert space and as time variable tending to infinity, the limit exists. The precise statements of the mathematical results is stated in section 2. The full argument can be found in [11].

2 mathematical results

The new model above is motivated by our works in [4], [9], and [8]. Similar to the global existence results obtained in C.Caffarelli and F.Lin [2] and our previous work [10] (see also related works [12], [9], and [8]), we have following global existence result.

**Theorem 1** Problem (2) has a global solution $u(t) \in L^\infty(\mathbb{R}_+, H^1(D)) \cap L^\infty(\mathbb{R}_+, L^{p+1}(D)) \cap L^2_{\text{loc}}(\mathbb{R}_+, H^2(D)).$

**Remark 1** We note that solutions of (2) have automatically higher regularity for $t > 0$. Indeed, the bound of $\lambda(t)$ and the standard parabolic estimates imply that solutions are Hölder continuous. Then coming back to $\lambda(t)$, it would be a Hölder continuous function in time. A bootstrap argument implies that $u$ is smooth in both spatial and time variables if we assume $a$ is smooth function.

The stability result for (2) is below.

**Theorem 2** Let $u, v$ be the two bounded solutions to problem (2) with initial data $g_u, g_v$ at $t = 0$, where $g_u, g_v \in H^1(D) \cap L^\infty(D)$. Then

$$||u - v||^2_{L^2} \leq ||g_u - g_v||^2_{L^2} \exp(C_1 t)$$

and

$$||u - v||^2_{H^1} \leq ||g_u - g_v||^2_{H^1} \exp(C_2 t),$$

where $C_1, C_2$ are the constants depending on the upper bound of $||g_u||_{H^1(D)}$, $||g_v||_{H^1(D)}$ and $||g_u||_{L^\infty}$, $||g_v||_{L^\infty}$. In particular, the solution to problem (2) is unique.

As an application of theorem 1, we have the following asymptotic behavior of $u(t)$ of problem (2).

**Corollary 1** Suppose $u(t)$ is the solution to problem (2). Then one can take $t_i \to \infty$ such that $\lambda(t_i) \to \lambda_\infty$, $u(x, t_i) \to u_\infty(x)$ in $H_0^1(D)$ and $u_\infty$ solves the equation $\Delta u_\infty + \lambda_\infty u_\infty + a(u_\infty - u_{\infty}^p) = 0$ in $D$ with $\int_D u_\infty^2 dx = 1$.

3 Conclusion

It is interesting for future study to consider the case when $a$ is a smooth function both in space variable and time variable and $a = a(x, t)$ is a periodic function in time variable $t$. The space variable domain $D$ can also be replaced by a compact manifold (with or without boundary) as in the works [1] and [13]. We leave this subject for future research.

Based on conclusion about (2) above we would like to point out that the non-local population model of logistic type is a good model that the non-local term $\lambda(t)$ plays a key role so that the flow exists globally and has nice behavior at time infinity. This research shows that global (non-local) terms in population modeling should be an interesting subject in the future.

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Abstract

This paper studies that how an uncertain event can be outlined as an approximate common knowledge. By replacing “know” with “know with certainty $\alpha$” in standard definitions of common knowledge, approximate common knowledge with some certainty, defined iteratively and mutually, iteratively known and mutually known with some certainty, are explored. Examples are constructed to show that an event which is not common knowledge can be analyzed as an approximate common knowledge with some certainty. An application in the principal-agent model is investigated to show that approximate common knowledge based on uncertain measure can be applied to improve the behavior of an economic model.

Keywords: Common knowledge; Iteratively known; Mutually known; Uncertain event; Uncertain measure; Principal-agent model

1 Introduction

Common knowledge is of some interest in areas such as game theory and the economics of information, where people’s beliefs about each other’s beliefs are of importance. Lewis gave a definition of common knowledge that an event is common knowledge if everyone knows it, everyone knows that everyone knows it, and so on. Common knowledge can also be defined iteratively: “Suppose that there are two players, 1 and 2. When we say that an event is common knowledge, we mean more than just that both 1 and 2 know it; we also require that 1 knows that 2 knows it, 2 knows that 1 knows it, 1 knows that 2 knows that 1 knows it, and so on.”

Since strict common knowledge is almost impossible, Monderer and Samet considered a method to approximate common knowledge by common belief. Morris replaced “knowledge” by “belief with probability $p$” in standard definitions of common knowledge and demonstrated the difference between this approximate common knowledge and common knowledge when there are two players. Approximate common knowledge was also studied by many researchers, such as Brandenburger and Dekel and Morris and Shin. However, those literatures mentioned above featured approximate common knowledge in probabilistic terms. By contrast, a non-probabilistic model is developed in this paper.

In many situations, for events which are static not stochastic, players may not have full information about them because of lacking the ability to observe. Therefore, they may have different knowledge about them. For instance, consider the wealth of Bill Gates at this moment. It is difficult for us to form common knowledge about his true wealth. Someone may think “his wealth is greater than $3$ billion”, while others consider that “it is greater than $2$ billion”. But we all know that “Bill is wealthy”, which is vague but an approximate common knowledge with high certainty. In a principal-agent model, the type of an agent, such as the efficiency of a firm or the ability of a labor, is assumed as the agent’s private value. Since these notions are vague, the agents can’t know them exactly, and the principal can’t be in sheer ignorance of the matter. Thus it’s more reasonable to be outlined in an uncertain sense, and then the principal and the agent can form an approximate common knowledge about the value of the agent’s type. With this in mind, the principal can design a more effective contract.

Randomness is a basic type of objective uncertainty, while fuzziness is a basic type of subjective uncertainty. Probability theory and credibility theory are branches of mathematics for studying the behavior of random phenomena and fuzzy phenomena, respectively. When the uncertainty behaves neither randomness nor fuzziness, uncertain measure was initialized by Liu to deal with it. In order to develop a theory of uncertain measure, Liu founded an uncertainty theory, which is a branch of mathematics based on normality, monotonicity, self-duality, countable subadditivity, and product measure axioms. This paper studies that how an uncertain event can be analyzed as an approximate common knowledge based on uncertain measure. It is worth to noting that the probability measure and the credibility measure, which are basic concepts under probability theory and credibility theory respectively, are special kinds of uncertain measure. Thus, the main contribution of this paper to these existing literatures is that the approximate common knowledge is outlined in a more general situation.
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Approximate Common Knowledge Based on Uncertain Measure

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The remain of this paper is organized as follows. In Section 2, the uncertain measure and conditional uncertain measure are introduced. In Section 3, approximate common knowledge with some certainty is defined iteratively and mutually, respectively. Some properties and relations of these definitions are investigated. Examples are constructed to show that an uncertain event, which is not common knowledge, can be analyzed as an approximate common knowledge based on uncertain measure. In Section 4, an application in a principal-agent problem is investigated to show that this approximate common knowledge can be applied to improve the behavior of an economic model when requiring lower certainty. Section 5 makes a conclusion.

2 Basic Concepts

Given a universe $\Gamma$, $\mathcal{L}$ is a $\sigma$-algebra over $\Gamma$. Each element $\Lambda \in \mathcal{L}$ is called an event. An uncertain measure $\mathcal{M} : \mathcal{L} \rightarrow [0, 1]$, is a set function defined on $\mathcal{L}$, and it satisfies the following conditions [7].

Axiom 1. (Normality) $\mathcal{M}\{\Gamma\} = 1$.

Axiom 2. (Monotonicity) $\mathcal{M}\{\Lambda_1\} \leq \mathcal{M}\{\Lambda_2\}$ whenever $\Lambda_1 \subset \Lambda_2$.

Axiom 3. (Self-Duality) $\mathcal{M}\{\Lambda\} = \mathcal{M}\{\Lambda^c\} = 1$ for any event $\Lambda$.

Axiom 4. (Countable Subadditivity) For every countable sequence of events $\{\Lambda_i\}$, we have

$$\mathcal{M}\left\{\bigcup_{i=1}^{\infty} \Lambda_i \right\} \leq \sum_{i=1}^{\infty} \mathcal{M}\{\Lambda_i\}.$$ 

The following examples are introduced by Liu [7] to illustrate the uncertain measure.

Example 2.1. Let $\Gamma = \{\gamma_1, \gamma_2, \gamma_3\}$. For this case, there are only 8 events. Define

$\mathcal{M}\{\gamma_1\} = 0.6, \mathcal{M}\{\gamma_2\} = 0.3, \mathcal{M}\{\gamma_3\} = 0.2, \mathcal{M}\{\gamma_1, \gamma_2\} = 0.8, \mathcal{M}\{\gamma_1, \gamma_3\} = 0.7, \mathcal{M}\{\gamma_2, \gamma_3\} = 0.4, \mathcal{M}\{\phi\} = 0, \mathcal{M}\{\Gamma\} = 1$.

