



**The 18th International Conference On
Electronic Business**

**Proceedings of
The 18th International
Conference on
Electronic Business**

ISSN: 1683-0040

2-6 Dec 2018 Guilin China





Proceedings of The Eighteenth International Conference on Electronic Business

"AI and Smart Tourism"

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ICEB 2018

2-6 December 2018

Sheraton Guilin Hotel, Guangxi, China

ISSN: 1683-0040

Reference to this book should be made as follows: Li, E.Y. & Chang, F.K. Eds. (2018). *Proceedings of the 18th International Conference on Electronic Business* (ISSN: 1683-0040). ICEB, Guilin, China, December 2-6, 832 pages.

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PREFACE

Welcome to the 18th International Conference on Electronic Business (ICEB) in Guilin, Guangxi, China. The theme of this year's Conference is "AI and Smart Tourism." We received 136 submissions and 114 papers were accepted into the final program that consisted of 34 sessions. The topic areas of the papers in this conference include big data analytics, recommendation systems, blockchain technology and applications, smart hotels and buildings, social and cross-border e-commerce, e-health and smart tourism, internet and e-business, IoT technologies and applications, online consumer behavior, supply chain and logistics, design science and service designs, social media and multimedia designs, and other e-business research issues. In this year, we established a Best Paper Award Committee to evaluate full papers. Out of 88 full papers, 11 were selected to be the outstanding papers and the top three papers will receive the "Best Paper Award". These papers are identified before the title of each paper on the program schedule to share their honor with the participants.



On the opening day, we have scheduled four keynote speakers: Prof. Vladimir Zwass, Editor of *Journal of Management Information Systems* and *International Journal of Electronic Commerce*; Prof. Patrick Y.K. Chau, Editor of *Information and Management*; Prof. Ho-Fung Leung from Computer Science and Engineering area at The Chinese University of Hong Kong; and Dr. Xiuwen Yi, Technical Leader of Intelligent Solution Division at JD Group, China. Continued with the practice from last year, we have adopted virtual meeting for those who are not able to attend the meeting due to special reasons. In addition, three special sessions have been created: "Meet the Editors" and "Blockchain Concept and Applications" on the opening day, and "Structural Equation Modeling, Do's and Don'ts" on December 5.



The annual conference of ICEB is an excellent opportunity for the scholars like you and me to share research ideas and get informed about the latest development in the fields. We could meet leading scholars from around the world so as to establish a research network and engage in future collaborations. In this conference, there are 130 registered scholars from 14 countries or regions, including Australia, China, Finland, Hong Kong,

India, Lithuania, Macau, New Zealand, Saudi Arabia, Singapore, Taiwan, and U.S.A.

Finally, we would like to thank you for your participation in this conference, without which it will not be successful. We also thank all the speakers, presenters, reviewers, the program committee members, and session chairs, who all have contributed their efforts and support to this conference. Special thanks go to our conference staffs, faculties and students from Guangxi Normal University, who had planned and executed the conference events tirelessly and effectively. Finally, on behalf of the entire Conference Committee and the Sheraton Guilin Hotel staffs, we sincerely wish that the experience during your stay in Guilin was very delightful and memorable and we look forward to seeing you again in ICEB 2019 in England.

Cordially yours,

Eldon Y. Li

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A Conceptual Framework for Smart City International Standards

(Full Paper)

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ABSTRACT

Smart cities construction has been a global focus during the past ten years. It contributes to the achievement of the sustainability development goals (for economy, society, and environment) by leveraging information and communication technologies (ICTs). International organizations (such as ISO, IEC, and ITU-T) have developed standards to encapsulate precise and state-of-the-art knowledge regarding research, practice and policy. However, thousands of such standards have not been fully used due to the lack of generally agreed vocabularies or frameworks. In this article, a conceptual framework named 'ALL' is proposed. Some initial evaluations on the proposed framework have been performed. The result shows that the framework could help people observe, organize and use such standards more efficiently. Some preliminary conversations with governments prove the potential usefulness of the framework in practice.

Keywords: Conceptual framework, smart cities, international standards.

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INTRODUCTION

More than half of the world's population lives in cities (DIVISION, 2018). And it is predicted that by 2050, the world population will reach nearly 10 billion (Goals, 2017). Cities are facing unprecedented challenges. Cities need to produce wealth and innovation. Cities need to be capable of integrating people with different social and culture backgrounds. Cities also need to be green, safe, and sustainable. Authors of (Barber, 2013) argued that city government is crucial to solving many global problems, and stated "mayors rule the world".

Debates about the future of urban development have been increasingly influenced by discussions of smart cities (Hollands, 2008). In order to ensure prosperity, end poverty and protect the planet for all, cities need to be smart to pursue sustainability in economy, society and environment. The idea that Information and Communication Technologies (ICTs) are central to the operation of future cities is widely agreed (Aurigi, 2005). However, IT itself cannot automatically transform and improve cities. Rather, smart cities must start with people and human capital equation (Eger, 2000). Smart city seeks to balance economic growth with sustainability. In addition, it needs to create a shift in the balance of power between the use of IT by government, communities, business, and ordinary people who live in cities (Amin, Massey, & Thrift, 2000). Correspondingly, making a city "smart" is emerging as a strategy to mitigate the problems generated by the urban population growth and rapid urbanization. An increasing number of international examples have emerged from across the world. For instance, China has become the keenest country in the world on smart city projects development. There are 500 smart city projects which are far more than those in Europe (90 which ranked second in the world) (Deloitte, 2018). During this process, smart cities have attracted an extensive and increasing interest in both science community and industry.

Meanwhile, some international non-profit organizations have contributed to this global effort by developing a large number of standards (Trivedi, 2016). Such standards encapsulate "an agreed way of doing something, written down as a set of precise criteria so that they can be used as rules, guidelines, or definitions" (BSI, 2018a). These standards could provide state-of-the-art knowledge regarding the interface between research, practice and policy (Joss, Cook, & Dayot, 2017). Usually, these standards are developed by groups of experts which are called as Technical Committees (TC) (ISO, 2018a). TCs are made up of representatives from industry, non-governmental organizations, governments and other stakeholders who are put forward by members in the organization. Usually, each TC deals with a different subject, such as energy management, water quality or intelligent transport systems. For example, ISO/TC 268, the technical committee for Sustainable Cities and Communities, is made up of city and standardization experts from more than 50 countries around the world. It is responsible for the ISO 37100 series of standards to help cities define their sustainability objectives and put strategies in place to achieve them. Among all the standards regarding smart cities, the BSI (British Standards Institution) smart city standard was the first such specification worldwide. It has served as a template for the development of other international standards regarding smart city by the International Organization for

Standardization (ISO, 2018b). Other international organizations that have developed such standards are like IEC (IEC, 2015), ITU-T (ITU-T, 2018), and ISO/IEC JTC1 (Joint Technical Committee 1).

Despite the importance of such international standards, they have some limitations. For instance, although such standards are inevitable to ensure the interoperability of technologies and transfer best practices, present standards have not fully achieved the requirements for technology integration. Standard bodies still operate in sectorial parallel silos, developing standards which are not quite easy to understand for non-specialists, city managers for instance. In addition, the development of standards has not been fully coordinated. There are overlaps and conflicts among standards that are developed in different sectors. As a result, many valuable standards have not been used widely and efficiently in practice. It is difficult for service vendors to find the correct standard set to ensure the success of their projects (IEC, 2015). Experts advocate general frameworks and vocabularies for understanding and communicating with such standards.

In this article, we propose a framework to organize standards regarding smart cities. Based on the framework, some initial review and evaluation have been performed. The remainder of this article is organized as below. Section 2 presents some theoretical backgrounds and introduction to main international organizations. Section 3 proposes the conceptual framework named ‘ALL’. Section 4 presents some initial review results based on the framework. Some related work is introduced in Section 5. And in Section 6, we conclude the article and point out some future work.

LITERATURE REVIEW

The literature related to this research is discussed in this section.

Smart City

Although the concept of smart city has been gaining attentions around the world, there is still not a clear and consistent understanding of the concept among practitioners and academia. Smart city has been defined in different ways. In a simplistic explanation, a smart city is a place where traditional networks and services are made more flexible, efficient, and sustainable with the use of information, digital and telecommunication technologies, to improve its operations for the benefit of its inhabitants (Mohanty, Choppali, & Kougianos, 2016).

(Giffinger, Fertner, Kramar, & Meijers, 2007) defined smart city as “A city well performing in a forward-looking way in economy, people, governance, mobility, environment, and living, built on the smart combination of endowments and activities of self-decisive, independent and aware citizens”. (Harrison et al., 2010) defined smart city as a city “connecting the physical infrastructure, the IT infrastructure, the social infrastructure, and the business infrastructure to leverage the collective intelligence of the city”. (Washburn et al., 2009) defined smart city as “the use of Smart Computing technologies to make the critical infrastructure components and services of a city—which include city administration, education, healthcare, public safety, real estate, transportation, and utilities—more intelligent, interconnected, and efficient”. (Toppeta, 2010) defined smart city as A city “combining ICT and Web 2.0 technology with other organizational, design and planning efforts to de- materialize and speed up bureaucratic processes and help to identify new, innovative solutions to city management complexity, in order to improve sustainability and livability”. Based on the exploration of literature on smart city from various disciplinary areas, (Chourabi et al., 2012) proposed an integrative framework that can be used to examine how local governments are envisioning smart city initiatives. The following eight critical factors have been identified in the framework: management and organization, technology, governance, policy context, people and communities, economy, built infrastructure, and natural environment.

International Standards

The main focus of smart city seemed to be on the role of ICT infrastructure. However, Smart cities have lately not been limited to ICT, but and are focused on enhancing urban life regarding six dimensions: people, government, economy, mobility, environment and living (Anthopoulos, 2015).

The European Union has devoted constant efforts to working on different strategies and standards for achieving urban growth in a “smart” way for its metropolitan areas (Caragliu, Del Bo, & Nijkamp, 2011). As we look at the complexities of many different systems that make up the infrastructure of our smart cities, it is apparent that technology standards play an important role in the context of building smart cities (Trivedi, 2016). Moreover, there are no clear standard approaches to deal with different ideas and solutions of smart city.

It is believed that standards play an important role in the development and construction of the smart city. Standards are able to provide requirements for monitoring various aspects involved with developing and constructing smart cities. For instance, standards can also help address security issues with smart transportation. Standards take into account various factors such as business practices and resource management, while helping to monitor the performance of building smart cities (Mohanty et al., 2016).

Since there is no clear smart city approach yet, there have been several attempts by international organizations to standardize smart city solutions, such as for smart water, energy, transportation, buildings etc. for instance, International Standards Organization (ISO, 2014) proposed a standard for city services and quality of life, as a means to measure smart city sustainable development. These ISO models are able to capture a large number of aspects, including Economy, Education, Energy, Environment, Finance, Fire and Emergency Response, urban planning, and so on.

International Standards Organization (ISO)

ISO is an independent and non-governmental international organization. ISO makes international standards and provides a platform for developing practical tools through common understanding and cooperation with stakeholders. ISO standards are developed by groups of experts within Technical Committees (TCs). The TC of Sustainable cities and communities (ISO/TC 268), is made up of experts from more than 50 countries around the world. It is responsible for the ISO 37100 series of standards. These standards provide a framework to define what being smart means for cities and how cities can get there. For example, ISO 37101, in which the basic requirements for sustainable communities are set out, can help cities determine their sustainability objectives and put in place a strategy to achieve them. In addition, these standards also develop specific standards for various needs that are important to cities such as energy management systems, road safety, intelligent transportation, responsible water consumption, health and well-being, cyber security, connectivity and more.

International Electrotechnical Commission (IEC)

Founded in 1906, IEC is one of three global sister organizations (IEC, ISO, ITU) that develop International Standards. IEC prepares and publishes International Standards for all electrical, electronic and related technologies which are known collectively as “electrotechnology”. IEC has a specific role to play in the development of smart city standards. This is because cities are giant systems with countless subsystems, while all of them depend on electric power and hardware to move people and things, collect data and exchange information. Because electricity and electronics are an integral part of nearly all city systems, the IEC doesn’t propose a single suite of Smart City Standards. Instead, hundreds of IEC standards literally come into play to tailor the integration of many city and financial services such as energy generation, buildings, transportation, lighting, healthcare, and safety/security.

When appropriate, IEC cooperates with other organizations like ISO. Joint Committees are set up to combine all relevant knowledge of experts working in related areas. Therefore, international standards could fit together seamlessly and complement each other. ISO/IEC JTC 1 is such a joint committee where Information and Communication Technology (ICT) standards for business and consumer applications are developed. In addition, standards approval environments to integrate diverse and complex ICT technologies are provided by JTC1. JTC 1 recognizes the importance of Smart Cities as a trend that will shape many standards in the ICT sector. Actually, technology plays the central role of a Smart City as the concept of ‘smartness’ is addressed in terms of performance relevant to technologically implementable solutions. JTC1 tries to address the ICT-specific standardization requirements based on an understanding of the particular needs of Smart Cities. Such requirements include understanding and modeling Smart Cities, facilitating smart infrastructure, education, business, and services, facilitating instrumentation, analysis, decision-making, and automation, and responding to societal challenges.

International Telecommunication Union (ITU)

ITU is the United Nations specialized agency for information and communication technologies – ICTs. And similar to ISO and IEC, the Study Groups of ITU’s Telecommunication Standardization Sector (ITU-T) assemble experts from around the world and develop international standards as defining elements in the global infrastructure of ICTs. In particular, ITU-T Focus Group on Smart Sustainable Cities (FG-SSC) elaborated on a series of steps to guide urban stakeholders through the gradual transitioning process to SSC. Based on this work, key desirable features for SSC and key performance indicators to monitor transitions to SSC have been elaborated. Later, the work on SSC was continued by the new ITU-T Study Group 20 on “Internet of things (IoT) and smart cities and communities (SC&C)”. This study group provides a platform to influence the development of IoT standards and their application which are thought as part of urban-development master plans.

British Standards Institution (BSI)

BSI Group, also known as the BSI, is appointed by the United Kingdom Government as the National Standards Body and represents UK interests at the ISO, the IEC and the European Standards Organizations (CEN, CENELEC and ETSI). Formed in 1901, BSI was the world’s first National Standards Body. BSI publishes over 2,700 standards annually, underpinned by a collaborative approach, engaging with industry experts, government bodies, trade associations, businesses of all sizes and consumers to develop standards that reflect good business practice. BSI produces technical standards on a wide range of products and services, and also supplies certification and standards-related services to businesses. Smart & sustainable city standards are also being written through BSI to reflect identified needs of diverse stakeholders, addressing urban challenges and creating common markets. Through standards, cities can provide the right conditions for open innovation and reduce barriers to systems integration. They enable collaboration and an open ecosystem for city partnerships resulting in productivity increase and service transformation in our future cities.

In particular, PD 8100 contains a smart city capability assessment/gap analysis diagnostic tool, aimed at enabling city leaders to make a quick overall assessment of the readiness of their city to take advantage of the transformational opportunities offered by smart city approaches. It helps the city define its own vision. Having derived a vision, the next step is to help a city set its strategy. PAS 181, soon to be published as an international standards (ISO 37106), gives guidance on establishing a city's unique strategy. It puts the citizen at the center, helping the city manage its digital assets, to create effective services and deliver change. With a vision and a strategy in place, PD 8101 provides guidance for holistic planning, taking into account future city potential. It recognizes that multi-party projects need a shared vision and benefits realization plan, covered within. It also recognizes that user needs and behaviors have to be incorporated in the design phase. Following planning, the following standards for implementing infrastructure have been published (BSI, 2018b).

The Standardization Administration of the People's Republic of China (SAC)

SAC is the competent authority for the unified management of the national standardization work in China. Under the impetus of the SAC, the National Standardization General Working Group on Smart City (SMCSTD) was established in 2014 (SMCSTD, 2018). The SMCSTD consists of more than one hundred member units involving technical committees, research institutions, businesses, alliances, etc. The SMCSTD is responsible for formulating the standardization strategy and advancing measures of Smart City in China. In addition, The SMCSTD formulates the framework of the standard system of Smart City in China, and formulates national standards for smart city. Until November 2018, more than 20 national standards relating to smart cities have been published by SAC (SAC, 2018).

ALL: A CONCEPTUAL FRAMEWORK FOR SMART CITY STANDARDS

The framework is named as 'ALL' according to the three perspectives it consists of:

- **Application Domain:** which domain or domains a standard is expected to be applied in;
- **Life Cycle:** which development stages a standard is primarily used in;
- **Smartness Level:** which level of smartness a standard is to address;

For each perspective, there are some options which will be introduced a little bit later. These three perspectives allow us to observe, organize, and use standards from three orthogonal angles. Application Domain and Life Cycle address "where" and "when" a standard is used, while Smartness Level addresses to what extent, or "how" smart the standard expects to regulate the smart city solutions.

To develop the framework, we reviewed and analyzed standards, white papers that have been published or underdeveloped by the three main international standard organizations regarding smart cities: ISO, IEC, and ITU-T. *Firstly*, we reviewed the standards categories to get a first eye impression on each organization. *Secondly*, we read introductory articles (overview article, white paper, or general standards) published in these organizations including corresponding technical committees or groups. We learned how these organizations divide the tasks and cooperate. *Thirdly*, we studied top level models in such articles. This time, we recorded vocabularies, dimensions, definitions, and relations, and so on, which were used in such models. By classifying, refining, combining the terminologies and their relations, we come up with the draft of our framework. We also enumerate possible options for each perspective. *Fourthly*, we reviewed standards based on this framework. For each standard, we checked: 1) whether one or several options can be used for each perspective; 2) whether the existing options were enough for the perspective. During this process, if one of the answers is no, we go back to refine the framework (perspectives and options); If both the answers are yes, we continue with the next standard. After several rounds of the process, the framework became comparatively stable as it is at present.

Application Domain

Smart city implies a very complex management system. A standard for such systems could cover everything a city must address to become smarter. Some of the standards provide cities with an overall framework for defining what "being smart" means for them and how they can get there. For example, ISO 37101, which sets out the basic requirements for sustainable development in communities, helps cities determine their sustainable development objectives and put in place a strategy to achieve them. Such standards are often supported by a number of other standards such as terminology and key indicators for measuring the performance of city services, which offer specific guidance for developing strategies and implementing them. Such standards are usually applied for all domains. But for most other standards, they are generally used in one or several specific domains, such as **Transportation** (e.g., ISO 39001), and **Healthcare** (e.g., ISO 45001). Other application domains include but not limited to: Responsible Resource Use, Environmental Management, Citizens' Health and Well-being, Governance, and Mobility.

Life Cycle

Smart city systems' development usually takes at several stages of the life cycle. We propose four stages in our framework: Plan, Construction, Operation, and Check. Usually the overall process should be iterative instead of one way and one time off. For different stages, the goals and focus differ a lot. For **Plan** stage, usually the high-level objectives should be determined and strategies to achieve them should be put in place. Thus, guides on how to determine the strategies and put strategies in place could

be provided in corresponding standards. For **Construction** stage, the system should be designed and developed. Thus, more technical details such as architecture, reference models, technical regulations, interfaces and constrains might need to be defined in corresponding standards. For **Operation** stage, best practices and practical guides for operation part can be presented in the standards. Lastly, standards containing indicators or other tools to measure the performance of city services are usually used more in **Check** stage.

Smart Level

We propose 3 levels/options in this perspective: Data level, Information level, and Application Level. This is inspired by the three levels of Management Information Systems (Guru99, 2018). The key ingredient to develop smart city solutions is data. Sensors need to be deployed throughout city infrastructures to collect raw data, and transmit them through communications networks, either wired or wireless. Data can be collected automatically or manually. Standards which regulate (most in a technical way) solutions in this part fall into the **Data** level. Further, advanced analytics can translate the large amount of raw data into meaningful and structured information that smart city applications can use. Standards in this **Information** level usually regulate how such information should be cleaned, stored, processed, conversed, combined, shared and retrieved. Some artificial intelligent (AI) technologies might be used to generate higher level information in this part. Later, information would be used for specific purposes for various users in various application domains. Thus, in **Application** level, standards focus more on how smart city applications could serve for specific purposes in a result-oriented way.

INITIA REVIEW AND USER EVALUATION

We have performed some initial reviews to evaluate this framework. For instance, nearly 30 representative standards have been introduced in the ISO smart city white paper (ISO, 2018b). For each standard, we judged the value for each option in the three perspectives and organized them in a table. Table 1 shows one part of the results. Because most of the standards are not free to download, and we could only judge according to titles and limited introductory texts, some of the value may not be ideally precise. Despite this, some useful information can be found in the table. For instance, we can easily find out which standards might be useful when we are developing smart water management systems (those with value of ‘Water’ and ‘All’ in the Application Domain perspective). Another instance is, if we are planning to start smart city projects for a new city, we may firstly need to look at those with value of ‘ALL’ in Application Domain, and with value ‘Plan’ in Life Cycle.

Table 1: A Review for ISO Standards Based on the Framework ‘ALL’.

Standard ID	Application Domain	Life Cycle				Smart Level		
		Plan	Construction	Operation	Check	Data	Info	App
ISO 37100	All	X	X	X	X	X	X	X
ISO 37101	All	X						X
ISO 37120	All				X			X
ISO 26000	All	X						X
ISO 17742	Energy				X			X
ISO 50001	Energy	X						X
ISO 50006	Energy				X			X
ISO 39001	Urban mobility	X						X
ISO 39002	Urban mobility		X			X	X	X
ISO 24510	Water		X	X	X	X	X	X
ISO 24511	Waste Water		X	X	X			X
ISO 24512	Drinking Water		X	X	X			X
ISO 20325	Storm Water	X						X
ISO 24516	Water	X						X
ISO 24518	Water	X						X
.....								

It is also possible to use the framework when we focus on one or two perspectives among all the three perspectives. Figure 1 demonstrates the case when we review Chinese National Standards regarding smart cities when Life Cycle and Application Domains are the focuses. In this figure, information in these two perspectives can be shown in a clearer and more visualized way.

For instance, GB/T33356 is about evaluation indicators for new-type smart cities, and it is primarily used in Check stage. While GB/T36333 includes top-level guides for requirement analysis, architecture design, objectives and strategies setting. Thus, it could be used in Plan, Construction, and Operation stages.

In addition, we have some initial discussions with our research partner from a local government in China. They have been trying to develop and promote some local standards to improve the interoperability among smart city solutions from different vendors. According to the representative who is responsible for integrating smart city solutions and corresponding standardization work, the framework is orthogonal, and has the potential to work as a basis for organizing and referencing existed standards, as well as developing new standards in the near future.

RELATED WORK

In (Chourabi et al., 2012), a literature review was performed, and eight critical factors of smart city initiatives were identified: natural environment, built infrastructure, economy, people and communities, management and organization, technology, governance, and policy context. This reveals various application domains that smart cities could be applied in, and different kinds of issues that smart cities could apply (e.g., technical, manageable, and governable ones). These factors can be used to examine how local governments are envisioning smart city initiatives. But this is a critical factor list, instead of a full list of factors. In addition, the review is for scientific papers regarding smart cities, not for international standards. For the latter, different scopes and focuses exist.

(Arman, Abbas, & Hurriyati, 2015) proposed the step by step process of how to identify smart city ICT related initiatives for each domain in ISO 37120. The step by step process includes: 1). Defining common smart city definition, 2). Defining smart city technology aspects, 3). Defining ISO 37120 indicator purpose, 4). Defining business architecture and system functionality, 5). Defining ICT initiatives, 6). Refining ICT initiatives. This process can lead to list of initiatives that may be applicable for city manager to move the city to next better level.

Life
Cycle :

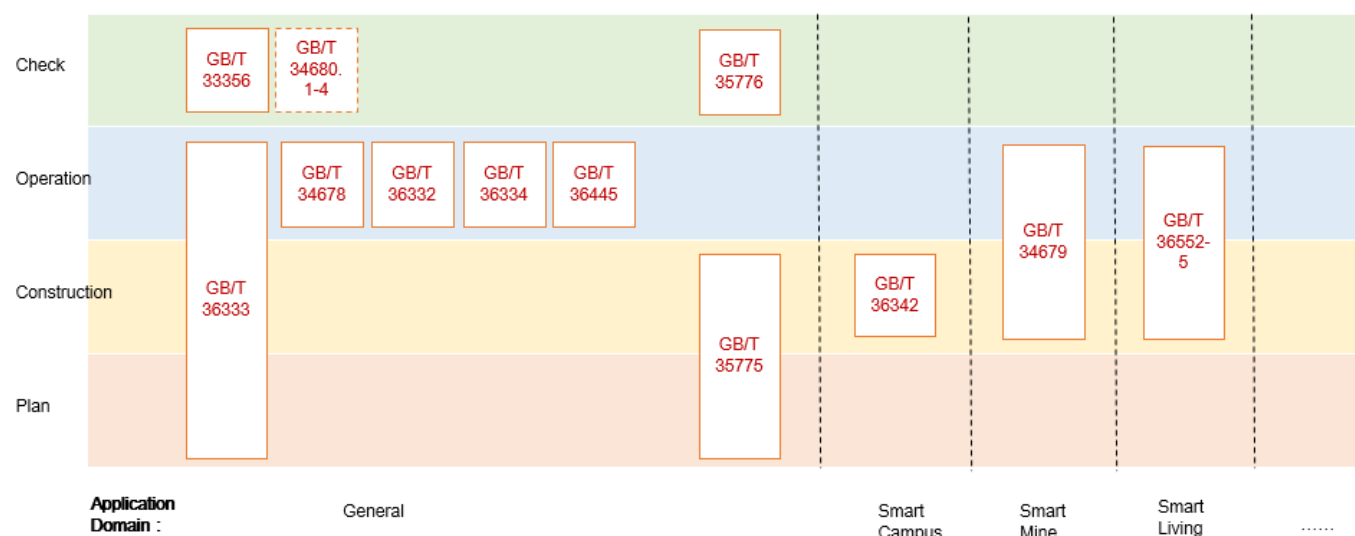


Figure 1: A Review for Chinese National Standards Based on the Framework 'All'.

In (Zdraveski, Mishev, Trajanov, & Kocarev, 2017), an architecture concept guided by the ISO 37120 standard for city services and quality of life is suggested as a unified framework for smart city dashboards. The architecture supports three tasks: acquire and manage data from heterogeneous sensors; process data originated from heterogeneous sources (e.g., sensors, OpenData, social data, blogs, and news); and implement such collection and processing on the cloud. A prototype application based on the proposed architecture concept is developed for the city of Skopje, Macedonia. This discloses one perspective that can be used to observe smart city documents or solutions. This is similar to the Smart Level perspective in our framework.

In BSI smart city white paper (BSI, 2018b), standards bodies (and most standards that have been developed in the bodies) are classified according to whether it is about strategies, processes, or techniques. For instance, ISO/TC268 Sustainable development in Communities is primarily about processes, but also somewhat strategic. While IEC Systems Evaluation Group on Smart Cities is

primary technical, but contains some content regarding processes. This approach shares some similarities with the Life Cycle perspective in our framework, but is a bit too simply and high level to organize a large number of standards.

A more complex framework/model is used in to position ISO/IEC JTC1 contributions with regard to the other international organizations. In the model, five blocks (with some sub-blocks inside) and ellipses in different colours on the blocks have been drawn representing core areas of ISO, ISO/IEC JTC1, ITU-T and the IEC. This model presents more detailed information regarding how different bodies divide the work and cooperate. In our opinion, two perspectives (Application Domain and Smartness Level) are included in this model in an implicit way. But it is not suitable to organize and provide specific information for many standards.

FUTURE WORK AND CONCLUSION

In this article, we have introduced a conceptual framework that includes three perspectives (Application domain, Life cycle, and Smartness level) to observe, communicate and use smart city standards. We reviewed some international standards which have been developed by different organizations. The result shows that the framework could help us find proper standard sets for different purposes by organizing them in a more structured way. In addition, some initial discussions have been performed with people in a governmental sector who are responsible for smart city development. They indicated that the framework is orthogonal and has the potential to be used when understanding existed standards and developing new standards.

As for future work, we do not claim that the suggested set of perspectives and corresponding options used in this article is ideally precise and exhaustive. Refinements and improvements would be made later. For instance, is there a unified set of application domains? And for Life Cycle, some people propose to use five options instead of current four options. Which proposal is better? In addition, whether such a framework could be useful in practice, in which way it could help? Larger scale review on smart city standards and more formal user evaluation have been planned in the future to solve such issues.

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A Cryptocurrency Based Insurance Model

(Full Paper)

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ABSTRACT

Modern insurance has been operating in the same business model since its inception while its recent IT improvement is mainly for specific functions without overall structural review. This paper is to incorporate the concept of a cryptocurrency, called Risk Coin, as the foundation of a new model to enhance the risk financing efficiency with capital market. Risk Coin is 1) a shareholding token of the premium fund with benefits from law-of-large-numbers, and 2) a cryptocurrency with benefits from seigniorage as fiat currency anchored at value of coin fund formed by collected premium and refund from loss payments. Applications in current insurance environment of pipeline model as well as in an innovative environment of platform model are simulated. Both results show a self-balancing mechanism that higher coin value from less coin preference, therefore, encouraging coin receivers to keep coins. Overall the new model will enhance the effectiveness of risk funding by keeping risk coins and also turn insurance deal to a win-win situation from zero-sum game through premium payment as gaining ownership of risk fund.

Keywords: cryptocurrency, insurance model, insurtech, block chain

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INTRODUCTION

Information Technology (IT) has been widely adapted to improve efficiency in insurance industry, but overall insurance model is maintained more or less same as pre-IT epoch especially in risk financing arrangements. However, recent development of FinTech vitalizes the research of potential new models for insurance.

In this paper we focus on commercial insurance with the capital circle of Risk – Insurance – Capital – Enterprise, and look into the two-dimension relation of Risk vs. Capital and Risk Owner vs. Capital Owner, where we review two current typical insurance models of Stock Insurance Companies as Risk-Insurance-Capital RIC model and Mutual Insurance Companies as Risk-Pooling-Capital RPC model. Then, a new model, Risk Coin RC model is introduced which is based on the concept of a cryptocurrency called Risk Coin. RC model is switching from RIC and RPC models depending on risk owners' decision to keep Risk Coins which is given to risk owner to a proportion of the paid premium as ownership token of premium fund. As RC model is issuing Risk Coins anchored at the received premium, it is taking the benefit of both currency seigniorage and direct acceptance of coins as risk financing channel.

The implementations of this new model under both current insurance company environment and an innovative environment are discussed and simulated. The results show self-balancing mechanism of Risk Coins which helps its acceptance, as well as better development of the premium fund which assures the success of this new insurance model.

LITERATURE REVIEW

In the last few years, fintech has been adopted progressively in financial industry. Examples technology, insurtech, for insurance industry is also drawing more and more attention. There are many examples, such as bitcoin, have demonstrated the new development in various aspects. The following reviews are categorized to three groups (1) needs and opportunities for changes; (2) adoption and risks of technology; and (3) examples of cryptocurrency.

(1) Needs and Opportunities for Changes.

Many papers investigate the requirements and impact of changes. Catlin et al. (2017) conclude main threat for insurance industry is upending traditional business model of insurers, instead of insurtechs, to destroy value. Johansson and Vogelgesang (2016) study the impact of automation on insurance industry and conclude some full-time positions in the insurance industry may be consolidated or replaced. There is also paper reviews the landscape and potential of insurance technology for financial and insurance services (Yan et al., 2018). A four-step practical guide to build insurtech value chain ecosystems is proposed by Ivan Gruer (2018). Bernardo Nicoletti (2017) define a business model of insurtech initiatives for changes.

There are many studies point out opportunities to explore for changes. Godsall et al. (2017) focus on mass-market and middle-market in slow economy and propose four strategies to spur growth. Passler (2018) discusses the key differences that are potential to deeply change, or even disrupt, the insurance industry. Many studies further emphasize the opportunities of technology adoption in insurance industry. Gandhi et al. (2017) urge the insurance to embrace digital change quickly, Wilson (2017) describes the future of insurance from viewpoint of technology trend. Hagan (2018) emphasizes the importance of collaboration in development of an InsurTech sector, and Balasubramanian et al. (2017) emphasize the importance of analytics initiatives in

insurance industry.

(2) Adoption and Risks of Technology.

Many papers focus on the track of technology adoption in insurance industry. Catlin et al. (2018) point out ecosystems and platforms as the main chance for new development in insurance industry. Jans (2018) discusses the general concept about insurtech and Nicoletti (2017) discusses the drivers of disruption for insurance industry. Kaniyar et al. (2017) discuss automation (e.g. robotics, cognition, artificial intelligence, and machine learning) at scale in insurance. Cappiello (2018) explain the loss of the interpersonal relationship due to adoption of digital distributive forms and imperative calls for market relationship. Balasubramanian et al. (2018) explore the impact of AI on insurance in 2030 from AI-related trends shaping insurance.

Some papers further explore how to achieve the goal in high level. Gaar and Hupfeld (2017) examine what potential impact Insurtechs could have on the insurer's value chain. Chester et al (2016) advocate insurance carriers and actuaries should adopt the advanced analytics and explain the four-stage journey for adopting advanced analytics. Some papers emphasize the challenges and risks issues. Collins (2018) points out the penetration rate for insurance in China remains low compared to Western measures. Catlin et al. (2016) explain digital transformation in insurance industry needs. Bloemers (2018) concludes insurers need to evolve into organizations offering a much broader set of risk management solutions.

(3) Examples of Cryptocurrency

There are more and more papers from both academic and industry to discuss the application for Cryptocurrency used for insurance. The cryptocurrency and blockchain technology applied for financial industry were extensively discussed (e.g. Scott 2016). Sarasola explained insurers are aware of blockchain technology and how it might impact the industry, but not how it fits in with technology development plans (2018).

Sockiny and Wei Xiong develop a model to determine the fundamental value of a cryptocurrency (2018). Barlyn argues that major global insurers are starting to offer protection against cryptocurrency theft to tackle daunting challenges (2018a). Barlyn also shared that insurers test bitcoin with heist policies for the business (2018b). Several examples have been discussed recently. Ethereum is a good example for Decentralized insurance protocol to collectively build insurance products (2018). Temperley gives an introduction of crypto tokens in insurance (2018). News BT (2018) provides background of a peer-to-peer Ethereum-based decentralized cryptocurrency Insurance platform, BITRUST.

In the above, most of the studies concentrate on future trend, conceptual framework, and impact study. The challenges associated with risk issue are till the focal point. In this paper, we propose a framework of risk coin for insurance industry.

PRELIMINARY

Risk Coin is a cryptocurrency and also a token of ownership of the insurance fund by collected premium and profit of the fund management as well as refund from loss payments. A new insurance operation model is designed to use Risk Coin as risk financing channel which allows switching from mutual insurance to company insurance depending on decisions, to keep or return received Risk Coin, of involve parties including Insureds and/or Risk Carriers by different models. Expectedly Risk Coin can be accepted by capital markets to broaden risk financing scope.

Capital Circle

An insurable risk is a potential financial loss covered by Insurance Contract to pay for the loss when it occurs. Their valuations are in dollar amount, namely premium and Liability/Loss, and therefore can be reviewed in Capital Circle:

- Risk is from activities of Enterprises and requires protection of Insurance.
- Insurance protects Risks and returns profits to Capital for solvency support.
- Capital supports solvency of Insurance and fund Enterprises as investment.
- Enterprise is funded by Capital and upholding Risks from its operations.

Currently insurance is a type of Enterprise with Capital specifically supporting its solvency for amortization of claims payments from collected risks. In order to have broader view of the future of Insurance, we define the role of Insurance as a necessary function which can be performed in different ways and not necessarily by an Enterprise. When it is performed by an Enterprise, this Enterprise is different from Risk Owners, although it can be invested by one or a group Risk Owners.

On the other hand, Enterprise is Risk Owner that the insurable risks are resulted from its activities of business operations. Insurable risks including buildings and machineries for manufacturing; Enterprise's liability such as public liability and products liability from its business operation; estimated income as Business Interruption coverage and investment in new factories as Construction All Risks coverage.



Figure 1: Capital Circle

To simplify these roles in RICE circle, we focus on the relation of Risk and Capital so as to better verify the purposes of insurance:

- For Risk Owners: to obtain insurance protection at an affordable price;
- For Risk Carriers: to know the risk the risks to a level that a right price can be provided;
- From the overall view of Capital: to improve the capital efficiency to amortize the loss (or potential loss) via law of large numbers and fund management of collected premium.

From the first two points are addressing the legal definition of insurance that, once the price is agreed by both parties, the insurance contract is concluded that one party will have to pay the premium and the other will have to pay for the loss if the covered loss occurred. The third point is addressing the financial definition of insurance that the loss or potential loss is spread so that single Risk Carrier do not have to maintain substantial capital to sustain its operations/ activities, therefore improving the overall capital efficiency of the whole society.

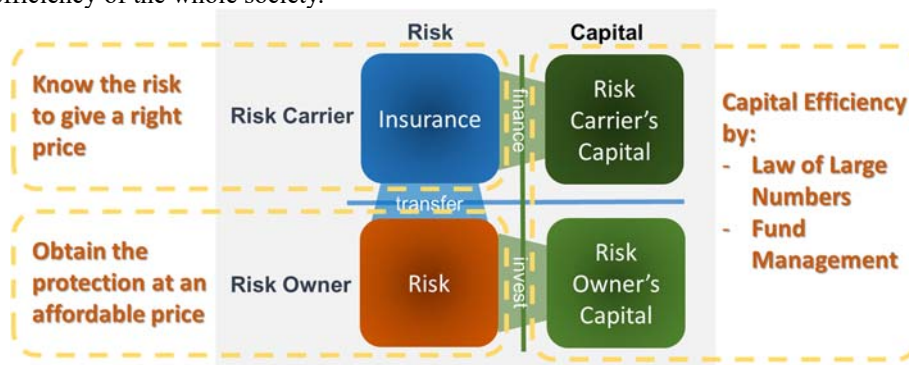


Figure 2: Purposes of Insurance

Any modification of this model will be of important value if it will bring better efficiency to serve these purposes.

Insurance Models – Current and New

From financial definition, we can review insurance models from two dimensions:

- Risk vs Capital, where Capital can be formed by accumulation of risk premium or from other sources of capital market
- Risk Owner vs Risk Carrier, where risk carrier means the party other than original risk owner and pays for the risk losses.

(1) Risk – Insurance – Capital (RIC) Model

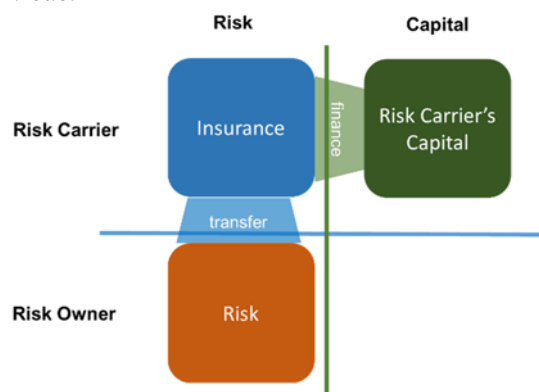


Figure 3: RIC Model

Usually called Stock Insurance Companies: “a publicly traded corporation owned by its stockholders. However, a stock company can be owned by other stock or mutual companies. The objective of a stock company is to make a profit for the stockholders. The policyholders do not directly share in the profits or losses of the company. To operate as a stock corporation, an insurer must

have a minimum of capital and surplus on hand before receiving approval from state regulators.”