Then $\mathcal{M}$ is an uncertain measure because it satisfies the four axioms.

Example 2.2. Suppose that $\lambda(x)$ is a nonnegative function on $\mathbb{R}$ satisfying

$$\sup_{x \neq y} (\lambda(x) + \lambda(y)) = 1.$$ (1)

Then for any set $\Lambda$ of real numbers, the set function

$$\mathcal{M}\{\Lambda\} = \begin{cases} \sup_{x \in \Lambda} \lambda(x), & \text{if } \sup_{x \in \Lambda} \lambda(x) < 0.5 \\ 1 - \sup_{x \in \Lambda^c} \lambda(x), & \text{otherwise} \end{cases}$$ (2)

is an uncertain measure on $\mathbb{R}$.

Example 2.3. Suppose $\rho(x)$ is a nonnegative and integrable function on $\mathbb{R}$ such that

$$\int_{\mathbb{R}} \rho(x) dx \geq 1.$$ 

Then for any Borel set $\Lambda$ of real numbers, the set function

$$\mathcal{M}\{\Lambda\} = \begin{cases} \int_{\Lambda} \rho(x) dx, & \text{if } \int_{\Lambda} \rho(x) dx < 0.5 \\ 1 - \int_{\Lambda^c} \rho(x) dx, & \text{if } \int_{\Lambda^c} \rho(x) dx < 0.5 \\ 0.5, & \text{otherwise} \end{cases}$$

is an uncertain measure on $\mathbb{R}$.

Example 2.4. Suppose that $\lambda(x)$ is a nonnegative function and $\rho(x)$ is a nonnegative and integrable function on $\mathbb{R}$ such that

$$\sup_{x \in \Lambda} \lambda(x) + \int_{\Lambda} \rho(x) dx \geq 0.5$$

and/or

$$\sup_{x \in \Lambda^c} \lambda(x) + \int_{\Lambda^c} \rho(x) dx \geq 0.5$$

for any Borel set $\Lambda$ of real numbers. Then the set function

$$\mathcal{M}\{\Lambda\} = \begin{cases} \sup_{x \in \Lambda} \lambda(x) + \int_{\Lambda} \rho(x) dx, & \text{if } \sup_{x \in \Lambda} \lambda(x) + \int_{\Lambda} \rho(x) dx < 0.5 \\ 1 - \sup_{x \in \Lambda^c} \lambda(x) - \int_{\Lambda^c} \rho(x) dx, & \text{if } \sup_{x \in \Lambda^c} \lambda(x) - \int_{\Lambda^c} \rho(x) dx < 0.5 \\ 0.5, & \text{otherwise} \end{cases}$$

is an uncertain measure on $\mathbb{R}$.

For any uncertain measure $\mathcal{M}$, we have the following propositions.

Proposition 2.1. Suppose that $\mathcal{M}$ is an uncertain measure. Then

1. $\mathcal{M}\{\phi\} = 0$ and $0 \leq \mathcal{M}\{\Lambda\} \leq 1$ for any event $\Lambda$.
2. $\mathcal{M}\{\Lambda_1\} \lor \mathcal{M}\{\Lambda_2\} \leq \mathcal{M}\{\Lambda_1 \cup \Lambda_2\} \leq \mathcal{M}\{\Lambda_1\} + \mathcal{M}\{\Lambda_2\}$ for any events $\Lambda_1$ and $\Lambda_2$.
3. $\mathcal{M}\{\Lambda_1\} + \mathcal{M}\{\Lambda_2\} - 1 \leq \mathcal{M}\{\Lambda_1 \cap \Lambda_2\} \leq \mathcal{M}\{\Lambda_1\} \land \mathcal{M}\{\Lambda_2\}$ for any events $\Lambda_1$ and $\Lambda_2$.

Proposition 2.2. Let $\Gamma = \{\gamma_1, \gamma_2, \ldots\}$. If $\mathcal{M}$ is an uncertain measure, then

$$\mathcal{M}\{\gamma_i\} + \mathcal{M}\{\gamma_j\} \leq 1 \leq \sum_{k=1}^{\infty} \mathcal{M}\{\gamma_k\}$$

for any $i$ and $j$. 

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Definition 2.1. Let $\Gamma$ be a nonempty set, $\mathcal{L}$ a $\sigma$-algebra over $\Gamma$, and $\mathcal{M}$ an uncertain measure. Then the triplet $(\Gamma, \mathcal{L}, \mathcal{M})$ is called an uncertainty space.

Definition 2.2. An uncertain variable is a measurable function $\xi$ from an uncertainty space $(\Gamma, \mathcal{L}, \mathcal{M})$ to the set of real numbers, i.e., for any Borel set $B$ of real numbers, the set
\[
\{\xi \in B\} = \{\gamma \in \Gamma \mid (\xi(\gamma)) \in B\}
\]
is an event.

Definition 2.3. The uncertainty distribution $\Phi : \mathbb{R} \to [0, 1]$ of an uncertain variable $\xi$ is defined by
\[
\Phi(x) = \mathcal{M}\{\xi \leq x\}.
\]

Definition 2.4. Let $\xi$ be an uncertain variable. Then the expected value of $\xi$ is defined by
\[
E[\xi] = \int_{-\infty}^{+\infty} \mathcal{M}\{\xi \geq r\} dr - \int_{-\infty}^{0} \mathcal{M}\{\xi \leq r\} dr
\]
provided that at least one of the two integrals is finite.

Under an uncertain environment, the certainty of an event $A$ after it has been learned that some other event $B$ has occurred can be measured by conditional uncertain measure \(\mathcal{M}_{\mid B}\), which is defined formally as follows.

Definition 2.5. \(\mathcal{M}_{\mid B}\) is an uncertainty space, and $A, B \in \mathcal{L}$. Then the conditional uncertain measure of $A$ given $B$ is defined by
\[
\mathcal{M}(A | B) = \begin{cases} \frac{\mathcal{M}(A \cap B)}{\mathcal{M}(B)}, & \text{if } \mathcal{M}(A \cap B) < 0.5 \\ 1 - \frac{\mathcal{M}(A^c \cap B)}{\mathcal{M}(B)}, & \text{if } \mathcal{M}(A^c \cap B) < 0.5 \\ 0.5, & \text{otherwise} \end{cases}
\]
provided that $\mathcal{M}(B) > 0$.

Proposition 2.3. Let $(\Gamma, \mathcal{L}, \mathcal{M})$ be an uncertainty space, and $B$ an event with $\mathcal{M}(B) > 0$. Then the conditional measure $\mathcal{M}(\cdot \mid B)$ is an uncertain measure, and $(\Gamma, \mathcal{L}, \mathcal{M}(\cdot \mid B))$ is an uncertainty space.

Definition 2.6. $\xi$ is an uncertain variable on $(\Gamma, \mathcal{L}, \mathcal{M})$. A conditional uncertain variable of $\xi$ given $B$ is a measurable function $\xi_B$ from the conditional uncertainty space $(\Gamma, \mathcal{L}, \mathcal{M}(\cdot \mid B))$ to the set of real numbers such that
\[
\xi_B(\gamma) = \xi(\gamma), \forall \gamma \in \Gamma.
\]

Definition 2.7. Let $\xi$ be an uncertain variable. Then the conditional expected value of $\xi$ given $B$ is defined by
\[
E[\xi | B] = \int_{0}^{+\infty} \mathcal{M}\{\xi \geq r | B\} dr - \int_{-\infty}^{0} \mathcal{M}\{\xi \leq r | B\} dr
\]
provided that at least one of the two integrals is finite.

3 Uncertain Event as an Approximate Common Knowledge

Consider the case that there are two players, 1 and 2. Let $\Gamma$ be the set of states of the world, $\mathcal{L}$ a $\sigma$-algebra over $\Gamma$. Then each element $A \in \mathcal{L}$ is referred as an event. An uncertain measure $\mathcal{M}$ is defined on $\mathcal{L}$ such that for each event $A, \mathcal{M}\{A\}$ denotes the certainty that the true state is in $A$. Then the triplet $(\Gamma, \mathcal{L}, \mathcal{M})$ is an uncertainty space. Without loss of generality, any state in $\Gamma$ should be true with a positive certainty, i.e., $\mathcal{M}\{\gamma\} > 0$ for each $\gamma \in \Gamma$.

3.1 Information partitions and common knowledge

For player $i \in \{1, 2\}$, the information structure of his knowledge about the true state of the world is a partition of $\Gamma$, denoted by $Q_i$. For any event $A, B \in Q_i$, we have $A \cap B = \phi$ and $\cup_{A \in Q_i} A_j = \Gamma$. For each $\gamma \in \Gamma$, let the symbol $P_i(\gamma)$ denote the element of $Q_i$ that contains $\gamma$. Therefore, if $\gamma \in \Gamma$ is the true state of the world, then $P_i(\gamma)$ is the event which can be observed by player $i$ according to his information structure.

Definitio 3.1. For the partitions $Q_1$ and $Q_2$, their meet, denoted by $Q_1 \wedge Q_2$, is the finest partition that is coarser than any of the partitions $Q_1$ and $Q_2$.

Definition 3.2. For the partitions $Q_1$ and $Q_2$, their join, denoted by $Q_1 \vee Q_2$, is the coarsest partition that is finer than any of the partitions $Q_1$ and $Q_2$.

If $\gamma$ is the true state of nature and the player 1 and 2 are willing and able to cooperate, then they learn that the element of their join $Q_1 \vee Q_2$ containing $\gamma$ has occurred, and this is the most exact information they can learn from each other.

Definition 3.3. Given $\gamma \in \Gamma$, an event $A$ is said to be common knowledge at $\gamma$ if and only if $A$ includes the member of $Q_1 \wedge Q_2$ that contains $\gamma$.

Let $\text{CK}(\gamma)$ denote the set of events which are common knowledge at $\gamma$, and $\text{CKA}$ denote the set of states at which $A$ is common knowledge, i.e., $\text{CKA} = \{\gamma \mid A \in \text{CK}(\gamma)\}$. The notations can be demonstrated through the following example.

Example 3.1. Consider a principal-agent model where there are two players, the principal and the agent, denoted by player 1 and 2 respectively. Let $\gamma$ denote the efficiency of the agent and the set of all the possible values of $\gamma$ be denoted by $\Gamma = \{\gamma_1, \gamma_2, \ldots, \gamma_{11}\}$, where $\gamma_1$ means the least efficient, $\gamma_1$ is the most efficient and $\gamma_i$ is more efficient than $\gamma_j$ for all $i > j$. Assume that the principal only knows that the agent is “less efficient”, “efficient” or “very efficient” corresponding to that $\gamma$ is in $\{\gamma_1, \gamma_2, \gamma_3\}$, $\{\gamma_4, \gamma_5, \gamma_6, \gamma_7\}$ or $\{\gamma_8, \gamma_9, \gamma_{10}, \gamma_{11}\}$, respectively. Thus,$\text{Q}_1 = \{\{\gamma_1, \gamma_2, \gamma_3\}, \{\gamma_4, \gamma_5, \gamma_6, \gamma_7\}, \{\gamma_8, \gamma_9, \gamma_{10}, \gamma_{11}\}\}$. 

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Proposition 3.1. The agent has more information about his/her own type than the principal, thus $\mathcal{Q}_1$ is coarser than $\mathcal{Q}_2$. Without loss of generality, assume that $\mathcal{Q}_2 = \{\{\gamma_1\}, \{\gamma_2, \gamma_3\}, \{\gamma_4, \gamma_5, \gamma_6\}, \{\gamma_7, \gamma_8\}, \{\gamma_9, \gamma_{10}, \gamma_{11}\}\}$. By Definition 3.1 and 3.2, $\mathcal{Q}_1 \wedge \mathcal{Q}_2 = \{\{\gamma_1, \gamma_2, \gamma_3\}, \{\gamma_4, \gamma_5, \gamma_6, \gamma_7, \gamma_8, \gamma_9, \gamma_{10}, \gamma_{11}\}\}$ and $\mathcal{Q}_1 \vee \mathcal{Q}_2 = \{\gamma_1, \gamma_2, \gamma_3\}, \{\gamma_4, \gamma_5, \gamma_6, \gamma_7\}, \{\gamma_8\}, \{\gamma_9, \gamma_{10}, \gamma_{11}\}\}$.

It follows from Definition 3.3 and $\mathcal{Q}_1 \wedge \mathcal{Q}_2$ that, for each state $\gamma$, the set of events which are common knowledge at $\gamma$ can be expressed as

$$\text{CK}(\gamma) = \begin{cases} \{A | \{\gamma_1, \gamma_2, \gamma_3\} \subseteq A\}, & \text{if } \gamma \in \{\gamma_1, \gamma_2, \gamma_3\} \\ \{A | \{\gamma_4, \gamma_5, \gamma_6, \gamma_7, \gamma_8, \gamma_9, \gamma_{10}, \gamma_{11}\} \subseteq A\}, & \text{if } \gamma \in \{\gamma_4, \gamma_5, \gamma_6, \gamma_7, \gamma_8, \gamma_9, \gamma_{10}, \gamma_{11}\} \end{cases}$$

Specifically, $\{\gamma_1, \gamma_2, \gamma_3\} \in \text{CK}(\gamma)$ for $\gamma \in \{\gamma_1, \gamma_2, \gamma_3\}$, and $\{\gamma_4, \gamma_5, \gamma_6, \gamma_7, \gamma_8, \gamma_9, \gamma_{10}, \gamma_{11}\} \in \text{CK}(\gamma)$ for $\gamma \in \{\gamma_4, \gamma_5, \gamma_6, \gamma_7, \gamma_8, \gamma_9, \gamma_{10}, \gamma_{11}\}$. Therefore, “the agent is less efficient” is common knowledge at $\gamma \in \{\gamma_1, \gamma_2, \gamma_3\}$ and “the agent is efficient or very efficient” is common knowledge at $\gamma \in \{\gamma_4, \gamma_5, \gamma_6, \gamma_7, \gamma_8, \gamma_9, \gamma_{10}, \gamma_{11}\}$.

Furthermore, for the uncertain events $\mathcal{E} = \{\gamma_4, \gamma_5, \gamma_6, \gamma_7\}$ and $\mathcal{C} = \{\gamma_8, \gamma_9, \gamma_{10}, \gamma_{11}\}$, $\text{CK}\mathcal{E} = \text{CK}\mathcal{C} = \phi$, which means that “the agent is efficient” cannot be common knowledge, neither is “the agent is very efficient”. In the following subsections, we can view that $\mathcal{B}$ and $\mathcal{C}$ are approximate common knowledge based on uncertain measure.

3.2 Iteratively known with some certainty

Given a true state $\gamma$, let $P_1(\gamma) \in \mathcal{Q}_1$ be the event observed by player $i$. Then the conditional uncertain measure of $A \in \mathcal{L}$ for player $i$ at state $\gamma$ is $\mathcal{M}(A | P_1(\gamma))$, i.e., player $i$ knows that the event $A$ happens with certainty $\mathcal{M}(A | P_1(\gamma))$ given the true state $\gamma_1$. Writing $K_0^\alpha A$ for the set of states at which player $i$ knows that event $A$ happens with certainty $\alpha$, then

$$\mathcal{M}(A | P_1(\gamma)) = 1$$

$\gamma \in K_0^1 A$. Thus, $A \subseteq K_0^1 A$. So $K_0^1 A = A$.

(2) If $K_0^\alpha A = \phi$ then the result is obvious, else for any $\gamma \in K_0^\alpha A$, $\mathcal{M}(A | P_1(\gamma)) \geq \alpha$. Since $\alpha \geq \beta$, thus $\mathcal{M}(A | P_1(\gamma)) \geq \beta$. By Definition 3.1, $K_0^\beta A \subseteq K_0^\alpha A$. So $K_0^\alpha A \subseteq K_0^\beta A$.

(3) For any $\gamma \in K_0^\alpha A$, $\mathcal{M}(A | P_1(\gamma)) \geq \alpha$. Since $A \subseteq B$, thus $\mathcal{M}(B | P_1(\gamma)) \geq \mathcal{M}(A | P_1(\gamma))$, which means that $\gamma \in K_0^\alpha B$. So $K_0^\alpha A \subseteq K_0^\alpha B$.