(2) Risk – Pooling – Capital (RPC) Model

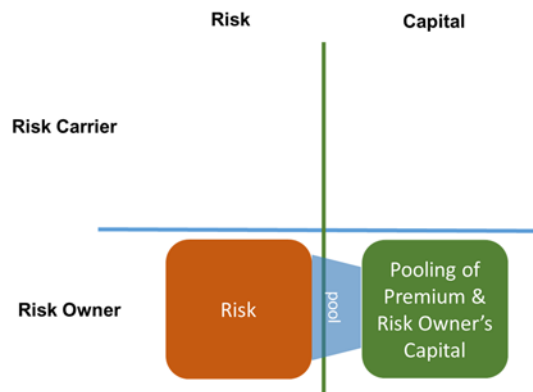


Figure 4: RPC Model

Usually called Mutual Insurance Companies: “a corporation owned exclusively by the policyholders who are "contractual creditors" with a right to vote for the Board of Directors. Generally companies are managed, and assets -- insurance reserves, surplus, contingency funds, dividends -- are held for the benefit and protection of the policyholders and their beneficiaries. Management and the Board of Directors determine what amount of operating income is paid out each year as a dividend to the policyholders. While not guaranteed, there are companies that have paid a dividend every year, even in difficult economic times.”

A New Model – Risk Coin (RC) Model

In view of previous discussions of RICE circle and current insurance models, we devise a new Model based on a cryptocurrency called Risk Coins:

- Risk owners' receive Risk Coins equivalent or proportional to paid premium. Risk Coins are the proof of shareholding of collected premium fund.
- When claims, loss suffered risk owner can choose to return received Risk Coins for full claims payment, or to keep received Risk Coins by deducting the equal value of received Risk Coins from claims payment.
- Once the loss suffered risk owner chooses to return received Risk Coins the insurance is same as buy insurance from a Stock Insurance Company, Risk Coin model becomes RIC model.
- If the loss suffered risk owner chooses to keep Risk Coins the insurance the risk owner keeps its shareholding as a Mutual Insurance Company, Risk Coin model becomes RPC models.
- Risk Coin is the proof of shareholding and its unit value is defined as total premium fund divided by total number of Risk Coins in the market, namely not returned when claims occurred.
- As premium fund will grow due to investment and accumulation from previous years, its value will fluctuate. Mechanism is also designed and test to be sure of its positive development of value.

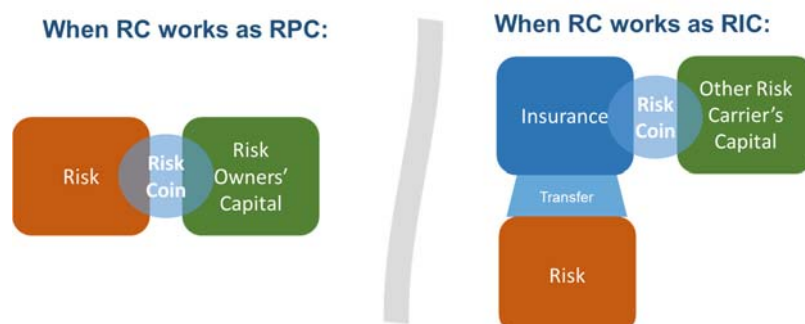


Figure 5: Risk Coins Model working as RPC and RIC models

The above figure “Risk Coins Model working as RPC and RIC models” expresses RC model switching to RIC model or RPC model, depending on Coin Receiver’s decision to keep or return Coins when loss occurred.

Risk Coin model with external risk carriers

In this extension, reinsurance premium is paid in Risk Coins of equivalent value when reinsurance is arranged for:

- Stabilizing the performance during early stage of portfolio building;
- Representing an insurer’s retention if the insurer is adapting this model and participating the risk pool as a pure risk carrier.
- Making Reinsurers the additional party to pay for the loss, to expedite the collection of premium fund.

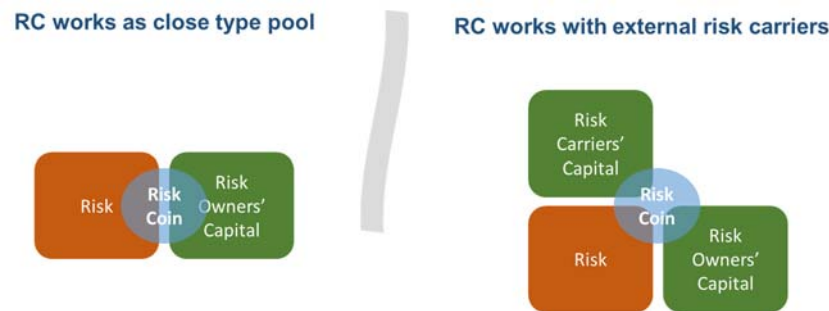


Figure 6: RC Model with External Risk Carriers

Risk Coin model with external capital market

Once Risk Coins are accepted in open market, the returned Coins or additional Coins can be issued as supplementary to the fund as a direct risk funding channel, and the more investors accepting Risk Coins will push up the value of Coins.

By doing this, there are three different risk financing channels and Network effect will be enhanced as more participants accepting the Coins. For capital market, Risk Coin is a type of fiat currency with anchoring its unit value, and its unit price may fluctuate in market which will be discussed in later chapter.



Figure 7: RC Model with External Capital Market

APPLICATION OF RC MODEL

Two types of environments for implementation of RC model are discussed:

- Current Insurance Environment, CIE: This is to apply RC model to current insurance environment that insurance companies and brokers are same as today's insurance industry. Risk Coins will be issued to Insureds as incentive to join the pool and to Reinsurers as reinsurance premium.
- BlockChain Environment, BCE: This is to apply RC model in an internet environment with blockchain or similar technology, with new business entity to provide necessary functions. Risk Coins will be issued only to Insureds for there's no reinsurance arrangement.

The proposed percentages in following are applied to simulations in later chapter and be adjusted to fit the real implementations.

CIE Application

The first method is to incorporate RC model in current insurance environment. Following points for this scenario, some of them are not exactly same as today's arrangements:

- All underwriting, accounting and claims handling are same as today's operations.
- All accumulated risks ceded by reinsurance treaty to reinsurers. Company's retention is considered as one of the reinsurers.
- Coins are issued to risk owners as incentive and to reinsurers for 100% of liability for claims payment.
- Insurance Company is making revenue from management of the premium fund, therefore no commission income.

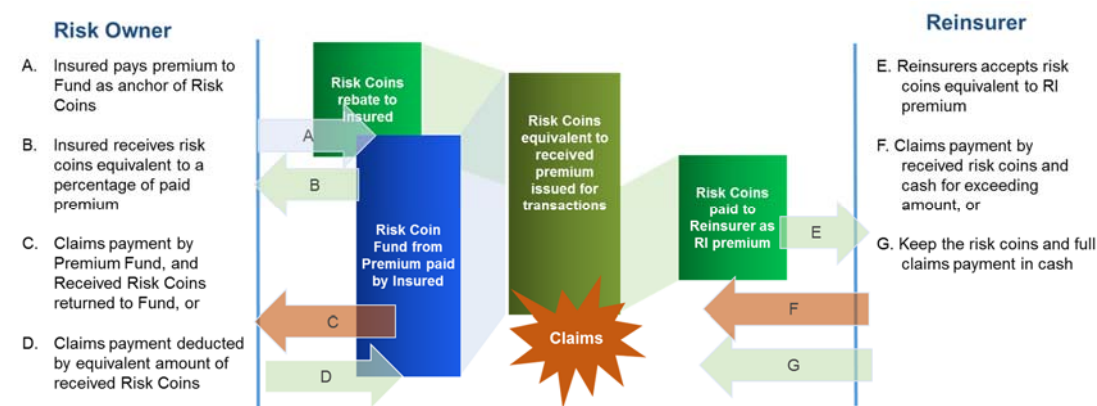


Figure 8: Procedure of CIE Application

A quick review of the performance of this design on assumption:

- \$100 as premium income with 65% loss ratio on underwriting year basis
- Insured and reinsurers can choose to keep risk coins or return risk coin for loss payment in cash.
- Risk coins kept by Insured and Reinsurer are considered risk coins in market.

Four scenarios as following are shown below and the results show self-balancing nature that less preference of keeping coins will make higher coin value.

Scenario I of CIE

Table 1: CIE - Insured returns coins and Reinsurer returns the coins

		RC Model		Insured		Reinsurer		Remark
		Fund	Risk Coin	Fund	Risk Coin	Fund	Risk Coin	
A	Insured pays premium to Fund as anchor for Risk Coins	100	100	-100				
B	Insured receives risk coins equivalent to 35% of paid premium		-35		35			
C	Claims payment by Fund and Risk Coins returned to Fund, or	-65	35	65	-35			Insured returns coins
D	Claims payment deducted by equivalent amount							
E	Reinsurer accepts Risk Coins equivalent to RI premium		-65				65	
F	Claims payment by Risk Coins and cash for exceeding amount, or		65				-65	Reinsurer returns coins
G	Keep Risk Coins and full claims payment in cash							
RESULT		35	100	-35	0	0	0	
Risk Coin in Market			0					
Fund for Risk Coin in Market			35					
Market Coin Value			N/A					

Scenario II of CIE

Table 2: CIE - Insured keeps coins and Reinsurer returns coins

		RC Model		Insured		Reinsurer		Remark
		Fund	Risk Coin	Fund	Risk Coin	Fund	Risk Coin	
A	Insured pays premium to Fund as anchor for Risk Coins	100	100	-100				
B	Insured receives risk coins equivalent to 35% of paid premium		-35		35			
C	Claims payment by Fund and Risk Coins returned to Fund, or	-65		65				
D	Claims payment deducted by equivalent amount	35		-35				Insured keeps coins
E	Reinsurer accepts Risk Coins equivalent to RI premium		-65				65	
F	Claims payment by Risk Coins and cash for exceeding amount, or		65				-65	Reinsurer returns coins
G	Keep Risk Coins and full claims payment in cash							
RESULT		70	65	-70	35	0	0	
Risk Coin in Market			35					
Fund for Risk Coin in Market			70					
Market Coin Value			2.00					

Scenario III of CIE

Table 3: CIE - Insured returns coins and Reinsurer keeps coins

		RC Model		Insured		Reinsurer Carrier		Remark
		Fund	Risk Coin	Fund	Risk Coin	Fund	Risk Coin	
A	Insured pays premium to Fund as anchor for Risk Coins	100	100	-100				
B	Insured receives risk coins equivalent to 35% of paid premium		-35		35			
C	Claims payment by Fund and Risk Coins returned to Fund, or	-65		65				
D	Claims payment deducted by equivalent amount		35		-35			Insured returns coins
E	Reinsurer accepts Risk Coins equivalent to RI premium		-65				65	
F	Claims payment by Risk Coins and cash for exceeding amount, or							
G	Keep Risk Coins and full claims payment in cash	65				-65		Reinsurer keeps coins
RESULT		100	35	-35	0	-65	65	
Risk Coin in Market			65					
Fund for Risk Coin in Market			100					
Market Coin Value			1.54					

Scenario IV of CIE

Table 4: CIE - Insured keeps coins and reinsurer keeps coins

		RC Model		Insured		Reinsurer		Remark
		Fund	Risk Coin	Fund	Risk Coin	Fund	Risk Coin	
A	Insured pays premium to Fund as anchor for Risk Coins	100	100	-100				
B	Insured receives risk coins equivalent to 35% of paid premium		-35		35			
C	Claims payment by Fund and Risk Coins returned to Fund, or	-65		65				
D	Claims payment deducted by equivalent amount	35		-35				Insured keeps coins
E	Reinsurer accepts Risk Coins equivalent to RI premium		-65				65	
F	Claims payment by Risk Coins and cash for exceeding amount, or							
G	Keep Risk Coins and full claims payment in cash	65				-65		Reinsurer keeps coins
RESULT		135	0	-70	35	-65	65	
Risk Coin in Market			100					
Fund for Risk Coin in Market			135					
Market Coin Value			1.35					

BCE Application

Second method is to apply RC model in a full internet community, such as in a Block Chain environment, to avoid monopoly of business solicit and underwriting. An example can be as:

- Units are set up in community for both business solicit and risk underwriting, called SU units. Risks are solicited by SU and submitted to the community.
- Submitted risks for underwriting by SUs other than the SU submitting this risk, to avoid monopoly.
- Accepted risks are classified in pools to reach certain homogeneous level and scale to maximize the law-of-large-numbers principle.
- Classified pools can sustain itself, or supported by Capital Market.
- Coins of a certain percentage of written premium is given to risk owner, as incentive to join the fund. The effect of percentage will be discussed later.
- Additional coin issuance when necessary to supplement the fund or to finance large losses.
- Example of rules and mechanism in underwriting and solicit as following:
- Submitted risk to be underwritten by 3 SUs, and the middle price is treated as the price produced by the community.
- SU which submits a risk will get a reward. The submitted risk eventually been accepted as bound business will be additional reward.
- SU which quotes accepted price will get a reward. This reward can be the permission to submit new risks to the community.

The above rules are set to avoid any SU becoming monopoly at the same time encouraging SU to improve their capability in risk assessment for acceptable quotations.

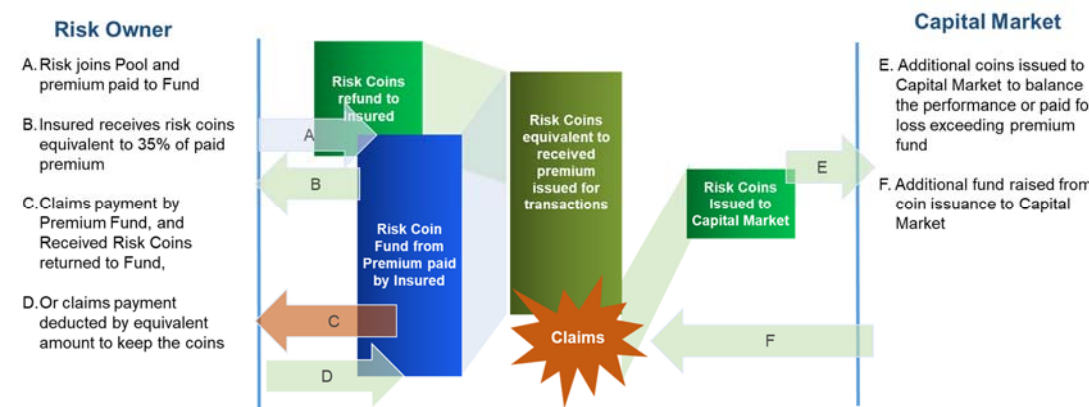


Figure 9: Procedure of BCE

Similar to CIE except no reinsurance, all losses will be financed by the premium fund. As only Insured's preference is concerned, there are only two scenarios and the results are similar to Scenario I and II under CIE.

As there is no reinsurers' involvement, we will calculate unit value under only two scenarios of Insured's decision to keep or return coins when loss occurred.

Following are two scenarios below show the changes of values of Coin in market and of the fund supporting the coin value, depending on the decisions of Insured and Reinsurer to keep or return received coins.

Scenario I of BCE

Table 5: BCE - Insured chooses to keep coins

		RC Model		Insured		Reinsurer		Remark
		Fund	Risk Coin	Fund	Risk Coin	Fund	Risk Coin	
A	Insured pays premium to Fund as anchor for Risk Coins	100	100	-100				
B	Insured receives risk coins equivalent to 35% of paid premium		-35		35			
C	Claims payment by Fund and Risk Coins returned to Fund, or	-65		65				
D	Claims payment deducted by equivalent amount	35		-35				Insured keeps coins
RESULT		70	65	-70	35	0	0	
Risk Coin in Market		35						
Fund for Risk Coin in Market		70						
Market Coin Value		2						

Scenario II of BCE

Table 6: BCE - Insured chooses to return coins

		RC Model		Insured		Reinsurer		Remark
		Fund	Risk Coin	Fund	Risk Coin	Fund	Risk Coin	
A	Insured pays premium to Fund as anchor for Risk Coins	100	100	-100				
B	Insured receives risk coins equivalent to 35% of paid premium		-35		35			
C	Claims payment by Fund and Risk Coins returned to Fund, or	-65	35	65	-35			Insured Returns the coins
D	Claims payment deducted by equivalent amount							
RESULT		35	100	-35	0	0	0	
Risk Coin in Market		0						
Fund for Risk Coin in Market		35						
Market Coin Value		N/A						

Observations

Under CIE, the value of Risk Coins in market is not the highest when Coins are most popular that both Insured and Reinsurer are keeping risk coins. To generalize this observation we assume, under certain conditions, the less popular of coin the higher value of the coin value, and this will give extra incentive for coin receivers to keep them. We will be explore further in the simulations of later chapter.

Also in this quick review of performance, we assume one Insured and one Reinsurer in the scenarios. For Reinsurer side under CIE, this does not affect the result if to change to multiple Reinsurers. But for Insured side under both CIE and BCE, it does affect the results if change to multiple Insureds.

As losses among multiple Insureds occur randomly with loss amount usually much larger than the suffering Insured's paid premium. Even if all Insureds do not want to keep coins, those who do not suffer losses will not have chance to return coins and there's always some coins in the market. Therefore, a percentage of loss, called Refundable Loss Ratio, is defined to make the simulations closer to real situations with the basic trend of bring lower when the more Insureds in the portfolio, and higher with more evenly occurred loss amount.

SIMULATION FOR GENERAL INSURANCE

Understanding from observations of quick performance review, general assumptions are setting as below for simulations in this chapter.

General Assumption for Both CIE and BCE

First we set up a simplified growing insurance portfolio running for 20 years as the simulation basis with following assumptions:

- New premium at first year is 100, and incremental by 10% in every following year. Premium renewal ratio is 70%.
- Underwriting Year Loss Ratio is 65%, claims occurring evenly over 4 years.
- Collected Premium Fund is managed with 5% investment return.
- Refundable Loss Ratio/Amount to simulate single insured's received coins being part of total individual loss amount.
- Returning Ratio is defined as percentage of Refundable Loss Amount from 0%, increased by 10% to 100%, altogether 11 sets marked as R0% to R100%, to simulate different level of coin preference. Comparison is made for fixed preference levels over 20 years.

- Coins given to insured at previous years' coin value and first year coin value is 1.
- Coin issuance ratio to Insured is 35% of premium and 65% of premium to Reinsurer for CIE.
- Coin issuance ratio to Insured will be a range including 35% for BCE.
- Additional Coin Issuance Ratio is also tested to the maximum level that the self-balancing nature of Risk Coin can still be maintained.

Developments of coin value and fund value are derived from the above portfolio with different settings of Refundable Loss Ratio, Returning Ratio, Coin Issuance Ratio and Additional Coin Issuance Ratio.

Simulation - CIE

Firstly let's check Basic Conditions of Insured 35%/ Reinsurer 65% coin split, with 10% Refundable Loss Ratio and Returning Ratio from 0% to 100%:

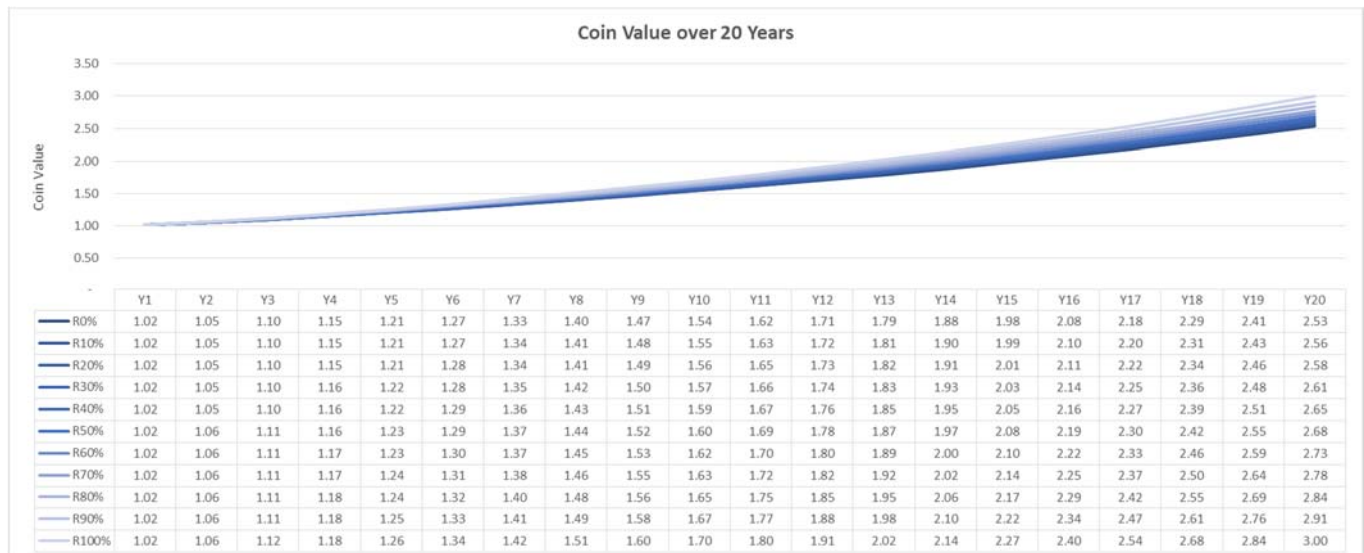


Figure 10: Coin Value over 20 Years under CIE

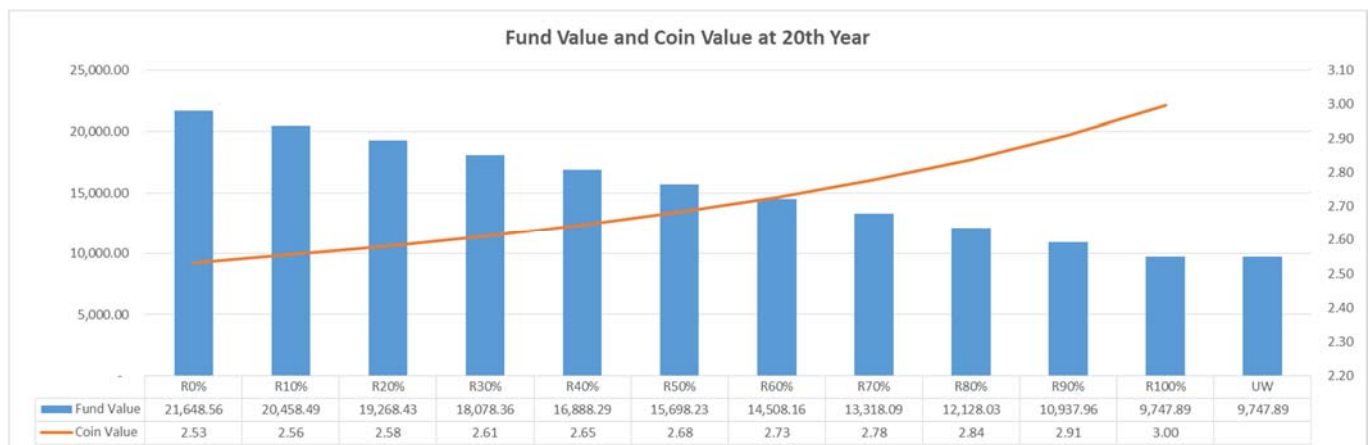


Figure 11: Fund Value and Coin Value at 20th Year under CIE

In the above chart, UW represents the result of no coin issuance as existing insurance model, to compare with different level of coin preference in RC model.

Overall, the coin value is increasing over 20 years, and the less preference of coin the higher coin value.

We can further check the effects of different Refundable Loss Ratio from 5% to 30%:

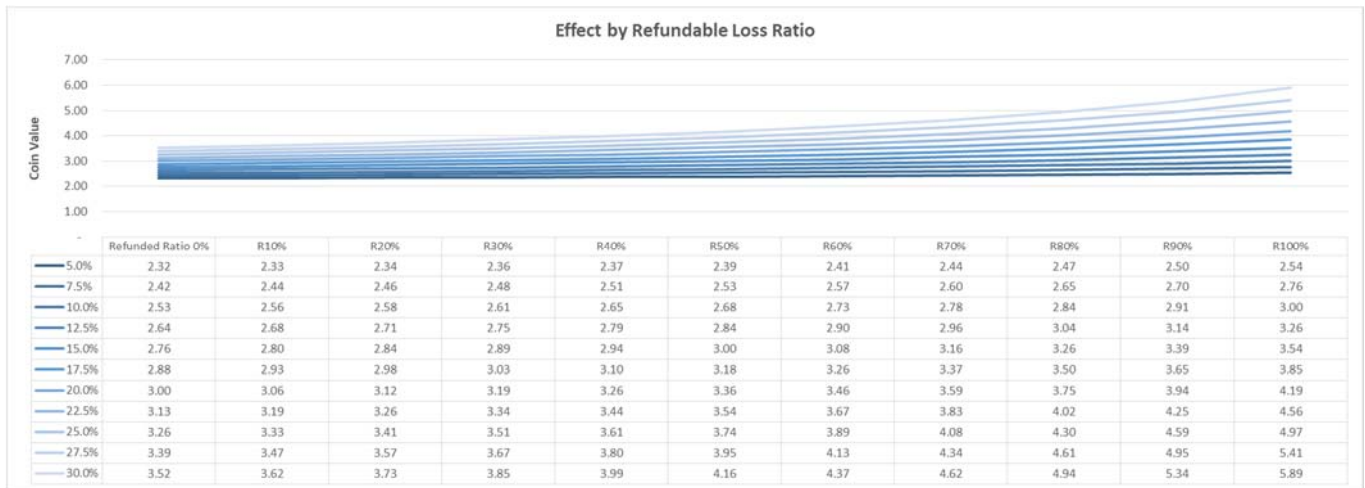


Figure 12: Effect by Refundable Loss Ratio on Coin Value under CIE

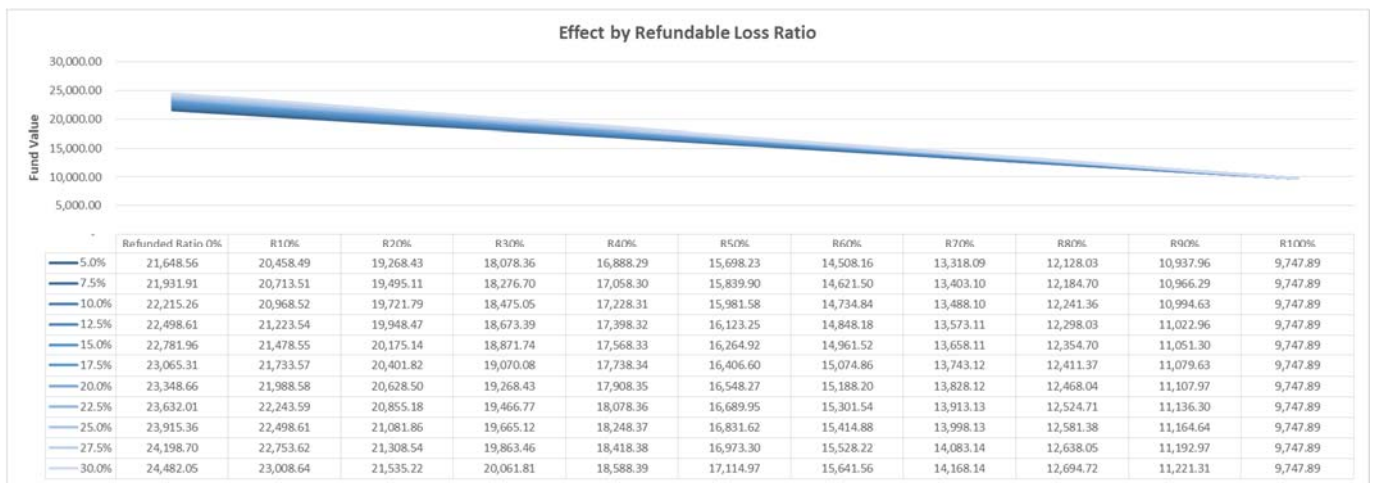


Figure 13: Effect by Refundable Loss Ratio on Fund Value under CIE

From the above charts, high Refundable Loss Ratio will cause both high Coin Value and Fund Value, but:

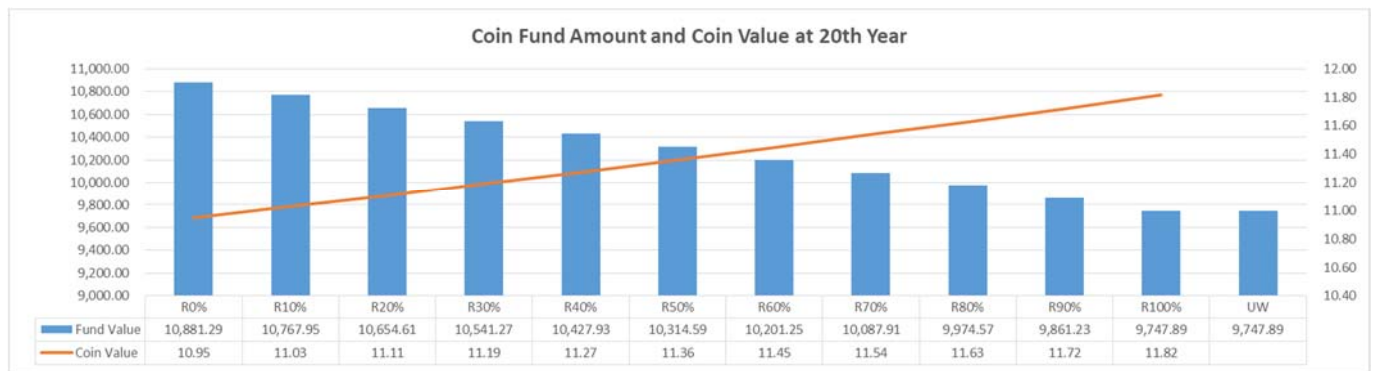
- More significant when Refunded Ratio is high for Coin Value;
- More significant when Refunded Ratio is low for Fund Value.

Simulation - BCE

Starting from coin issued to Insured at 35%, with 10% Refundable Loss Ratio from 0% to 100%:



Figure 14: Coin Value over 20 Years under BCE

Figure 15: Fund Value and Coin Value at 20th Year under BCE

The result looks similar as that under CIE for fund value and coin value at 20th year, fund value is about half of CIE while coin value is about four times.

Result of different levels of Refundable Loss Ratio:



Figure 16: Effect by Refundable Loss Ratio on Coin Value under BCE



Figure 17: Effect by Refundable Loss Ratio on Fund Value under BCE

Similar result as in CIE that High Refundable Loss Ratio will cause both high Coin Value and Fund Value.

Levels of Coin Issuance to Insured while Refundable Loss Ratio fixed at 10%:

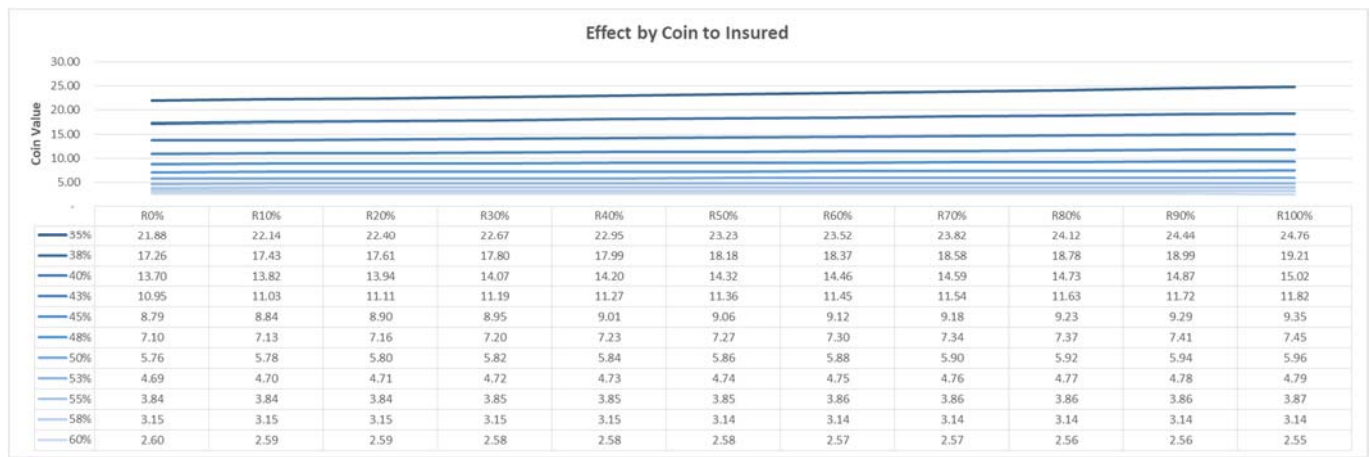


Figure 18: Effect by Coin to Insured on Coin Value under BCE – Refundable Loss Ratio at 10%

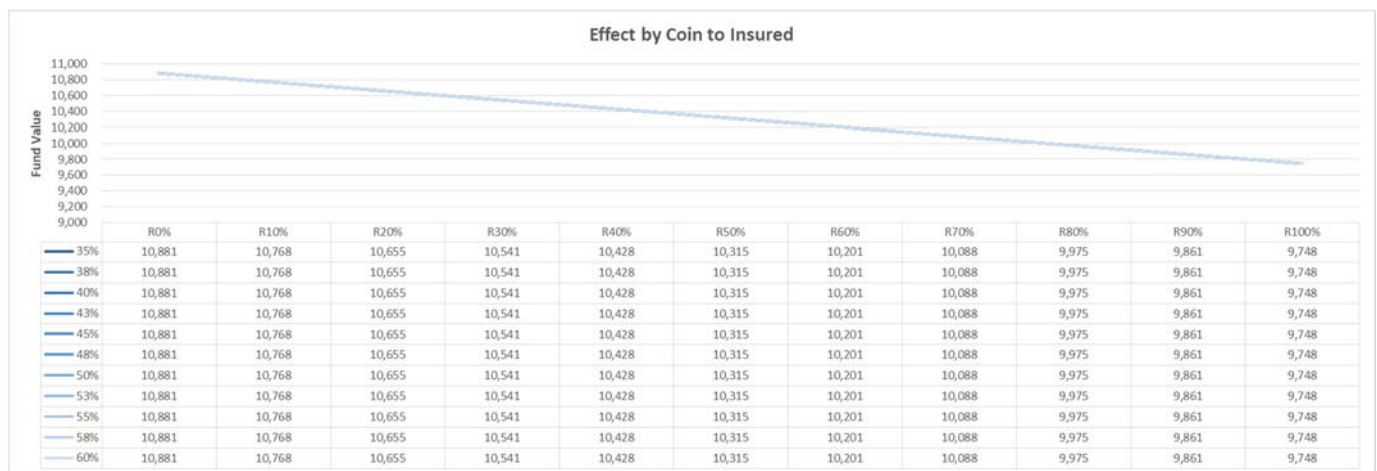


Figure 19: Effect by Coin to Insured on Fund Value under BCE - Refundable Loss Ratio at 10%

Levels of Coin Issuance to Insured while Refundable Loss Ratio fixed at 20%:

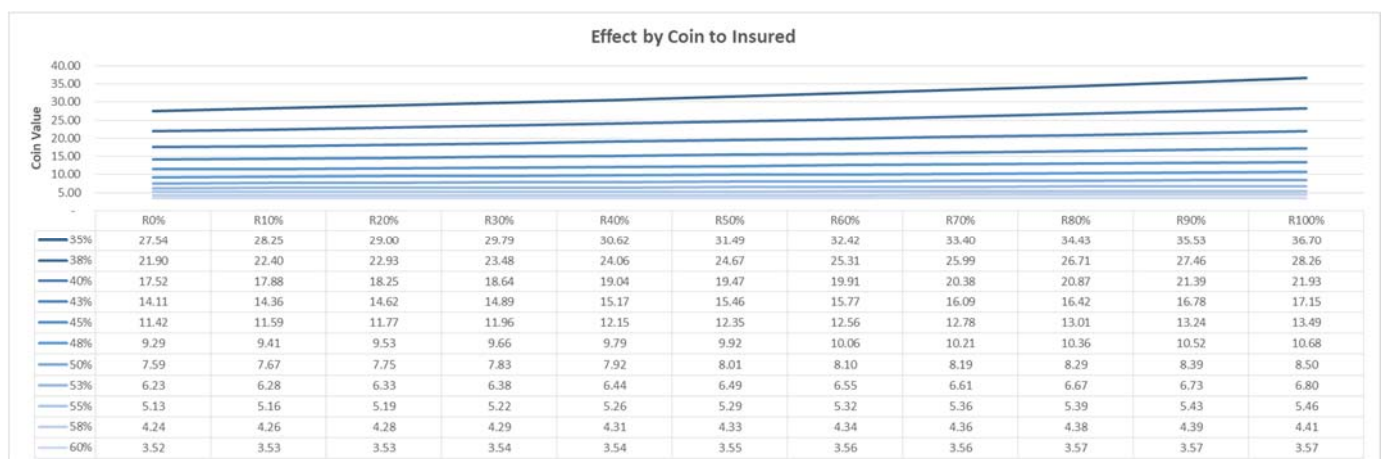


Figure 20: Effect by Coin to Insured on Coin Value under BCE – Refundable Loss Ratio at 20%



Figure 21: Effect by Coin to Insured on Fund Value under BCE – Refundable Loss Ratio at 20%

Higher ratio of Coin Issuance reduces coin value but Fund Value remains the same.

Effect of Additional Coins

We will check the effect of Additional Coins for following scenarios, while self-balancing can be still maintained:

- CIE: Insured 35%/ Reinsurer 65% coin split, with 10% Refundable Loss Ratio
- CIE: Insured 30%/ Reinsurer 65% coin split, with 10% Refundable Loss Ratio, the 5% difference is extra room for additional coins.
- BCE: Coin to Insured at 35%, with 10% Refundable Loss Ratio
- BCE: Coin to Insured at 50%, with 20% Refundable Loss Ratio which is to reflect the higher ratio of Coin to Insured at 50%.

CIE: Insured 35%/ Reinsurer 65% split, with 10% Refundable Loss Ratio

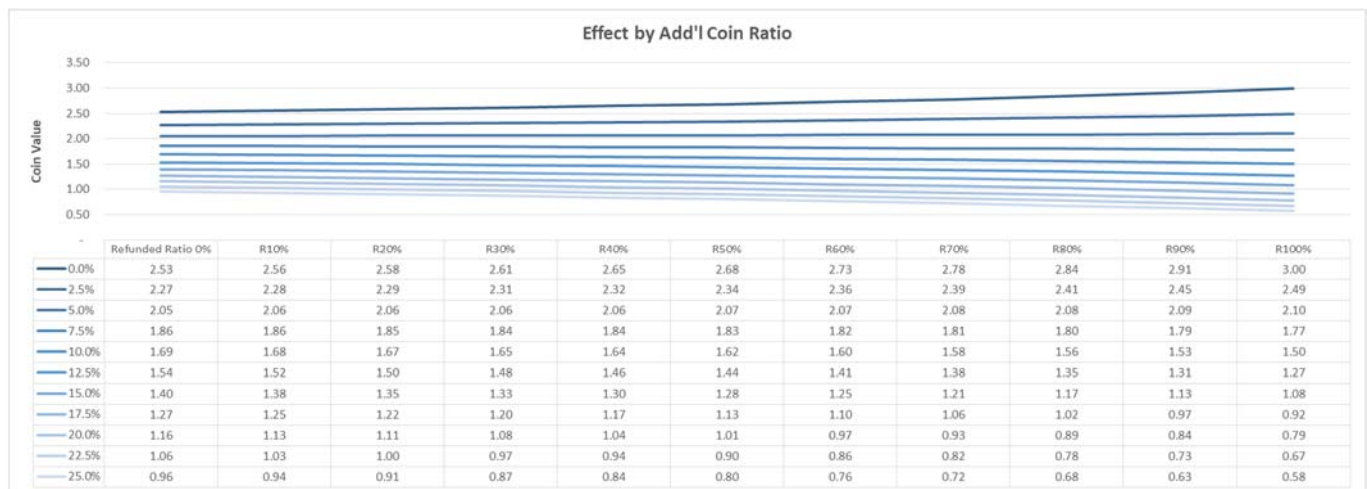


Figure 22: Effect by Additional Coin Ratio on Coin Value under CIE with 35%/65% Split

From the above chart, the maximum level of additional coin ratio is around 5% to maintain self-balancing mechanism.