Player 1 iteratively knows that event $A$ happens with certainty $\alpha$ if 1 $\alpha$-knows it, 1 $\alpha$-knows that 2 $\alpha$-knows it, 1 $\alpha$-knows that 2 $\alpha$-knows that 1 $\alpha$-knows it, and so on. Let

$$K_0^\alpha K_0^\alpha A = \{\gamma | \mathcal{M}(K_0^\alpha A | P_1(\gamma)) \geq \alpha\}$$

denote the states where player $j$ $\alpha$-knows that player $i$ $\alpha$-knows $A$. Writing $IK_0^\alpha A$ for the set of states where player $i$ iteratively knows that event $A$ happens with certainty $\alpha$, then

$$IK_0^\alpha A = K_0^\alpha A \cap K_0^\alpha K_0^\alpha A \cap K_0^\alpha K_0^\alpha K_0^\alpha A \cap \cdots$$

and $IK_0^\alpha A = K_0^\alpha A \cap K_0^\alpha K_0^\alpha A \cap K_0^\alpha K_0^\alpha K_0^\alpha A \cap \cdots$

Definition 3.5. Event $A$ is iteratively known with certainty $\alpha$ if both players iteratively know it with certainty $\alpha$. Thus $A$ is iteratively known with certainty $\alpha$ at state $\gamma$ if $\gamma \in IK_0^\alpha A \equiv IK_0^\alpha A \cap IK_0^\alpha A$.

Proposition 3.2. For any $\alpha, \beta \in (0, 1]$ and $A, B \in \mathcal{L}$, $IK_0^\alpha A$ satisfies that

(1) if $A \subseteq Q_1 \cap Q_2$, then $IK_0^\alpha A = A$;
(2) if $\alpha \geq \beta > 0$, then $IK_0^\alpha A \subseteq IK_0^\beta A$;
(3) if $A \subseteq B$, then $IK_0^\alpha A \subseteq IK_0^\beta B$.

Proof. (1) Since $A \subseteq Q_1 \cap Q_2$, it follows from Proposition 3.1 that $K_0^\alpha A = A$ for all $i \in \{1, 2\}$. Thus, from the definition of $IK_0^\alpha A$, it can immediately draw that $IK_0^\alpha A = A$.

(2) If $\alpha \geq \beta$, it follows from Proposition 3.1 that $K_0^\alpha A \subseteq K_0^\beta A$ for all $i \in \{1, 2\}$. We first show that $IK_0^\alpha A \subseteq IK_0^\beta A$. Obviously, $K_0^\alpha K_0^\beta A \subseteq K_0^\beta K_0^\beta A$ and $K_0^\beta K_0^\beta A \subseteq K_0^\beta K_0^\beta A$. Similarly, $K_0^\alpha K_0^\beta K_0^\beta A \subseteq K_0^\beta K_0^\beta A$. Then $K_0^\alpha K_0^\beta K_0^\beta A \subseteq K_0^\beta K_0^\beta K_0^\beta A$. Similarly, $K_0^\beta K_0^\beta K_0^\beta A \subseteq K_0^\beta K_0^\beta K_0^\beta A$.

Iteratively, $K_0^\alpha [K_0^\beta K_0^\beta]^n A \subseteq K_0^\beta [K_0^\beta K_0^\beta]^n A$, and $K_0^\beta [K_0^\beta K_0^\beta]^n A \subseteq K_0^\beta [K_0^\beta K_0^\beta]^n A$, for all $i = 0, 1, 2, \ldots$ Thus, $IK_0^\alpha A \subseteq IK_0^\beta A$. Similarly, $IK_0^\alpha A \subseteq IK_0^\beta A$. Therefore, $IK_0^\alpha A \subseteq IK_0^\beta A$.

(3) If $A \subseteq B$, it follows from Proposition 3.1 that $K_0^\alpha A \subseteq K_0^\beta B$ for all $i \in \{1, 2\}$. We first show that $IK_0^\alpha A \subseteq IK_0^\beta B$. It is obviously that $K_0^\alpha K_0^\beta B \subseteq K_0^\beta K_0^\beta B$ and $K_0^\beta K_0^\beta A \subseteq K_0^\beta K_0^\beta B$. Then $K_0^\alpha K_0^\beta A \subseteq K_0^\beta K_0^\beta K_0^\beta B$ and $K_0^\beta K_0^\beta K_0^\beta A \subseteq K_0^\beta K_0^\beta K_0^\beta B$. Iteratively, $K_0^\alpha [K_0^\beta K_0^\beta]^n A \subseteq K_0^\beta [K_0^\beta K_0^\beta]^n A$, and
Let $IK^\alpha(\gamma)$ denote the set of events which are iteratively known with certainty $\alpha$ at $\gamma$. Then $IK^\alpha(\gamma) \equiv \{ A | \gamma \in IK^\alpha A \}$, which satisfies the following properties.

**Proposition 3.3.** For any $\gamma \in \Gamma$ and $\alpha, \beta \in (0, 1)$,

1. (i) if $A \subseteq IK^\alpha(\gamma)$ and $A \subseteq B$, then $B \subseteq IK^\alpha(\gamma)$;
2. (ii) if $\alpha \geq \beta > 0$, then $IK^\alpha(\gamma) \subseteq IK^\beta(\gamma)$.

**Proof.** (1) Since $A \subseteq IK^\alpha(\gamma)$ then $\gamma \in IK^\alpha A$. Since $A \subseteq B$, it follows from Proposition 3.2 that $IK^\alpha A \subseteq IK^\alpha B$, which implies that $\gamma \in IK^\alpha B$ and $B \subseteq IK^\alpha(\gamma)$.

(2) For any $C \subseteq IK^\alpha(\gamma)$, $\gamma \in IK^\alpha C$. Since $\alpha \geq \beta$, it follows from Proposition 3.2 that $IK^\alpha C \subseteq IK^\beta C$. Thus, $\gamma \in IK^\beta C$ and $C \subseteq IK^\beta(\gamma)$. Finally, $IK^\alpha(\gamma) \subseteq IK^\beta(\gamma)$.

**Example 3.2.** Consider the principal-agent model described in Example 3.1. Let $\lambda(\gamma)$ be a nonnegative function depicted in Table 1. It is easy to verify that $\lambda(\gamma)$ satisfies Equation 10. Let $L$ be the power set of $\Gamma$. Then an uncertain measure $M$ can be constructed according to Equation 11 and the triplet $(\Gamma, L, M)$ is an uncertainty space. Consider the event $B = \{ 95, 96, 97 \}$. For any $\alpha \in (0, 1]$, since

<table>
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<tr>
<th>$\gamma$</th>
<th>$\gamma_1$</th>
<th>$\gamma_2$</th>
<th>$\gamma_3$</th>
<th>$\gamma_4$</th>
<th>$\gamma_5$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\lambda(\gamma)$</td>
<td>0.1</td>
<td>0.2</td>
<td>0.3</td>
<td>0.4</td>
<td>0.5</td>
</tr>
<tr>
<td>$\gamma_6$</td>
<td>$\gamma_7$</td>
<td>$\gamma_8$</td>
<td>$\gamma_9$</td>
<td>$\gamma_{10}$</td>
<td>$\gamma_{11}$</td>
</tr>
<tr>
<td>$\lambda(\gamma)$</td>
<td>0.5</td>
<td>0.5</td>
<td>0.4</td>
<td>0.3</td>
<td>0.2</td>
</tr>
</tbody>
</table>

**Table 1: The value of the function $\lambda(\gamma)$**

Consider the case $\alpha = 0.5$. Then $K^\alpha_1 B = B$ and $K^\alpha_2 B = \{ 94, 95, 96, 97, 98 \}$. Since

\[
M(\{ \{94, 95, 96, 97, 98\}| P_1(\gamma) \}) = \begin{cases} 
1, & \text{if } \gamma \in B \\
0, & \text{otherwise}
\end{cases}
\]

then $K^\alpha_1 K^\alpha_2 B = \{ 94, 95, 96, 97, 98, 99, 100, 101 \}$ and $K^\alpha_2 K^\alpha_1 B = K^\alpha_1 K^\alpha_2 B = \{ 94, 95, 96, 97, 98, 99, 100, 101 \}$.

Iteratively, we have $K^\alpha_1 [K^\alpha_1 K^\alpha_2]^n B = K^\alpha_1 [K^\alpha_2 K^\alpha_1]^n B = K^\alpha_2 [K^\alpha_2 K^\alpha_1]^n B$ for all $n \geq 1$. Thus $IK^\alpha B = B$, meaning that $B$ is iteratively known with certainty 0.5 at states $94, 95, 96$ and $97$.

Consider $C = \{ 98, 99, 100, 101 \}$. Similarly, $IK^\alpha C = \phi$ for all $\alpha \in (0.5, 1]$ and $IK^\alpha C = C$ when $\alpha = 0.5$.

### 3.3 Mutually known with some certainty

An event $A$ is mutually known with certainty $\alpha$ if both players $\alpha$-know it, both $\alpha$-know that both $\alpha$-know it, and so on. Formally, define a “both $\alpha$-know” operator as follows: $K^\alpha_1 A \equiv K^\alpha_1 A \cap K^\alpha_1 A$ and $K^\alpha_2 K^\alpha_1 A \equiv K^\alpha_1 K^\alpha_2 K^\alpha_1 A$.

**Definition 3.6.** Event $A$ is mutually known with certainty $\alpha$ at $\gamma$ if

$$\gamma \in MK^\alpha A \equiv \cap_{n \geq 1} [K^\alpha]^n A$$

$$\equiv K^\alpha_1 A \cap K^\alpha_2 K^\alpha_1 A \cap K^\alpha_2 K^\alpha_2 K^\alpha_1 A \cap \cdots$$

**Proposition 3.4.** For any $\alpha, \beta \in (0, 1]$ and $A \subseteq L$,

1. (i) if $A \subseteq Q_1 \cap Q_2$, then $MK^\alpha A = A$;
2. (ii) if $\alpha \geq \beta > 0$, then $MK^\alpha A \subseteq MK^\beta A$;
3. (iii) if $A \subseteq B$, then $MK^\alpha A \subseteq MK^\beta A$.

**Proof.** (1) Since $A \subseteq Q_1 \cap Q_2$, it follows from Proposition 3.1 that $K^\alpha_i A = A$ for all $i \in \{ 1, 2 \}$. Thus, $K^\alpha_1 A = A$ and $[K^\alpha_1]^n A = A$ for $n = 1, 2, \ldots$. Therefore, $MK^\alpha A = A$.

(2) If $\alpha \geq \beta$, it follows from Proposition 3.1 that for any $A \subseteq B$ and $i \in \{ 1, 2 \}$, $K^\alpha_i A \subseteq K^\alpha_2 A$ and $K^\alpha_i A \subseteq K^\alpha_1 A$, thus $K^\alpha_2 A \subseteq K^\alpha_1 A$. Furthermore, $K^\alpha_2 K^\alpha_1 A \subseteq K^\alpha_2 K^\alpha_2 K^\alpha_1 A$, i.e., $[K^\alpha_2]^2 A \subseteq [K^\alpha_2]^2 A$. Repeat this process, we have $[K^\alpha_2]^n A \subseteq [K^\alpha_2]^2 A$ for all $n = 1, 2, \ldots$, thus $MK^\alpha A \subseteq MK^\beta A$. 

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Let $MK^\alpha(\gamma)$ be the set of events which are mutually known with certainty $\alpha$ at $\gamma$. Then $MK^\alpha(\gamma) = \{A | \gamma \in MK^\alpha(A)\}$.

**Proposition 3.5.** For any $\gamma \in \Gamma$ and $\alpha \in (0, 1]$, 

1. If $A \subseteq MK^\alpha(\gamma)$ and $A \subseteq B$, then $B \subseteq MK^\alpha(\gamma)$;
2. If $\alpha \geq \beta > 0$ then $MK^\alpha(\gamma) \subseteq MK^\beta(\gamma)$.

**Proof.** Since $A \subseteq MK^\alpha(\gamma)$ then $\gamma \in MK^\alpha(A)$. Since $A \subseteq B$, it follows from Proposition [3.4] that $MK^\alpha(A) \subseteq MK^\alpha(B)$, which implies that $\gamma \in MK^\alpha(B)$ and $B \subseteq MK^\alpha(\gamma)$.

For any $C \subseteq MK^\alpha(\gamma)$, we have $\gamma \in MK^\alpha(C)$. Since $\alpha \geq \beta$, it follows from Proposition [3.4] that $MK^\alpha(C) \subseteq MK^\beta(C)$. Thus, $\gamma \in MK^\alpha(C)$ and $C \subseteq MK^\alpha(\gamma)$. Finally, $MK^\alpha(\gamma) \subseteq MK^\beta(\gamma)$. \qed

**Proposition 3.6.** For all events $A \subseteq \mathcal{L}$ and $\alpha \in (0, 1]$, we have $MK^\alpha(A) \subseteq IK^\alpha(A)$.

**Proof.** Since for any $A \subseteq \mathcal{L}$, $\alpha \in (0, 1]$, and $i \in \{1, 2\}$, we have $IK^\alpha_i(A) \subseteq K_i^\alpha A \subseteq K_1^\alpha A$. Thus, $K_i^\alpha K^\alpha_i(A) = K_i^\alpha K_1^\alpha A \cap K_i^\alpha K_2^\alpha A \subseteq K_i^\alpha K_1^\alpha A \cap K_i^\alpha K_2^\alpha A$. By induction, we have

$$[K_2^\alpha]^{2n-1} A \subseteq [K_2^\alpha K_1^\alpha]^{n-1} A \cap K_1^\alpha [K_2^\alpha K_1^\alpha]^{n-1} A$$

and

$$[K_2^\alpha]^{2n} A \subseteq [K_2^\alpha K_1^\alpha]^n A \cap [K_2^\alpha K_1^\alpha]^n A$$

for all $n \geq 1$. Thus

$$MK^\alpha A \equiv \bigcap_{n \geq 1} [K_2^\alpha]^{n} A \subseteq IK^\alpha_i A \cap IK^\alpha_i A \equiv IK^\alpha A.$$ 

The proposition is proved. \qed

**Example 3.3.** Consider the principal-agent model as described in Example [3.1] and [3.2] and the events $B = \{(\gamma_4, 75, \gamma_6, \gamma_7)\}$ and $C = \{(\gamma_7, 75, 76, \gamma_11)\}$. When $\alpha \in (0.5, 1]$, $K_i^\alpha B = \{\gamma_1 \in \mathcal{M} \{A^i \cap [P_2(\gamma_1)] \cap \mathcal{M}(A^i)\} \geq \alpha\} = B$ and $K_2^\alpha B = \{\gamma_1 \in \mathcal{M} \{A^i \cap [P_2(\gamma_1)] \cap \mathcal{M}(A^i)\} \geq \alpha\} = \{\gamma_4, \gamma_5, \gamma_6, \gamma_7\}$. Thus $K_i^\alpha B = K^\alpha_1 B \cap K^\alpha_2 B = \{\gamma_4, \gamma_5, \gamma_6, \gamma_7\} = K^\alpha_2 B$. Since $K_i^\alpha K^\alpha_i B = \phi$, so $K_i^\alpha K^\alpha_i B = \phi$. Thus $K_i^\alpha K^\alpha_i B = \phi$ and $MK^\alpha B = \phi$, which means that $B$ can be mutually known at any state when $\alpha \in (0.5, 1]$. Consider the case $\alpha = 0.5$. Then $K_i^\alpha B = B$ and $K_2^\alpha B = \{\gamma_4, \gamma_5, \gamma_6, \gamma_7, \gamma_8\}$. Thus $K_2^\alpha B = B$. So $[K_2^\alpha]^{n} B = B$ for any $n \geq 1$, and $MK^\alpha B = B$, which means that $B$ is mutually known with certainty 0.5 at states $\gamma_4, \gamma_5, \gamma_6, \gamma_7$, and $\gamma_8$.

Similarly, $MK^\alpha C = \phi$ for all $\alpha \in (0.5, 1]$ and $MK^\alpha C = C$ when $\alpha = 0.5$.

**4 An Application in Principal-Agent Model**

In this section, an application is given to show that how the approximate common knowledge in an uncertain sense can be applied to improve the behavior of an economic model while requiring lower certainty.

The basic principal-agent model developed by Lafont [23] is investigated. Consider a consumer or a firm (the principal) who wants to delegate a task of producing $q$ unit goods to an agent. The production cost of the agent is divided into two parts, fixed cost $F$ and marginal cost $\gamma$. Assume that $\gamma$ belongs to the set $\Gamma = \{\gamma_1, \gamma_2, \ldots, \gamma_{11}\}$ and $(\Gamma, L, M)$ is the uncertainty space described in Example [3.4]. The information partition $Q_1$ and $Q_2$ are given as in Example [3.4]. The economic variables of the problem are the quantity produced $q$ and the transfer $t$ to the agent. Let $A$ be the set of feasible allocations. Formally, $A = \{(q, t) : \Gamma \rightarrow \mathbb{R}_+ \times \mathbb{R}\}$, where $\mathbb{R}_+ = \{x \in \mathbb{R} | x > 0\}$. Since $\Gamma$ has finite elements, then $A$ can be rewritten as

$$A = \{(q_1, t_1), (q_2, t_2), \ldots, (q_{11}, t_{11}) \mid q_i \in \mathbb{R}_+, t_i \in \mathbb{R}, i = 1, 2, \ldots, 11\}.$$ 

Since the agent chooses the production level according to what s/he observes about the marginal cost, therefore, $q$ and $t$ are $Q_2$-measurable functions. Furthermore, it follows from $Q_2 = \{(\gamma_1), (\gamma_2, \gamma_3), (\gamma_4, \gamma_5, \gamma_6), (\gamma_7, \gamma_8), (\gamma_9, \gamma_{10}, \gamma_{11})\}$ that $q_2 = q_3$, $q_4 = q_5 = q_6$, $q_7 = q_8$ and $q_9 = q_{10} = q_{11}$. Similarly, $t_2 = t_3$, $t_4 = t_5 = t_6$, $t_7 = t_8$ and $t_9 = t_{10} = t_{11}$.