CIE: Insured 30%/ Reinsurer 65% split, with 10% Refundable Loss Ratio

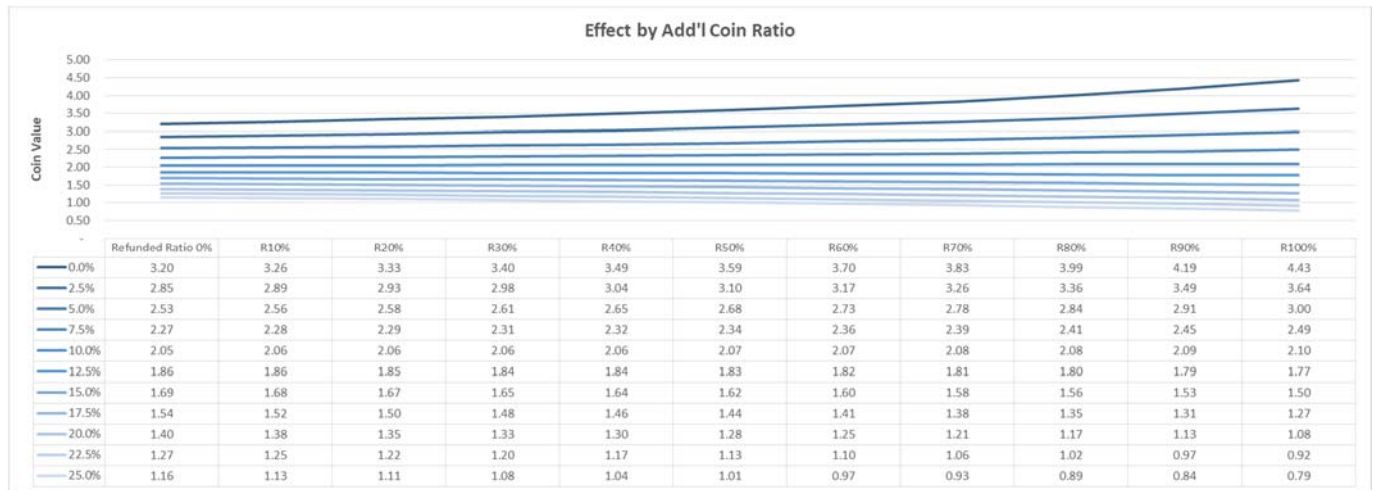


Figure 23: Effect by Additional Coin on Coin Value under CIE with 30%/65% Split

From the above chart, the maximum level of additional coin ratio is around 10% to maintain self-balancing mechanism.

BCE: Coin to Insured at 35%, with 10% Refundable Loss Ratio



Figure 24: Effect by Additional Coin under BCE with 35% Coin to Insured and 10% Refundable Loss Ratio

From the above chart, the maximum level of additional coin ratio is around 20% to maintain self-balancing mechanism.

BCE: Coin to Insured at 50%, with 20% Refundable Loss Ratio

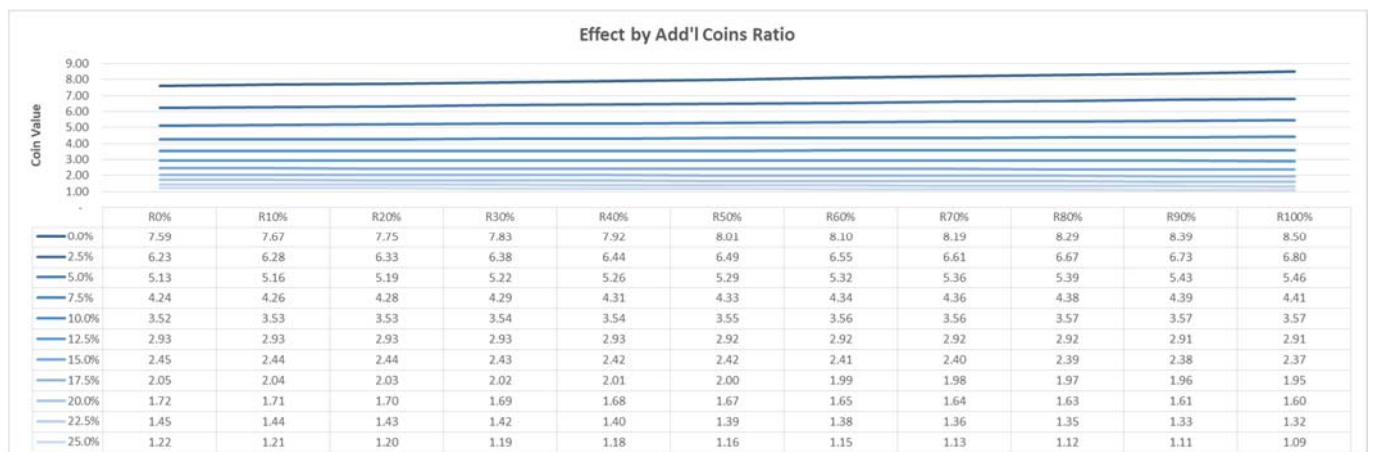


Figure 25: Effect by Additional Coin Value under BCE with 50% Coin to Insured and 20% Refundable Loss Ratio

From the above chart, the maximum level of additional coin ratio is around 10% to maintain self-balancing mechanism.

Observations of Simulations

Under both CIE and BCE, the simulations show Premium Fund running over 20 years is better than that of current insurance model, and only when there's no preference of Risk Coins the result is same as current insurance model. As there is self-balancing nature of Risk Coins that less preference will cause higher coin value, it is reasonable to estimate the RC model will help in the scale of the premium fund. On top of that, capability of additional coin issuance gives the fund manager more resource for risk financing when facing expected large or catastrophe loss occurrences. Moreover, under CIE the fund value is increasing faster than that Under BCE, as more coins are issued to help building the fund.

DISCUSSION AND CONCLUSION

The concept of Risk Coin is to explore alternate risk financing channel and therefore to be the basis for new insurance operation model. The purposes of Risk Coin are multiple:

- Being a token for shareholding of the coin fund/ premium fund, and Insureds are encouraged to keep the coins issued to them therefore it changes the premium payment from a zero-sum game to a win-win cooperation.
- Being a cryptocurrency anchored at the premium fund which guarantees the minimum value of Risk Coin, and with self-balancing mechanism which encourages the coin receivers to keep them instead of returning.

Beside its attraction turning premium payment to ownership of premium fund, Risk Coin Model is therefore taking the advantages of:

- Law of large numbers from risk pooling as traditional insurance;
- Seigniorage from issued Coin Issuance;
- Broader acceptance of Risk Coins by Insureds, Reinsurers or direct acceptance of Capital Market.

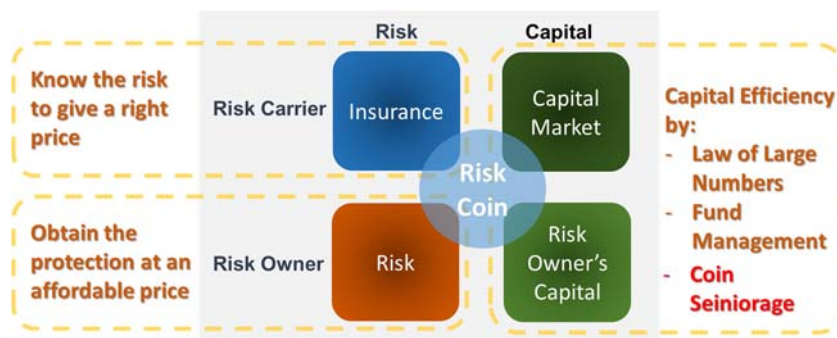


Figure 26: Effect of Risk Coin

Both of the implementations on current insurance and blockchain environments show self-balancing mechanism, even with additional coin issuance up to certain level. Although the application on blockchain environment seems less effective in fund building, it has high potential to be a platform insurance model of direct risk financing by risk coins.

Other future researches may include:

- simulation on portfolio with volatility in premium development and loss pattern;
- applications to life insurance or pension insurance;
- acceptance of Risk Coin as payment solution beyond insurance and the influences to Enterprise's operation;
- a dual-currency system if risk coin accepted as a general payment vehicle.

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APPENDIX A: ROLE OF IT IN INSURANCE

Inferences are made based on the initiatives benefiting from the use of certain Information Technology. These inferences are not necessary in chronological order, though it shows reasonable developing sequence, that some innovations may make one initiative more appealing and materializing sooner than other initiatives.

A.1 IT as a Tool - Current Status

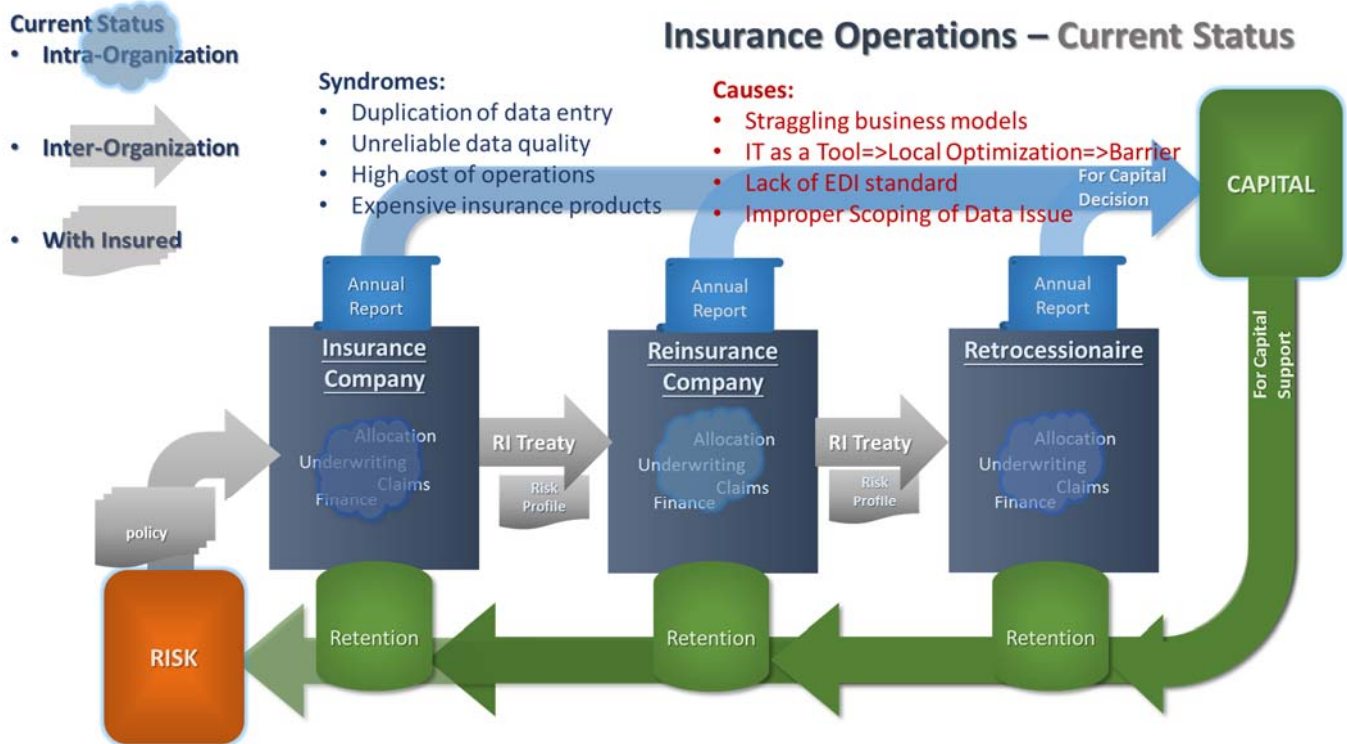


Figure 27: Current Status

The existing operation model of insurance industry is a legacy of pre-IT epoch, and IT is used as tools to improve the efficiency of manual work as on paper files. The overall structure of the industry is not reviewed for optimization to the purpose of insurance. Initiative is mainly to improve operation efficiency.

A.2 IT as Information Channel

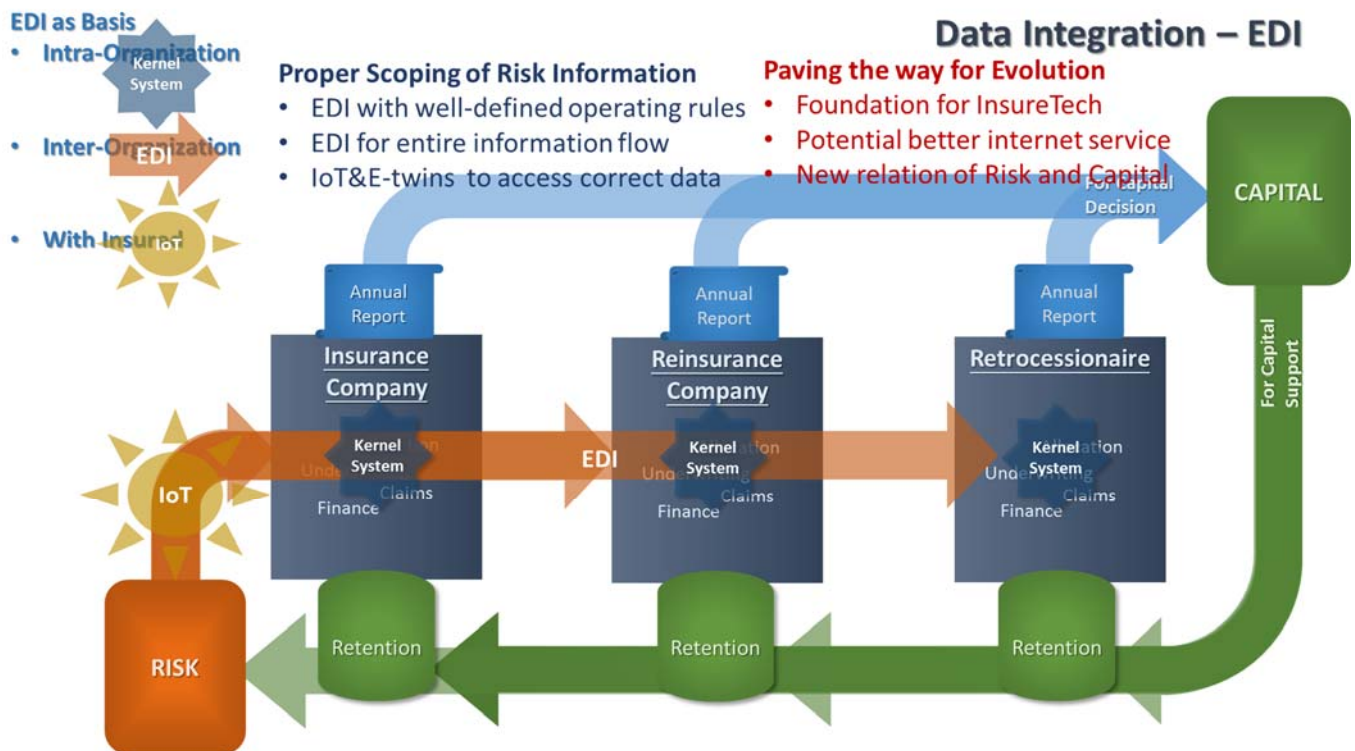


Figure 28: IT as Information Channel

EDI standard built within insurance industry and with risk owners so that risk information can flow from origin via IoT. Although the overall structure of industry remains, duplication of data entry is eliminated and transparency of data can be guaranteed. Initiative is mainly to improve risk assessment.

A.3 IT as Information Platform

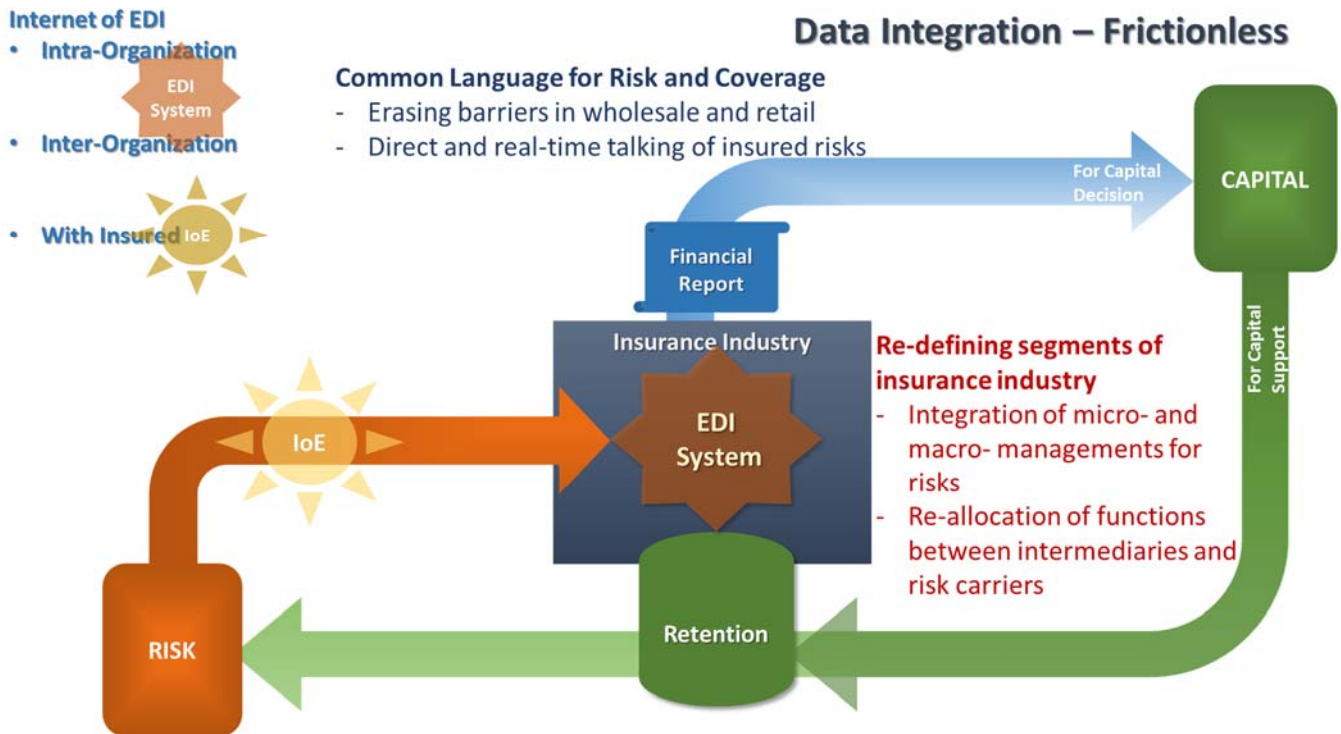


Figure 29: IT as Information Platform

Risk information available on micro and macro level, therefore erasing barriers between treaty/facultative reinsurance and direct insurance, and new management tools triggers the review of structural module and division of functions of brokerage, underwriting and risk financing. Initiative is mainly to reduce redundancy.

A.4 IT as Risk Pooling Platform

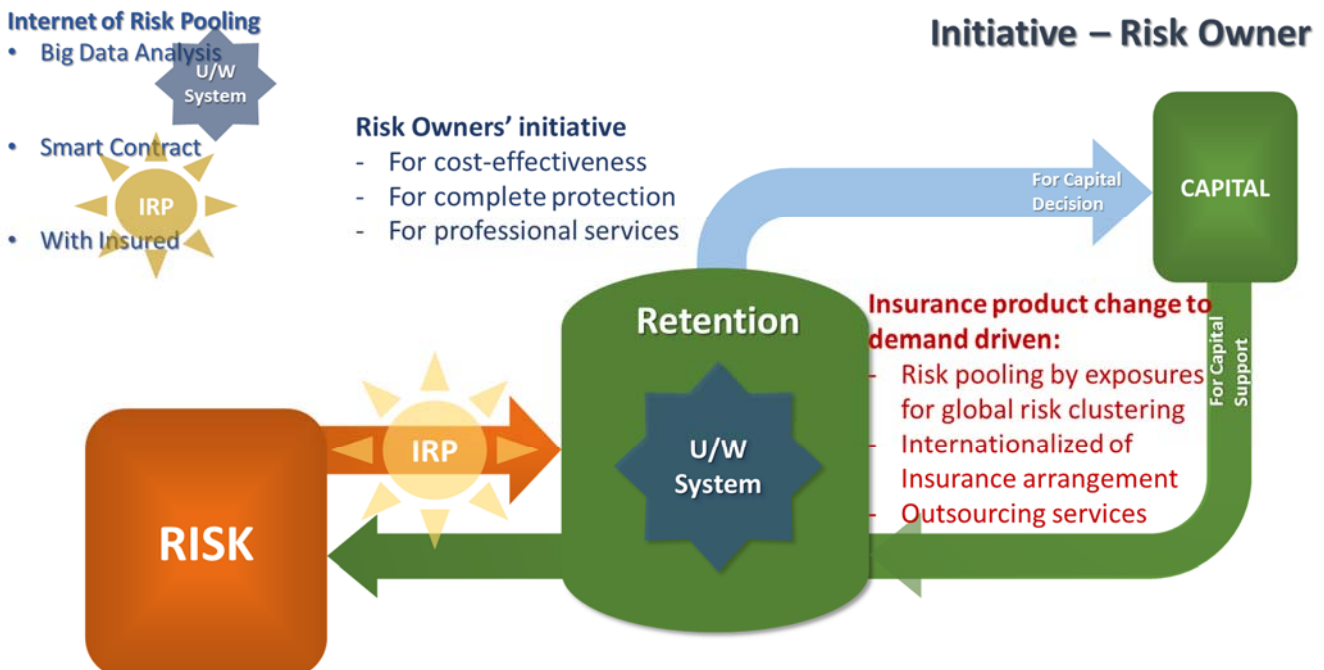


Figure 30: IT as Risk Pooling Platform

Real-time information of risk or loss available for assessments, and risk exposures pooled globally for analysis and acceptance. Insurance products are driven by demand of risk owners, instead of insurance companies' supply. Smart contracts in internet supersede local admitted policies. Initiative is to achieve cost-effectiveness and coverage completeness.

A.5 IT as Financing Platform

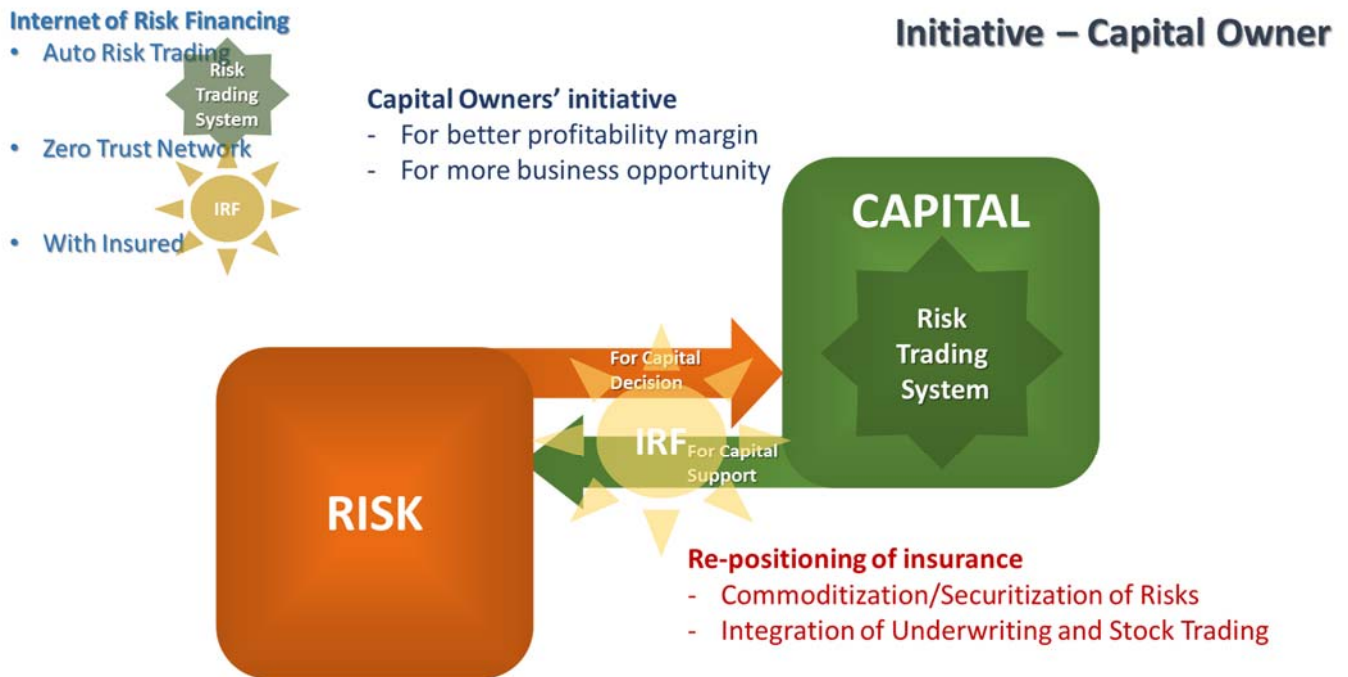


Figure 31: IT as Financing Platform

Reliable financing over internet and Risk as Commodity familiarized in Capital markets. Risk pooling and re-pooling for better application of Law of Large Numbers pushes the development of risk trading system in Capital market. Initiative is to get more business opportunity and better profitability for Capital Market.

A.6 IT as Capital Platform

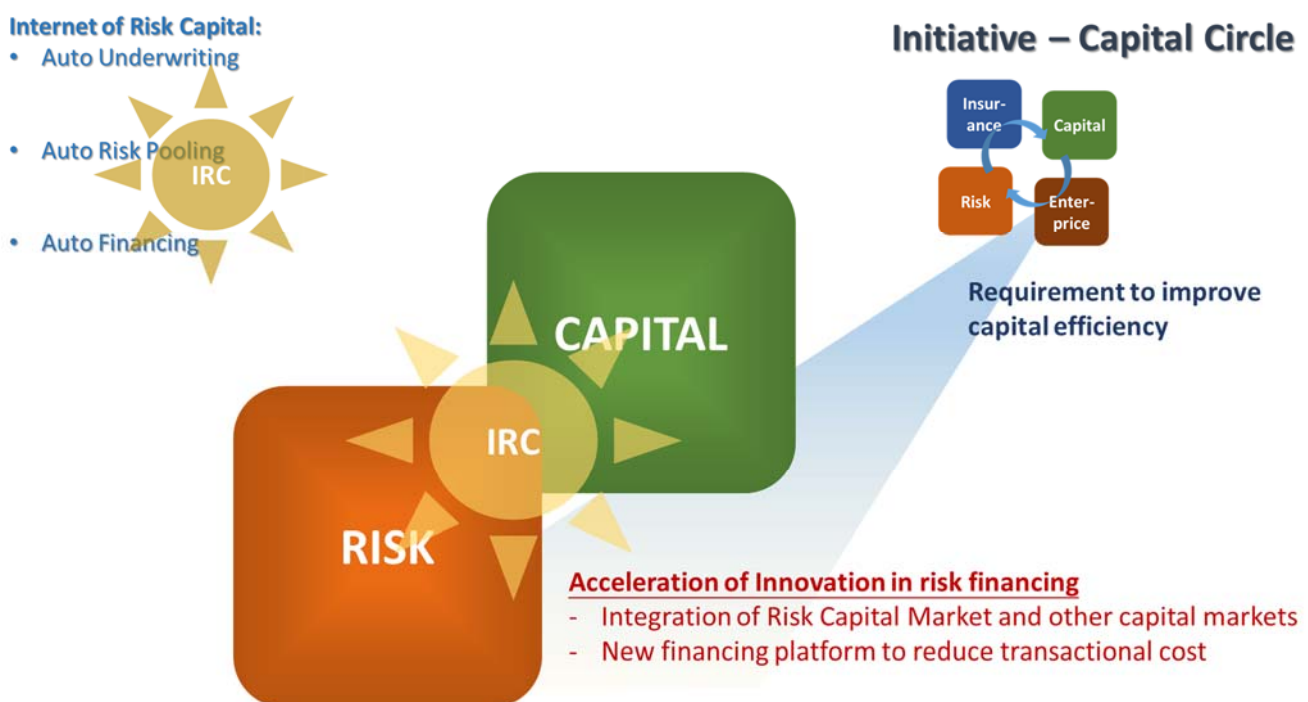


Figure 32: IT as Capital Platform

Insurance as necessary risk financing incorporated in other financing activities. Internet services are capable to support all necessary functions of Underwriting, Risk Pooling and Financing operations. Initiative is to review Capital Circle for practical and better efficiency of risk financing model.

A four stage approach towards speeding GitHub OSS development

(Full Paper)

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ABSTRACT

Many open source software (OSS) project creators adopt GitHub as their chosen online repository. They seek out others within the global OSS community of developers. Such community developers are then encouraged to add their capabilities, ideas and coding into a creator's developing OSS project. A structural equation modelling study of three top OSS programming languages deploys GitHub's operational elements as a four stage directional suite of (1) dependent, (2) intermediaries, and (3) independent elements. It shows a project's activity levels can be enhanced when additional project contributions are effectively stage-wise pursued. A staged development approach helps creators understand the process of attracting OSS developers into a creator's GitHub project.

Keywords: GitHub, open source software; OSS, developer repo, big data

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INTRODUCTION AND MOTIVATION

GitHub is the most popular hosting site for open source software (OSS) development and repositories (Cosentino, Izquierdo & Cabot, 2017). It houses over 57 million project repositories, with contributions from over 28 million developers (GitHub, 2018). GitHub's active big data projects are places where its software developers, and/or its responders or contributors alter and generally improve their developing OSS project (Gousios, *et al.*, 2014). Occasionally, apparent GitHub projects (each housed in its own repository or repo) can just be an individual programmer's additional code storage site, or they can be a cache that stores a personal code such as a 'code cracking tool' allowing unauthorized access into an existing commercial software package such as illegal pathway into the Chinese internet..

Over time, GitHub's active OSS developer repositories grow in size. Here, new knowledge and additional software capabilities are included as: (1) project corrections and improvements are made, (2) issues are discovered, (3) code is tested, stabilized and solved, (4) observers and raters offer the project external recognition, (5) coders, external developers, and contributors enhance the project's capabilities, and (6) new code, ideas, and documentation are accepted into a specific GitHub OSS project's master branch. Thus, a GitHub repository is dynamic ecosystem (Alshomali *et al.*, 2017) made up of ongoing contributing elements built by a global suite of uniquely-skilled, code-related contributors (Tsay, Dabbish & Herbsleb, 2014).

As little is known of how a GitHub ecosystem of contributors interact, this pilot study models the three most frequently engaged GitHub programming languages. It tests whether GitHub's operational elements do actually combine and align into a directional suite of (1) dependent, (2) intermediary, and (3) independent elements. It also seeks answers as to whether these combined elements exert an effect (or effects) that can provide other repo developers with a potential way to speed their individual project's 24/7/365 net activity level developments.

BUILDING THE GITHUB ECOSYSTEM ELEMENT MEASURES

Theoretical Basis

Within GitHub's OSS platform, teams of software developers act as communities and associates. They combine their interests into solving problems and they build operational or release versions of software (Wu *et al.*, 2014). This behavior fits across 'Information Integration Theory' which also builds on the common beliefs and behaviors of the 'Theory of Planned Behavior' (Ajzen, 1991). It links each community of GitHub software developers' attitudes with their subjective norms (Ajzen, 1991) in working collectively, and intentionally, on a project. Thus, a behavioral strength-of-belief is generated, and together they theoretically combine to jointly create an increase in a project's activity level. This also likely reduces this project's overall OSS development time.

Further theoretical support emerges through the 'Theory of Social Translucence' which draws a broad, visual, community-wide awareness around a project, its design strategies, and its deliverable(s) targets (Erickson & Kellogg, 2000). Here, each member of the project's community is recognized for their contributions, and ongoing activities – again ensuring collaboration into and

throughout each shared project. (Dabbish *et al.*, 2012) also support that such community behaviors do occur within GitHub projects.

Natural Ecosystem theory infuses a living community with its non-living organisms, whilst social network theory understands the interactions of participants inside a network. These theories jointly underpin that each element interacts across biological, physical and chemical processes. Similarly, in a GitHub repo ecosystem, the living community of OSS developers, observers, and interested parties interact within the GitHub project, and together they build an operational software solution that runs on a non-living hardware platform. A GitHub ecosystem also generates participant gratification which may be further behaviorally-understood through user gratification theory and motivation-consumption-gratification theory. (Katz, 1959; Severin & Tankard, 2000; Oliver & Raney, 2011; Hamilton & Tee, 2016).

Research Agenda

Hence, this study considers both such theory, and the behavior of OSS developers contributing into 600 top GitHub language specific projects. It study's 200 projects for the three most popular GitHub programming languages, and engages their OSS element contributions to poses answers to the research questions:

- *RQ1: do GitHub's operational elements actually combine and align in to a directional suite of (1) dependent, (2) intermediary, and (3) independent elements for a programming language?*
- *RQ2: do these combined elements exert an effect (or effects) that can provide other repo developers with a potential way to speed their individual project's net activity levels?*

GITHUB ECOSYSTEM CONTRIBUTING ELEMENTS

A GitHub project commences when a project creator seeks OSS development assistance to create a repo as generically shown in Figure 1. Those on social media, hacker sites, or on GitHub observation watch the project. There are both passive OSS watchers who merely observe a GitHub repo, and active OSS developer watchers who monitor and occasionally comment on this GitHub repo. These constitute the 'watchers' element. Others note the quality or direction of the project and rate it. These represent the 'stars' element. Still others take a sample of the project creator's code and either use it themselves for other purposes, or develop it. These skilled OSS developers make-up the 'forks' element. These three elements collectively engage and commence to assist the initial creator's project. Hence these independent variables constitute the initial engagement (or interest) group.



Figure 1: Aspects of a GitHub Repo

Table 1 summarizes the GitHub open source developer contributions to the above repo.

Table 1 Repo contributions

Repo Encounters	Description
Watchers	developers who observe repo content changes
Stars	developers who indicate a liking for the repo
Forks	developers who take a copy of the repos to work on
Issues	developers who solve a software issue for the repo
Pulls	developers who feed-back a potential solution to improve the repo
Contributors	developers who build a direct contribution to the repo
Releases	milestone in the development life cycle of the repo
Commits	new addition/update to the current repo

When a developer clones a repo, this gives them a complete copy of the repo content without necessarily being an active part of that repo. Unfortunately, GitHub statistics do not track information about cloning. When a fork element is then feedback (with new developments) into the creator's original project, and these points are accepted, then this action contributes a 'pull' element. An OSS developer can also recognize a problem that needs to be solved (arising from several possible sources). This constitutes an 'issues' element, which once solved is included in the creator's OSS improvements. As time progresses a 'release' element or new, improved version of the creator's OSS code may emerge. As OSS developers come to the creator's project, some skilled ones are invited to join as new additions to the 'contributors' element. Thus the intermediate variables may split into two groups – one raising expectations, and the other adding values to the project.

All these community elements assist the creator in the build of a successful and useful OSS outcome. Each addition that is committed to the project is termed a 'commit' element. Hence the more accepted commits, the higher the project's activity level. This dependent variable (commits) delivers levels of gratification to its OSS community.

Thus, the GitHub project repo has at least three main community blocks of OSS elements: (1) a starting, dependent, engagement/interest group, (2) an intermediary, participant and solvers group, and (3) an intermediary values capturing group, and (4) an independent or OSS activities outcome group. We conceptually model these elements as Figure 2.

GitHub offers select approaches when analyzing its data. However, to build a popular GitHub project, a forks approach is typically selected. Aggarwal, Hindle & Stroulia, (2014) suggest extracting top repos against number of forks generally offers clearer, more-consistent documentation advice, and this helps to draw-in other coding contributors (Hata *et al.*, 2015). Documentation is also related to issues, solutions, and testing (Tsai, Dabbish & Herbsleb, 2014) and to social media and websites (Jiang *et al.*, 2017), again suggesting forks, watchers and stars are also likely related.

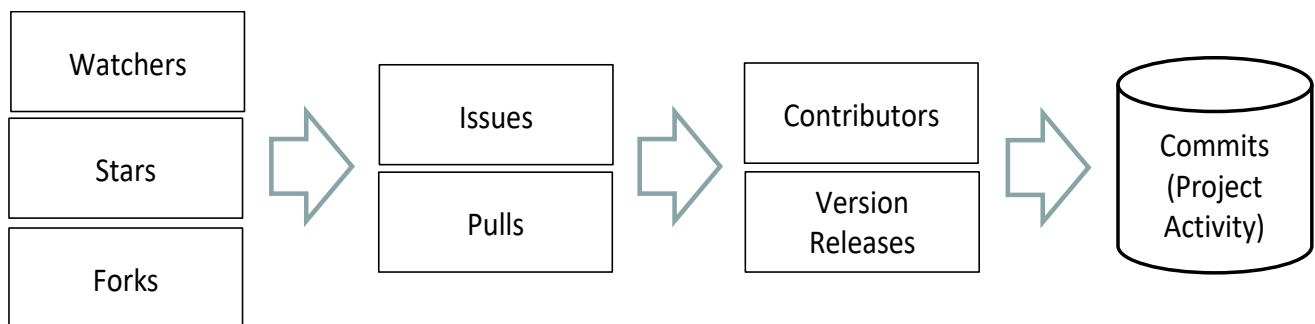


Figure 2: GitHub project ecosystem model

METHODOLOGY

This study extends and refines Alshomali *et al.*'s (2017) and Hamilton *et al.*'s (2017) papers. It engages three programming languages, and follows a similar procedure for data capture. It requires many weeks of continuous downloading to collect the programming language repo data sets. Hence, the number of top repos for each of the top three GitHub programming languages engaged in this study is limited at 200 repos each. This number of repos per language allows for a more definitive structural equation model finding, as with over 20 cases per model construct a valid model can be established for each programming language studied (Hair *et al.* 2010).

Data Capture

This study again uses GitHub's web-based API. It again extracts GitHub data using this team's developed code (available at <https://github.com/ozyjay/GithubQuery>). This process of data extraction takes weeks of continual download time. Captured data is then collated into eight constructs with pulls open and closed combined into a pulls construct, and issues open and closed combined into an issues construct. Eight GitHub constructs and their measures are then imported to SPSS and AMOS 23.0 and SEM path modelled.