For each $(q_i, t_i)$, the utility of the agent under state $\gamma$ is denoted by $U(q_i, t_i, \gamma)$. Thus $U(q_i, t_i, \gamma)$ is an uncertain variable defined on $(\Gamma, L, M)$. Let $A_1 = \{\gamma_1\}$, $A_2 = \{\gamma_2, \gamma_3\}$, $A_4 = \{\gamma_4, \gamma_5, \gamma_6\}$, $A_7 = \{\gamma_7, \gamma_8\}$ and $A_9 = \{\gamma_9, \gamma_{10}, \gamma_{11}\}$ denote the events those can be observed by the agent. On learning the event $A_i$ and choosing the item $(q, t)$, the agent can calculate the conditional expected value by following Definition [3.2] as

$$U(q, t | A_i) = E[U(q, t, \gamma) | \gamma \in A_i].$$

In this application, the effectiveness of the approximate common knowledge applied to the principal-agent problem can be checked by considering the incentive compatibility constraints. In order to make a comparison, we first explore the case when common knowledge is required. When the true state is contained in $\{\gamma_1, \gamma_2, \gamma_3\}$, then $\{\gamma_1, \gamma_2, \gamma_3\}$ is a common knowledge according to Example [3.1]. The contract for the agent to choose can be restricted to

$$A(\gamma_1, \gamma_2, \gamma_3) = \{(q_1, t_1), (q_2, t_2) \mid q_i \in \mathbb{R}_+, t_i \in \mathbb{R}, i = 1, 2\}.$$
satisfying the following incentive compatibility constraints
\[ U(q_1, t_1|A_1) \geq U(q_2, t_2|A_1), \]
\[ U(q_2, t_2|A_2) \geq U(q_1, t_1|A_2). \]

Similarly, when the true state belongs to \( \{\gamma_4, \gamma_5, \ldots, \gamma_{11}\} \), the contract can be designed restricting to
\[ A|_{\{\gamma_4, \gamma_5, \ldots, \gamma_{11}\}} = \{ (q_4, t_4), (q_7, t_7), (q_9, t_9) \mid q_i \in \mathbb{R}_+, t_i \in \mathbb{R}, i = 4, 7, 9 \} \]

satisfying the following incentive compatibility constraints
\[ U(q_4, t_4|A_4) \geq U(q_i, t_i|A_4), \quad \forall i \in \{4, 7, 9\}, \]
\[ U(q_7, t_7|A_7) \geq U(q_j, t_j|A_7), \quad \forall j \in \{4, 7\}, \]
\[ U(q_9, t_9|A_9) \geq U(q_k, t_k|A_9), \quad \forall k \in \{4, 7\}. \]

Let \( A_{CK}(\gamma) \) denote the set of all feasible contracts satisfying incentive compatibility constraints at \( \gamma \). Then
\[ A_{CK}(\gamma) = \begin{cases} \{(q_1, t_1), (q_2, t_2) \mid \text{satisfying (1), (2) and (3)}\}, & \text{if } \gamma \in \{\gamma_1, \gamma_2, \gamma_3\} \\ \{(q_4, t_4), (q_7, t_7), (q_9, t_9) \mid \text{satisfying (15), (16), (17) and (18)}\}, & \text{if } \gamma \in \{\gamma_4, \gamma_5, \ldots, \gamma_{11}\} \end{cases} \]

If the principal provides the contract \( A|_{\{\gamma_4, \gamma_5, \gamma_6, \gamma_7\}} \), then the agent can conclude that the true state is contained in \( \{\gamma_4, \gamma_5, \gamma_6, \gamma_7\} \). On observing the event \( \{\gamma_7, \gamma_8\} \), the agent can learn the true state \( \gamma \). Otherwise, the contract can be designed restricting to
\[ A|_{\{\gamma_4, \gamma_5, \gamma_6, \gamma_7\}} = \{(q_4, t_4), (q_7, t_7) \mid q_i \in \mathbb{R}_+, t_i \in \mathbb{R}, i = 4, 7\} \]

with the following incentive compatibility constraints
\[ U(q_4, t_4|\gamma_8) \geq U(q_7, t_7|\gamma_8), \]
\[ U(q_7, t_7|\gamma_7) \geq U(q_4, t_4|\gamma_7). \]

The timing of the contracting game can be depicted as follows:

1. the principal and the agent learn the true state according to what they observe;
2. the principal offers a contract with restriction according to what s/he learns;
3. the agent accepts or refuses the contract;
4. the contract is executed.

Let \( A_{MJK}(\gamma) \) denote the set of feasible contracts satisfying incentive compatibility constraints at \( \gamma \). Then
\[ A_{MJK}(\gamma) = \begin{cases} \{(q_1, t_1), (q_2, t_2) \mid \text{satisfying (1), (2) and (3)}\}, & \text{if } \gamma \in \{\gamma_1, \gamma_2, \gamma_3\} \\ \{(q_4, t_4), (q_7, t_7) \mid \text{satisfying (15), (16), (17) and (18)}\}, & \text{if } \gamma \in \{\gamma_4, \gamma_5, \gamma_6, \gamma_7\} \\ \{(q_9, t_9) \mid \text{satisfying (19), (20), and (21)}\}, & \text{if } \gamma \in \{\gamma_8, \gamma_9, \gamma_{10}, \gamma_{11}\} \end{cases} \]

It is obviously that \( A_{CK}(\gamma) = A_{MJK}(\gamma) \) for each \( \gamma \in \{\gamma_1, \gamma_2, \gamma_3\} \). When \( \gamma \in \{\gamma_4, \gamma_5, \gamma_6, \gamma_7\} \), there are 6 incentive compatibility constraints in \( A_{CK}(\gamma) \), i.e., (15), (16) and (17), while 2 incentive compatibility constraints, (15) and (19), in \( A_{MJK}(\gamma) \), and (15) is contained in (11). Intuitively, \( A_{MJK}(\gamma) \) is much larger than \( A_{CK}(\gamma) \). Especially, when \( \gamma \) approaches to \( \gamma_8 \), \( U(q_i, t_i|\gamma_8) = U(q_i, t_i|\gamma_7) = U(q_i, t_i|\gamma_7) \) for each \( i = 7, 8 \), then \( A_{CK}(\gamma) \subset A_{MJK}(\gamma) \).

When \( \gamma \in \{\gamma_8, \gamma_9, \gamma_{10}, \gamma_{11}\} \), we have a similar result. Thus the principal can design a more effective contract while applying approximate common knowledge with lower certainty.

5 Conclusion

This paper analyzes how an uncertain event, which is not common knowledge, can be analyzed as an approximate common knowledge with some certainty. Iteratively known and mutually known with some certainty are two different concepts for approximate common knowledge. Their properties and relations are also investigated in this paper. Since the probability measure and the credibility measure are special kinds of uncertain measure, thus, our work can be considered as an extension to the existing literatures about approximate common knowledge.
In the principal-agent model, with this approximate common knowledge in mind, the principal can construct a more effective contract with an agent. Thus approximate common knowledge in the uncertain environment is of great value to analyzing economic problems and this will be studied in our further work.

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References

\(L^2\) P-FORMS AND RICCI FLOW WITH BOUNDED CURVATURE ON MANIFOLDS

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Abstract

In this paper, we study the evolution of \(L^2\) p-forms under Ricci flow with bounded curvature on a complete noncompact or a compact Riemannian manifold. We show that under the curvature operator bound condition on such a manifold, the weighted \(L^2\) norm of a smooth p-form is non-increasing along the Ricci flow. The weighted \(L^\infty\) norm is showed to have monotonicity property too.

Keywords: Ricci flow, forms, monotonicity

1 Introduction

In this paper we study the evolution of a p-form under the Ricci flow introduced by R. Hamilton in 1982 ([8]). To understand the change of the DeRham cohomology of the manifold under Ricci flow, we need to compute the heat equation for p-forms. Then we try to use some trick from the paper [10] to get some monotonicity results.