Data Analysis

The data is visually assessed to remove any outlier cases such as individual code storage cases, or any anti-social/'crack code tool' cases, or any non-release sites from each programming language's data set. This discriminant validity check enhances the accuracy of the targeted data and its modelling.

Table 2. GitHub construct elements (top 200 projects per language)

GitHub Elements	Watchers	Stars	Forks	Releases	Contributors	Issues	Pulls	Commits	Total
JavaScript	165153	3553983	809328	15324	46707	434580	241377	708605	5,975,057
Python	100346	1551498	426286	10897	44978	296256	306725	1178386	3,915,372
Java	119342	1495595	527948	9230	14563	185634	130475	941579	3,424,366
									<u>13,314,795</u>

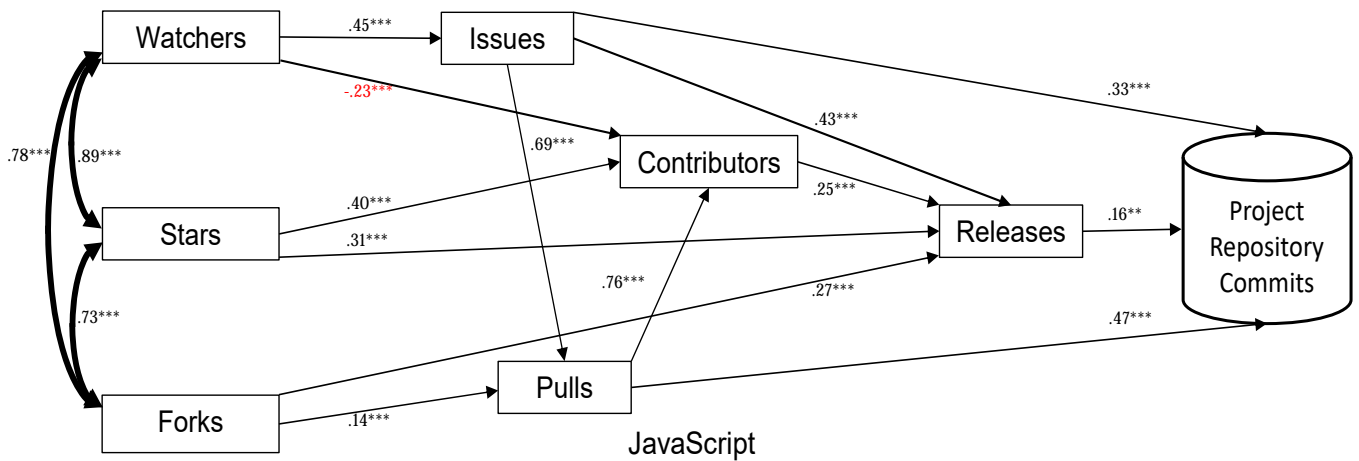
For these top 200 active projects in JavaScript, Python and Java the total element measures total 13.3 million, and all relate to project code or information contributions. Each project is current, active, and has existed in GitHub for at least one year. The dependent outcome variable commits is measured as the number of accepted changes into the repo of the project.

In this study we expect path differences, as OSS developers working in one of these three languages likely bring different individual talents and code building capabilities to their chosen OSS project. Also, JavaScript and Python are more a client side scripting language and Java is more a server side language activates web/file targets (and runs fast across platforms). Thus this study deploys different languages and it looks for commonalities across Figure 2's elements.

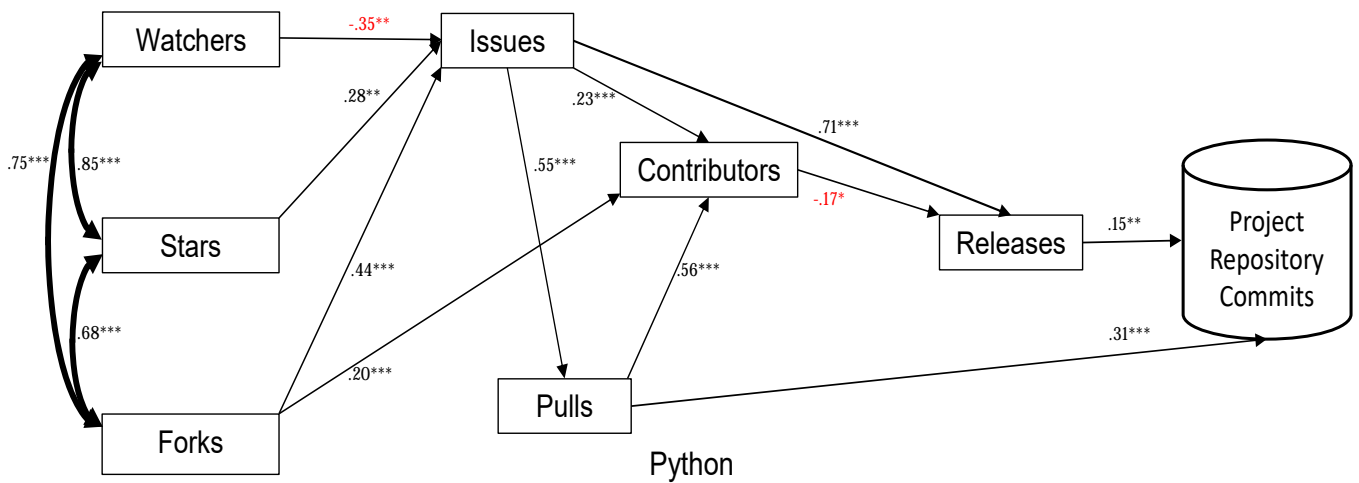
Each GitHub OSS project activity level structural path model, for each of the three GitHub OSS programming languages, is shown below across Figures 2 to 4. These three Figures each engage their respective Table 2 programming language data sets.

After outlier removal (typically those projects that: (1) are not actually OSS developer community projects, or (2) involve anti-social activities, or (3) have just one developer, or (4) show no releases) all three programming language SEM path models show excellent fit.

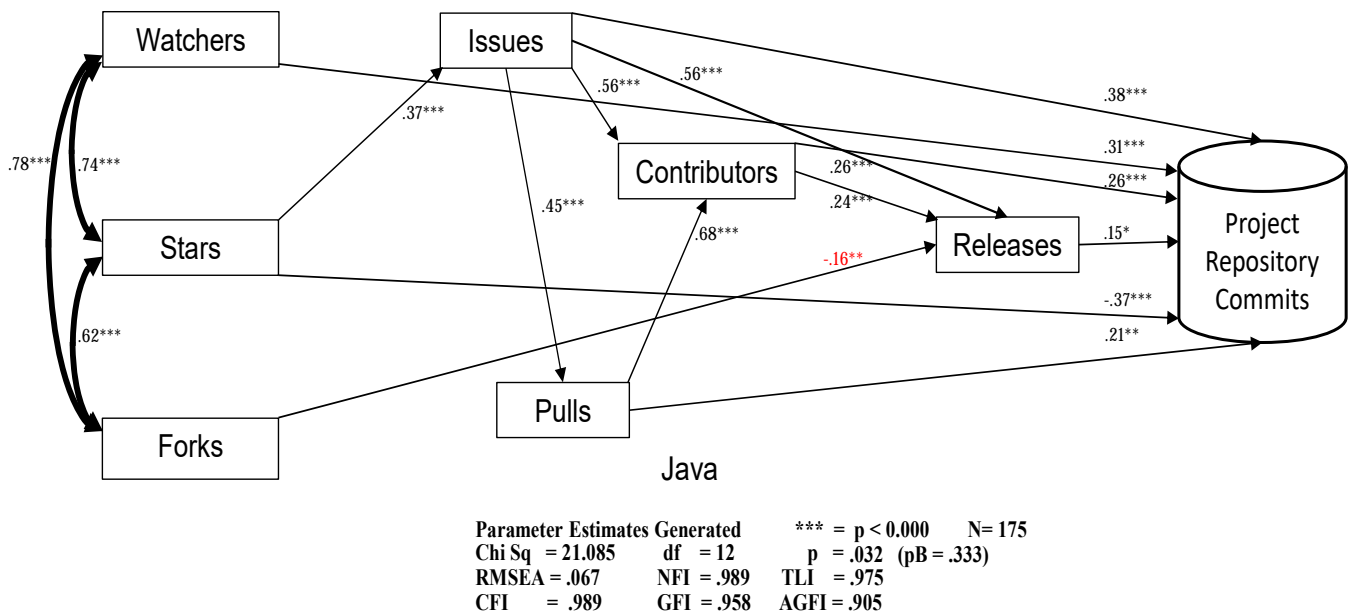
The χ^2/df ratios (between 1 and 3) supported by p values (>0.05) indicate excellent fit. All other measures displayed also support excellence of fit. (Cunningham, 2008; Hair *et al.*, 2010). All models have data sets in excess of 160 cases (20 per element) (Hair *et al.*, 2010; Muthén & Muthén, 2002). The maximum number of additive paths towards the dependent outcome variable is five. This is an acceptable maximum structural path length (Hair *et al.*, 2010). Validation by bootstrapping (200 times) further confirms model convergence and validity (Cunningham, 2008; Hair *et al.*, 2010). Thus each structural path model is representative of its top OSS GitHub programming language, and each offers suitable representative insights into the stage-wise behavior of their constituent elements.



Parameter Estimates Generated *** = $p < 0.000$ N = 195
 Chi Sq = 20.143 df = 12 p = .064
 RMSEA = .059 NFI = .989 TLI = .985
 CFI = .994 GFI = .976 AGFI = .927



Parameter Estimates Generated *** = $p < 0.000$ N = 195
 Chi Sq = 21.774 df = 14 p = .083
 RMSEA = .054 NFI = .989 TLI = .985
 CFI = .993 GFI = .974 AGFI = .932



Figures 3 to 5: GitHub JavaScript SEM path model for project activity level.

DISCUSSION

Figures 3 to 5 show the concept model's 4 stage transition to delivering project activity. In each case there is an internal OSS development transition from issues to pulls to contributors to releases. In each case these paths are strong and significant. Hence, based on the similarities across our three programming languages, we propose Figure 2's conceptual model as a general project activity model for GitHub. We extend this into Figure 6, indicating the likely progression of successive element influence triggers.

Considering the independent external factors (watchers stars and forks), we note watchers just track the project's activities, and generally, they do not contribute. Hence, they generally exert an indirect, and negative effect, on the overall project activity levels. Thus, although watchers and fairly highly correlated with stars and forks, a strategy to move watchers into being stars providers, or into taking forks, or even into being contributors, or into generating issues contributions is desirable when pursuing accelerated GitHub OSS project developments.

This study notes there are four negative, but significant, paths (one or two in each programming language). Each negative path is both logical for the programming language's normal use applications, and readily explained. Hence when combined with other path strength measures, each programming language SEM model is accepted as valid.

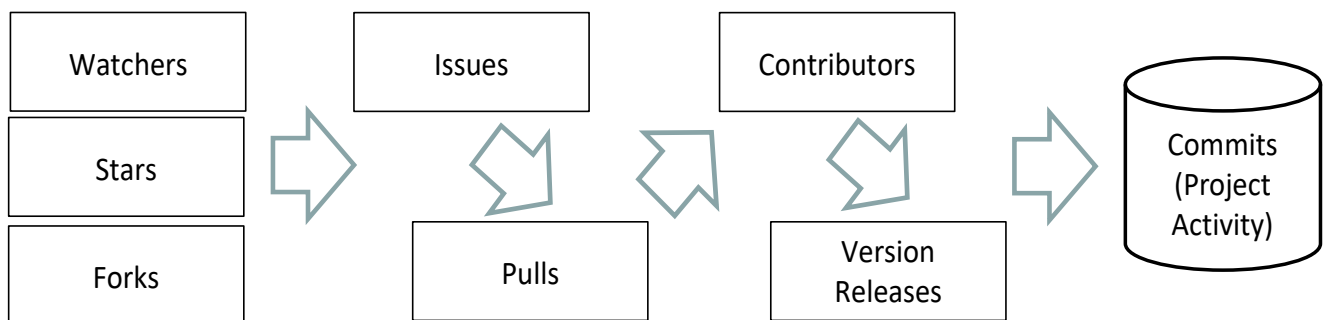


Figure 6: Progression of successive element influence triggers across the GitHub project ecosystem model

CONCLUSION

This SEM study shows that GitHub's operational elements do actually combine and align into a directional suite of (1) dependent, (2) intermediaries, and (3) independent elements for each programming language studied in GitHub. Figures 3 to 5 support the GitHub project OSS contribution elements of a project's activity level into its repository storage as a GitHub ecosystem.

The path models (Figures 2 to 4) indicate strong interrelationships amongst the elements. Thus, any improvement to the elements likely positively accelerates the GitHub projects OSS development. The SEM study also shows a consistency of combined elements exerting positive directional pathways effects towards the delivery of a project's activity levels. This is summarized in Figure 5's progression of successive element influence triggers across the GitHub project ecosystem model. This suggests a project's activity levels can be enhanced when additional project contributions are effectively stage-wise pursued. This staged development approach helps creators understand the process of attracting further OSS developers into a GitHub project.

Beyond the three languages studied, GitHub contains an additional 150+ project programming languages. Hence, this study's GitHub project ecosystem model likely has application to many of these additional languages – especially when their creators wish to (1) identify the interrelationships within each GitHub project's repo ecosystem, and/or (2) model the elements of these interrelationships as a four stage structural model, and/or (3) stage-wise attempt to accelerate the element uptakes within each of these projects, and/or accelerate their projects towards completion.

The knowledge flows embedded in this study's GitHub project ecosystem model (Figures 1 and 5) likely extends and hold ideas application to other OSS hosting platforms beyond GitHub. Those individual OSS platform creators, working on such hosting platforms, can use this study's approach when considering pathways towards specifically minimizing the OSS development timeframes involved whilst pursuing their next OSS project release.

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A Framework of Cloud and AI based Intelligent Hotel

(Full Paper)

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ABSTRACT

In the past 10 years, the hospitality industry's discussions on cloud technology have been ongoing to rise, but they had been stuck in the stage of paper talks, and there were no substantive action. In view of the huge potential of the intelligent hospitality industry market, and the related academic research literatures about the virtualized cloud architecture, AI technology application and intelligent virtual housekeeper system among in this industry is still relatively few. Therefore, I selected the industry success case led by Taiwan's Ministry of Science and Technology as a case study for this research, besides, quantified the system's trial operation phase, relevant operational performance results, as the focus of this intelligent hotel case implementation effectiveness evaluation.

Keywords: Cloud computing, artificial intelligence (AI), intelligent hotel, innovation service

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INTRODUCTION

Now, more and more companies are starting to offer true cloud-based applications that are flexible, always online and always up-to-date, and offer easy and affordable open integration options. In the past, high costs and difficulties in integration have been a major obstacle to innovation, but hospitality technology is now moving from a closed system to an open platform that can easily interface with each other. We can envision that a "stacked" hotel management solution will soon be born that will integrate all of today's critical system functions, such as PMS (Property Management System), CRS(the Preferred Hotels & Resorts Central Reservation System), CRM(Customer Relationship Management), RMS (Revenue Management System), ERP (Enterprise Resource Planning), etc., form a holistic hotel management platform, hotels could easily choose to join other functions they need, and ultimately realize the "platform" Service(PaaS)and "software-as-a-service"(SaaS) efficient and customized development platform.

Due to the rapid development of information technology applications and artificial intelligence (AI) technologies, virtualization, cloud architecture, Internet of Things, big data and AI are constantly integrated into all walks of life. In the hospitality industry, "intelligent hotels" based on artificial intelligence are gradually entering the public perspective. Many hotels have undergone a series of upgrades. Many hotels have undergone a series of system upgrades and will compete and develop in the market with the appearance of "intelligent hotel".

Throughout these intelligent hotels, the competition factors mainly focus on four aspects: interactive intelligence, scene humanization, experience personalization, and data informatization. The hotel is only the medium and entrance to the accommodation scene. After the real stay, the users will have a series of information and personalized services, such as catering, entertainment, travel, butler service and these are also inextricably linked to the concept of "wisdom".

With regard to data transformation and insight, today's systems are becoming more interconnected, so the way of data being stored, aggregated and accessed is changing. Merging data into the cloud means that a 360-degree view of the guest will be realized. More and more systems will become increasingly efficient in exchanging information. The hotel will be able to access signals anytime, anywhere, and a more intelligent system will be able to predict consumer behavior at a subtle level that has never been seen before.

Having the various applications of cloud technology, but, if lack of consolidated data; or with the integration of data warehousing, but no analysis system to predict and perfect implementation of decision-making, can't achieve the "complete integration, seamless perfect wisdom" realm. The future is beginning to take shape: many hotel brands and hotel technology companies are investing millions of dollars to build this smart system.

However, a true smart system should be intelligent and user-friendly, that is, the center is a human rather than a system device, which not only allows users to experience the ultimate technological experience, but also meet their diverse and individual needs. The hotel is intelligently transformed, and the intelligent system is the core. Generally speaking, the hotel intelligent system has three development directions:

1. Self-learning system based on big data: Hotel intelligence is a system that can realize self-evolution according to the user's living and usage habits as well. Whether it is a hotel operator or a guest, it can be fully intelligently adjusted according to their own needs. For example, after you enter the hotel for the first time, the system will analyze your usage data. When you stay at

the hotel for the second time, the system will provide you with the most comfortable and convenient service according to your previous stay habits.

2. Centralized automatic sensing system: through the use of mobile phones, routers, sockets, and software / hardware / firmware / weak power mode relevant control architecture to make hotel facilities intelligent, allowing users to feel the true technological wisdom experience, through the association equipment to achieve the control of hotel room lighting, air conditioning, curtains, audio and video equipment.

3. Wisdom virtual butler: integrate all hotel information such as guest customization leisure service, value-added service, VIP identification, room service, business service, etc. In the hotel, let the tenants through the anthropomorphic multimedia technology and AI System, virtual characters could easily get information, moreover, all the hotel service personnel will have a butler system to integrate and remind all service items, so that every service staff can become the "most professional reception."

Regarding the case study of this research, in terms of technical aspects, most of the current hotel industry in Taiwan is limited to the size of the company and the low level of awareness of the enterprise leaders. Normally, they do not willing to invest in relevant innovation and technology. In this practical case, the innovations that differ from traditional hotels are mainly: the technical architecture uses information technology integration applications such as virtualization, cloud computing and artificial intelligence.

As far as the application and operation of the hotel industry is concerned, the traditional hotel competition projects focus on the building internal hardware, appearance, decoration, hotel facilities, service quality and price of the hotel. Nowadays, the era of technological application is gradually maturing, and these traditional competition projects have progressively relegated to the second line. In the near future, the degree of hotel intelligence and informatization will be the main key factor for the industry market competition. Therefore, thinking about how to use cloud technology and artificial intelligence to establish the differentiation of hotel operation characteristics will be the key to the competitive advantage of the hotel industry.

The main purposes of this paper are: 1) to explore the architecture of cloud computing technology applied to intelligent hotels, and to build a "virtualized + cloud technology" operation mode of intelligent hotels, which could provide a successful model reference for cloud computing system architecture in related practical industries; 2) Combining AI with intelligent hotels can more effectively enhance the technology innovation of the hospitality industry, improve customer satisfaction, enterprise competitiveness, and improve operational performance; 3) Analyze relevant smart application for intelligent hotel practice cases and business operations as well. Under the relevant system platform data, analyze the target hotel service innovation development process, and determine how various related activities affect the final innovation results. Moreover, to explore the hospitality industry further AI innovation service business opportunities.

LITERATURE REVIEW

Cloud Computing

According to the definition of the National Institute of Standards and Technology (NIST), there are five behavioral frameworks such as (Figure 1) NIS definition cloud computing architecture diagram: 1) Cloud Consumer, 2) Cloud Provider (servo Device provisioning, cloud service management, security and privacy), 3) Cloud Auditor, 4) Cloud Broker, 5) Cloud Carrier Actor has five behavioral frameworks and a total of four deployment modes and three service types state(Qu *et al.*, 2018).

Types of Cloud Computing Systems include public, private, community, and hybrid clouds.

(1) Public Cloud: It is an open cloud computing platform. It is cheaper. If you pay, you can use the resources of the cloud computing platform. However, using public cloud data is easy to steal, so there is often privacy security (Hintze & Mike, 2018).

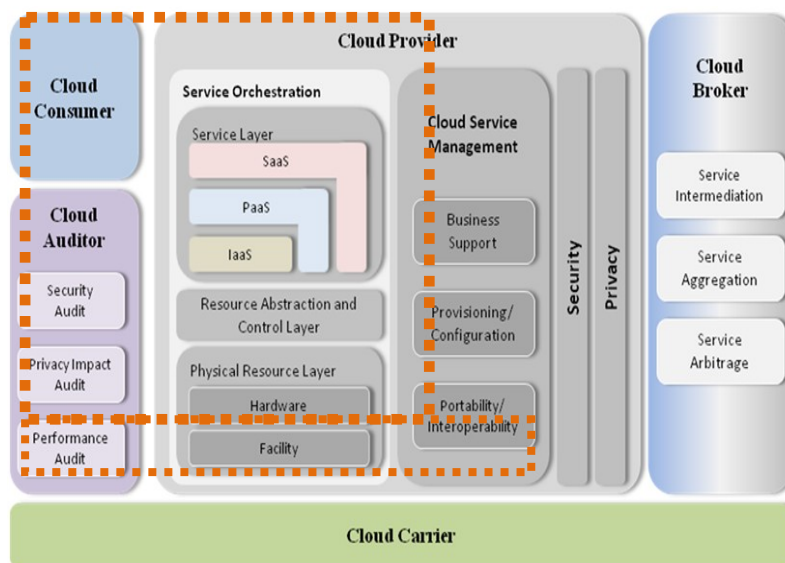
(2) Private Cloud: It is the establishment and management of maintenance, all of which are the company itself. The cloud computing platform is only used by internal companies and is not open to the public. In this way, it can protect the internal data security of the company (Neville & George, 2018; Ogrea & Claudia, 2018).

(3) Community Cloud: It combines the characteristics of a public cloud and a private cloud. It consists of multiple clouds. Non-enterprise public data is processed on the public cloud, and enterprise confidential information is placed in a private cloud. This saves some costs. The security of the data can also be maintained (Zhang *et al.*, 2018).

(4) Hybrid Cloud: The platform is jointly constructed by several organizations to share resources. This platform supports the same demand services. These cloud systems include private clouds, social clouds, public clouds, etc. (Kietzmann & Treen, 2018).

At present, the current development of Cloud Computing application in the intelligent hotel industry, in addition to foreign companies and Taiwan's group chain five-star, four-star hotel, there is a possibility of introduction, the general hotel industry is

generally based on technology, management and cost considerations, there is no such model.



Source: NIS of NIST.

Figure 1: NIS definition cloud computing architecture diagram

Artificial Intelligence (AI)

Artificial intelligence refers to science and technology that can imitate human sensing, thinking, reasoning and action, and demonstrates the ability to solve problems with human intelligence. Artificial intelligence uses human input data to acquire knowledge, and enhances problem-solving through machine learning mode. Ability to reduce errors and increase their efficiency (Maurício, da Silva, & Wee, 2018; McCracken, 2017).

The specific reference to the definition of AI depends on the context of the problem we are discussing and the focus of attention. The book lists five definitions: "Definition 1, AI is an incredible computer program (La Porte, 2018). It refers to the machine to complete what people think the machine is impossible to do. Definition 2, AI is a computer program similar to human thinking. It means that AI can have logic and thinking similar to human beings. Definition 3 is a computer program similar to human behavior, and the behavior of AI is similar only in similar environments. Definition 4, AI is the computer that will learn. The program is similar to machine learning. Definition 5: AI is a computer program that makes the best interests based on the perception of the environment.

The core issues of artificial intelligence include reasoning, planning, learning, communication, and the ability to perceive. There are a large number of tools that apply artificial intelligence, including search and logical deductions, etc. (Hollebeek, Elina & Matthew, 2018; Wirth, 2018). The development of artificial intelligence is simply divided into three waves [8]. The third wave began in the 2010s with the analysis of big data and the development of the Internet. Machine learning began to emerge. Among them, deep learning focused on deep learning, which is a kind of machine learning. Vauhini (2018) proposed that machine learning aims to apply statistical learning and artificial intelligence techniques to automatically learn hidden knowledge or patterns from training data or past experience.

Schuller(2018) listed four technologies used by AI in the use of network security, including: Application of Intelligent Agents, Application of Neural Nets, Expert System Applications, Application of Learning Description and Definition.

The use of artificial intelligence in life and household goods is more common and widespread, such as AI smart refrigerators, smart boxes, artificial intelligence TVs and many other home appliances. In addition to the temperature adjustment, the smart refrigerator can also recommend recipes, food ingredients, and even the function of the refrigerator touch screen to buy ingredients (Lee, 2018). Amazon's smart speaker Echo Dot, which is the best gift of Christmas in 2017, is the best-selling item on the site. AITV can control voice commands and automatically recommend programs, while learning the habits of user use and search, providing more precise interaction. Wagner and Howard (2018) studied the technological development of smart families to meet the services and living spaces that households need.

At present, the current development of AI application in the intelligent hotel industry, in addition to foreign companies and Taiwan's group chain five-star, four-star hotel, is more likely to have, the general hotel industry is generally based on technology, management and cost considerations, there is no introduction of this model.

Intelligent Hotel

The hotel occupies a status that cannot be ignored in today's economic system and leisure industry. Therefore, the importance

of hotel management has its significance and value. However, the hospitality industry is changing and will continue to change; therefore, modern hotel management technology must adapt to changing circumstances. Hotel management refers to the management of hotels, restaurants, and tourism related units. Information Technology (IT) Definition: A general term for information technology used primarily to manage and process information. It mainly uses computer science and communication technology to design, develop, implement and install information systems and application software. It is also often referred to as Information and Communication Technology (ICT) (Jose, Gautam & Jörg, 2018; Joshi *et al.*, 2017; Panos, Ola & Geoffrey, 2018). With the continuous development of information technology (IT), Internet of Things and communication network technology, IT is also widely used in the hospitality industry (Alessandra *et al.*, 2018; Wikipedia, 2018). In addition to investing in IT hardware, inter-organizational and external information systems are also important. Among these companies, many hotels use a more efficient system to manage. In terms of corporate governance, the first application of network systems also appeared in the aviation and hospitality industries. The most obvious example is the automated booking and central reservation system (Nathalie & Béchir, 2018).

The operation of 21st century hotels will have to rely on more and more information technology to enhance the value of personalized services (Alessandra *et al.*, 2018). Hotel managers face the challenge of quality of service and diversity. They need the ability to manage and implement IT operations, so that they can have a competitive advantage (Kumar & Vikas, 2018). Murphy, Chen and Cossutta (2016) also pointed out that IT has become the necessary tool for providing customers with room facilities, adding concierge services and private information, checking out, providing wake up service and room service, on-demand movies or personal TV shows. In many cases over the past decade, business or academics have agreed to the benefits of using information technology in the hospitality industry, including the upgrading of service quality, the design of long-term development of enterprises, the improvement of efficiency and efficiency, and the integration of departments; the specialization in human resources management. Aspects, speed up communication, reduce costs, differentiation and cooperation, and improve performance (Naseeb Ullah, Shahid & Bakhsh, 2018).

The IT revolution is reshaping the hotel industry, which is an inevitable trend for international tourists to use IT (Scorțe, 2017). While investing in IT applications, the international tourism industry is most concerned about whether IT will improve operational performance. Therefore, the development of intelligent hotels can help solve the limitations and problems encountered in this industry (Naseeb Ullah, Shahid & Bakhsh, 2018). The intelligent system can mainly control the hotel operation and optimize the service mode. So far, there have been many researches on intelligent hotels, mainly based on technical applications, resource management and peripheral business (Murphy, Chen & Cossutta, 2016). However, there is relatively little research on the technical architecture of the overall solution for hospitality service innovation.

Innovation Service

Tourism and tourism has become an important driving force for economic growth in various countries (iThome, 2016). Thinking about how to create "service innovation" is the top priority of all walks of life, and the hotel industry is no exception (Hollebeek & Andreassen, 2018; Shi *et al.*, 2018). Den Hertog and Bliderbeek (1999) proposed a service innovation model that points out the technology choices of service delivery, new service concepts, new customer interfaces and new delivery systems; among them, (1) New Service Concept (New Service Concept), that is, a new method to generate services, the focus is on providing customers with new service processes or new service connotations, which may be specific or abstract; (2) New Client Interface, usually referred to as it is to use IT technology to improve the existing service interface and to connect existing customers with potential customers. (3) New Service Delivery System, which focuses on transforming the internal organization of service providers and Education and training enable employees to realize their potential to stimulate new services and professional services. (4) Technical Options means that information technology (IT) is the most innovative technology choice used by the industry. The promotion or the use of technology can implement the above three aspects of innovative ideas faster and more efficiently.

METHODOLOGY

Based on the above research background and motivation, purpose and problems, and related literature, this study develops research methods and implementation, using case study method and questionnaire survey method. First, the case study method used in this study is described. The second is the selection of case study subjects. The selection criteria are based on the consideration of service innovation. The organizations with exemplary role in the industry are research cases. The third is customer satisfaction. Questionnaire design, based on the research purpose and the service innovation in the important literature and the learning experience of the intelligent hotel industry, the customer design and implementation of the system satisfaction survey, the questionnaire data and the subsequent analysis.

The case study is to explore the nature of the activity of a case in a specific context, and hope to understand its uniqueness and complexity. A case study is a review of a particular phenomenon. Yin (2009) considers a "case" to be a bounded system and has its boundaries. It describes a well-defined object rather than a specific process.

The study covered three main topics: 1) virtualized cloud and network intelligence management; 2) virtual butler service, and 3) "innovative service model to improve operational efficiency and shape digital features." Why is this research focused on the virtual butler service platform? In addition to the brand strategy of smart learning companies, the company also creates future business blueprints and goals through the following projects: 1) improving hotel intelligence; 2) continuing service innovation,

thereby enhancing customer satisfaction.

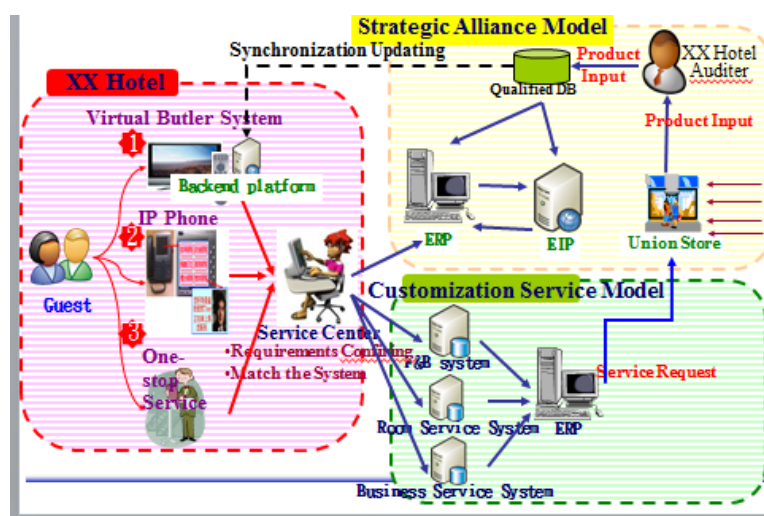
According to the four dimensions of service innovation of Hertog and Bliderbeek (1999), the link corresponds to the research structure of this case (see Figure 2); the fourth dimension of "Technological Options" facet, this case through the virtual housekeeper technology platform Use, in order to more effectively implement innovative models of service new methods, new service interfaces and new service delivery systems.

In the first dimension of the "Service Innovation Method" section, the virtual butler information system can be linked to the service center to provide relevant ;1) customized services such as catering services, room service and business services; 2) Combine with strategic alliances to make subscription services to provide customers with new service processes and innovative service connotations.

The second dimension of "innovation service system delivery" is based on smart network TV design, combined with hotel services, private tours, business secretaries, omnipotent butlers and customer-related customer service packages, etc. The type, combined with the education of artificial intelligence, continues to inspire new professional services.

In the third dimension of the "new service interface" section, through the development and design of IT application systems, combined with virtual butler information system technology components and customized service models, the interface and service quality of hotel intelligent services are greatly improved. Therefore, it can enhance existing customer satisfaction and more effectively integrate virtual and real channels through intelligent network platform, in order to strive for a larger global potential customer.

Finally, the results of the innovation platform related to this research case are presented. Based on the information generated by the innovation system platform of this case, the business operation data report generated by the annual, monthly, weekly and daily time related to the application system database is compared with the research. A "key performance indicator" that measures case management practices. In addition, according to the data analysis results of engineering, marketing, financial and operational performance, as the operational performance measurement indicators and benchmarks of this cloud intelligent virtual butler platform case.



Source: This study.

Figure 2: The framework of Virtual Butler Information System

RESULTS AND DISCUSSIONS

Virtual Butler System

In the current case study, we found that an intelligent hotel can be built on the integration of the following pillars. First, the innovation of service model: using smart network services to create differentiation of competitive advantage, and using IT intelligence to provide a new model of virtual butler service; Second, improve operational efficiency: improve operational efficiency can allow hotel staff to have more time To provide better services; third, to adopt and provide virtual housekeeper related functions: hotel-related artificial intelligence devices can actively provide more friendly, convenient and efficient functions, and provide customers with more intimate personalized services. Using the virtual cloud related technology application and intelligent room control function in the smart virtual service system can improve the rapid response capability, store valuable service records, reduce unnecessary resource waste, and thereby improve customer housing related consumption.

Integrate hotel information such as leisure services, value-added services, VIP identification, room service, business services. Through personalized multimedia-related technology, hotel guests can easily access relevant information through personalized

tour guides, business secretaries and the role of the all-round butler; in addition, all hotel service personnel should have a housekeeping system to integrate and track their services. Let each service staff turn into the most professional receptionist. See Table 1 for the smart virtual housekeeping system architecture of the relevant research model.

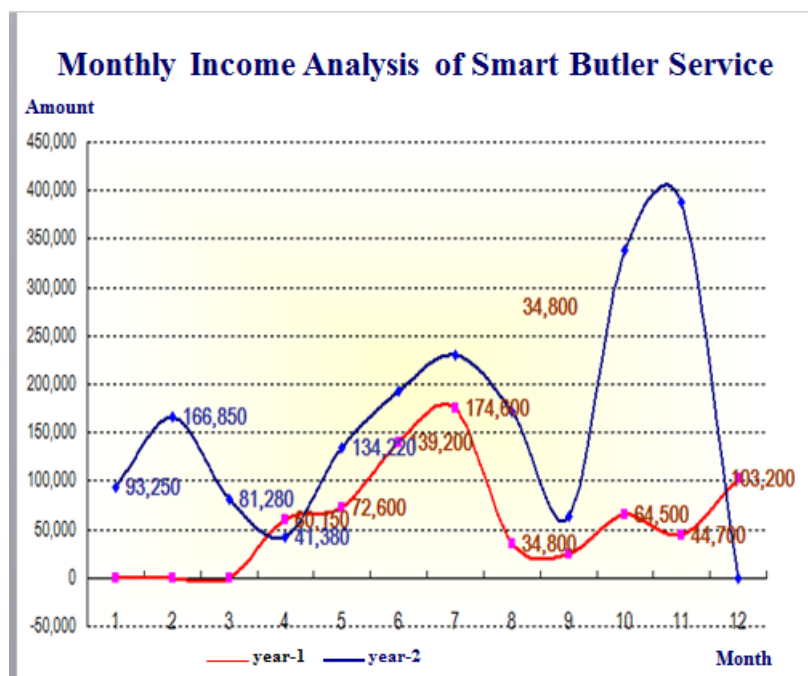
Table 1: Architecture of the Virtual Butler Management System

1	front desk guest subsystem (including 4 design modules)
2	front desk service subsystem (including 4 sub-modules)
3	backend management subsystem (including 3 integrated interfaces)
4	backend 4 databases and 1 integration interface

Service Innovation Concept and its System Performance Reward

The intelligent virtual housekeeping system related to the intelligent hotel in this case integrates the virtual cloud technology component development and related information application system, and fully presents the new service concept, new customer interface and new service delivery in Hertog and Bliderbeek (1999) "Service Innovation" concept. Key elements such as systems and new technology choices.

A series of surveys were conducted in this study to measure the performance of intelligent hotels in this case: system operation and financial income data [see Figure 3], and use it as the basis for project performance measurement information collection and analysis. The results of this survey show that the smart housekeeping system of intelligent hotels can reduce long-term operating costs and improve the overall operational performance of the company.



Source: This study.

Figure 3: Monthly Income Analysis of Smart Butler Service

CONCLUSION

This research focuses on the use of virtual cloud technology combined with information system architecture to achieve the virtual housekeeper function of intelligent hotels. The implementation of the relevant virtual butler application system architecture, combined with the service innovation model concept proposed by den Hertog & Bliderbeek (1999), results in the service model, operational process and operational performance of the innovative hotel.

The main contributions of this paper are 1) proposing an intelligent virtual hotel system architecture based on virtualized cloud technology, which can provide a successful model reference for the virtual butler intelligent system architecture in the relevant practical industry; 2) combined with virtual cloud, green energy and carbon reduction Technology in the hotel industry application, can more effectively strengthen the technology innovation of the hotel industry, improve customer satisfaction, corporate competitiveness, and improve operational performance; 3) according to recent development trends in international smart properties, smart hospitals and smart homes, Based on the relevant technology applications that have been successful in intelligent hotel, explore the extension of its related smart applications in this area.

Virtual butler's intelligent hotels need to be integrated and innovative with technological innovation; they should be customer-driven rather than purely focused on the technology itself. Technological innovation and application is an ongoing

process in the world, and it is no exception to the smart tourism industry. This case study introduces Taiwan's five-star luxury business hotel - P company and explains how they built their smart hotel through the integration and innovation of cloud IoT technology architecture and friendly and convenient service model. Furthermore, this five-star luxury business hotel can be classified into a differentiated strategy for niche innovation services. In addition, the hotel has strong coordination in the development of interactive creative systems that ensure high quality services and maintain its core competencies. Become a quality intelligent hotel by leveraging and combining IoT architecture, information technology, services, operations and marketing activities to create a differentiated effect. We also found that integrating a comprehensive innovation structure with relevant features, technologies, operations and service models to retain old customers, attract potential customers, improve business operations performance and improve customer satisfaction is the key to building intelligent hotels.

It is recommended that the follow-up research direction, through the Big Data, the Cloud IoT of the Intelligent Hotel System, further explore the relevant consumer behavior and market consumption trends, and further revise the business strategy and competition strategy of the enterprise marketing strategy. Second, it can also be combined with other cloud IoT applications, biometrics cloud computing, big data, Blockchain and artificial intelligence applications (robots), big health technologies (sleep technology, smart sleep detectors, sleep houses, etc.). 5G (ICT), 3D printing and smart wearable device technology are used in related industries to effectively upgrade the intellectual and intellectual energy of the enterprise, enhance the loyalty and adhesion of international customers, and at the same time strengthen the technological competition project and net profit rate of enterprises increase.

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A Heterogeneous Systems Public Key Encryption with Equality Test in Smart City

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ABSTRACT

Smart cities have been identified as areas which are urbanized and utilize diverse types of electronic data collection sensors that are used to oversee resources and assets efficiently. Smart meters are a unit of smart cities and they collect information about users and their consumption patterns. Consequently, the Internet of Things (IoT) being at a steady evolution has prompted multiple users into having their data collected from smart meters, stored on cloud servers. This is a way of saving costs and time involved in accessing the data. In spite of that, the cloud-assisted IoT faces privacy and security issues. This is as a result of the cloud servers possessing an untrusted nature. Due to this, it is essential for the data accumulated from the smart meters be encrypted hitherto outsourcing it to the cloud server. However, having encrypted data in the cloud server leads to a complication when it comes to accessing the data. For users who are on a different public key system, it becomes illogical for the users to first download the entire data on the cloud in order to access the required data. Therefore to resolve this issue, a heterogeneous systems public key encryption with equality test (HS-PKE-ET) scheme was proposed. The HS-PKE-ET scheme integrates certificateless public cryptography with equality test (CLC-ET) with the public key encryption with equality test (PKI-ET). This scheme allows an authorized cloud server to determine if two encryptions encrypted within heterogeneous systems possess equivalent messages. Basing on the random oracle model, the proposed scheme's security is stated under the bilinear Diffie-Hellman assumption together with the computational Diffie-Hellman assumption. Ultimately the size of storage, computation complexities and properties with other related works are focused on and illustrations indicate our proposed scheme reflects a good performance.

Keywords: Smart grid, cloud, heterogeneous systems equality test.

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INTRODUCTION

Based on the challenging new network possibilities, and on steerable competitiveness profits and network improvement efforts, the concept of "smart" cities has seemed. (Batamuliza, 2018.) states that a lot of effort has been put in smart cities to understand and engage in a world that is increasingly connected. This clearly means growth in urban environments in terms of education, healthcare, transportation, etc. Consequently the concept of "smartness" has been embraced in all the aforementioned areas in order to fulfill the demands that have emerged as a result of their growth. Based on the facts given by the communication technologies, the growth of these utilities will result to better, efficient ways of living for their users. The growth of IoT however can be considered to be a booster for the growth of these utilities. And as a result growth of data generated from these utilities is experienced such as data from smart watches, smart healthcare, smart vehicles and so forth. This data therefore requires processing and storage and hence the cloud servers are responsible for these functionalities. They however require a great extent of network resources which culminates to the security and privacy of this data is being compromised. This is because the cloud servers have been rendered insecure putting the security and privacy of users into the limelight. A case in point is where body sensors collect the health status of a user during a workout and upload to the cloud. This information is considered personal and needs to be kept safe. And because of that, users have taken to protect the privacy of their data before storing it to the cloud servers. The continuous growth of such smart devices means a rise in demands for power usage for these devices (Jokar, Arianpoo, & Leung, 2016). And considering that the current power networks cannot fully bare the demands, smart grid has been considered a new solution to this challenge. Smart grid aims at ensuring reliable digital responses to the quickly changing electricity demands and concurrently focusing on providing efficient and reliable power systems. The fact that the smart grid has been put into implementation, just like

any other technologies, it experiences security and privacy difficulties (Li, Lu, Wang, & Choo, 2016). Devices located from homes, businesses, vehicles to personal gadgets collect information about their users and usage patterns and thereafter upload them to the cloud. As earlier mentioned the information from these devices is confidential and needs to be secured and to ensure this, the data is therefore encrypted before it's uploaded to the cloud servers. And because of this, public-key encryption has proved to be an efficient way to ensure that there is confidentiality. This is achieved by the smart devices using the public key of receivers within the network to encrypt the users' sensitive data before uploading to the cloud server. With this, the data that is uploaded to the cloud is secured. Therefore in cases where an authorized user wants to access this data the user is required to download the data and then use his/her own private key to decrypt the data in order to access it. However this is quite a tiresome and time-consuming process in situations where the data is in huge amounts. With this in consideration, to ensure that a user's information is not disclosed whenever their data is searched; search functionality is supported in the ciphertexts that are stored in the cloud server. This allows for the searchability, with no information related to the ciphertexts being exposed. This idea was first proposed by Boneh *et al.* (2004), where the keyword search function was incorporated into Public Key Cryptography and is known as PKE-KS. However, PKE-KS being able to support search functionality still experiences a drawback where the search function only works for ciphertexts encrypted under the same public key.

To deal with this drawback, Yang *et al.* (2010) presented a scheme known as Public Key Encryption with Equality Test (PKE-ET) where an equality test can not only be performed on ciphertexts encrypted under the same public key but also under different public keys. Consequently a lot of work has been put into improving the equality test scheme such as (Tang, 2011; Ma, Zhang, Huang, & Yang, 2014; Huang *et al.*, 2015; Lee, Ling, Seo, & Wang, 2016a; Ma, Huang, Zhang, & Yang, 2015; Xu *et al.*, 2017).

As a matter of fact, all the above-mentioned schemes have their construction based on the traditional Public Key Infrastructure (PKI). A further look into these schemes by (Ma, 2016) resulted in the idea of PKE-ET being incorporated with Identity-based public key cryptosystem. This brought forth identity-based encryption with outsourced equality test (IBE-ET) that was built on the basis of IBC. The breakthrough in this scheme was that it managed to take a user's identity as their public key hence eliminate certificates found within the PKI. However, the scheme still experiences difficulties as a result of key escrow. Key escrow happens when decryption keys are put in the care of third parties. Here the third parties have access to a user's encrypted data and can access it any time.

Al-Riyami *et al.* (2003) however found a way to deal with the key escrow. He proposed a certificateless public key cryptosystem (CL-PKC) where user private keys were in two parts; one in possession of the user while the other in possession of the key generator center (KGC). This means that the KGC can partially access a user's private key, which is a good thing since the third parties are excluded from accessing users' data. More research led to Qu *et al.* (2018) proposing a new notion where he incorporated CL-PKC with equality test (CL-PKC-ET). An observation into the above-mentioned schemes indicates their homogenous nature, in that they can only be used in environments observing the same public key cryptography. Hence none of them can be considered for a cloud-assisted IoT environment that is heterogeneous. Furthermore, we recognize that currently, no public key encryption scheme with equality test is pertinent in the current environment.

To address this issue, we establish an effective public key encryption scheme that provides a heterogeneous systems equality test (abbreviated as HS-PKE-ET). A typical application scenario using HS-PKE-ET is shown in Figure 1. Within a smart grid environment, the data being conveyed (i.e., between the smart meter and cloud server) requires encryption to guarantee users' privacy. Namely, a public key encryption scheme that efficiently provides equality test in a heterogeneous environment is therefore required hence the public key infrastructure (PKI) and the certificateless public key system are merged. The PKI has proved to be efficient when it comes to achieving user identity authentication and security of data, the customers usually choose to use the PKI system to encrypt data. However, the CLC system has solved the certificate management problems brought by the PKI system and the problem of key escrow within the IBC system, most smart meters choose to use the CLC system to encrypt data. The collected data is encrypted by the smart meter and uploaded to the cloud server. A case in point is a customer wanting to retrieve their information stored on the cloud server (i.e., consumption of electricity on specific days). The customer will have to make use of their secret key to generate trapdoors, which will be forwarded to the cloud server. This cloud server however has been delegated the task of searching the data and then returning the results to the customer. Formerly, performing equality test for customers in different public key systems required them to encrypt the accumulated information using the identity of the smart meter owners. Considering that different smart meters are matched to different identities, it is imperative that customers find identities that match all smart meters. However, this results to substantial overhead and that is where our scheme is incorporated since it diminishes vapid process as it improves the operating efficiency.

Our contribution

This paper nominates a heterogeneous system public key encryption with equality test (HS-PKE-ET) with the integration between (PKE-ET) and (CLC-ET) as the center of attention. We base it on the bilinear pairing design that is depicted for smart grid environment. Our scheme security will be proved under the BDH assumption and the CDH assumption in the random oracle model (ROM). A demonstration of how the scheme will perform shall be illustrated in terms of computation and communication costs incurred through storage size, encryption, decryption, and testing phases.

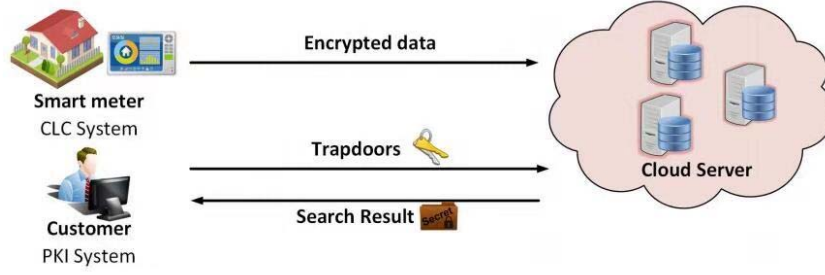


Figure 1: A typical scenario of the smart meter.

RELATED WORKS

Boneh *et al.* (2004) proposed a way of searching the public key encryption scheme by the use of key-words known as Public Key Encryption with Keyword search (PKE-KS). The ciphertexts in this scheme would be run through an equivalence test to determine if the keywords are the same. This is done by a third-party that is considered semi-trusted. The unfortunate issue is that IBE-KS has limitations when it is applied in real-time applications. Yang *et al.* (2010) however solved this limitation by proposing an encryption scheme that incorporated the equality test, not only on ciphertexts encrypted with the same public keys but also with different public keys. This scheme was known as Public Key Encryption with Equality Test (PKE-ET). The advantage of this scheme is that, it is quite flexible since an authorized cloud server has the search functionality hence can search messages to ascertain whether two ciphertexts encrypted with same or different public keys are equivalent. Consequently, (Tang, 2011) proposed a scheme that would enforce authorization on the PKE-ET which was known as fine-grained authorization Public key encryption with equality test (FG-PKE-ET). This scheme made provision for only two users to perform equality test. Nevertheless, there were situations where delegated parties were the only ones required to finish work in practical multi-user settings. Hence a delegated equality test scheme was of importance leading Ma *et al.* (2014) to propose such a scheme, which was known as (PKE-DET). Additionally, Ma *et al.* (2015) improved the PKE-AET by introducing support of flexibility when it came to authorization which was known as PKE-ET-FA. Unfortunately the public key infrastructure has proved to be unreliable when it comes to scalability since the distribution of public keys is unmanageable. New research areas on Identity-based encryption have hence sprouted as shown by (Ma, 2016; Lee, Ling, Seo, & Wang, 2016b; Wu, Zhang, Choo, & He, 2017). This encryption scheme has considered the outsourcing of equality tests in order to make the process more flexible when it comes to certificates management. And despite this encryption sourcing from key escrow, Lin *et al.* (2016) managed to find a solution by introducing the notion of certificateless public cryptography incorporated with equality test.

DEFINITIONS

Preliminaries

Bilinear Map

Considering two multiplicative cyclic groups $\mathbb{G}_1, \mathbb{G}_2$, and their prime order is p . g is a generator of \mathbb{G}_1 . A bilinear map $e : \mathbb{G}_1 \times \mathbb{G}_1 \rightarrow \mathbb{G}_2$ is required as follows:

1. Bilinearity: $\forall g \in \mathbb{G}_1, \exists a, b \in \mathbb{Z}_p^*, e(g^a, g^b) = e(g, g)^{ab}$.
2. Non-degeneracy: $e(g, g) \neq 1$.

Hardness Problems

Establishing our scheme under the Bilinear Diffie-Hellman (BDH) problem and the Computational Diffie-Hellman (CDH) problem, the security of our system is defined. We describe these two hardness problems as follows:

BDH problem. Randomly choose $b, c \in \mathbb{Z}_p^*$, the BDH assumption holds if for any polynomial-time algorithm \mathcal{A} which wants to distinguish the tuple $\langle g^a, g^b, g^c, e(g, g)^{abc} \rangle$ from $\langle g^a, g^b, g^c, e(g, g) \rangle$, the advantage is negligible.

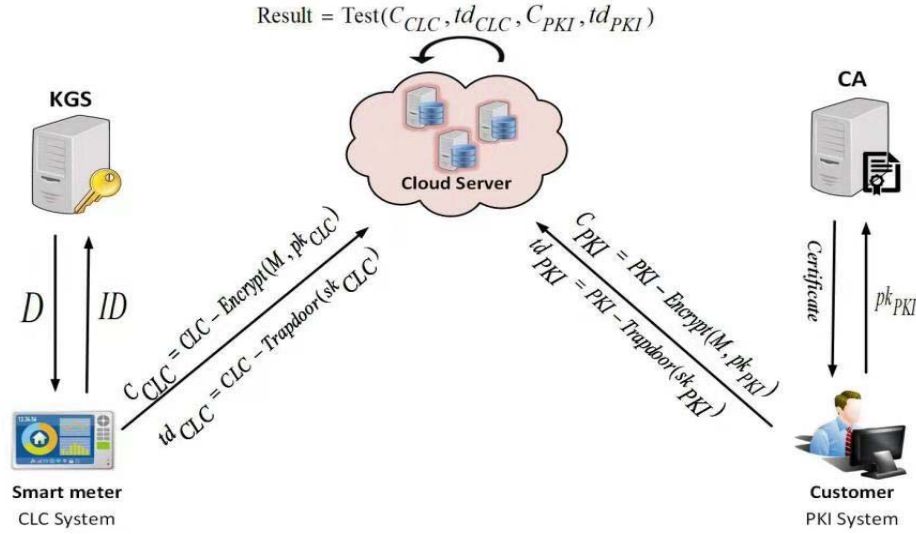


Figure 2: System Model of HS-PKE-ET.

CDH problem. Randomly choose $a, b, c \in \mathbb{Z}_p^*$, the CDH assumption holds if for any polynomial-time algorithm \mathcal{A} which wants to distinguish the tuple $\langle g^a, g^b, g^{ab} \rangle$ from $\langle g^a, g^b, g^c \rangle$, the advantage is negligible.

System model

Figure 2 illustrates the heterogeneous systems public key encryption with equality test (HS-PKE-ET). The HS-PKE-ET model is made up of five entities: the smart meter, customer, key generation center (KGC), the certificate authority (CA), and a cloud server. Smart meter belongs to the CLC system, while the customer belongs to the PKI system. For the CLC system the smart meter sends its identity to the KGS, and the KGS prompts a corresponding partial secret key (D) and delivers it back to the smart meter. Consequently, on the PKI system side customer communicates with the CA to obtain a certificate signed by the CA. The smart meter and the customer then compute their particular trapdoors denoted by td_{CLC} and td_{PKI} , respectively. Subsequently, the smart meter uses the owner's ID to encrypt the collected data and uploads the encryptions alongside the trapdoor td_{CLC} to the cloud server for storage. When the customer desires to retrieve information, he/she uploads his/her trapdoor td_{PKI} to the cloud server for retrieval. The cloud server now possesses the td_{CLC} and td_{PKI} hence can execute an equivalence test between the CLC system and PKI system.

Security Models

According to (Ma, 2016), one-way chosen-ciphertext attack (OW-CCA) security against the adversary in HS-PKE-ET is defined. For streamlining, **HS-PKE-ET-CLC** to denote the situation that users belong to the CLC system and **HS-PKE-ET-PKI** to denote the situation that users belong to the PKI system are used.

Definition 1. For the security of **HS-PKE-ET-CLC** we consider two types of adversaries. Type-1 adversary \mathcal{A}_1 cannot retrieve the system's secret master key, but has the ability to replace any user's public key. Type-2 adversary \mathcal{A}_2 has no ability to replace a user's public key, but can retrieve the system's master secret key. **HS-PKE-ET-CLC**'s security model is expounded by the following two games:

Game 1: Given a security parameter λ , the game between \mathcal{A}_1 and the challenger is defined as follows:

1. *Setup:* The challenger creates the public parameters $PubP$ and the master secret key msk . Finally, the challenger returns $PubP$.
2. *Phase 1:* The \mathcal{A}_1 is permitted to issue the following queries:
 - *Partial secret key queries* $\langle ID_i \rangle$: The challenger sends D_i to \mathcal{A}_1 .
 - *Secret key queries* $\langle ID_i \rangle$: The challenger sends sk_{CLC_i} to \mathcal{A}_1 .
 - *Public key queries* $\langle ID_i \rangle$: The challenger sends pk_{CLC_i} to \mathcal{A}_1 .
 - *Replace public key queries* $\langle ID_i, pk'_{CLC_i} \rangle$: The challenger replaces the public key pk of the corresponding user with pk'_i .

- *Decryption queries* $\langle ID_i, C_i \rangle$: The challenger runs the algorithm $CLC\text{-Decrypt}(C_i, sk_{CLCi})$ where sk_{CLCi} is the secret key corresponding to ID_i . Finally, the challenger gives M_i to \mathcal{A}_1 .
 - *Trapdoor queries*: The challenger creates the trapdoors td_{CLCi} and td_{PKIi} by using $CLC\text{-Trapdoor}$ and $PKI\text{-Trapdoor}$ algorithms, respectively. Eventually, the challenger gives td_{CLCi} and td_{PKIi} to \mathcal{A}_1 .
3. *Challenge*: The challenger randomly chooses the plaintext $M \in G_1^*$ and computes $C' = CLC\text{-Encrypt}(ID_{ch}, M)$. Finally, the challenger sends C' to \mathcal{A}_1 as its challenge ciphertext.
 4. *Phase 2*: The challenger's response to \mathcal{A}_1 is similar to that in Phase 1 on the grounds that:
 - ID_{ch} is not queried in the *Secret key queries*.
 - If the public key associated with ID_{ch} is replaced, the ID_{ch} should not be queried in the *Partial secret key queries*.
 - If the public key of the user is replaced, the corresponding identity ID_j should not be queried in the *Secret key queries*.
 - ID_{ch}, C' is not inquired in the *Decryption queries*.
 5. *Guess*: \mathcal{A}_1 outputs M' , and wins if $M' = M$. The advantage of \mathcal{A}_1 in the game above is defined as follows:

$$Adv_{HS-PKE-ET, A}^{OW-CCA, HS-PKE-ET-CLC}(\lambda) = Pr[M = M']$$

Game 2: Provided with a security parameter λ , the game between \mathcal{A}_1 and the challenger is expounded as follows:

1. *Setup*: The challenger generates the public parameters $PubP$ and master secret key msk . Finally, the challenger gives $PubP$ and the msk to \mathcal{A}_2 .
2. *Phase 1*: \mathcal{A}_2 issues queries as in **Game 1**, except the *Partial secret key queries* and the *Replace public key queries* are not allowed to issue in this game.
3. *Challenge*: The challenger randomly picks the plaintext $M \in G_1^*$ and computes $C' = CLC\text{-Encrypt}(ID_{ch}, M)$. Finally, the challenger gives C' to \mathcal{A}_2 as its challenge cipher-text.
4. *Phase 2*: The challenger's response to \mathcal{A}_2 is similar to that in *Phase 1* on grounds that:
 - ID_{ch} is not queried in the *Secret key queries*.
 - (ID_{ch}, C') is not queried in the *Decryption queries*.
5. *Guess*: \mathcal{A}_2 outputs M' , and wins if $M' = M$. Therefore, \mathcal{A}_2 advantage in the game is:

$$Adv_{HS-PKE-ET, A}^{OW-CCA, HS-PKE-ET-CLC}(\lambda) = Pr[M = M']$$

Definition 2. For the security of **HS-PKE-ET-PKI** scheme, we say the **HS-PKE-ET-PKI** has *OW-CCA* property if no polynomially bounded adversary \mathcal{A} has a non-negligible advantage in the following game.

1. *Setup*: The challenger uses as input security parameters λ . Then, the challenger accords the system parameters to \mathcal{A} and retains the msk secret.
2. *Phase 1*: \mathcal{A} is allowed to inquire as follows:
 - *Key generation queries* $\langle i \rangle$: The challenger sends sk_{PKIi} to \mathcal{A} .
 - *Decryption queries* $\langle i, C_i \rangle$: The challenger runs $PKI\text{-Decrypt}(C_i, sk_i)$ algorithm and sends the plaintext M to \mathcal{A} .
 - *Trapdoor queries* $\langle i \rangle$: The challenger creates the trapdoors td_{CLCi} and td_{PKIi} by using $CLC\text{-Trapdoor}$ and $PKI\text{-Trapdoor}$ algorithms, respectively. Finally, the challenger sends td_{CLCi} and td_{PKIi} to \mathcal{A} .
3. *Challenge*: The challenger arbitrary chooses a plaintext $M \in G_1^*$ and computes $C' = PKI\text{-Encrypt}(pk'_{PKI}, M)$. In addition, the challenger creates a trapdoor td_{PKI} associated with sk'_{PKI} by using $PKI\text{-Trapdoor}$ algorithm. Finally, the challenger sends (C', td_{PKI}) to \mathcal{A} .

4. *Phase 2*: In this phase, the response of C to \mathcal{A} is similar to the one obtained in *Phase 1*. The following constraints are considered.
 - $\langle pk' \rangle$ is not requested in the *key generation queries*.
 - $\langle pk', C' \rangle$ is not requested in the *decryption queries*.
5. *Guess*: \mathcal{A} outputs $M' \in G_1^*$, and wins if $M = M'$. The advantages of \mathcal{A} in the game above is defined as follows:

$$Adv_{HS-PKE-ET,A}^{OW-CCA,HS-PKE-ET-PKI}(\lambda) = Pr[M = M']$$

CONSTRUCTION

The concrete constructions of heterogeneous systems public key encryption with equality test are instituted in this section.

1. *Setup*: Provided a security parameter λ , the algorithm runs as follows:
 - Generate the pairing parameters: two groups G_1, G_2 of prime order p and an admissible bilinear map $e: G_1 \times G_1 \rightarrow G_2$. Then choose a random generator $g \in G_1$.
 - Choose cryptographic hash functions:
 $H_1: \{0,1\}^* \rightarrow G_1, H_2: G_2 \rightarrow G_1, H_3: G_2 \rightarrow \{0,1\}^{n_1+n_2}$, where $n_1 = |G_1|$ and $n_2 = |Z_p^*|$
 - Randomly choose $(s_1, s_2) \in Z_p^*$, then set $g_1 = g^{s_1}$ and $g_2 = g^{s_2}$. The *CLC-PKG* publishes system parameters $\langle p, G_1, G_2, e, g, g_1, g_2, H_1, H_2, H_3 \rangle$ and keeps the master secret key (s_1, s_2) secret.
2. *CLC-PKG*: To generate public and secret key, this algorithm works as follows:
 - *Generate partial secret key*: Given a string $ID \in \{0,1\}^*$:
 - Compute $h_{ID} = H_1(ID) \in G_1$
 - Compute partial secret key $D = (D_1, D_2) = (h_{ID}^{s_1}, h_{ID}^{s_2})$, where (s_1, s_2) is the master secret key.
 - *Assign secret value*: The algorithm uses as inputs $PubP$ and D . It chooses $x \in Z_p^*$ randomly then returns x as a secret value.
 - *Assign secret key*: The algorithm uses as inputs $PubP$, D , and x . It computes $sk = (sk_1, sk_2) = (D_1^x, D_2^x)$.
 - *Assign public key*: The algorithm uses as inputs $PubP$ and a secret value x . It returns public key
 $pk = (X, pk_1, pk_2) = (g^x, g_1^x, g_2^x)$.
3. *IBC-Trapdoor*: This algorithm takes as input sk of a user in the CLC system and outputs a trapdoor $td_{CLC} = sk_1 = D_1^x$.
4. *PKI-KG*: A user in the PKI system chooses two arbitrary numbers $\theta, \beta \in Z_p^*$, and computes $(sk, pk) = ((\theta, \beta), (g^\theta, g^\beta))$.
5. *PKI-Trapdoor*: This algorithm utilizes as input sk of a user in the PKI system and outputs a trapdoor $td_{PKI} = \theta$.
6. *CLC-Encrypt*: This algorithm proceeds as follows:
 - Take the message $M \in G_1^*$, the identity ID , and the public key $pk = (X, pk_1, pk_2)$ as inputs.
 - Verify that if $pk = (X, pk_1, pk_2) \in G_1^*$ and $e(X, g_1) = e(pk_1, g)$ and $e(X, g_2) = e(pk_2, g)$. If these verifications pass, perform the encryption. Otherwise, terminate the encryption.
 - Compute $h_{ID} = H_1(ID) \in G_1^*$.
 - Pick two arbitrary numbers $(r_1, r_2) \in Z_p^*$.
 - Compute $C = (C_1, C_2, C_3, C_4)$, where $C_1 = g^{r_1}, C_2 = g^{r_2}, C_3 = M^{r_1} \cdot H_2(e(h_{ID}, pk_1)^{r_1})$, and $C_4 = (M || r_1) \oplus H_3(e(h_{ID}, pk_2)^{r_2})$.
7. *CLC-Decrypt*: The algorithm uses as inputs a ciphertext C and a secret key sk . It returns the plaintext M by working as follows.
 - Compute $C_4 \oplus H_3(e(sk_2, C_2)) = C_4 \oplus H_3(e(sk_2, C_2)) = C_4 \oplus H_3(e(D_2^{x_{ID}}, g^{r_2})) = C_4 \oplus H_3(e(h_{ID}, g_2^{x_{ID}})^{r_2}) = (M || r_1)$
 - Verify if $C_1 = g^{r_1}$ and $\frac{C_3}{M^{r_1}} = H_2(e(sk_1, C_1))$.
 - If both verifications pass, return M . Otherwise, return the symbol \perp .

8. *PKI-Encrypt*: It utilizes as inputs a message M and the public key pk of a user in the PKI system. Then, it chooses two random numbers $(r_1, r_2) \in \mathbb{Z}_p^*$ and computes $C = (C_1, C_2, C_3, C_4)$, where $C_1 = g^{r_1}, C_2 = g^{r_2}, C_3 = M^{r_1} \cdot H_2(g^{\theta r_1})$, and $C_4 = (M || r_1) \oplus H_3(g^{\beta r_2})$
9. *PKI-Decrypt*: It takes as inputs a ciphertext C and secret key sk of a user in the PKI system. Then, gives back the plaintext M by computing $M || r_1 \leftarrow C_4 \oplus H_3(C_2^\beta)$, and then verifies both $C_1 = g^{r_1}$ and $\frac{C_3}{M^{r_1}} = H_2(C_1^\theta)$. In the event that both verifications pass, it returns M else, it returns the symbol \perp .
10. *Test* $(C_i, td_{CLC}, C_j, td_{PKI})$: Let U_i and U_j be two users of heterogeneous systems. Let U_i be a user in the CLC system and U_j be a user in the PKI system. Let $C_i = (C_{i,1}, C_{i,2}, C_{i,3}, C_{i,4})$ and $C_j = (C_{j,1}, C_{j,2}, C_{j,3}, C_{j,4})$ be the ciphertexts of U_i and U_j , respectively. The Test algorithm for heterogeneous systems works as follows:

$$\begin{aligned}
 R_i &= \frac{C_{i,3}}{H_2(e(td_{CLC}, C_{i,1}))} \\
 &= \frac{M_i^{r_{i,1}} \cdot H_2(e(h_{ID,i}, pk_{i,1})^{r_{i,1}})}{H_2(e(sk_{i,1}, C_{i,1}))} \\
 &= \frac{M_i^{r_{i,1}} \cdot H_2(e(h_{ID,i}, g_1^{x_i})^{r_{i,1}})}{H_2(e(D_{i,1}^{x_i}, g^{r_{i,1}}))} \\
 &= \frac{M_i^{r_{i,1}} \cdot H_2(e(h_{ID,i}, g_1^{x_i})^{r_{i,1}})}{H_2(e(h_{ID,i}, g_1^{x_i})^{r_{i,1}})} \\
 &= M_i^{r_{i,1}}
 \end{aligned}$$

$$\begin{aligned}
 R_j &= \frac{C_{j,3}}{H_2(C_{j,1}^{td_{PKI}})} \\
 &= \frac{M_j^{r_{j,1}} \cdot H_2(g^{\theta r_{j,1}})}{H_2(g^{\theta r_{j,1}})} \\
 &= M_j^{r_{j,1}}
 \end{aligned}$$

The **Test** algorithm returns 1 if $e(C_{i,1}, R_j) = e(C_{j,1}, R_i)$. Otherwise, it returns the symbol \perp .

SECURITY ANALYSIS

In this segment, the security of the **HS-PKE-ET** scheme is presented. The basic notion of security proof is similar to the scheme in (Al-Riyami & Paterson, 2003) and (Huang et al., 2015).

Theorem 1: Presuming that H_1, H_2, H_3 are random oracles and assume that the BDH problem is hard. Therefore, our **HS-PKE-ET-CLC** is OW-CCA secure. Significantly, assume there is a **Type-1 adversary** \mathcal{A}_1 that has advantage $\varepsilon_1(\lambda)$ against the **HS-PKE-ET-CLC**. Assume that \mathcal{A}_1 makes q_{pk} public key queries, q_{sk} secret key queries, q_{psk} partial secret key queries, q_t trapdoor queries, q_{rpk} replace public key queries, q_{dec} decryption queries, q_{H_2} hash queries to H_2 , and q_{H_3} hash queries to H_3 . Thus, we have an algorithm \mathcal{B}_1 which breaks BDH problem with advantage at least $\varepsilon_1(\lambda)/e(q_{sk} + q_{psk} + q_t + 1) \cdot q_{H_3}$.

Theorem 2: Presuming that H_1, H_2, H_3 are random oracles and assume that the BDH problem is hard. Therefore, our **HS-PKE-ET-CLC** is OW-CCA secure. Significantly, assume there is a **Type-2 adversary** \mathcal{A}_2 that has advantage $\varepsilon_2(\lambda)$ against the **HS-PKE-ET-CLC**. Assume that \mathcal{A}_2 makes q_{pk} public key queries, q_{sk} secret key queries, q_t trapdoor queries, q_{dec} decryption queries, q_{H_2} hash queries to H_2 , and q_{H_3} hash queries to H_3 . Thus, we have an algorithm \mathcal{B}_2 which breaks BDH problem with advantage at least $\varepsilon_2(\lambda)/e(q_{sk} + q_t + 1) \cdot q_{H_3}$.

Theorem 3: **HS-PKE-ET-PKI** is OW-CCA secure against the adversary \mathcal{A} if CDH problem is intractable.

Proof: Assume that \mathcal{A} is an adversary, who is permitted to make q_k key generation queries, decryption queries, q_t trapdoor queries, q_{H_2} hash queries to H_2 , and q_{H_3} hash queries to H_3 . The algorithm \mathcal{B} emulates certain games, dominates oracle O_K, O_D, O_T, O_{H_2} , and O_{H_3} , and then utilizes the advantage of \mathcal{A} to break CDH problem if \mathcal{A} breaks **HS-PKE-ET-PKI**. Consequently, a sequence of

hybrid games are presented for verification of the security of our scheme. Due to the limited number of pages, the interested readers can refer to (Al-Riyami & Paterson, 2003) and (Huang et al., 2015) for more details.

PERFORMANCE ANALYSIS

In Table 1, the computation cost and communication cost of the proposed **HS-PKE-ET** scheme and the schemes in (Yang et al., 2010), (Ma, Huang, et al., 2015), (Ma, 2016), (Lin et al., 2016), and (Qu et al., 2018) are compared.

Table 1: Comparison

Schemes	PK	SK	CT	Enc	Dec	Test	H-ET
(Yang et al., 2010)	\mathbb{G}	$2Z_p$	$3\mathbb{G}+Z_p$	3Exp	3Exp	2Pair	No
(Ma et al., 2015)	$3\mathbb{G}$	$3Z_p$	$5\mathbb{G}+Z_p$	6Exp	5Exp	2Pair+2Exp	No
(Ma, 2016)	$2\mathbb{G}$	$2Z_p$	$4\mathbb{G}+Z_p$	6Exp	2Pair+2Exp	4Pair	No
(Lin et al., 2016)	$2\mathbb{G}$	$2Z_p$	$5\mathbb{G}+Z_p$	6Exp	2Pair+2Exp	4Pair	No
(Qu et al., 2018)	$2\mathbb{G}$	$2Z_p$	$5\mathbb{G}+Z_p$	5Exp	2Pair+2Exp	4Pair	No
HS-PKE-ET	$2\mathbb{G}$	$2Z_p$	$3\mathbb{G}+Z_p$	5Exp	2Pair+2Exp	3Pair+1Exp	Yes

Legends: |PK|, |SK|, and |CT|: size of public key, size of secret key, size of and ciphertext, respectively; Enc, Dec, and Test: the computation complexity of encryption, decryption, and test algorithms; Exp: an exponentiation operation; Pair: pairing operation; H-ET: the scheme that provides heterogeneous equality test.

CONCLUSION

We nominate an efficient equality test for heterogeneous systems in this paper. The nature of the heterogeneity in our scheme allows for a cloud server to accomplish an equivalence test between ciphertexts that have been encrypted under the PKI system and CLC system. Furthermore, we have reduced our scheme's security proof to the standard Bilinear Diffie-Hellman assumption and computational Diffie-Hellman assumption by basing it on the random oracle model. Our speculative analysis and simulations from experiments indicate our scheme's practicability and suitability in comparison to other related works. Future works include expansion of the heterogeneous equality test to make provision for users to delegate a cloud server rights to execute equality test employing different types of authorizations.

ACKNOWLEDGMENT

This work was supported in part by the 13th Five-Year Plan of National Cryptography Development Fund for Cryptographic Theory of China under Grant MMJJ20170204, in part by the Fundamental Research Funds for the Central Universities under Grant ZYGX2016J091, the Guangxi Colleges and Universities Key Laboratory of Cloud Computing and Complex Systems, and in part by the Natural Science Foundation of China under Grants U1401257, 61472064 and 61602096.

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A Modified KNN Algorithm for Activity Recognition in Smart Home

(Full Paper)

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ABSTRACT

Nowadays, more and more elderly people cannot take care of themselves, and feel uncomfortable in daily activities. Smart home systems can help to improve daily life of elderly people. A smart home can bring residents a more comfortable living environment by recognizing the daily activities automatically. In this paper, in order to improve the accuracy of activity recognition in smart homes, we conduct some improvements in data preprocess and recognition phase, and more importantly, a novel sensor segmentation method and a modified KNN algorithm are proposed. The segmentation algorithm employs segment sensor data into fragments based on predefined activity knowledge, and then the proposed modified KNN algorithm uses center distances as a measure for classification. We also conduct comprehensive experiments, and the results demonstrate that the proposed method outperforms the other classifiers.

Keywords: Activity recognition, sensor segmentation, KNN algorithm.

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INTRODUCTION

With the advancement of pervasive computing, more and more non-invasive, wireless and inexpensive sensors are used for collecting activity information (Krishnan & Cook, 2014), so sensor-based activity recognition becomes possible with the help of the technology in pervasive computing. Sensor-based activity recognition needs to collect a series of sensor data streams from locations of smart home environment to infer specific activities. These sensors can be used to capture contextual information about user activity data and its surroundings, thereby activity recognition is extended from the computer vision domain to sensor domain. In fact, there are three kinds of data collection methods for activity recognition. The first one is to collect data from cameras and analyze activities by computer vision algorithms; the second one is to collect wearable sensor data to identify actions of residents; the third one is to collect data from environmental sensors, which called non-obtrusive sensors (Chen *et al.*, 2012a). The method of collecting data from environmental sensors makes a great effort on the Ambient Intelligence (AmI), because it does not change living habits and also protects private information of residents. When a resident moves from one room to another or uses objects on different areas in a home, a series of firings with the corresponding timestamps are generated that allows to automatically detect activities performed by residents.

Two main types of activity recognition methods have been developed for sensor-based recognition: data-driven and knowledge-driven (Azkune *et al.*, 2015; Chen *et al.*, 2014; Janidarmian *et al.*, 2017). A data-driven activity recognition method uses the existing machine learning technology to train a classifier, and then uses the established activity model to perform activity recognition on the unlabeled data. At present, the data-based models of activity recognition include decision tree (Bergeron *et al.*, 2016; Zhao *et al.*, 2011), support vector machine, conditional random field, Hidden Markov Model (HMM) (Singla *et al.*, 2010), K-Nearest Neighbor (KNN), neural network, topic model and so on. For example, Singla *et al.* (2010) first used a single HMM to model the independent and joint activities among multiple residents, and then, with manual data association, they modeled one HMM for one resident. Zhao *et al.* (2011) proposed an algorithm known as transfer learning embedded decision tree that integrates a decision tree and a k-means clustering algorithm to solve the cross-people activity recognition problem for personalized activity-recognition model adaptation. Fallahzadeh *et al.* (2016) proposed a personalized context-aware prompting system. It uses the nearest neighbor and decision tree. The proposed system can help patients with cognitive impairment. The results demonstrated that the proposed system can improve the response rate of intervention and reduce inappropriate prompts. Tong and Chen (2014) presented an application of probabilistic graphical model Latent Dynamic Conditional Random Field (LDCRF) to detect the goals of the individual subjects when observations have wide range dependencies or multiple overlapping features. The results demonstrated that LDCRF favorably outperforms other models, especially when there are extrinsic dynamic activities changes and intrinsic actions (sub-activities). Moreover, Chen and Tong (2014) proposed a two-stage Hidden Markov model and a two-stage linear chain conditional random field for multi-user behavior recognition. The method introduces invariant prior knowledge in multi-user environments by defining merge tags and their state sets. The experimental results showed that the two-stage method does not need to compute data association, and the accuracy of activity recognition is better than the representative multi-user activity recognition method. Fergani *et al.* (2015) solved the problem that simple sensor reading information from the collection of smart home environment is difficult to infer high-level activity problems, and they showed Optimized Cost-Sensitive Support Vector Machines (OCS-SVM) can increase the recognition performance to classify multiclass sensor data and improve the performance in prediction of the less represented activities significantly. In the same year, Tong *et*

al. (2015) presented an application of the Hidden State Conditional Random Field (HCRF) method to detect and assess abnormal activities (AAR) that always occur in elderly person homes. Based on HCRF, they designed two AAR algorithms, and validated them by comparing them with a feature vector distance based algorithm in two experiments. The results demonstrated that the proposed algorithms favorably outperform the competitor, especially when abnormal activities have the same sensor type and sensor number as normal activities. Lee *et al.* (2017) proposed a robust human activity recognition method based on one-dimensional convolutional neural network method in order to solve the variability problem of raw human activity data in human activity recognition. The experimental results showed that the accuracy of the one-dimensional convolutional neural network method is better than the baseline random forest method. Chen *et al.* (2016) proposed an improved method for unsupervised activity recognition of topic models in order to recognize daily life activities in a smart home. This novel unsupervised approach can model the continuous sensor data and avoid the expensive requirement of providing annotated training data. Their experimental results showed that this method can detect abnormal activities and monitor the sleep quality of residents effectively.

In a knowledge-driven approach, knowledge engineers and domain experts use a wealth of prior knowledge and knowledge engineering to specify activity models manually. This is because daily life activities of residents usually occur at a relatively fixed time, locations and space. Thus, we can use a variety of knowledge modeling tools to create activity models. In recent years, people have also used knowledge-driven methods to recognize activities of daily living. For example, Chen *et al.* (2012b) proposed a knowledge-driven approach based on real-time and continuous activity recognition of multi-sensor data in smart homes. This method goes beyond the traditional data-driven activity recognition methods. Okeyo *et al.* (2013) extended their previous work by introducing knowledge-driven methods to identify complex activities, such as interleaved and concurrent activities. To support complex activity modeling, it combined ontological and temporal knowledge modeling forms. The experimental results showed that the average recognition accuracy of composite activities is 88.26%. Okeyo *et al.* (2014) proposed an integrated architecture that combines ontological and temporal method to composite activity modeling and recognition by extending the existing ontology-based knowledge-driven approach. The compelling feature of the approach combined ontological and temporal knowledge representation formalism to provide powerful representation capabilities for activity modeling.