By definition, the Ricci-Hamilton flow on a manifold \(M\) of dimension \(n\) is the evolution equation for Riemannian metrics:

\[
\partial_t g_{ij} = -2R_{ij}, \quad \text{on} \quad M_T := M \times [0, T)
\]

where \(R_{ij}\) is the Ricci tensor of the metric \(g := g(t) = (g_{ij})\) in local coordinates \((x^i)\) and \(T\) is the maximal existing time for the flow. Given an initial complete Riemannian metric of bounded curvature, the existence of Ricci flow with bounded sectional curvature on a complete noncompact Riemannian manifold had been established by Shi [13] in 1989. This is a very useful result in Riemannian Geometry. Interestingly, the maximum principle of heat equation is true on such a flow, see [13]. Then we can easily show that the Ricci flow preserves the property of nonnegative scalar curvature (see also [8]). Given a smooth \(L^2\) p-form \(\phi\) with compact support on a Riemannian manifold \((M, g)\). Recall that its \(L^2\) norm is defined by

\[
\|\phi\|_{L^2_g} = \left(\int_M |\phi|^2_g(x) dv_g\right)^{1/2},
\]

and the \(L^\infty\) norm is defined as

\[
\|\phi\|_{L^\infty_g} = \sup_{x \in M} |\phi(x)|_g(x)
\]

Assume that \(d\phi = 0\). Let \(\Phi = [\phi]\) be the \(L^2\) cohomology class of the form \(\phi\) in \((M, g)\). Define

\[
\|\Phi\|_{L^2_g} = \inf_{\phi \in \Phi} \|\phi\|_{L^2_g}
\]

and

\[
\|\Phi\|_{L^2_g(t)} = \|\Phi\|_{L^2_g(t)}
\]

for the flow \(\{g(t)\}\). It is well-known that \(\|\Phi\|_{L^2_g}\) is a norm on \(H^1_{dR}(M, \mathbb{R})\). We denote by \(d_g(x, y)\) the distance of two points \(x\) and \(y\) in \((M, g)\).

Our new results are the following

Theorem 1 Let \((M, g_0)\) be a compact or complete noncompact Riemannian manifold with non-negative scalar curvature. Assume that \(g(t)\) is a Ricci flow with bounded curvature on \([0, T]\) with initial metric \(g(0) = g_0\) on \(M\). For \(t \in [0, T]\) the Ricci curvature satisfies

\[
R_{ij} \xi^i \xi^j \geq 0
\]

and it holds the curvature pinching condition

\[
W(t) + \frac{2R(t)}{(n-1)(n-2)} \leq \frac{4}{n-2} L(t),
\]

where \(R(t)\) is the scalar curvature of the flow \((g(t))\), and

\[
W(t) = \sup_{\xi} \frac{|W_{ijkl}(t)\xi^i \xi^j \xi^k \xi^l|}{\xi^i \xi^j},
\]

\[
(\xi^i = -\xi^{ij})
\]

with

\[
W_{ijkl} = R_{ijkl} - \frac{1}{n-2}\left(R_{ik}g_{jl} - R_{il}g_{jk} + R_{ij}g_{kl} - R_{jk}g_{il}\right)
\]

\[
+ \frac{R}{(n-1)(n-2)} (g_{ik}g_{jl} - g_{il}g_{jk}),
\]

is the Weyl conformal curvature tensor. \(L(t)\) is the smallest eigenvalue of the metric \(R_{ij}(t)\).

Then for a \(L^2\) p-form \(\xi\), we have

\[
\|\xi\|_{L^2_g(t)} \leq \|\xi\|_{L^2_g(s)}, \text{ for } t > s,
\]

along the Ricci flow \(g(t)\). Similarly, we have the \(L^\infty\) monotonicity of the p-form heat flow along the Ricci flow.
It is easy to see that the $L^2$ monotonicity gives the monotonicity of De Rham cohomology class of a closed p-form with compact support. So we shall not state the corresponding result for De Rham cohomology class. We remark that the pinching curvature condition in the theorem above is not nature since it may not be preserved along the Ricci flow. However, this is a classical condition used in the book of Bochner and Yano [1] (see page 89 of the [1]), which is quite similar to ours.

As a comparison, we would like to mention a pinching result of G.Huisken [9]. It is well known that the curvature tensor $R_{nm}$ of a Riemannian manifold can be decomposed into three orthogonal components which have the same symmetries as $R_{mn}$:

$$R_{nm} = W + V + U.$$  

Here $W = \{W_{ijkl}\}$ is the Weyl conformal curvature tensor, whereas $V = \{V_{ijkl}\}$ and $U = \{U_{ijkl}\}$ denote the traceless Ricci part and the scalar curvature part respectively. The following pointwise pinching condition was proposed by Huisken in [9] (see also the works of C.Margerin [11] and S.Nishikawa [12]):

$$|W|^2 + |V|^2 \leq \delta_n |U|^2,$$  \hspace{1cm} (2)

with

$$\delta_1 = \frac{1}{5}, \quad \delta_5 = \frac{1}{10}, \quad \delta_n = \frac{2}{(n-2)(n+1)}, \quad n \geq 6,$$

and define the norm of a tensor:

$$|T|^2 = |T_{ijkl}|^2 = g^{im}g^{jn}g^{kp}g^{sq}T_{ijkl}T_{mnpq} = T_{ijkl}T^{ijkl}.\hspace{1cm}$$

Then we have the following result of G.Huisken:

**Theorem 2** Let $n \geq 4$. Suppose $(M^n, g_0)$ is an $n$-dimensional smooth compact Riemannian manifold with positive and bounded scalar curvature and satisfies the pointwise pinching condition (2). Then $M^n$ is diffeomorphic to the sphere $S^n$ or a quotient space of $S^n$ by a group of fixed point free isometries in the standard metric.

Note that the pinching curvature conditions (even the assumption about behavior at infinity see [6] and [5]) in Theorem 2 and Theorem 3 are preserved along the Ricci flow, see [9] [11] and [12]. So our pinching condition in Theorems 2 is more nature. We point out that the pinching condition (2) gives positive curvature operator. Recently, the deep work of C.Boehm and B.Wilking [2] proved the same result for positive curvature operator case.

In the following we just try to give another way to understand the monotonicity of the norms of closed forms under Ricci flow for general lower bound curvature operator case.

**Theorem 3** Let $n \geq 4$. Suppose $(M^n, g_0)$ is an $n$-dimensional smooth compact Riemannian manifold. Assume that $g(t)$ is a Ricci flow with its curvature operator bounded from below by the constant $2k$ on $[0, T)$ with initial metric $g(0) = g_0$ on $M$.

Then for a $L^2$ p-form $\xi$ on $(M, g(t))$, we have

$$||e^{k(p-1)t}\xi||_{L^2(g(t))} \leq ||e^{k(p-1)s}\xi||_{L^2(g(s))}, \quad \text{for } t > s,$$

along the Ricci flow $g(t)$. Similarly, we have the $L^\infty$ monotonicity of the p-form heat flow along the Ricci flow.

Note that R.Hamilton [8] proved that the non-negative curvature operator condition is preserved along the Ricci flow on compact Riemannian manifolds. With the help of the curvature decay estimate, one can show that similar result to Theorem 3 is also true in complete non-compact Riemannian manifolds. However, we omit the detail of the proof here since the argument is similar to Theorem 3.

**Theorem 4** Let $n \geq 4$. Suppose $(M^n, g_0)$ is an $n$-dimensional smooth complete noncompact Riemannian manifold with bounded curvature operator and with curvature decay condition as in [5]. Assume that $g(t)$ is a Ricci flow with its curvature operator bounded from below by the constant $2k$ on $[0, T)$ with initial metric $g(0) = g_0$ on $M$.

Then for a $L^2$ p-form $\xi$ on $(M, g_0)$, we have

$$||e^{k(p-1)t}\xi||_{L^2(g(t))} \leq ||e^{k(p-1)s}\xi||_{L^2(g(s))}, \quad \text{for } t > s,$$

along the Ricci flow $g(t)$. Similarly, we have the $L^\infty$ monotonicity of the p-form heat flow along the Ricci flow.

2 Basic formulae from Riemannian Geometry

Some basic materials in Riemannian geometry are stated here, to the extent that will serve as computational notations the later sections. Readers who are interested in pursuing further along the line are referred to the book by Yano and Bohnner [1] and the paper by Huisken [9]. However, we make a caution that we use modern convention from the book of [4].