The above activity recognition methods need to deploy an activity recognition framework on each sensor data segment to recognize the activity that performed. Therefore, the accuracy of activity recognition to a large extent depends on accurately extracting sensor events segmentation associated with each activity from the sensor data stream to ensure that the complete activity of each resident is recognized during the activity recognition phase. Sensor segmentation methods in smart homes can usually be divided into static segment methods and dynamic segment methods. Static segmentation methods employ the fixed time windows or the fixed number of sensor events. However, these methods are not robust. Dynamic segmentation methods use dynamic time windows to segment data. However, this method may divide sensor data into many small fragments. To solve the above problems, we propose a novel segmentation method to segment sensor data with the help of prior knowledge. Besides, we also modify standard KNN algorithm to recognize activities according to a small amount of annotation data different from other supervised learning algorithms. Moreover, there exist currently three main influence factors of the standard KNN algorithm that are the number of k , the size of training dataset and the method of distance calculation. Thus, to overcome the weaknesses of the standard KNN, we present a novel modified KNN algorithm combined with the concept of center distance. We compute Euclidean distances between the training set and the testing set and the corresponding class label of each testing data by different k value as the standard KNN algorithm dose. At the same time, we calculate the center points of each class in the training set, and get the center distance between these center points and the testing data. Then, we define some weights for Euclidean distance and center distance to classify test data. Finally, we verify the effectiveness of the proposed method by implementing experiments.

NOTATIONS AND DEFINITIONS

In this paper, we concentrate on the sensor-based activity recognition. Consider an environment in a smart home, where sensors are installed, such as infrared-based motion sensors and door sensors. Data produced by those sensors are collected for recognition. For a more detailed presentation of our sensor data, we take the Table 1 as an example, where a sensor sequence sample of “Sleep” is indicated.

Table 1: A sensor sequence sample of “Sleep”

Number	Date_time	Sensor	Reading	labeled activity
1	2013-04-01 00:04:09.340911	M007	ON	Sleep=“begin”
2	2013-04-01 00:04:10.485392	M007	OFF	
			
17	2013-04-01 00:28:13.571107	T108	24	
18	2013-04-01 00:35:44.36996	BATV013	9100	
			
67	2013-04-01 02:45:47.215554	M006	OFF	Sleep=“end”

In the followings, we will introduce some notations and definitions to describe each attribute of the dataset. A sensor event is defined as $se = (dt, h, d, s, r, la)$, where dt represents the date_time of a sensor event happened; h shows that the hour of every sensor event occurred; d shows the sensor event that occurred on the i -th day in a month; s is the name of each sensor; r indicates the states of sensor events; la shows the activity that is taking place, but some sensor events may have no la attributes, which

can be inferred from their nearest *la* attribute value. For example, the first sensor event “2013-04-01 00:04:09.340911 M007 ON Sleep = “begin” (the first line in Table 1) can be described as $se = (2013-04-01\ 00:04:09.340911, 0, 1, M007, ON, Sleep = “begin”)$. It represents that sensor M007 is activated at 00:04:09.340911 on 1 April 2013 and the sensor reading is “ON”. At that time, the resident went to sleep.

An activity segment is defined as $AS = \{se_1, ..., se_i, ..., se_n\}$, where se_i denotes the i -th sensor event in the segment; se_1 represents a sensor event at the beginning of this activity; se_n represents a sensor event at the ending of this activity; $se_1.dt$ shows the specific time of the activity occurred; $se_n.dt$ shows the specific time when the activity ended; $se_i.h$, $se_i.d$, $se_i.s$ and $se_i.r$ represent the other attributes of the sensor event of the activity; n is the number of sensor events in the activity segment. Such as, in Table 1, $AS = \{(2013-04-01\ 00:04:09.340911\ M007\ ON\ Sleep=“begin”), ..., (2013-04-01\ 00:28:13.571107\ T108\ 24), ..., (2013-04-01\ 02:45:47.215554\ M006\ OFF\ Sleep=“end”)\}$ indicates a “Sleep” activity segment. We can know that the resident went to sleep at 00:04:09.340911 on 1 April 2013 and woke up at 02:45:47.215554 on 1 April 2013. Furthermore, we can also easily calculate the sleeping segment duration of this resident which is close to two hours and forty minutes.

A sensor segment is defined as $SS = \{se_1, ..., se_i, ..., se_n\}$. The meaning of every attribute of SS is same as AS . However, the sensor segment is used to the test dataset and the activity segment is used to the train dataset. We can use Algorithm 1 in the next section to describe the generated process of sensor segment.

A sensor segment frequency feature is defined as $SSF = (f_1, ..., f_i, ..., f_m)$, where m is the number of the whole dataset sensor types and f_i represents the frequency when the i -th sensor is triggered in this segment. For instance, $SSF = (0.2, 0.1, 0.3, 0.15, 0.25)$, we can know the dataset has five types of sensors. In this segment, the first sensor is triggered at a frequency of 0.2.

A sensor segment duration feature is defined as $SSD = (d_1, ..., d_i, ..., d_m)$, where d_i denotes the duration frequency when the i -th sensor is triggered in this segment, it can be calculated by the duration of every sensor state pair, such as “ON” and “OFF”. Thus, d_i is the total sum frequency of duration of the i -th sensor state pair. m is the number of the dataset sensor types. For example, $SSD = (0.15, 0.1, 0.35, 0.15, 0.25)$, and we can know the dataset has five types of sensors. In this segment, the first sensor is triggered at a duration frequency of 0.15.

PROPOSED ALGORITHMS

In this section, we first introduce our activity recognition framework. Then, we propose a novel segmentation algorithm for sensor data based on prior knowledge. We also present a new modified KNN algorithm based on standard KNN algorithm combined with center distance.

Activity Recognition Framework

Our activity recognition framework, shown as Figure 1, is divided into two phases that are data preprocess phase and activity recognition phase. In the data preprocess phase, we first divide the raw sensor data into the training dataset and the testing dataset. The training dataset represents the labeled activity segments and we can get the activity segments according to the labeled activity data. The testing dataset represents the sensor segments and we can use the proposed sensor segment method based on the predefined activity knowledge to segment raw sensor events. Then, we separately extract the features of the sensor frequency and sensor duration. In the activity recognition phase, we use the extracted features of activity segments to build activity model. Afterwards, we apply this model to the features extracted by the sensor segment in testing dataset to test the model. Finally, we can predict the activity label of the corresponding sensor segment by the training model.

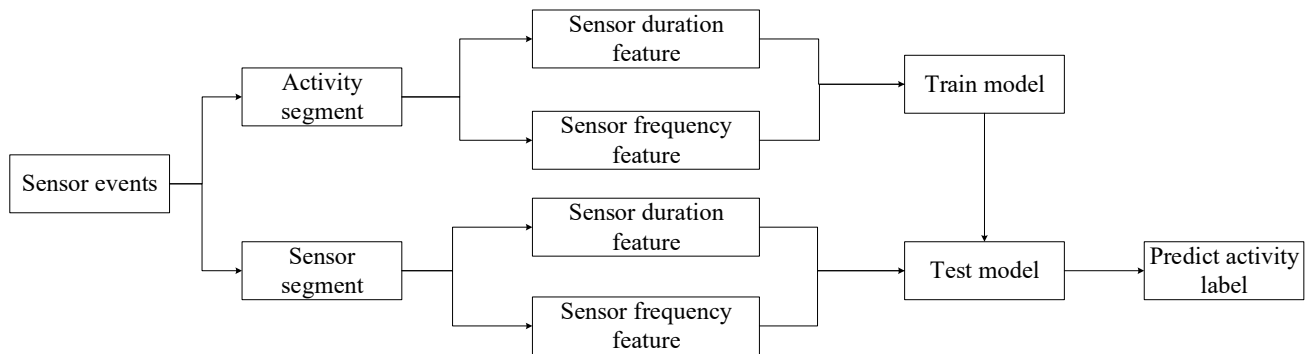


Figure 1: Framework of our activity recognition approach

The Sensor Segmentation Algorithm

First, we represent an activity associated with a sensor set S . The set contains main sensors of the activity. In S , simple features are used for specifying the activity, and these features can be easily fixed by customers using their own knowledge. There may be many activities in a smart home, such as bed_toilet_transition, toilet, watch_TV, cook and so on. These activities often occur in certain locations. For example, the activity “sleep” often takes place in the bedroom; the activity “toilet” often occurs in the bathroom. Therefore, each activity will trigger certain sensors, and thus we can predefine the sensor set for each activity. This

will help the segment algorithm to divide the input data stream. In the followings, we take the dataset hh122 as an example. There are 24 sensors distributed in a smart home. There are 32 activities considered in the smart home. Thus, we should predefine each activity by fixing its features. Table 2 shows the features for main activities. In Table 2, we can see main sensors of “Sleep” are M006, M007 and M008; main sensors of “Bathe” are M004 and MA005.

Table 2: hh122 main activities features

Activities	Main sensor (S)
Sleep	{M006, M007, M008}
Bathe	{M004, MA005}
Cook_breakfast	{M010, MA011, M012, M024}
Leave_Home	{M001, M002}
Work	{M022, M014, MA023}

Algorithm 1 describes the procedure of the sensor data segmentation based on the prior knowledge of main sensors in an activity. We introduce some definitions used in Algorithm 1 first: D denotes a sequence of sensor events with a sensor set; n is the number of sensor event; S is the main sensors set of the activity; t is an input parameter which indicates a time threshold; Seg is a set of sensor data segment index and Seg_i is a pair of ($start_index$, end_index); new_S and $Last_S$ represent the subsets of S and they will be updated in the process of implementation of Algorithm 1. We use the knowledge and raw sensor data as the input of Algorithm 1. Because that the raw sensor data contains some noise data and we consider that the noise data may affect the segmentation of the sensor data, and thus we defined a time threshold (fixed to 4 seconds) to determine whether this sensor data is noise data. In detail, we assume that one sensor data does not belong to the sensor group data of relevant activity. If there appears sensor data belonging to the sensor group data of relevant activity in the next seconds, then we call this sensor data as noise data and the sensor data segmentation do not be performed. Otherwise, the next sensor segment will use this sensor data as segmental start data. After that, we delete segments within 2s duration in order to decrease influence of noise sensor data, as those segments usually make no sense.

Algorithm 1. Knowledge-based segmentation algorithm

Input: $D = \{D_1, \dots, D_i, \dots, D_n\}$, $S = \{S_1, \dots, S_j, \dots, S_m\}$, time threshold: t

Output: $Seg = \{Seg_1, \dots, Seg_i, \dots, Seg_n\}$

```

1.   $start\_index \leftarrow 0$ 
2.   $new\_S \leftarrow \phi$ 
3.   $Seg \leftarrow \phi$ 
4.  While  $start\_index < n$ 
5.       $Last\_S \leftarrow S$ 
6.      For each  $D_i$  in  $D_{start\_index}$  to  $D_n$ 
7.          For each  $S_j$  in  $Last\_S$ 
8.              If  $D_i$  not in  $S_j$  then
9.                  remove  $S_j$  from  $Last\_S$  and add it to  $new\_S$ 
10.             If  $len(new\_S) = 0$  then
11.                  $dt_i \leftarrow \text{date\_time of } D_i$ 
12.                 For each  $D_z$  in  $D$ 
13.                     If  $\text{date\_time of } D_z \text{ in } (dt_i, dt_i+t)$  then
14.                         For each  $Last\_S_m$  in  $Last\_S$ 
15.                             If  $D_z$  not in  $Last\_S_m$  then
16.                                  $end\_index \leftarrow i$ 
17.                                 goto 20
18.                     Else  $Last\_S \leftarrow new\_S$ 
19.             end for
20.              $Seg \leftarrow Seg \cup \{(start\_index, end\_index)\}$ 
21.              $start\_index \leftarrow end\_index + 1$ 
22. return  $Seg$ 

```

The Modified KNN Algorithm

In this subsection, we first briefly introduce the standard KNN algorithm. In order to demonstrate our dataset training model process on the standard KNN algorithm, we combine sensor frequency and time feature. And then, we can get the sensor merge feature $SMF = (fd_1, \dots, fd_i, \dots, fd_m)$. Each fd_i indicates a normalized value. The standard KNN algorithm calculates the Euclidean distances to make the classification. With the predefined parameter k , it can obtain the class label of each test data. To further enhance the accuracy of the standard algorithm, we present a novel modified KNN algorithm combined with center distance. Algorithm 2 indicates the procedure of the modified KNN algorithm we proposed.

Algorithm 2. Modified KNN algorithm

Input: Training feature set: $Trfs = \{SMF_1, \dots, SMF_i, \dots, SMF_n\}$

Training label set: $Trls = \{se_1.la, \dots, se_i.la, \dots, se_n.la\}$

Test feature set: $Tefs = \{SMF_1, \dots, SMF_j, \dots, SMF_m\}$

Output: Testing predict label set: $Tepls = \{se_1.la, \dots, se_j.la, \dots, se_m.la\}$

-
1. Initialize $Trls'$, $Trfs'$, C , $Tels$, $Tels'$ and $Tepls$ to be empty set
 2. $Trls' \leftarrow \{se_1.la, \dots, se_z.la, \dots, se_k.la\}$, each $se_z.la$ indicates an activity label and the dataset has k non-duplicate activity labels. Similarly, let $Trfs' \leftarrow \{Trfs_1, \dots, Trfs_z, \dots, Trfs_k\}$
 3. **For each** $Trfs_z$ in $Trfs'$ **do**
 4. Calculate $m \leftarrow$ the mean of sum feature of $Trfs_z$ and record correspond training label $l \leftarrow se_z.la$
 5. $C \leftarrow C \cup (m, l)$
 6. **For each** SMF_z in $Trfs_z$ **do**
 7. Get the first five minimum value: $dist' \leftarrow SMF_z - C_{il}$ ($0 < i < k$)
 8. $Tels' \leftarrow Tels' \cup (dist', C_{i2})$
 9. Using standard KNN algorithm to calculate the first five minimum value of Euclidean distance: $dist$ and corresponding label: cl
 10. $Tels \leftarrow Tels \cup (dist, cl)$
 11. Calculate the sum of $Tels$ and $Tels'$ with the corresponding weights and let the class label whose weight value is maximum append to $Tepls$.
 12. **Return** $Tepls$
-

In the algorithm 2, we define three sets as input. They are training data feature set, labels set corresponding to the training data and testing data feature set. At the beginning of Algorithm 2, we initialize some empty sets including: $Trls'$ a training label set after removing all duplicate labels, $Trfs'$ a training feature set, each of which is a feature corresponding to each label in $Trls'$. Each element in C contains two items: the center point of a cluster of the input training set and its label value. An element in $Tels$ contains five shortest Euclidean distance values between a point in $Tefs$ and points in $Trfs$, and their corresponding training labels of the five nearest points. $Tels'$ contains five shortest distance values between a point in $Tefs$ and all cluster centers, as well as their corresponding training labels. In line 2, we obtain a non-duplicate label set of the training dataset and get the corresponding training feature set which combines frequency feature and duration feature of sensor data. In line 3 to 5, the algorithm obtains the center point of clusters in training data by calculating the mean of the sum of each category feature. In line 6 to 8, it chooses five minimum values of distances to cluster centers. In line 9 to 10, it calculates five minimum values of Euclidean distances and adds them into $Tels$. After computation of distances, $Tels$ and $Tels'$ are merged with weighted sum operation, and the label with the maximum weighted value is returned.

EXPERIMENT

In this section, we present our experiments designed in our work. Our experimental datasets come from CASAS (Cook *et al.*, 2013). It is a research group established by Washington State University. Those datasets contain sensor data that collected in the home of a volunteer adult and there is only one resident in a smart home. We select three datasets, namely hh110, hh120 and hh122, to develop our experiment. These datasets are partially annotated with activities that generated by residents performing daily living activities in smart homes. For example, we describe hh122 dataset features in detail. This smart home environment consists of two frontdoors, one bedroom, a kitchen, a diningroom, a bathroom, a study, a livingroom and a toilet. Table 3 shows the statistical data of dataset we selected. The “Raw sensor events” column represents the number of raw sensor event data; the “Annotated sensor event” column shows the number of raw sensor event labeled data. The “Raw activity” column indicates the number of raw labeled activities; the “Merge activity” column shows the number of merged activities which we merge the similar class of activities into a merged activity. The “Raw sensor” column indicates the sensor number of raw dataset and the “Selected sensor” shows the number of sensors that we used for our experiment, this is because we only consider binary sensors that the sensor readings are “ON”, “OFF”, “OPEN” and “CLOSE”. We set the proportion of training dataset and testing dataset is set as 1:9 in our experiments. This is because the sensor data collected in the smart home has a timing relationship. For example, in the hh122 dataset, we select one-tenth data as the training set that contains three days data. During the three days, daily life activities of residents contain all the activity information in the smart home basically, so one-tenth data as a training set is enough to train our activity recognition model. In the following, we first describe our experimental datasets. Then, we introduce our experimental evaluation indicator and results.

Table 3: Description of dataset

Dataset	Raw sensor events	Annotated sensor events	Raw activity	Merge activity	Raw sensor	Selected sensor
hh110	162426	138331	25	6	83	26
hh120	2581453	300037	32	6	77	24
hh122	1378407	202112	32	8	118	24

We introduce two evaluation indicators including activity recognition accuracy and confusion matrix. To indicate our experimental activity recognition accuracy, we calculate the recognition accuracy by Eq. 1, where $No_{correct}$ symbolizes the total number of correctly recognized activity labels, while No_{total} signifies the total number of sensor segmentation. We also calculate the total accuracy and recognition accuracy of every merge activity. The total accuracy shows accuracy of the whole dataset activities. Recognition accuracy of every merge activity represents probability of correctly recognizing each merge activity.

$$Recognition\ Accuracy = \frac{No_{correct}}{No_{total}} \quad (1)$$

Furthermore, in order to show the recognition results of our experiments in detail, we use the confusion matrix to list the final recognition results of each merged class. Each column of the confusion matrix represents the prediction category, the total number

of each column represents the number of data predicted for the category; each row represents the true activity category of the data and the total number of data for each row represents the data for that category. The value in each column indicates that the real data is predicted as the number of that class.

Before analyzing experimental results, we explain the reasons for merging similar activities. For example, in the hh122 dataset, we merged 32 annotation activities of the dataset into eight merge activities. However, some rooms contain only two sensors, e.g. the bathroom. Therefore, the two sensors will be triggered when people perform daily activities like groom and bathe. It is difficult to distinguish activities in this bathroom. Thus, we consider combining these similar activities to merge activities.

The following tables show the recognition accuracy of our proposed methods, the confusion matrixes of activity recognition that including the modified KNN and standard KNN algorithms, and the recognition accuracy of other existing classifier on our three datasets. First, we use “MK” to represent our modified KNN algorithm and use “SK” to represent the standard KNN algorithm. As is indicated, in hh110, hh120 and hh122 datasets, the recognition accuracy of activity recognition when using our proposed method are 0.839, 0.933 and 0.918, respectively. From Table 4, we can see the hh110 dataset has six merge activity classes, namely “sleep class”, “bathroom class”, “kitchen class”, “leave and enter home class”, “eat class” and “work class”. The number in each cell counts the activities identified as the corresponding class by a classifier. Clearly, the modified algorithm performs better than the standard one as more activities are identified correctly. For example, we can see the total number of “Sleep class” is 296 and we can obtain the four error classifications of this label class. Among them, there are 14 “sleep class” activities classified into “bathroom class”, there are 5 “sleep class” activities classified into “kitchen class” when using our proposed algorithm and there are 6 “sleep class” activities classified into “kitchen class” when using standard algorithm.

From Table 5, we can see the best recognition accuracy of these activities is 0.98, which represents that residents leave home and enter home only trigger the sensors of the front door in the smart home. However, this accuracy value is not 1, because there exists some boundary data does not belong to the label activity class when we divide raw sensor data to sensor segmentation. Though our algorithm cannot obtain the best value for every class, it has the best average performance.

Table 4: Confusion matrix of hh110

	Sleep class		Bathroom class		Kitchen class		Leave and enter home class		Eat class		Work class	
	MK	SK	MK	SK	MK	SK	MK	SK	MK	SK	MK	SK
Sleep class	271	271	14	14	5	6	0	0	1	1	5	4
Bathroom class	3	3	215	215	0	0	0	0	1	1	1	1
Kitchen class	0	0	0	1	161	161	2	2	18	19	8	6
Leave and enter home class	0	0	0	0	0	0	50	50	0	0	1	1
Eat class	2	2	0	0	11	13	1	2	87	85	14	13
Work class	21	20	11	13	47	49	17	16	8	18	209	197

Table 5: Comparison with other classifiers on recognition accuracy of hh110

	Sleep class	Bathroom class	Kitchen class	Leave and enter home class	Eat class	Work class	acc
Modified KNN	0.916	0.977	0.852	0.98	0.757	0.668	0.839
Standard KNN	0.916	0.977	0.852	0.98	0.739	0.629	0.827
RandomForest	0.912	0.977	0.915	0.98	0.765	0.441	0.789
DecisionTree	0.895	0.995	0.878	0.902	0.739	0.406	0.767
GradientBoosting	0.899	0.995	0.921	0.961	0.704	0.54	0.809
LogisticRegression	0.878	0.977	0.841	0.98	0.757	0.524	0.79
GaussianNB	0.848	0.977	0.788	0.647	0.565	0.502	0.735
BernoulliNB	0.838	0.955	0.937	0.961	0.661	0.272	0.714
MLPC	0.878	0.977	0.862	0.98	0.765	0.585	0.81

Table 6 and 7 show the results of dataset hh120, and Table 8 and 9 dataset hh122, where hh120 is divided into six and hh122 eight merge activities. We remove the “entertain guests” activity before merging similar activities, because the “entertain guests” activity takes place in every area in the smart home, so the sensor frequency and duration features do not display the activity feature. Table 8 is the activity confusion matrix of dataset hh122. We can see the “dress class” has the lower recognition accuracy. This is because the “dress class” do not happen in one place, a small part of the activity take place in the bedroom, kitchen and study. Thus, it is be classified to “sleep class”, “cook class”, “work class” and so on. However, the recognition accuracy of “leave and enter home class” activity has the best accuracy.

Table 6: Confusion matrix of hh120

	Sleep class		Bathroom class		Kitchen class		Leave and enter home class		Eat class		Dress class	
	MK	SK	MK	SK	MK	SK	MK	SK	MK	SK	MK	SK
Sleep class	383	374	3	4	2	0	0	2	0	4	28	32
Bathroom class	0	0	519	519	0	0	0	0	0	0	0	0
Kitchen class	0	0	0	0	230	231	2	2	5	4	0	0
Leave and enter home class	2	1	1	1	1	1	179	180	0	1	3	2
Eat class	2	2	0	0	27	23	2	8	207	205	0	0
Dress class	32	31	3	5	0	0	0	0	0	2	61	58

Table 7: Comparison with other classifiers on recognition accuracy of hh120

	Sleep class	Bathroom class	Kitchen class	Leave and enter home class	Eat class	Dress class	acc
Modified KNN	0.921	1.0	0.97	0.962	0.87	0.635	0.933
Standard KNN	0.899	1.0	0.975	0.968	0.861	0.604	0.926
RandomForest	0.947	0.994	0.924	0.925	0.891	0.542	0.925
DecisionTree	0.918	1.0	0.907	0.892	0.866	0.542	0.91
GradientBoosting	0.945	0.998	0.903	0.892	0.882	0.542	0.918
LogisticRegression	0.99	1.0	0.975	0.962	0.87	0.042	0.917
GaussianNB	0.298	0.981	0.975	0.952	0.866	0.906	0.788
BernoulliNB	0.918	0.958	0.759	0.909	0.924	0.375	0.877
MLPC	0.954	1.0	0.975	0.973	0.87	0.292	0.924

Table 8: Confusion matrix of hh122

	Sleep class		Bathroom class		Cook class		Eat class		wash_dishes class		Work class		Leave and enter home class		Dress class	
	MK	SK	MK	SK	MK	SK	MK	SK	MK	SK	MK	SK	MK	SK	MK	SK
Sleep class	136	133	0	0	0	0	0	0	0	0	0	0	0	0	1	4
Bathroom class	0	0	353	354	0	0	0	0	0	0	0	0	0	0	2	1
Cook class	0	0	0	0	58	47	2	2	25	36	0	0	0	0	0	0
Eat class	0	0	0	0	0	0	41	44	0	0	14	3	0	0	0	8
wash_dishes class	0	0	0	0	14	13	6	6	69	70	0	0	0	0	0	0
Work class	0	0	0	0	0	0	1	8	0	0	182	132	0	0	0	43
Leave and enter home class	0	0	0	0	0	0	0	0	0	0	0	0	64	64	0	0
Dress class	7	6	0	0	7	7	0	0	0	0	4	3	1	1	33	35

Table 9: Comparison with other classifiers on recognition accuracy of hh122

	Sleep class	Bathroom class	Cook class	Eat class	wash_dishes class	Work class	Leave and enter home class	Dress class	acc
Modified KNN	0.993	0.994	0.682	0.745	0.775	0.995	1.0	0.635	0.918
Standard KNN	0.971	0.997	0.553	0.8	0.787	0.721	1.0	0.673	0.862
RandomForest	0.964	0.997	0.624	0.745	0.73	0.967	0.984	0.635	0.9
DecisionTree	0.964	0.997	0.647	0.727	0.764	0.951	0.953	0.75	0.905
GradientBoosting	0.964	0.997	0.506	0.8	0.764	0.945	0.984	0.75	0.898
LogisticRegression	0.985	0.997	0.682	0.745	0.742	0.995	1.0	0.615	0.914
GaussianNB	0.526	0.969	0.459	0.673	0.865	0.978	1.0	0.673	0.83
BernoulliNB	0.985	0.983	0.588	0.691	0.539	0.978	0.984	0.615	0.876
MLPC	0.985	0.997	0.435	0.745	0.854	0.995	1.0	0.654	0.905

In order to show the overall performance of our proposed modified algorithms, we also tested other classifiers to recognize activity of residents in the smart home. In Table 10, we list the average accuracy of different classifiers. As is indicated, the method we proposed shows better accuracy than other classifiers including Standard KNN, Random forest, Decision tree, Gradient boosting, Logistic regression, Gaussian NB, Bernoulli NB and Multilayer perceptron (MLPC).

Table 10: Accuracy comparison of different classifiers

	Modified KNN	Standard KNN	Random Forest	Decision Tree	Gradient Boosting	Logistic Regression	Gaussian NB	Bernoulli NB	MLPC
hh110	0.839	0.827	0.789	0.767	0.809	0.79	0.735	0.714	0.81
hh120	0.933	0.926	0.925	0.91	0.918	0.917	0.788	0.877	0.924
hh122	0.918	0.862	0.9	0.905	0.898	0.914	0.83	0.876	0.905

CONCLUSIONS

This paper presents a novel segmentation method based on predefined activity knowledge and we predefine each activity by fixing its features. Then, based on the standard KNN algorithm, we also propose a new modified KNN algorithm combining with center distance to recognize activities of daily life in smart homes. This center distance represents the distance between center point of each training set and every testing data. Our proposed algorithms are tested on three CASAS datasets. We only consider the annotation data and extract sensor features by calculating sensor frequency and duration. The experimental results show that the proposed approach can achieve total accuracies of 0.839, 0.933 and 0.918, respectively. Furthermore, the results demonstrate that the proposed method outperforms the other classifiers.

ACKNOWLEDGMENT

This work is supported by the National Natural Science Foundation of China (No. 61672122, No. 61602077, No. 61763003, No. 61502111), the Public Welfare Funds for Scientific Research of Liaoning Province of China (No. 20170005), the Natural Science Foundation of Liaoning Province of China (No. 20170540097), the Natural Science Foundation of Guangxi Province of China (No. 2016GXNSFAA380192), and the Fundamental Research Funds for the Central Universities (No. 3132016348, No. 3132018194).

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A Scientometrics Review on Research of Knowledge Sharing in Virtual Communities

(Full Paper)

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ABSTRACT

The number of literature on knowledge sharing in virtual communities has gained rapid growth during last decade; however, there have been few attempts to map the global research in this domain. In this study, the CiteSpace software package was used to conduct a series of content analyses to identify the state of the field and trends in knowledge sharing in virtual communities, including the distribution of core authors and institutions; high-frequency categories and keywords; highly cited papers and hot topics of research; and trends pertain to co-author analysis, co-word analysis, co-citation analysis, and particularly cluster analysis. We present all research focuses in a scientometric way and arrive at the following findings. First, the most significant developments and progress in knowledge sharing in virtual communities have occurred primarily in China, Taiwan, USA, Malaysia. Second, the existing studies in the field of knowledge sharing in virtual communities focus primarily on Business & Economics, Engineering and Computer Science. Third, five hot knowledge sharing in virtual communities topics were also disclosed, they are: knowledge sharing, virtual communities, trust, behavior, management and network.

Keywords: Knowledge sharing, virtual community, Web of Science, CiteSpace

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INTRODUCTION

The emergence of the Internet enables users to interact and share information through virtual space or cyberspace. The interaction, openness and sharing of the Internet have enabled knowledge and information to be transmitted to all corners of the world, and the geographical boundaries of traditional communities have been weakened. Users from all walks of life join virtual communities in order to share their knowledge relevant to common interests and topics (Tamjidyamcholo, 2014). Virtual community, also known as an online community, refers to an online social network in which individuals have common interests, goals, and behaviors share knowledge and participate in social interaction (Chiu, 2007). As a new type of interaction mode, virtual community can break through the limitations of time and space, improving people's interaction efficiency and becoming a new platform for people to exchange information and share knowledge. Many organizations view virtual communities as the key to knowledge management. They are increasingly focusing on the operation and development of virtual communities to achieve their operational goals. The key to the prosperity and development of virtual communities is knowledge sharing among community members. Therefore, it is of great significance to study the influencing factors, sharing process and sharing mechanism of virtual community knowledge sharing for community managers to develop targeted incentives and effective community management.

Because of the importance of knowledge sharing in virtual communities, scholars are increasingly concerned about related topics. A large number of high quality studies have emerged in recent years. A number of literature reviews on knowledge sharing in virtual communities have been completed. Charband and Navimipour (2016) offer a comprehensive, detailed, and systematic study of the state-of-the-art knowledge sharing mechanisms in an online environment. Assegaff and Kurniabudi (2017) apply literature review study as main approach to identify factors related with people barriers when contributing their knowledge through virtual communities. Li *et al.* (2018) systematically discussed the theories that most studies took, summarize existing empirical study of knowledge sharing in virtual communities, and identified four mostly used representative theories. Unlike previous reviews of knowledge sharing in virtual communities, we conducted a scientometric review and obtained a snapshot of this fast-growing field between January 1999 and December 2017. Scientometric review is an important approach to make comprehensive evaluation of the development of regarding research area (Kim & Chen, 2015). Our findings could assist researchers in better understanding the dynamics of knowledge sharing in virtual communities and in identifying the frontier of knowledge sharing in virtual communities research.

The purpose of this study is as follows: First, we try to identify the most productive contributors, including individual and institutional researchers, based on co-author analyses at the country, institution and author levels. Second, through co-word analyses at the keyword, term and category levels, we strive to reveal the major categories and primary research topics in the field of knowledge sharing in virtual communities. Third, we seek to illuminate the distribution of core articles, authors and journals related to knowledge sharing in virtual communities by mapping co-citation networks at the document. Finally, the vital goal of this paper is to detect the hot research topics and trends in the field of knowledge sharing in virtual communities.

METHODOLOGY

Data Collection

Database

Web of science (WOS) is an ideal choice for obtaining data sources in bibliometric research, bringing researchers representativeness and accuracy. It covers the world's most influential journals and covers multiple disciplines. In addition, it provides researchers with web-based bibliographic and citation information access. Most of the main papers on virtual community knowledge sharing can be retrieved in WOS, and relevant publications can be easily extracted through appropriate search strategies. Therefore, this study used the WOS core collection database as the selection data set.

Defining search keywords

The research goal of this review is to explore the knowledge landscape in the knowledge sharing field. A priority is obvious that each research field has various types of relevant keywords. Traditionally, the process of defining the keywords was relied on the summarizing of previous papers. We use web of science as data source and use "Title= (virtual knowledge sharing) OR Title= (online AND knowledge sharing), Database= (SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, CCR-EXPANDED, IC), Languages= (ENGLISH), Timespan= 1999-2017" as search factors.

Refinement of data

After obtaining 271 bibliographic records, we further refined the data to two types: articles and reviews. This refinement brought us a valid final literature set of 262 publications for further analysis. Most publications are articles.

ANALYSIS OF PUBLICATION OUTPUT

Figure 1 shows the snapshot of annual publication output. Papers in this field started primarily at 1999 and the distribution of bibliographic records was divided into two main phases. The first stage, named emergence, dates from 1999 to 2006. The annual number of papers published was less than 10 and these achievements aimed at importing the basic theory and laid a foundation for the later researches. The second stage are defined as an expansion phase, in which the production achieved an uppermost point in 2007. Although there is a decline during 2010 and 2013, a rapid growth occurred between year 2014 and 2017 again. As presented in Figure 1, the number of publications pertain to knowledge sharing in virtual communities showed an overall increase trend, indicating that researchers have been concerning this topic with a rising heat and have achieved a wealthy of publications. In 2017, the actual number of publications shows a little decline trend, but the published quantity index still shows an upward trend. All in all, the research stage in terms of knowledge sharing in virtual communities have not gone into the mature phase and more publications will appear in the future.

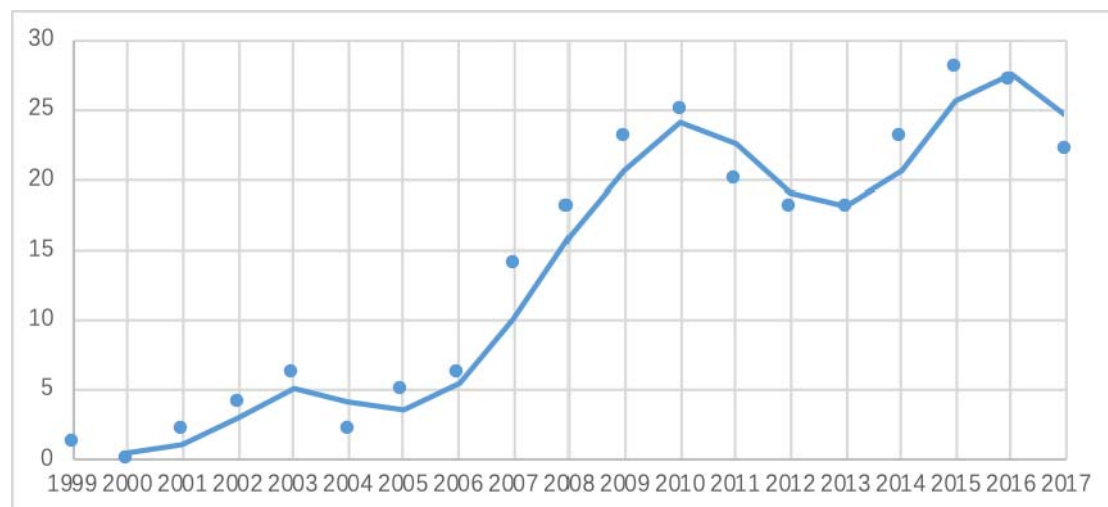


Figure 1: Trends in the number of scholarly publications concerning knowledge sharing in virtual communities research from 1999 to 2017.

CO-AUTHORSHIP ANALYSIS

Co-authorship Network

Co-authorship networks are an important class of social networks and have been analyzed extensively, both at network level and individual node level, to explore different statistical characteristics (Newman, 2001) and behavioral patterns of scientific collaborations (Liu *et al.* 2005). Through the co-authorship analysis, we can obtain the productivity of authors, recognize the research teams and their core builders. Figure 2 shows the outputs and author cooperation network knowledge map in research of knowledge sharing in virtual communities. All the primary authors of this research field are presented in the map, in which 22 nodes and 10 links exist. Every node represents an author; the node's size indicates the productivity of each author and the links reflect the collaboration relationships among authors.

The statistical analysis demonstrated that the 262 publications on research of knowledge sharing in virtual communities were drafted by more than 22 authors. The top-5 most scholarly productive researchers are presented in table 1. It is obvious that Pee, L.G., a professor who belongs to Nanyang Technology University, is the most productive author in the field of knowledge

sharing in virtual communities, followed by HARA N, LI JY, CHANG KE and HOU HT. As seen in Table 1, the first publication years of these productive authors are distributed between 2015 and 2017. Pee, L.G. started his research in 2015 and he is the latest one to start in the top-5 authors, however, he is the most efficient author with 4 papers in 3 years. Hara Noriko, Li Jinyang, Chang Kuo-En and Hou Huei-Tse all pressed 2 papers and Hara Noriko is the earliest one.

Regarding the collaborative relationships, as shown in Figure 2, we can draw the conclusion that there are some research communities and most community has one main highly productive author, to whom many other authors connect. For example, professor Pee, L.G. occupies the core position of a community and has direct close connections with three other authors, including Lee, J. and Min, Jinyong. Furthermore, the number of nodes is 2 times the number of links, indicating that cooperation strength between researchers is weak.



Figure 2: co-authorship network, with 22 nodes and 10 links

The co-authorship analysis help recognize the authors with high productivity based on the co-occurrence frequency criterion. A prior it is that the level of output can't represent the influence and contribution. In the later co-citation part, we will explore the relationship between the productivity and influence by comparing the conclusions in these two parts.

Table 1: The top-5 most productive authors and their publication frequencies and institutions

Ranking	Frequency	Year	Author
1	4	2015	Pee, L.G.
2	2	2007	Hara, Noriko
3	2	2015	Li Jinyang
4	2	2009	Chang, Kuo-En
5	2	2009	Hou, Huei-Tse

RESEARCH POWER NETWORK

Collaboration between different countries and institutions facilitates the sharing of useful information and provides researchers with more diverse research materials. To explore the distribution of publications on knowledge sharing in virtual communities and the collaboration relationships, a cooperative network was generated in terms of institutions and countries.

A network on behalf of the collaborating countries and institutions between 1999 and 2017 has been provided in Figure 3, in which every node represents a country or an institution and the 13 nodes and 13 links indicate a weak cooperation state. It is obvious that the major contributions concerning the total publication output are mainly derived from China, Taiwan, USA, Malaysia and England in Table 2. In terms of the frequency distribution, 262 papers are distributed among 13 countries and 20 institutions. The top-10 countries totally published 203 papers, accounting for 80%. It is clear that the largest node in the figure is China, which is the largest contributor publishing 65 papers. Aisa is the most productive region publishing 138 papers, including 65 from China, 45 from Taiwan, 12 from Malaysia, 9 from South Korea and 7 from Singapore. According to the

color of the nodes and links, we can see that the time these mainly productive countries started digging into the research of knowledge sharing in virtual communities was earlier, indicating a very obvious time accumulation characteristic of academic research.