Consider an n-dimensional Riemannian manifold $M^n$ with the metric $(g_{ij})$. Denote by $(g^{ij}) = (g_{ij})^{-1}$ and $\Gamma^i_{jk}$ the Christoffel symbols.

For a scalar $f(x)$, the covariant derivative of $f(x)$ is given by

$$f_{,j} = \frac{\partial f}{\partial x^j},$$

and the second covariant derivative is given by

$$f_{,jk} = \frac{\partial^2 f}{\partial x^j \partial x^k} - \frac{\partial f}{\partial x^j} \Gamma^s_{jk}. $$
Thus, we see that $f_{j;k} = f_{k;j}$. However, for vectors and tensors, successive covariant differentiations are not commutative in general. For example, for a contravariant vector $v^i$, we obtain
\[ v^i_{;k} - v^i_{;l} = -v^j R^i_{klj}, \tag{4} \]
where
\[ R^i_{ljk} = \frac{\partial R^i_{lk}}{\partial x^j} - \frac{\partial R^i_{lj}}{\partial x^k} + \Gamma^i_{lm} \Gamma^m_{jk} - \Gamma^i_{jm} \Gamma^m_{lk}. \tag{5} \]
Similarly, for a covariant vector $v_j$, then we have
\[ v_{k;ij} - v_{k;ji} = v_i R^i_{jk}, \tag{6} \]
and if we take a general tensor $T^i_{jk}$ for example, then we have
\[ T^i_{jk;l,m} - T^i_{jk;m,l} = -T^{s}_{jk} R^i_{lms} + T^a_{sk} R^i_{lma} + T^i_{js} R^i_{lkm}. \tag{7} \]
Formulas (4),(6) and (7) are called the Ricci formulas.

From the curvature tensor $R^i_{jkl}$, we get, by contraction,
\[ R_{jk} = R^i_{ijk}, \]
moreover, from $R_{jk}$, by multiplication by $g^{ij}$ and by contraction, we get
\[ R = g^{ik} R_{jk}. \]
$R_{jk}$ and $R$ are called Ricci tensor and curvature scalar of the metric $g$ respectively.

From the definition (5) of $R^i_{jkl}$, it is easily seen that $R^i_{jkl}$ satisfies the following algebraic identities:
\[ R^i_{jkl} = -R^i_{jkl}, \]
and
\[ R^i_{jkl} + R^i_{kjl} + R^i_{klj} = 0. \tag{8} \]
Consequently, from (8), we obtain $R_{jk} = R_{kj}$.

If we put
\[ R_{ijkl} = g_{hi} R_{ijkh}, \]
then $R_{ijkl}$ satisfies
\[ R_{ijkl} = -R_{jikl}, \]
and
\[ R_{ijkl} + R_{ikjl} + R_{kijl} = 0. \tag{9} \]
Equations (8) and (9) are called the first Bianchi identities.

Moreover, applying the Ricci formula and calculating the covariant components $R_{ijkl}$, we get
\[ R_{ijkl} = -R_{jikl}, \]
and
\[ R_{ijkl} = R_{klji}. \]

It is also to be noted that
\[ R^i_{jkl,m} + R^i_{jm,k} + R^i_{jm,k,l} = 0, \tag{10} \]
which is called the second Bianchi identity. From (10), we get
\[ 2R^i_{ijlm} = R_{ijl}, \]
in which $R^i_{ij} = g^{ij} R_{ij}$.

Denote by $Rc = \{R_{ij}\}$ and $R$ the Ricci tensor and scalar curvature. We can write the traceless Ricci part $V = \{V_{ijkl}\}$ and the scalar curvature part $U = \{U_{ijkl}\}$ as follows (see also [9]):
\[ U_{ijkl} = \frac{1}{n(n-1)} R(g_{ik} g_{jl} - g_{il} g_{jk}), \]
\[ V_{ijkl} = \frac{1}{n-2} (R_{ik} g_{jl} - R_{il} g_{jk} - R_{ij} g_{lk} + R_{jl} g_{ik}), \]
where
\[ \hat{R}_{ij} = R_{ij} - \frac{1}{n} R g_{ij} . \]
If we let
\[ R_{im} = \{ R_{ijkl} \} = \{ R_{ijkl} - U_{ijkl} \} = \{ V_{ijkl} + W_{ijkl} \}, \]
then
\[ |R_{im}|^2 = |W|^2 + |V|^2, \]
\[ |U|^2 = \frac{2}{n(n-1)} R^2, \]
\[ |R_{im}|^2 = |\hat{R}_{im}|^2 + |U|^2. \]

3 Proof of Theorem 1

We first set up a key lemma which is useful in the proof of all the Theorems above.

**Lemma 1** Let $\xi_{i_1 \ldots i_p} (x, t)$ be an anti-symmetric covariant vector for all the time $t$, and satisfying the heat equation
\[ \frac{\partial \xi_{i_1 \ldots i_p}}{\partial t} = \Delta_d \xi_{i_1 \ldots i_p}. \]
Then,
\[ \frac{\partial}{\partial t} |\xi|^2 = \Delta |\xi|^2 - 2 \xi^{i_1 \ldots i_p} \xi_{i_1 \ldots i_p} (p-1) \xi_{i_1 \ldots i_p \ldots i_{p-2}} R_{kl}^{i_1 \ldots i_p, -2}. \tag{11} \]
Here $\Delta_d = \delta d + \delta s$ is the Hodge-DeRham Laplacian of $g(t)$, $\Delta$ is the rough Laplacian in the sense of [4], and $R_{kl}^{i_1 \ldots i_p} = g^{ij} g^{kl} R_{ijkl}$. 

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Proof: Recall that for a covariant vector $\xi_{i_1 \ldots i_p}$, we have

$\Delta \xi_{i_1 \ldots i_p} = g^{i_k} \xi_{i_1 \ldots i_p; i_k} - \sum_{s} \xi_{i_1 \ldots i_s a_{i_{s+1}} \ldots i_p} R^a_{i_s} \xi_{i_1 \ldots i_p} - \sum_{s \neq t} \xi_{i_1 \ldots i_s b_{i_{s+1}} \ldots i_p} R^{ib}_{i_s} \xi_{i_1 \ldots i_p}$

(see page 74 in [1], and please note that we have used the same notations as in [1]).

Along the Ricci-Hamilton flow, we have

$$\frac{\partial g^{ij}}{\partial t} = 2R^{ij}.$$

Then,

$$\frac{\partial}{\partial t} |\xi|^2 = \frac{\partial}{\partial t} \left( \sum_{a} g^{i_k} \xi_{i_1 \ldots i_p; i_k} \xi_{i_1 \ldots i_p} \right)$$

$$= \sum_{a} g^{i_k} \sum_{a} g^{i_k} \xi_{i_1 \ldots i_p; i_k} \xi_{i_1 \ldots i_p}$$

$$= 2p R^{i_1 i_2 \ldots i_p} + 2p R^{i_1 i_2 \ldots i_p} \left( \Delta \xi_{i_1 \ldots i_p} \right)$$

$$= 2p R^{i_1 i_2 \ldots i_p} + 2p R^{i_1 i_2 \ldots i_p} \left( \Delta \xi_{i_1 \ldots i_p} \right)$$

$$= 2p R^{i_1 i_2 \ldots i_p} + 2p R^{i_1 i_2 \ldots i_p} \left( \Delta \xi_{i_1 \ldots i_p} \right)$$

$$= 2p R^{i_1 i_2 \ldots i_p} + 2p R^{i_1 i_2 \ldots i_p} \left( \Delta \xi_{i_1 \ldots i_p} \right)$$

By calculations, we obtain

$$\Delta |\xi|^2 = 2(\xi_{i_1 \ldots i_p; i_{i_1 \ldots i_p} + \xi_{i_1 \ldots i_p; i_{i_1 \ldots i_p}}), \quad \text{(13)}$$

for which $\Delta f = g^{ij; f_{ij}}, (f$ is a scalar field).

Putting (13) into (12), we get (11)

$$\frac{\partial}{\partial t} |\xi|^2 = \Delta |\xi|^2 - 2\xi_{i_1 \ldots i_p; i_{i_1 \ldots i_p}}$$

$$- p(p - 1) \xi_{i_1 \ldots i_{p-2}; i_{i_1 \ldots i_{p-2}} R^{i_{i_1 \ldots i_{p-2}}} k\ell \xi_{k\ell i_1 \ldots i_{p-2}}.$$
p-form. By the Maximum principle [13] we have the monotonicity of the $L^\infty$ norm of the p-form, and then the result of Theorem 3 has been completely proved.

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References