Collaboration networks exist in different countries and institutions, interestingly, although some research bodies come from the same region, there is no direct relationships among them. For example, the Chinese mainland and Malaysia are both prominent nodes, ranking first and fourth, and they are free of cooperation with each other.

Figure 3 and Table 2 also presents the cooperation networks among institutions in the domain of knowledge sharing in virtual communities. From the analysis of productive countries and the regional information of these more productive institutions, we can draw the conclusion that there exists a high level of consistency between the high-yield countries and institutions. For example, the most productive institution - National Central University is from Chinese mainland and the third productive institution is from Taiwan. Other similar relationships can be recognized in the same way. But there also exist exceptions. Although researchers coming from Malaysia, England and South Korea published 32 papers in this field, ranking fourth, fifth and sixth in the top-10 countries respectively. None of the top-8 institutions come from these three countries, in which the sense of cooperation among researchers wasn't strong over the past two decades.

Table 2: The top-10 most productive countries, institutions and their publication frequencies.

Ranking	Frequency	Country	Frequency	Institution
1	65	CHINA	7	Natl Cent Univ
2	45	TAIWAN	6	Nanyang Technol Univ
3	42	USA	4	Natl Taiwan Univ Sci & Technol
4	12	MALAYSIA	2	Indiana Univ
5	11	ENGLAND	2	Donghua Univ
6	9	SOUTH KOREA	2	Virginia Tech
7	7	SINGAPORE	2	Natl Cheng Kung Univ
8	6	ITALY	2	Univ Indonesia
9	4	GERMANY	2	Coventry Univ
10	2	AUSTRALIA	2	Univ Washington



Figure 3: Research power network, with 13 nodes and 13 links

CO-WORD ANALYSIS

To explore what areas have been most concerned in the field of knowledge sharing in virtual communities during the time periods covered by this study, we use the co-word analysis to estimate the research focuses. Furthermore, we also detect the bursts to clear the frontiers.

Co-occurring Categories Analysis

Figure 4 provides a network of co-occurring subject categories in research of knowledge sharing in virtual communities, including 32 nodes and 69 links. Statistical analysis showed that the Computer Science (130) and Business & Economics (80) were the most productive areas of all, followed by Information System (72), Management (64), Information Science & Library Science (47), Engineering (43) in Table 3. Furthermore, considering the initial years of the top-10 productive categories, we assigned the publications into four stages. The numbers in last stage are less than the third stage because the last stage 2014-2017 only covers 3/4 of the next four years. Considering this reality and observing the trend, we can get the obvious conclusion that publications of each category in the four stages shows an upward trend in terms of the increase in number. The growth rate in the third stage, years between 2009 and 2013, is fastest compared to other stages. Studies focusing on Business & Economics, Engineering and Computer Science have significantly increased in the total publications output. Similarly, categories of Management and Business have gradually increased in number of studies. In the present time, Business & Economics is the fastest developing field in the research of knowledge sharing in virtual communities.

As shown in figure 4, not all the bigger size nodes have red-purple rings, indicating that the nodes reflecting high level of production aren't consistent with those nodes reflecting high centrality. In the knowledge map, high centrality nodes are recognized in the categories of Engineering (0.43), Psychology (0.38), Computer Science (0.32), Electrical & Electronic (0.20), Management (0.16) and Business (0.16). All these categories have made a significant motive force on the development of knowledge sharing in virtual communities.

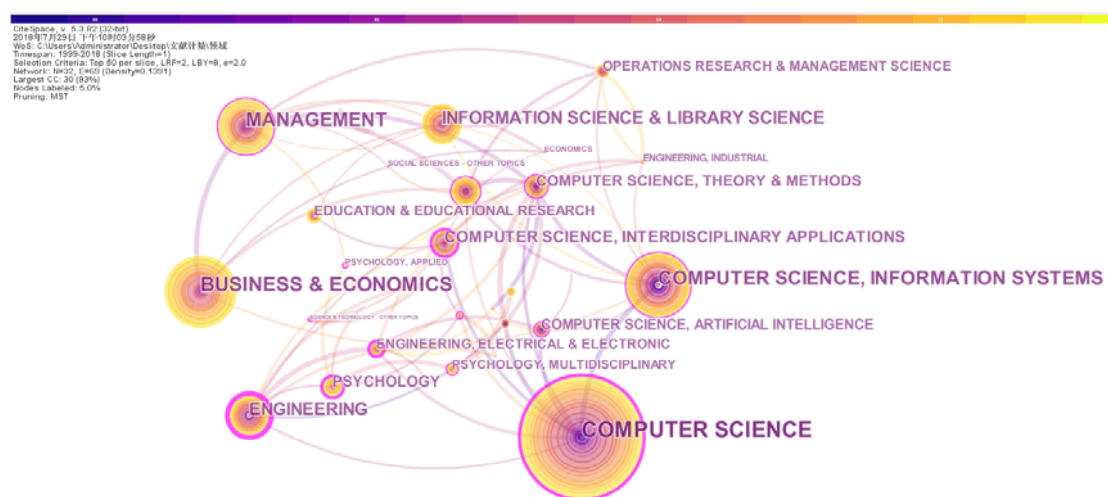


Figure 4: Co-occurring categories (WOS categories) network, with 32 nodes and 69 links

Table 3: The top-10 research categories and their co-occurrence frequency

Ranking	Frequency	Year	Category	1999-2003	2004-2008	2009-2013	2014-2017
1	130	2001	COMPUTER SCIENCE	11	29	54	36
2	80	2005	BUSINESS & ECONOMICS	0	13	33	34
3	72	2001	INFORMATION SYSTEMS	8	15	26	23
4	64	2005	MANAGEMENT	0	12	24	28
5	47	2007	INFORMATION SCIENCE & LIBRARY SCIENCE	0	4	22	21
6	43	2002	ENGINEERING	2	7	22	12
7	33	2005	BUSINESS	0	6	11	16
8	31	2003	INTERDISCIPLINARY APPLICATIONS	3	8	15	5
9	26	2003	THEORY & METHODS	3	6	9	8

CO-OCCURRING KEYWORDS ANALYSIS

The key word of the article is to concentrate the core content. Through co-occurrence analysis, high frequency keywords are obtained, summing up research priorities in the knowledge sharing field and detect the bursts to make a brief overview of the research frontier. On the basis of merging similar words or different words with same meaning (for example, the words “virtual community”, “online community”, “communities”, “virtual team” and “virtual enterprise” were mapped to “virtual community” and “knowledge sharing”, “knowledge-sharing”, “online knowledge sharing” and “knowledge management” were mapped to “knowledge sharing”), a final keyword co-occurrence knowledge map was established in Figure 5 based on the choose of keyword as the node type and the merger of some related keywords, in which there were 96 nodes and 179 links.

Since we used “knowledge sharing” and “virtual communities” as the search keywords, it is not surprising that they have the highest frequencies, 142 and 114 respectively. The keywords “trust”(56), “behavior”(45) and “self-efficacy”(16) represent the factors that influence knowledge sharing; “management”(34), “network”(31), “organization”(18) explain represent the application areas of knowledge sharing.

As shown in Figure 5, focuses of knowledge sharing in virtual communities and correlations among hot topics can be drawn on the basis of the size of nodes and the links between keywords analysis. For instance, researches regarding knowledge sharing in virtual communities are correlated with trust, internet, behavior, management and collaboration. Therefore, we can see that researches on the core focus user innovation contains three types of sub hot topics: effects of knowledge sharing in virtual communities, knowledge sharing management and ways for motivate knowledge sharing.

Table 4: The top-10 keywords and their frequency

Ranking	Frequency	Year	Category
1	142	2001	Knowledge Sharing
2	114	2006	Virtual Community
3	56	2005	Trust
4	45	2005	Behavior
5	34	2007	Management
6	31	2008	Network
7	30	2010	Perspective
8	28	2007	Model
9	18	2010	Organization
10	16	2013	Self-efficacy

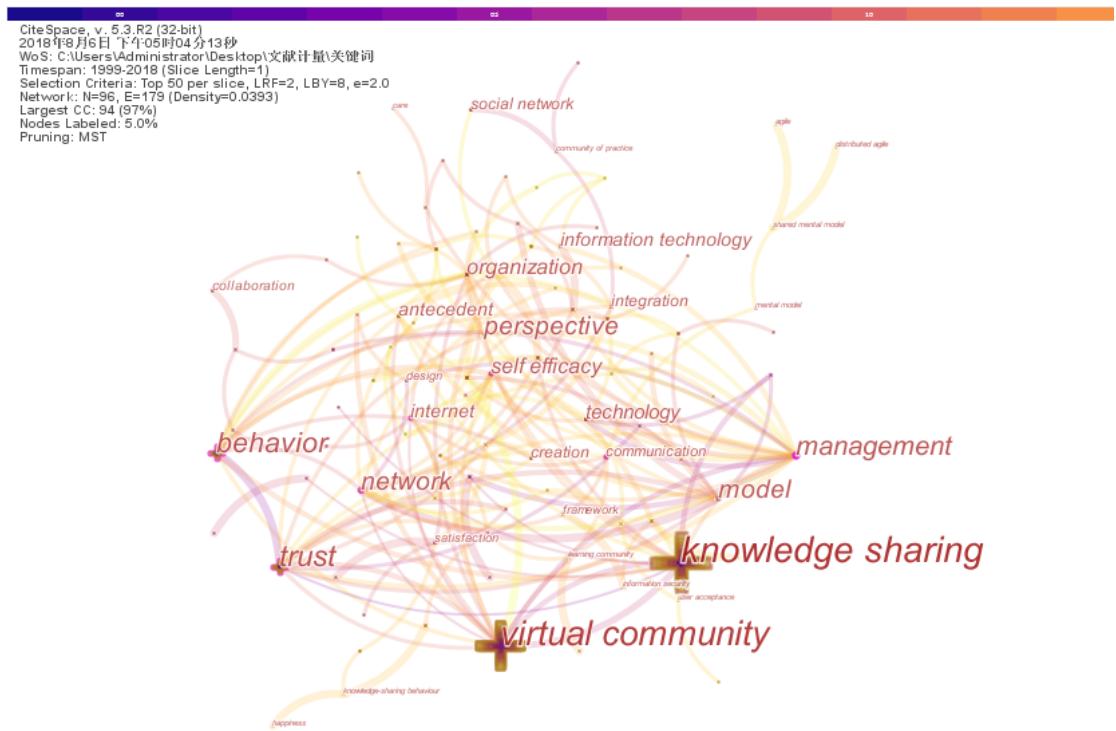


Figure 5: co-occurring keywords network, with 96 nodes and 179 links

CO-CITATION NETWORKS

Document Co-citation Network

Document co-citation analysis is a statistical method. It can be used not only reveal the quantity and authority of references cited by published papers, but also predict future research directions (Song & Dong, 2016). And the clusters generated during this process are important analytical units for cluster analysis.

Based on an analysis of the comprehensive collection and coordination of the 818 academic documents cited in the 262 records retrieved from the WOS core collection, the top 10 cited documents are summarized in table 4, from No.1 to No.10. Table 4 provides detailed descriptions of these documents in terms of their citation frequencies, publication years, document titles and corresponding clusters.

Table 5: The top 10 cited documents

Ranking	Frequency	Author	Year	Title	Cluster ID
1	41	HSU MH	2007	Knowledge sharing behavior in virtual communities: The relationship between trust, self-efficacy, and outcome expectations	3
2	36	Chiu CM	2007	Understanding knowledge sharing in virtual communities: An integration of social capital and social cognitive theories	0
3	35	Wasko ML	2005	Why should I share? Examining social capital and knowledge contribution in electronic networks of practice	0
4	30	Kankanhall A	2005	Contributing knowledge to electronic knowledge repositories: An empirical investigation	0
5	28	Bock GW	2005	Behavioral intention formation in knowledge sharing: Examining the roles of extrinsic motivators, social psychological forces, and organizational climate	0
6	22	Lin MJJ	2009	Fostering the determinants of knowledge sharing in professional	1

virtual communities					
7	14	Wang S	2010	Knowledge sharing: A review and directions for future research	2
8	14	Chang HH	2011	Social capital and individual motivations on knowledge sharing: Participant involvement as a moderator	1
9	13	Chen CJ	2010	To give or to receive? Factors influencing members' knowledge sharing and community promotion in professional virtual communities	1
10	12	HSU CL	2008	Acceptance of blog usage: The roles of technology acceptance, social influence and knowledge sharing motivation	1

A summary of the top 10 documents is presented in Table 4. As described in top 4 documents, a framework for knowledge sharing in virtual communities was formed. This framework specifies why people will share knowledge in virtual communities and what influence the willingness of knowledge sharing. (Hsu, 2007; Chiu, 2007; Wasko, 2005; Kankanhall, 2005). Based on the framework, user innovation studies from different perspectives emerged. Hsu (2007) proposed a model that includes knowledge sharing self-efficacy and outcome expectations for personal influences, and multidimensional trusts for environmental influences. The research showed that self-efficacy has both direct and indirect effects on knowledge sharing behavior, personal outcome expectations have significant influence on knowledge sharing behavior. Chiu (2007) investigated the motivations behind people's knowledge sharing in virtual communities. The study held that the facets of social capital-social interaction ties, trust, norm of reciprocity, identification, shared vision and shared language will influence individuals' knowledge sharing in virtual communities. Wasko (2005) found that people contribute their knowledge when they perceive that it enhances their professional reputations, when they have the experience to share, and when they are structurally embedded in the network. Kankanhall (2005) employed social exchange theory to identify cost and benefit factors affecting electronic knowledge repositories usage, and social capital theory to account for the moderating influence of contextual factors. The results reveal that knowledge self-efficacy and enjoyment in helping others significantly impact electronic knowledge repositories usage by knowledge contributors.

ANALYSIS OF CO-CITATION CLUSTERS

Based on the co-citation analysis of the literature, we can identify highly cited documents in each cluster that represent the key focus of each field, and based on these findings, combined with expert analysis, we can also explain the relationship between clusters and clusters. The color of each cluster indicates that cooler colors are closer to the year of 1999 whereas hotter ones represent close years to 2017.

Figure 6 visualizes the comprehensive research landscape in knowledge sharing in virtual communities. Each node on the time lines portrays a cited article by knowledge sharing in virtual communities. References with citation bursts are depicted with rings in yellow. Landmark articles are labeled. The cluster numbers are also labeled in ascending order, based on the number of references included in each cluster. That is, the more references the clusters have, the higher rankings they are given. It is evident that Cluster #0 has a high concentration of nodes in the light of citation bursts, which indicates that this is the most recently formed cluster. In addition to Cluster #0, Cluster #1 and #3 appear to have recent publications with citation bursts. As shown in figure 4, there are only 8 recent clusters emerging in the domain. We assume that this is because this domain is relatively new, still emerging, and developing.

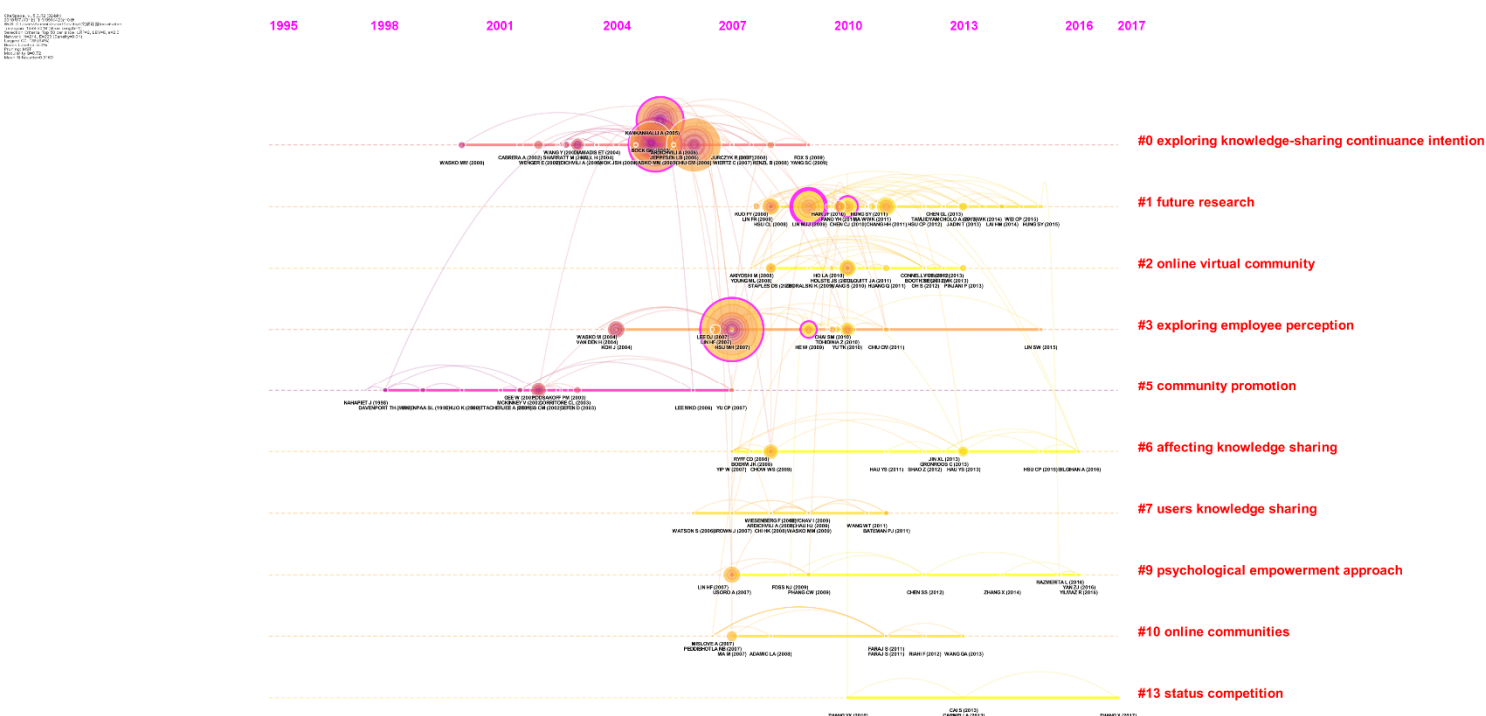


Figure 6: Timeline visualization of knowledge sharing in virtual communities

CONCLUSION

Knowledge sharing in virtual communities has been widely recognized and are attracting increasing attention. Researchers has strived to ensure the success of virtual community knowledge sharing. Based on 271 papers published from 1999 to 2017, this study collects papers from the WOS core collection database and provides a new scientific visualization method through knowledge domain mapping to explore the status and direction of knowledge sharing in virtual communities. The increasing published quantity index over time that pertain to knowledge sharing in virtual communities indicates that increasing attention is being directed toward user knowledge sharing research.

To identifying the status and trends of the domain in the virtual community knowledge sharing, a series of content analyses in this research examines the tendencies exhibited by publications from around the world, including the distribution of core authors and institutions, highly cited papers and high-frequency classifications, and keywords, popular research topics and trends. To visualize these trends, we applied co-author analysis, co-word analysis, co-citation analysis, and especially cluster analysis.

Regarding the contributions and influences of the lead authors identified in the co-authorship analyses, Pee, L.G. is the most productive author in the field. Considerable attention should be paid to Hara Noriko, Li Jinyang, Chang Kuo-En and Hou Huei-Tse.

In the distribution of publications on knowledge sharing in virtual communities, such publications are mainly derived from China, Taiwan, USA, Malaysia. National Central University, Nanyang Technology University, Natl Taiwan University Science & Technology are the most productive institutions in knowledge sharing in virtual communities.

Regarding the subject categories addressed in research on knowledge sharing in virtual communities, Business & Economics, Engineering and Computer Science may represent the major intellectual turning points linking studies from different phases and may have had significant influence on the development of knowledge sharing in virtual communities.

By analyzing the co-occurring keywords, high-frequency keywords are identified, and the results indicate that the various focuses of knowledge sharing in virtual communities in terms of research contents, Application areas and research methods are constantly evolving from 1999 to 2017.

The results of document co-citation analysis show that the most highly cited article, published by Pee, L.G. (2015), provides an overview of what the international research community now understands about knowledge sharing in virtual communities. Moreover, 4 typical clusters were identified based on the keywords and title terms associated with the analyzed documents, and the focuses of these clusters can be divided into 4 topics: exploring knowledge-sharing continuance intention, future research, online virtual community, exploring employee perception.

The information provided in this article is valuable to researchers and practitioners in the virtual community knowledge sharing area. The analysis provides insights from key academics and research institutions, focusing on core topics, and state of the research field. In addition, for practitioners, the results of this research report will enable practitioners to benefit more from the core research or core research results, and help them to follow appropriate procedures and select the appropriate advisory body for their application.

Therefore, the bibliographic records analyzed in this paper represent a sufficiently large, high-quality research system that accurately reflects the global picture of knowledge sharing in virtual communities, even though these records do not contain every publication on knowledge sharing in virtual communities.

ACKNOWLEDGMENT

This work is supported by grant 17YJA630050 of the Humanities and Social Sciences of Ministry of Education Planning.

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A Similar Legal Case Retrieval System by Multiple Speech Question and Answer

(Full paper)

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ABSTRACT

In real life, on the one hand people often lack legal knowledge and legal awareness; on the other hand lawyers are busy, time-consuming, and expensive. As a result, a series of legal consultation problems cannot be properly handled. Although some legal robots can answer some problems about basic legal knowledge that are matched by keywords, they cannot do similar case retrieval and sentencing prediction according to the criminal facts described in natural language. To overcome the difficulty, we propose a similar case retrieval system based on natural language understanding. The system uses online speech synthesis of IFLYTEK and speech reading and writing technology, integrates natural language semantic processing technology and multiple rounds of question-and-answer dialogue mechanism to realise the legal knowledge question and answer with the memory-based context processing ability, and finally retrieves a case that is most similar to the criminal facts that the user consulted. After trial use, the system has a good level of human-computer interaction and high accuracy of information retrieval, which can largely satisfy people's consulting needs for legal issues.

Keywords: Natural language understanding, artificial intelligence and law, information retrieval system, legal question and answer, semantic similarity, speech recognition and synthesis.

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INTRODUCTION

In daily life, it is not difficult to find that a large number of ordinary people (even well-educated ones) lack legal awareness and knowledge. Once they encounter a criminal case, they go to the hospital in a desperate way, and even some criminals take advantage of their families' eagerness to rescue their loved ones to cheat them out of their hard-won large amounts of money. Even if a lawyer can be found, they are usually busy and unwilling to take up too much valuable time and energy to answer repeatedly simple commonsense questions for free. In addition, the paralegals are not experienced enough to give professional advice and analysis in effective time. Therefore, it is very difficult for the family members of the parties to obtain fast, effective, and accurate legal services. In response to this phenomenon, in line with the current development trend of big data and artificial intelligence related technologies (Chen, Liu, Yin & Tang, 2017), the web-based legal question-and-answer retrieval system emerged at the right moment, bringing "artificial intelligence + law" into people's daily life and alleviating the burden of lawyers' consulting services to a large extent. At the same time, it also makes it easy for people to obtain efficient and high-quality legal services.

On the other hand, in the field of information retrieval, the exploration of the retrieval method of natural language understanding has been going on (Dong, 2013). The initial information retrieval system can, only through the keyword to the mechanical matching of information, search out answers, but with the development of natural language understanding technology, the combination of a new generation of information retrieval search engine (Wang & Ye, 2010) are improved greatly, and already have a very wide application in various fields. For example, mobile learning resource push system (Zhang & Wang, 2012), multimedia information retrieval system (He, 2018), efficient virtual counselor intelligent voice dialogue system (Gao, Wang & Dai, 2017), real-time message push system between teachers and students (Wang, Su & An, 2007), question-and-answer system on tourism information (Li, Wang & Liang, 2008), and so on. However, its application in legal retrieval has not been studied deeply.

To this end, This paper proposes theft similarity retrieval system based on natural language understanding (Zhang, Cao & Wang, 2017), speech synthesis and recognition, the system can allow users reading and writing online, and have basic memory context dialogue technology perfect fusion, so it alleviate the lawyers work, improve people's legal knowledge as the ultimate goal, quickly find cases similar to other cases.

The main contributions of this paper can be summarised as follows. 1) We employ cutting-edge speech reading, writing and synthesis technology, making users more convenient and efficient in conversation. 2) We solve the difficult problem of contextual semantic understanding in the previous dialogue system, and realise the multiple dialogue mechanism, making the dialogue system more colloquial. 3) Our system can retrieve the most similar answers to the legal questions consulted by users through the criminal

facts described in natural language, and state the reasons according to the doubts of users. 4) We integrate the semantic similarity technology in natural language processing, carry out semantic annotation, information extraction and word meaning disambiguation of the unstructured text in the dialogue system, realise the recognition of the diversity of questions, enhance the ability of understanding sentences, and facilitate the intelligent retrieval of subsequent answers.

The rest of this paper is structured as follows. Section 2 briefly introduces the system principle. Sections 3 and 4 explain in detail the design and implementation of the problem handling module and information retrieval module mentioned in the system principle. Section 5 illustrates the results of our system. Section 6 uses the case test results to test the close degree between the retrieval results of the experiment and the judgment results of the actual case, and the evaluation is conducted through the comparison of the experiment. Section 7 discusses related work, especially the differences between our work and theirs. Finally, Section 8 summarizes the work of this paper and gives a brief outlook on its prospects.

SYSTEM PRINCIPLE

In recent years, with the advent of the information age and the explosive growth of network information, it becomes more and more difficult for users to correctly and efficiently retrieve the information they need, thus making the retrieval system facing great challenges. The question and answer retrieval system is an important research direction in the field of information retrieval, which is a new generation of search engine combining natural language and information retrieval technology (Wu, Zhao & Duan, 2005). The detailed process of the principle of our question and answer retrieval system based on natural language understanding is shown in Figure 1.

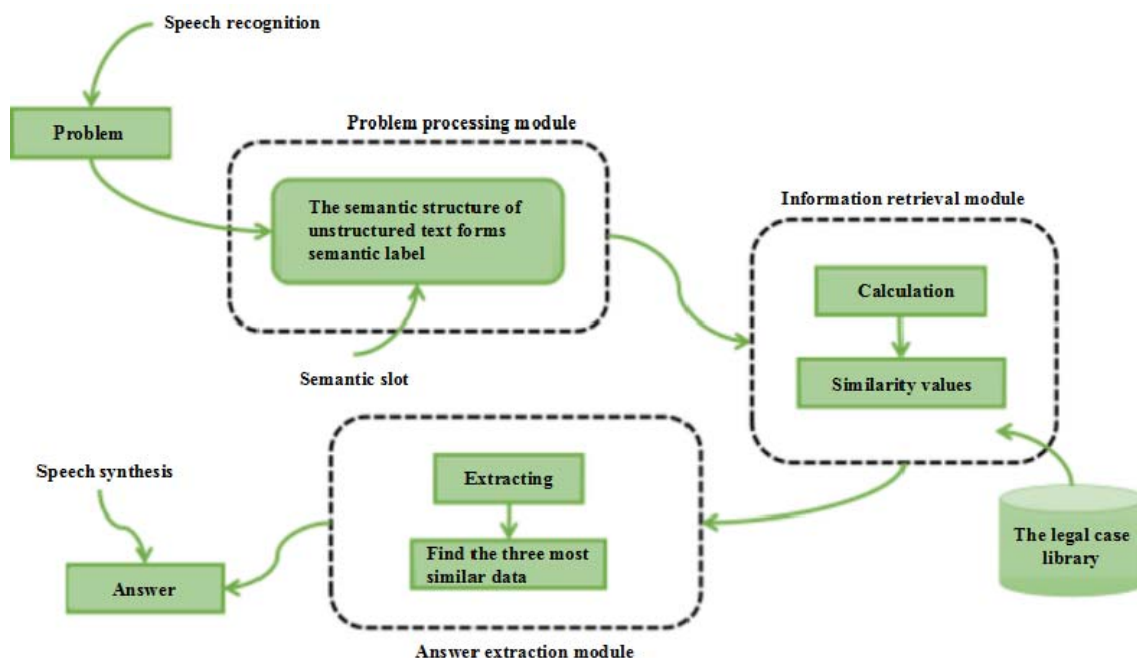


Figure 1: Natural language understanding based Q&A retrieval system schematic.

The system is mainly divided into three parts: 1) Problem processing module, which is mainly responsible for dealing with legal issues consulted by users, identifying relevant semantic slots, and understanding the semantics and intention of problems. 2) Information retrieval module, which mainly carries out weighted retrieval and query according to the semantic fields generated by the problem processing module, and retrieves relevant information most similar to the semantic of question (a set of data fields). 3) Answer extraction module which is mainly to extract relevant information that is consistent with the user's intention to consult legal questions.

In addition, our system problem in processing module and answer extraction module uses the IFLYTEK technology of speech synthesis and recognition, and allows the user to the web client using speech by legal advice in the form of natural language system to retrieve the answer at the same time also can use speech way to read it to the user, enabling users to easy operation.

PROBLEM PROCESSING MODULE

The problem processing module (Zhang, Shao & Zeng, 2012) aims to enable the computer to automatically understand and analyse the questions raised by people in Chinese spoken language, overcome the challenges brought by the diversified expressions

of Chinese spoken questions, and determine the semantic slots, semantic organization methods, and response methods of the questions. The overall framework for problem handling is shown in Figure 2.

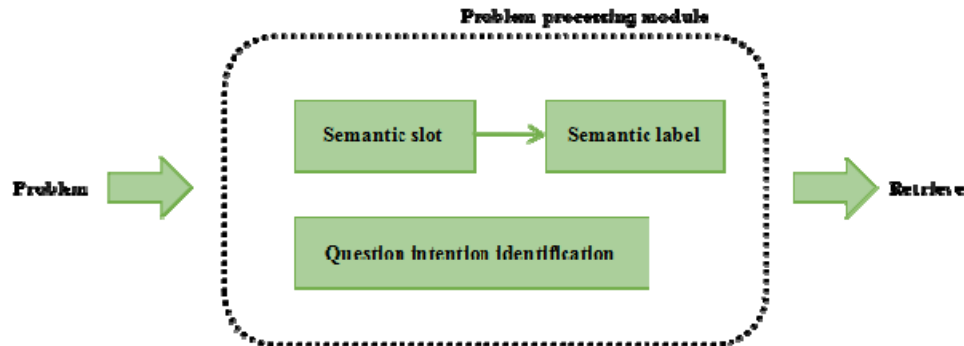


Figure 2: The overall framework of the problem processing module.

3.1 Problem handling process

We manually compile the question semantic slot and the legal related word library, and then carry out the semantic slot recognition to the question. Each semantic slot can uniquely determines the answer mode of the question, so as to realise the problem processing mechanism. The specific implementation of problem processing is mainly divided into three parts: 1) The user's input information is automatically matched to the corresponding semantic slot, and the similarity degree and synonym sentences are processed. 2) Classify user input information into intent category (Sun & Wang, 2007). 3) extract knowledge from statements entered by the user and label the field information with semantic label.

3.2 Semantic slots

Due to the diversity of oral Chinese expressions, there are many synonyms, but the sentence structure is limited. Diversified sentence expressions can cover the corresponding semantic slots through good sentence pattern. For example, the following questions have the same pattern.

- What is the likely punishment?
- What kind of punishment will there be?
- What are the consequences?

Pattern matching can be unified into a pattern *[excuse me] thief (should/need/will)... (indemnity/liability/penalty)*, or further signed as *<name><ad>...<thing>*. The semantic slot library and the synonym variable library are required. The semantic slot library and the synonym variable library are required.

Through the determination of semantic slots, we can also determine the user's intention of input questions, such as whether to inquire the punishment or compensation amount of the criminal in the theft. The thesaurus mainly solves the problems caused by the diversity of spoken Chinese expressions. In the semantic slot library, such as the words “need”, “should”, “will” and so on in the example above, if all these words are integrated into the semantic slot library, the data in the semantic slot will be very redundant, so we can effectively solve this problem by calling the synonym library in the semantic slot library.

3.3 Knowledge extraction and semantic annotation

The process of knowledge extraction and semantic annotation is listed in Algorithm 1.

Algorithm 1: Text semantic annotation

Input: user question text

Output: text semantic tags

Process:

1. Get the user question text from the web page.
 2. Pass the text to the Java background via Ajax requests.
 3. Conduct semantic annotation.
 4. Get the semantic tag line by line.
-

The question text entered by the user is unstructured data. In order to understand its semantics and extract its useful information, it needs to be transformed into structured data, that is, it needs to be semantically annotated to obtain semantic labels.

INFORMATION RETRIEVAL MODULE

The retrieval module (Zhao, Wang & Wang, 2016) adopts the edge weight model algorithm based on concept density to realise the weighted strategy to calculate the maximum similarity algorithm to retrieve the best answer, and abandons the search method based on the completely accurate or very weak fuzzy matching template to search the answer, so that the system can truly "understand" the user's question (Wang, Wang & Wang, 2008). The overall framework of the system information retrieval module is to a question shown in Figure 3.

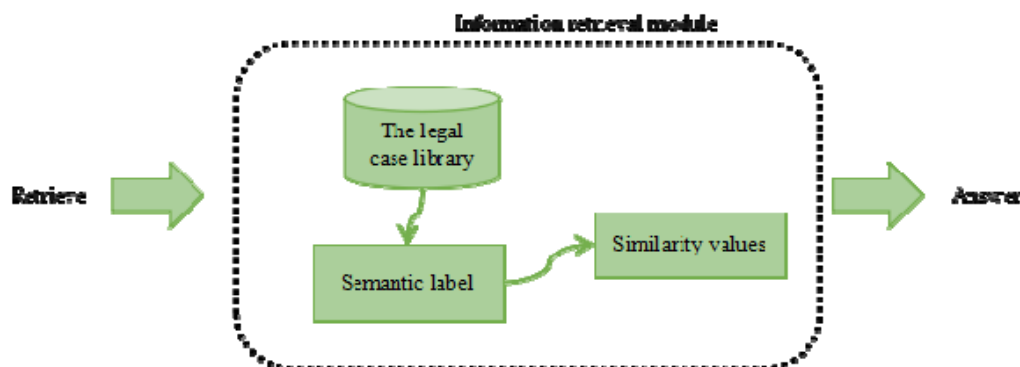


Figure 3: The overall framework of the information retrieval module.

4.1 Similarity retrieval algorithm

Based on the weight value model based on the concept density weight (Zhou, Lu & Wang, 2017), the relevant data in the database is weighted to find a piece of data with the maximum similarity, and then the field that needs to be returned is found according to the intention recognition semantics obtained from the question processing. The specific algorithm is shown in Algorithm 2.

Algorithm 2: Similarity retrieval algorithm

Input: semantic field and intent

Output: the most similar answer field

Process:

1. Determine whether the data is successfully found from the database.
 2. Through the data, if the fields in database equal to the fields in question semantic, weighted to store a piece of data.
 3. Find the case with the maximum similarity
 4. Identify the semantic output answer field based on intent.
-

In the similarity searching algorithm, the input information is the semantic field of question text and the semantic meaning of intention recognition, and the output is the answer with the highest similarity of question. The process is as follows. First, the weight value of each text semantic field is calculated based on the concept density weight model, and then the data is weighted one by one in the database, and the semantic similarity of each data and question text is obtained, and the data with the largest similarity is obtained. Finally, according to the intention to identify the semantics in the maximum similarity of the data, we find the answer field and output.

PROTOTYPE SYSTEM AND EXAMPLE

Legal consultation is a complicated situation in information retrieval, because the factors influencing the result of legal judgment are intricate and complex, and even the judgment standards of different regions and nationalities are different. For the legal retrieval system of this article, in terms of user experience, the dialogue text in the retrieval system will be saved by the page. At the same time, users can use voice to input text, the system can speak out the output text. From a technical perspective, the unstructured question text entered by the user is transformed, by using natural language processing technology to structured text, and its semantic annotation and intention recognition are obtained. See Figure 4 for details. In addition, two main functions are

implemented on the web page, one is user legal consultation and the other is user's query answer to the system. Will carry on detailed explanation with larceny case next.



Figure 4: User interface of our system.

5.1 User legal advice

Before user consultation, we need to perform automatic extraction of some court's judgment, and store its useful information in the database for the convenience of information retrieval later, this will be discussed in our paper. After the preparations are completed, the user can start legal consultation on the website.

When the user enters the question, the system runs the module of question processing, and the system will determine the semantic slot according to the question you asked, as well as the knowledge extraction and semantic annotation of the question content information. After semantic annotation, the default information will be sent: whether the thief has grown up or not, and whether he has a previous record. The system automatically raises the question and then adds the answer to the semantic field in the previous knowledge extraction. Then the system enters the retrieval module from the module of question processing. Since we have converted the judgment to structured SQL data in advance, and calculated the weight of each field through the weight calculation model (Zhang, Lu & Wang, 2017). According to the weight, the similarity of each group of data is obtained. Finally, in the answer extraction module, the system identifies the fields according to the intention obtained in the problem processing module and retrieve the field information required by the user for the data output in the module. After the legal consultation is completed, the user can also ask the questions about "whether the thief has criminal record" or "thief underage". The system will cover the original field with the user's modified field information.

5.2 Question the system answer

After the system output the judgment result of the legal case most similar to that of the legal case consulted by the user, the user questions the retrieval answer, and the system can give the judgment of the corresponding legal provisions that it violates. Table 1 is an example of a Q&A test.

Table 1. Q&A example	
Conversation	
System:	The thief will be sentenced to one year in prison.
User:	Why?
System:	For the violation of the following criminal laws: article 264, article 52, article 67, paragraph 3 of the criminal law of the People's Republic of China and article 5 of the supreme people's court's provisions on the application of certain property penalties.
User:	What are the contents of article 52?
System:	Article 52 of the criminal law of the People's Republic of China is

After the system retrieves the answers to the most similar case, users may ask the reason why it is. In this time our system will return to violate the criminal law sub system. The user can also directly ask questions law, without having to input their documents to the query.

EXPERIMENTAL RESULTS AND EVALUATION

6.1 Multiple rounds of Q&A test results

Considering the lack of legal knowledge of most users, the system realises a function of colloquial legal questioning and answering matured language. The useful information field is extracted according to the user's statement. Meanwhile, for the important field information that needs to be supplemented, the system will fill in the default information through multiple rounds of Q&A. One example of a multiple rounds Q&A comparison is shown in Figure 5.

The system will make different response mechanism according to the user's default information, so that the user can use the system more conveniently. As to the experimental effect shown in Figure5, when the user describes the criminal process, the left user answers the criminal amount, while the right user does not answer the criminal amount, so the system will automatically ask an additional question in the experimental effect on the right side. For example, "how much is the car?" In the same way, for a stolen mobile phone or others, the system will also intelligently consult with the corresponding amount. In addition, the user's default field is variable. Here, only the comparison of examples illustrates the effect of default amount. Some other important field information can also be default.



Figure5: Multiple rounds Q&A comparison diagram.

Compared with the current method of realising this function of legal robot, namely, single or multiple choice topics are supplemented with default field information. Multiple rounds of Q&A can make legal questions and answers closer to the real scene of consultation between consultants and lawyers, and more flexible and closer to the way of human communication.

6.2 Retrieval of experimental results

This system uses the field weighting method to search similar cases of theft, which greatly improves the closeness rate of sentencing compared with the field matching method. Therefore, it is reasonable to consider that different fields have different degrees of influence in the crime of theft. Figure 6 is a retrieval result test with a case of car theft. From this figure we can see that the searched results of similar cases are closer to the actual sentencing results by using field weighting, and the influence of individual special cases on the sentencing results can be effectively excluded. In contrast, the way a field is matched is vulnerable to individual special cases.

In the figure, the abscissa is the case and the ordinate is the judgment result of the corresponding case. The large scale is the month in the judgment result, a large scale is the month, a small scale is the fine in the judgment result, and a small scale is the thousand yuan. According to the six test examples, the retrieval results of the field weighting method are closer to its actual judgment results,

while the field matching method has great fluctuations, mainly because it cannot deal with special cases. After the field weighting, the judgment results of different decisions of the same case can be effectively avoided to some extent.

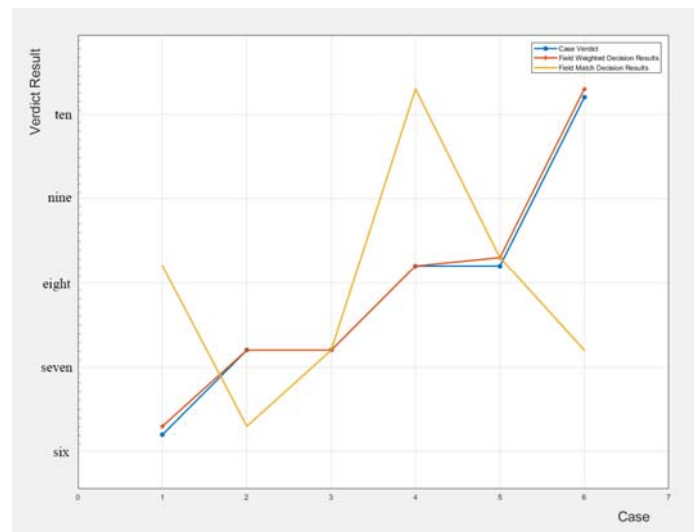


Figure6: Retrieval results comparison diagram.

RELATED WORK

7.1 Speech synthesis and recognition of IFLYTEK

The application of speech synthesis and speech reading and writing technology has been mature in China. The following are two examples of systems embedded with the open platform of artificial intelligence: efficient virtual counselor dialogue system (Zeng, Zheng & Zhou, 2017) and efficient 3d virtual experimenter guidance system (Qu, Gao & Wang, 2018). These systems, however, have nothing to do with legal advice. On the other hand, although the application of voice technology in legal robots is very common (such as the intelligent legal robot "small law" in Anhui province and the legal aid robot "Longhua small law" in Shenzhen, Guangdong.), it has not been applied in the legal question-answering system on the web page yet.

This system makes use of the speech synthesis and speech recognition functions of IFLYTEK and applies speech to the legal Q&A system of web page, realising the speech dialogue function of human and machine, realising the conversion between text and speech, and promoting the efficiency of user text input. In the dialog system, after users' voice input, the input box of the web page terminal will display the recognised voice text information intelligently, and then users can process the text information after the recognition and send it again, which can greatly alleviate the user's consuming typing text. At the same time, voice synthesis technology is applied into the system to answer in voice and display the corresponding Chinese text information in the dialogue system, which can make users have a good user experience and facilitate users to view and use the conversation later.

7.2 The context dialogue technique with basic memory

Table 2. Example of legal regulations for contextual dialogue

Conversation	
User:	I was stolen the thing that value should 5000 yuan, thief oneself went to police station surrender. Then how should the thief responsibility assume for excusing me?
System:	How old is the thief ?
User:	About 20 years old
System:	Did the thief have a previous conviction?
User:	No
System:	We predicted results about adult, no previous record and confession.

User:	What if the thief had a previous conviction?
System:	We predicted results about adult, previous record and confession.

In common dialogue system applications, context-related default data will appear, which will lead to the need for data retrieval of default data. This is because there are many relevant practical considerations: the thinking of artificial intelligence jurisprudence (Gao & Zhang, 2018) and the thinking of artificial intelligence on the mechanism of resolving legal disputes (Zhang & Yi, 2017). Yet most existing dialogue systems struggle to do so. However, after the legal voice dialogue system in this paper is integrated with the context dialogue technology with basic memory (Wang, Wang & Wang, 2016), users can conduct default inquiry based on contextual information and conduct multiple default inquiry operations.

In addition, the context processing technology with basic memory not only realises the system's multiple queries to the default field, but also enables the user to change the answer to the previous question and truly realise the conversational colloquialism. In several rounds of conversations, users can continuously correct or improve the legal issues they want to consult. At the same time, the system can help users to find satisfactory results of legal consultation by asking questions and confirming when users' questions are incomplete or unclear. An example of this is shown in Table 2.

7.3 Natural language comprehension techniques

Natural language is a good representation of the semantic structure of unstructured text information. In this dialogue system, due to the diversity of the same semantic expression, it is necessary to integrate the text processing methods of natural language understanding and the related processing methods of term vectors so as to automatically handle the semantic similarity questions in the text (Huang, Huang & Wu, 2014), such as answering the question of "is the thief grown up?", there are many ways for users to reply. See Table 3 for details.

Table 3. Adult or not semantic similarity judgment

Answer the statement	Semantic slot	Semantic
He's about 18		
Should be adults		
About 20 years old	Age default answer	Age of suspect: adult
Have come of age		
.....		
Eleven or twelve		
About fifteen	Age default answer	Age of suspect: under age
A minor		
.....		

In addition, in the process of dialogue, user input text information is unstructured data. In order to make the system to understand what we want to express the semantic, will translate into structured data, then extract the useful text field, understand its underlying semantics, and make corresponding answer or ask mechanism based on semantic. Take a legal question asked by a user, such as the semantic understanding of unstructured data in Table 4.

Table 4. Semantic understanding of unstructured data

Questions	Semantic slot	Semantic
I am stolen the thing which should 5000 Yuan, the thief was been caught now. How should the thief assume responsible excusing me?	Law to ask	Type of crime: theft Amount of crime: 5,000 Yuan

I was stolen a cellular phone, two computers, should be worth 10 thousand. To excuse me how should the thief be assume responsibility?	Law to ask	Type of crime: theft Amount of crime: 10,000 Yuan
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.....

CONCLUSION

Although the Q&A retrieval system based on natural language processing has become a hot research topic after years of development, the Q&A similar case recommendation system in the legal domain is studied little (He, 2012). In addition, the ability to understand language in the Q&A system is still insufficient, and various technologies are still immature (Su, 2005). In particular, it is still not enough to handle the retrieval of legal information. For example, in multiple rounds of Q&A, when the answer is ambiguous, what choices should be made so that the system can answer the user question best. To solve these problems, we developed a system that uses technologies of natural language understanding as well as speech recognition and synthesis to satisfy people's needs for similar case retrieval, which can help people to know, understand and obey the law better, thus reducing a little legal things.

However, there are still some aspects that need to be improved further. 1) The accuracy of information extraction needs to be improved, and the professionalism of information classification needs to be improved. The professional document content that our system can wander as well is not comprehensive enough and needs to be improved. 2) The answers to the certain questions need to be improved together with the similarity algorithm. In this paper, the weight is used to calculate the best answer that is asked by the user, but the value of the weight sometimes has some errors. Maybe the machine learning method can remove these errors. 3) Since the system fills in the default information through the questioning and confirmation mechanism when the user's consulting questions are incomplete and unclear, but if the user is unclear when answering the default information, how should the system choose? This paper has not found the appropriate algorithm to cope with the issue which showed definitely be investigated in future. 4) Due to the limitations of voice conversation, one time people cannot talk too long, which is a little insufficient in expression. However, this can be implemented through multiple rounds of questioning.

ACKNOWLEDGMENT

This work was supported by the National Natural Science Foundation of China No. 61762016.

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A Study of the Research Hot Topics and Visualization Analysis of Cross-border E-commerce in China

(Full Paper)

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ABSTRACT

With many incentive policies recently released, cross-border e-commerce has been highly concerned by all sectors of society. As an emerging research field, it has great research value. Applying SATI to the keywords in CSSCI papers relevant to CBEC from the CNKI periodical database, we undergo bibliometric and visualization study in terms of word frequency analysis. The visualization analysis reveals that: (1) hot topics in CBEC research fall into 4 areas: e-commerce and international business, government policy and supervision, cross-border logistics and cross-border e-commerce finance; (2) prospective research will focus on talent training, synergy, big data, import, customs supervision, etc.

Keywords: cross-border e-commerce, co-word analysis, social network analysis, hot topics

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INTRODUCTION

Cross-Border Electronic Commerce (CBEC) refers to a new type of shopping that transaction parties between different borders implement through e-commerce platforms (Lian & Cheng, 2016). It can mobilize every country's advantageous resources, reshape international industrial chain, at the same time, promote the transformation and upgrading of foreign trade, promote the development of small and medium-sized enterprises, internationalize their brand, and greatly enrich consumers' shopping choice, meet people's pursuit of lifestyle (Xu & Zhang, 2015). According to 2017-2018 China Cross-Border E-Commerce Market Research Report (iiMedia Research, 2018), cross-border e-commerce transactions in China reached 7.6 trillion yuan, and the number of users reached 65 million in 2017. In particular, with many incentive policies in recent years, cross-border e-commerce has been highly concerned by all sectors of society.

Furthermore, as an emerging research field in e-commerce research, it has great research value. At present, there are many valuable studies in cross-border e-commerce field conducted by the Chinese academic community. They discussed the status of cross-border e-commerce development, its influencing factors, existing problems, and suggestions for countermeasures. For example, Farhoomand et al. (2000) explored the main obstacles of cross-border e-commerce between Hong Kong and Finland; the study by Boyd et al. (2003) found that the US customs fees for e-commerce packaging were too high to hinder the development of import cross-border e-commerce, especially B2C cross-border e-commerce; Gomez-Herrera et al (2014) studied the dynamics and obstacles of the EU cross-border e-commerce; using a questionnaire, Yang et al. (2014) did a survey of the situation and existing problems of cross-border e-commerce applied by Chinese enterprises of different scales; Liu Jiaguo et al. (2015) used the grounded theory method to analyze the influencing factors of cross-border e-commerce between China and Russia; Han and Tian (2016) used gravity model to study the cross-border e-commerce export volume of Shanghai Free Trade Zone from the aspects of tariff, logistics, network infrastructure and customs administrative efficiency with GDP, population and spatial distance as control variables; Kim et al. (2017) used regression models to study the impact of distance and express adoption on the EU cross-border e-commerce market. There are relatively few research on hot topics and development trends of cross-border e-commerce research, and the methods used in related research are mainly quantitative analysis. So we use bibliometrics and visualization analysis to analyze the cross-border e-commerce research in China based on the keywords.

The following section describes the research methods and data source, then we make word frequency analysis and social network analysis in section 3, analysis of the research hot topics and future trends of CBEC research in section 4, and a conclusion in section 5.

RESEARCH METHOD AND DATA SOURCE

A. Research Method

Academic achievements are mainly published in journals, and keywords are the main points and generalizations of their contents. Keywords in a long period of academic research can reflect the overall content and future research directions in a field (Zhang et al., 2016). Wang and Leng (2010) found that scholars in academic frontiers mostly use word analysis methods, such as word frequency analysis and co-word analysis.

High-frequency keywords (HFK) represent the problems to which researchers have paid attention over a period of time, i.e., research hotspots. The research object of co-word analysis is studied from keywords frequency to keywords co-occurrence frequency, and then to a combination of the both, using cluster analysis, social network analysis and strategic coordinates as a tool to explore further (Tang & Zhang, 2015). Co-word analysis is a bibliometrics that use pairs of keywords to identify the phenomenon of word co-occurrences, determine their relationships, reveal structure of the research field, outline research hot topics, and help us discover emerging research areas. Social network analysis is a method to study the characteristics and attributes of various relationships in complex networks composed of different nodes (high-frequency keywords in this research) (Fan et al., 2018). Through the social network analysis of co-occurrence keywords, the frontier areas of research can be visually revealed. This method is widely used in literature research in combination with co-word analysis (Fan et al., 2018).

From the perspective of content analysis, this paper will use word frequency analysis, factor analysis and social network analysis to study the research hotspots of cross-border e-commerce. Then, through the time-term frequency evolution analysis, the evolution of hotspots will naturally emerge. Based on the co-word matrix and factor analysis, the clusters of research hotspots in cross-border e-commerce field will be obtained. Finally, the high-frequency keywords in the literature are analyzed by social network to explore the hotspots and development trends in cross-border e-commerce research in China.

B. Sources of Data

Chinese Social Sciences Citation Index (CSSCI), is a representative database used to retrieve papers and citations in Chinese humanities and social sciences. The data source for this study are papers from CSSCI journal in the CNKI periodical database. The search formula is “CSSCI Journal=Y and (Topic=Cross-Border E-Commerce or Topic=Cross-Border E-commerce) or (Title=Cross-Border E-Commerce or Title=Cross-Border E-Commerce)” (Exact Match)” on 2018 June 24th. As a result, 339 related papers were searched and then preprocessed with experts to eliminate irrelevant literature, and finally 308 papers were reserved (as shown in Tab.1). It can be seen that a significant increase has occurred in 2014. Since then, the research on cross-border e-commerce has grown fast, indicating that it gradually attract the attention of the academic community.

Further, we also searched for cross-border e-commerce research in international journals in Web of Science, in order to form a comparison between home and abroad. However, the number of searches is relatively small, and there are some differences in the definition of cross-border e-commerce (Chen & Yang, 2017; Giuffrida et al., 2017; Lian & Cheng, 2016). In view of this, this paper only analyzes the situation of domestic cross-border e-commerce research.

Table 1: CBEC related papers in CSSCI journals by year.

Year	2009	2011	2012	2014	2015	2016	2017	2018	Total
Number of papers	1	1	2	32	66	85	83	38	308

DATA ANALYSIS

Keywords involved in this study are 911 in total. Distribution characteristics of keywords frequency can reflect the extent of the research (Tao & Wang, 2017). The word frequency of CBEC is quite low, so the research is relatively decentralized. In order to avoid the influence of non-standard keyword naming in word frequency statistics, it is necessary to combine synonyms (Lu, 2016). Therefore, the keywords were merged by the research team. For example, "free trade trial zone" is replaced by "free trade zone".

A. Analysis of Word Frequency

(a) High-frequency Keyword

The frequency of keywords has reflected its development trend of research hotspots. High-frequency keyword shows the main research direction of CBEC. Top 25 high-frequency keywords (Freq >4) in cross-border e-commerce are shown in Tab. 2. Cross-border e-commerce was first mentioned in 2009. Since 2014, its frequency has been significantly higher than other keywords. Scholars have doubled their research every year. E-commerce, Belt and Road, Trade Facilitation, International Trade are hot topics in the field of cross-border e-commerce.

(b) Time-term Frequency Evolution Analysis

The time-high-frequency keywords evolution analysis helps us to reveal changes of research hotspots, and discover evolutionary defects. The cross-border e-commerce research on the time-HFK evolution network is shown in Fig. 1. CBEC is not put into this evolution map due to its significantly high-frequency. Time changes are sorted by the color of rainbow from red.

Table 2: Keywords of CBEC research (Top 25).

NO	Keyword	Freq	NO	Keyword	Freq
1	CBEC	188	14	Shanghai Free Trade Zone (SHFTZ)	6
2	E-commerce (EC)	32	15	China	6
3	Belt and Road(B & R)	32	16	Business Management	6

4	Finance	12	17	Financial and Monetary (F & M)	
5	Trade Facilitation	11	18	EC Platform	5
6	International Trade	10	19	Silk Road Economic Belt (SREB)	5
7	Overseas Warehouse	9	20	CBEC Platform	5
8	Cross-border logistics (CBL)	8	21	WTO	5
9	Big data	8	22	Logistics	5
10	FTZ	6	23	EC Logistics	5
11	development strategy	6	24	Internet	5
12	Company	6	25	Talent Training	5
13	New Normal	6			

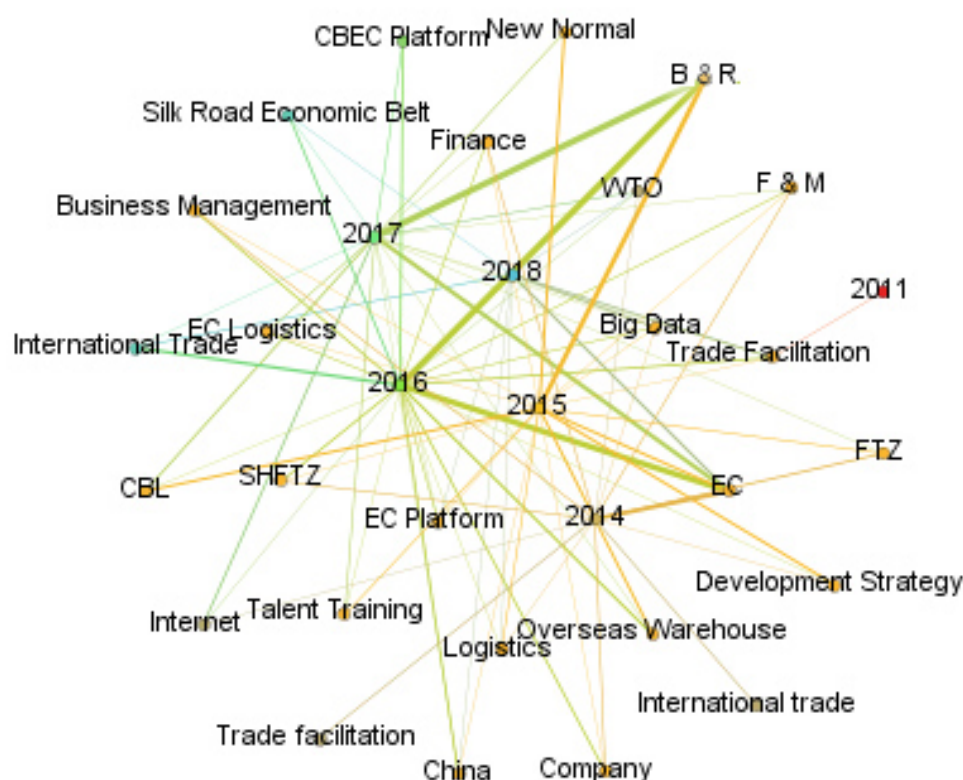


Figure 1: Time-HFK evolution in CBEC research.

There has been a focus on Trade Facilitation for six years. Though its intensity is not high, there is a trend of increasing attention in 2018. High-frequency keyword that emerged in 2014 was E-commerce. Cross-border e-commerce is a branch of e-commerce research. The early cross-border e-commerce research started from e-commerce, and mainly studied from the aspects of law, supervision and other feasibility aspects. In 2014, FTZ was a research hotspot; in 2015, B & R, Cross-border Logistics, New Normal, Overseas Warehouse, and Development Strategy were added into research hotspots. B & R was a research hotspot for three consecutive years. In 2016, the research on cross-border e-commerce has blossomed. The highlights are the studies of the SHFTZ, Silk Road Economic Belt, Business Management, and Cross-border E-commerce Platform and the number of studies for Big Data, Trade Facilitation has increased in 2018.

B. Factor Analysis

Since keywords such as Cross-border and Mode have no practical significance for this study, they are not analyzed in following study to avoid their influence (Bi, Zhao, & Qi, 2011). Through the keywords co-word analysis, the keywords of frequency above 2 is selected, so a total of 56 keywords are selected. And the Co-Occurrence Matrix (Similarity) is selected to generate the high frequency keywords matrix of 56*56. The word similarity coefficient matrix is shown in Table 3.

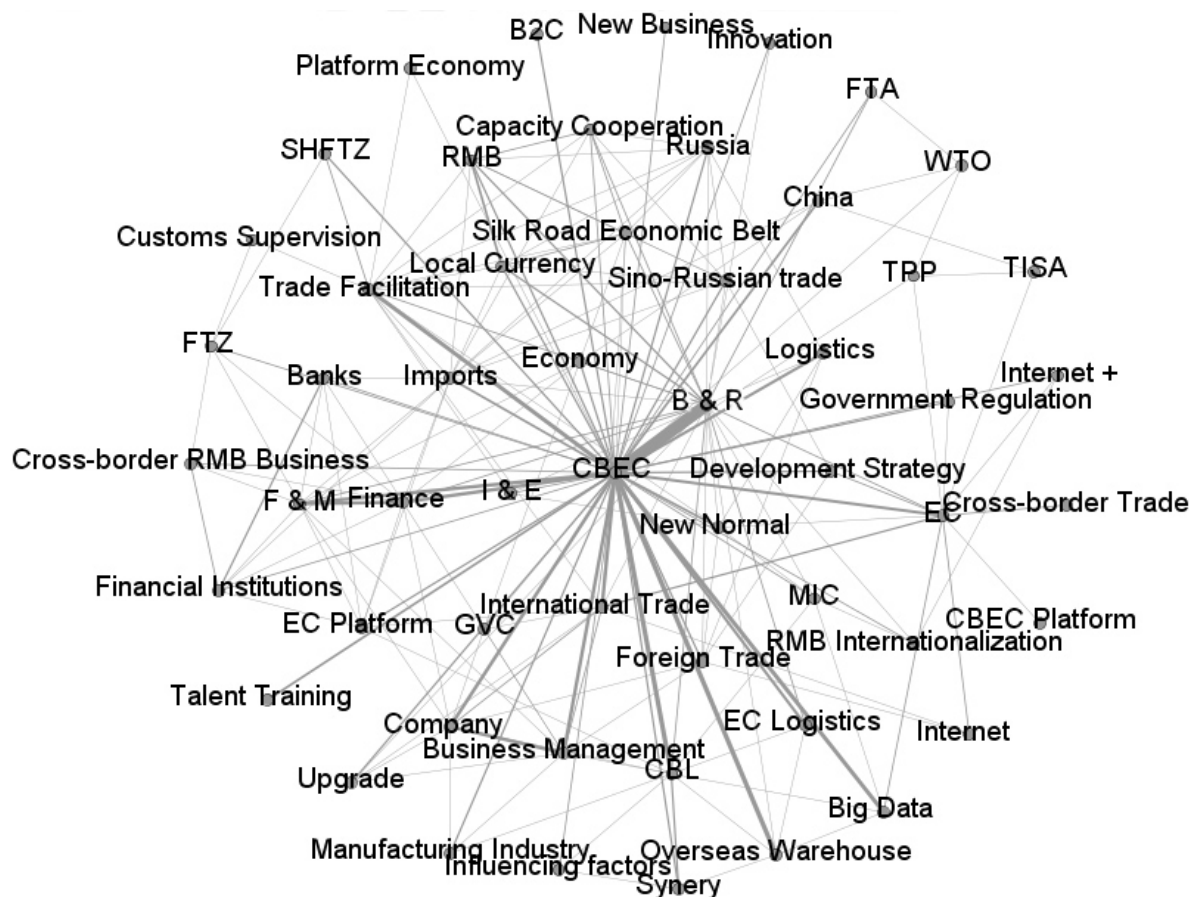
Factor analysis is to study the internal dependencies between variables, and use a few abstract variables (factors) to reflect the main information. In the factor analysis, the 56*56 coefficient correlation matrix is tested for KMO and Bartlett sphericity by SPSS. Due to the small number of samples or the low correlation between keywords, the result is not a positive definite matrix, and the KMO value cannot be obtained. The interpretation variance of 28 factors reached 0.6889, so it was not ideal. Therefore, the content of this study is more scattered and not suitable for cluster analysis.

Table 3: Correlation coefficient matrix (partially displayed).

[illegible]

C. Social Network Analysis

Social network analysis can show the implicit knowledge structure behind the research field and systematically present the overall framework of papers (Gao & Jia, 2016). We draw a HFK co-occurrence network (as shown in Fig. 2) by Gephi to study network properties, keyword co-occurrence and research hotspots. The keyword is used as a point, and a connection line indicates that there is a co-occurrence relationship between two keywords, and the thickness of lines represents the frequency of co-occurrence.



Note: Global value chain (GVC), Free Trade Agreement(FTA), Imports and Exports(I & E).

Figure 1: Co-occurrence network of CBEC.

As can be seen from Fig. 2, B & R, Trade Facilitation, E-commerce, and Cross-border Logistics are the research hotspots in the field of CBEC, with many keywords co-occurring. Among them, B & R is a hot issue for China's cross-border e-commerce research. Due to frequent cross-border e-commerce policies in China, terms directly co-occurred with CBEC are B & R, Internet +, Silk Road Economic Belt, and New Normal. In addition, there are high-frequency words about customs special supervision zone, such as SHFTZ, FTZ. Keywords related to trade agreements such as FTA, TPP, TISA and WTO. These trade negotiation rules are currently the focus of China's research on CBEC. Moreover, other keywords such as International Trade, Foreign Trade, Sino-Russian Trade, Imports and Exports, Cross-border Trade, and Imports are all about international business

(IB), which is the difference from foreign research. Cross-border e-commerce and logistics are inseparable. Research on Cross-border Logistics is relatively high. Logistics, Cross-border Logistics, Overseas Warehouses, and Synergy are all connected to CBEC. The financial industry has received more attention in the cross-border e-commerce sector. Connections between Finance, F & M, and CBEC are stronger. There are also Financial Institutions, Banks, Cross-border RMB Businesses, RMB and Local Currency. Although B2C, Talent Training, Big Data, Overseas Warehouses, and Synergy are at the edge, they are closely related to core keywords. Over the time, their contacts will gradually strengthen and marginal keywords may become core keywords. In addition, Talent Cultivation, B2C, and New Business only coexist directly with CBEC, and are not linked to other high-frequency keywords. Their links are not very strong, so research alike will be more in the future work.

HOT TOPICS AND TRENDS IN CBEC RESEARCH

Through keyword statistics (Tab. 2) and visualization analysis (Fig. 1 and 2), we found that current cross-border e-commerce research in China has formed following four research hot topics.

A. Topic 1: E-commerce and International Business

HFK: International Trade, WTO, E-commerce Platform, Cross-border E-commerce Platform, Internet, Company, and Enterprise Management. It can be seen from Fig. 1 that E-commerce has been the main keyword for CBEC research for many years. From Fig. 2, International Trade, E-commerce and Company are connected with multiple keywords, and there are other terms like B2C and Platform Economy. Just as cross-border e-commerce is considered to be a product of the combination of international trade and e-commerce (Chen & Yang, 2017). Due to the lack of comprehensive statistical data on CBEC, scholars prefer to use international trade data as a proxy. Most Chinese scholars believe that cross-border e-commerce is the internationalization of e-commerce and the electronicization of international trade, including B2B, B2C, and other models. There are many small and medium-sized enterprises (SMEs) in China, but their power is insufficient. The development of the Internet has reduced the information cost of enterprises, promoted the sales and promotion of products. The development of cross-border e-commerce has brought opportunities for SMEs to go global, promoted international brands, and accelerated the transformation and upgrading of foreign trade companies. Representative papers: Liu et al. (2015) proposed a Sino-Russian CBEC public service platform integrating administration, industry, university, and research to realize the digitalization of foreign trade management, electronization of cross-border business, and intelligentization of customs clearance services. Zhao & Yang (2014) built a cross-border e-commerce capability identification model for SMEs based on the TOE framework from international marketing, international e-payment, e-customs clearance, and cross-border e-commerce logistics aspects. Chen and Liu (2014) constructed a structural equation model about cross-border e-commerce adoption by infrastructure readiness, perceived earnings, perceived external pressure, policy and legal support, and scale of adjustment enterprises, and found that SMEs lack funds and technology support, while large companies are more looking forward to policy and legal support.

B. Topic 2: Government Policy and Regulation

HFK: B & R, Trade Facilitation, FTZ, New Normal, SHFTZ, and Silk Road Economic Belt. As can be seen from Fig. 1, B & R and Trade Facilitation have been hot spots for cross-border e-commerce research for many years. In Fig. 2, we can see that the strength between B & R, Trade Facilitation and CBEC are high, and there are other keywords such as TPP, WTO, TISA and FTA. As a big manufacturing country, China attaches great importance to cross-border e-commerce as a new mode of trade. Policies are considered to be an important factor in promoting the development of CBEC in China. Belt & Road, Internet Plus, Mass Entrepreneurship and Innovation and Made in China 2025 are important policies related to CBEC proposed by the Chinese government. Characteristics of CBEC is small-batch, multi-frequency, so how to coordinate the quantity, quality and speed become a vital issue to improve management capabilities of regulatory authorities to achieve rapid clearance (Li & Chen, 2015). At present, China has established special customs supervision areas such as free trade zones and comprehensive bonded zones, exploring new regulatory methods to facilitate cross-border trade, promote supervision and logistics, and reduce the tax burden on companies. The Shanghai Free Trade Zone, as a representative of the first try, has made more explorations. It has achieved division of labor and integration based on the perspective of the platform to further improve service levels. Representative literature: Hu et al. (2017) comprehensively combed the risk factors of customs supervision, and used Bayesian networks to establish a comprehensive risk model for CBEC customs supervision. Sun (2015) Summarized the valuable experience of the Shanghai Free Trade Zone, mainly including regulatory reform and innovation system, tariff collection and forms of goods flow. Wang (2015) realized that based on the platform perspective, achieving division of labor and integration, the service function is more perfect, and it resulted in many new trade formats, such as cross-border e-commerce, high value-added service trade, offshore trade, etc.

C. Topic 3: Cross-border E-commerce Finance

HFK: Finance and F & M. From Fig. 2, we can see that they have become a clear triangle with CBEC, indicating that they have a strong degree of co-occurrence. Besides that, there are keywords like Cross-border RMB Business, RMB Internationalization, RMB, Local Currency, Financial Institution, and Banks. Cross-border finance is constituted of financing and payment. Cross-border payment is an important part of the realization of CBEC, and also a direct obstacle (Zhao & Yang, 2014). Cross-border payment security can cause credit risk, and credit risk can affect cross-border payments (Liu, 2016). Cross-border e-commerce must establish a sound cross-border e-commerce credit system for healthy development. Due to many countries and various types of data, there are different statistical scales and legal standards, so collecting and sorting of credit evaluation data is really difficult, but some scholars have started tentative research. With the in-depth development of Sino-foreign trade, the increase in China's total economy, the internationalization of the RMB is accelerating and it is possible

to settle in RMB in the future. Representative literature: Zhao & Zhu (2015) conducted a quantitative study of third-party cross-border in combination with SWOT framework and analytic hierarchy process (AHP), and they believe that cross-border e-payment has become an emerging business for third-party payment institutions to expand e-commerce business and occupy the payment market. Zhou & Yu (2016) summarized two payment modes of cross-border e-commerce and their risks: the commercial bank remittance model and the Internet payment mode in which third-party payment institutions participate. Liu (2016) constructed a cross-border e-commerce credit evaluation system in the context of big data from the perspective of third-party data such as customs clearance records, e-commerce platform data such as product service quality, and user trajectory data and so on.

Topic 4: Cross-border Logistics

HFK: Overseas Warehouses, Cross-border Logistics, Logistics, and E-commerce Logistics. As can be seen from Fig. 1, the topic of CBEC research hotspot has entered the field of view of researchers in 2014 and has been growing rapidly. In Fig. 2, terms such as Cross-border Logistics, E-commerce Logistics, Overseas Warehouse, and Synergy, among which E-commerce Logistics, Cross-border Logistics, and CBEC constitute a clear triangle. Cross-border e-commerce is closely related to cross-border logistics (Zhang & Guo, 2016), one to solve information communication online and one to address entity flows offline to complement each other. Postal parcels, overseas warehouses, international logistics lines, international express delivery, and domestic logistics are the main ways to achieve cross-border logistics (Gao & Jia, 2016). Overseas warehouse research is a new direction. Establishing overseas warehouses can help solve problems such as transit time and legal conflicts. The overseas warehouse model can be divided into Amazonian FBA model, export enterprise self-built warehouse model, and third-party overseas warehouse service model. In addition, there are border warehouses and port warehouses, which can effectively improve company's supply chain capabilities, and realize cross-border logistics localization. Representative literature: Gao & Jia (2016) studied the supply chain risk of cross-border e-commerce companies by structural equation model (SEM) to investigate CBEC companies' internet marketing, cross-border logistics, customs clearance, e-payment, laws and regulations risks. Tao & Wang (2017) used system dynamics (SD) to study the functional linkage between industrial parks and logistics parks, and found that logistics parks would strengthen value-added services and supporting services, weakening the construction of basic service functions. Using the supply-demand matching theory, Zheng et al. (2016) constructed an index system model for mutual evaluation between cross-border e-commerce enterprises and platforms based on the perspective of knowledge service.

D. Future Research Trends

Through the above time-HFK analysis and social network analysis (Fig. 1 and 2), the future research trends of CBEC in China are as follows:

- (a) Cross-border e-commerce talent training. Talent cultivation is a high-frequency keyword in the field of CBEC. Although it is at the edge of the co-occurrence network, it is directly linked. However, talent cultivation do not link to other high-frequency keywords. Future work will strengthen this research with other keywords. Talents in CBEC need a wide range of knowledge, professional competence, and master international trade, e-commerce, marketing, logistics, computer technology, and foreign languages. How to cultivate comprehensive talents that can meet the need has become a difficult problem for enterprises, universities and government.
- (b) Synergy in CBEC. Although Synergy is at the edge, it is closely linked with CBEC and Cross-border Logistics. Many scholars have proposed collaborative ideas, such as regional collaboration and industry collaboration. The most mentioned is the collaboration between cross-border e-commerce and logistics. In the future, it will focus more on coordinated supervision among countries, such as laws and taxation.
- (c) Big data research. Nowadays cross-border e-commerce research is no longer limited to traditional methods such as questionnaires and interviews. It can achieve real-time and dynamic research by crawling network data. Internet has accelerated the globalization of consumption. Although there are political and cultural differences, with the support of new technologies, consumers' purchasing decisions and experiences, corporates' marketing and pricing capabilities, and government's credit management and supervision levels in CBEC environment will greatly improve.
- (d) Import CBEC research. Although Import is not a high-frequency word, it is connected to multiple keywords in the co-occurrence network as shown in Fig. 2. With the increase of people's consumption level and the development of CBEC, China, as the largest CBEC consumer source country, has a huge potential and is worth further research.
- (e) Customs supervision. Customs supervision is an important part of the CBEC process (Tao & Wang, 2017), but it is still at the edge of the co-occurrence network and it does not directly co-exist with CBEC.

CONCLUSIONS AND PROSPECTS

This paper shows the overall research structure of cross-border e-commerce in China by visualization analysis. Through high-frequency keyword analysis and social network analysis, we can comprehensively and deeply grasps the research hotspots and future trends in this field. The results reveal that: (a) the research hotspots of cross-border e-commerce in China can be summarized into four major research hot topics, e-commerce and international business, government policy and regulation, cross-border e-commerce finance and cross-border logistics; (b) cross-border e-commerce talent training, synergy, big data, import CBEC, and customs supervision research are becoming the future direction of research in this area. In future work, we will further conduct a comparative analysis of the entire cross-border e-commerce research from both domestic and international perspectives, and then further explore its cultural differences between East and West.

ACKNOWLEDGEMENT

Cross-border e-commerce (CBEC) is the future trend of cross-border trade. Although China is at the forefront of CBEC development, its transaction volume is still not satisfactory. This work is supported by National Social Science Fund (No. 16XGL014) of the National Planning Office of Philosophy and Social Science in China. It helps with further study on factors influencing the development of CBEC industry in China from the macro-environment perspective, which may lead up to a proposed model based on business ecosystem theory under a conceptual PEST framework. Authors are sincerely grateful to the anonymous reviewers and the editors for valuable comments and suggestions.

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Action Research on Development and Application of AIoT Traffic Solution

(Full Paper)

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ABSTRACT

AIoT solution based on the AI (*Artificial Intelligent*) and IoT (*Internet of Things*) is considered state-of-the-art technology and has emerged in various business environments. To enhance intelligent traffic quality, maximize energy saving and reduce carbon emission, this study applied an AIoT technology based on traffic counting modules and people behavior modules as traffic inference systems. Applications of the IoT technology based on WiFi, 3G/4G and NB-IoT (*Narrowband IoT*) was conducted gradually in key demonstration roads and cities worldwide, and the development and evaluation results were aligned to an action research framework. The five phases in the action research included designing, collecting data, analyzing data, communicating outcome, and acting phases. During the first two phases, problems of functional operations in traffic were verified and designed for network services by ICT (*Information and Communication Technology*) and IoT technologies to collection traffic big data. In the third phase, stakeholders may use basic statistic or further deep learning methods to solve traffic scheduling, order and road safety issues. During the fourth and fifth phases, the roles and benefits of stakeholders participating in the service models were evaluated, and issues and knowledge of the whole application process were respectively derived and summarized from technological, economic, social and legal perspectives. From an action research approach, AIoT-based intelligent traffic solutions were developed and verified and it enables MOTC (*Ministry of Transportation and Communications*) and stakeholders to acquire traffic big data for optimizing traffic condition in technology enforcement. With its implementation, it will ultimately be able to go one step closer to smart city vision. The derived service models could provide stakeholders, drivers and citizens more enhanced traffic services and improve policies' work more efficiency and effectiveness.

Keywords: AI, AIoT, IoT, intelligent traffic and smart city

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INTRODUCTION

According to Google CEO Sundar Pichai said "We're moving from a 'Mobile-First' to an 'AI-First' World" that human beings are entering the world of artificial intelligence. Most people may be slowly accepting the term artificial intelligence. When AI from science fiction movies, the film director Steven Spielberg had a movie directly called AI artificial intelligence in 2001. However, the film gradually came true along with the development of IoT and AI technology. When Google's AI AlphaGo defeated world's top human Go player, AI quickly entered to our lives (Whitwam, 2017). For example, more and more of our mobile handheld devices uses AI for face and image recognition. Now many online customer services also use AI robots to support customer inquiry service. The AI voice assistant can not only tell you the time, weather, but also play music, order food and shopping for you. AI applications have been applied around us gradually. The applications and services covered are far more than what we imagined and continue to spread rapidly. It's no wonder that Sundar Pichai's Google no longer calls itself a search engine company but he would say that Google is an AI company. AI is undoubtedly a mainstream.

When it comes to transportation, most people come into commuting and traffic jams every day. The reason is that most people live in cities. The urbanization causes population concentration is unavoidable. According to statistics, there will be 70% population concentrated in the city in 2050. In emerging countries such as Asia and Africa, up to 90% of people live in cities. It is not difficult to imagine that commuting and traffic jams will be a major problem that these cities need to overcome. To be able to overcome traffic problems, we must first understand the state of traffic.

London, England, was a city that had long been suffered from traffic problems. Therefore, in 1904 and 1935, respectively, traffic statistics were calculated for the main roads in London. It can be found that the traffic volume is much improved, and the entire traffic flow has an overflow effect. It is obviously an urban expansion. According to this report in London in 1936, the record traffic is not only to understand the current traffic situation, but to plan the construction strategy of the entire city. Therefore, traffic statistics are essential for major cities around the world. In the Americas, California, Texas, Canada, Brazil, Europe, London, Barcelona, Japan, Australia and Taiwan, there are public traffic statistics available for references. In many countries, even video streaming on the web allows people to watch the traffic in real time and understand the current traffic conditions of major roads and intersections for commuting or travel.

LITERATURE REVIEW

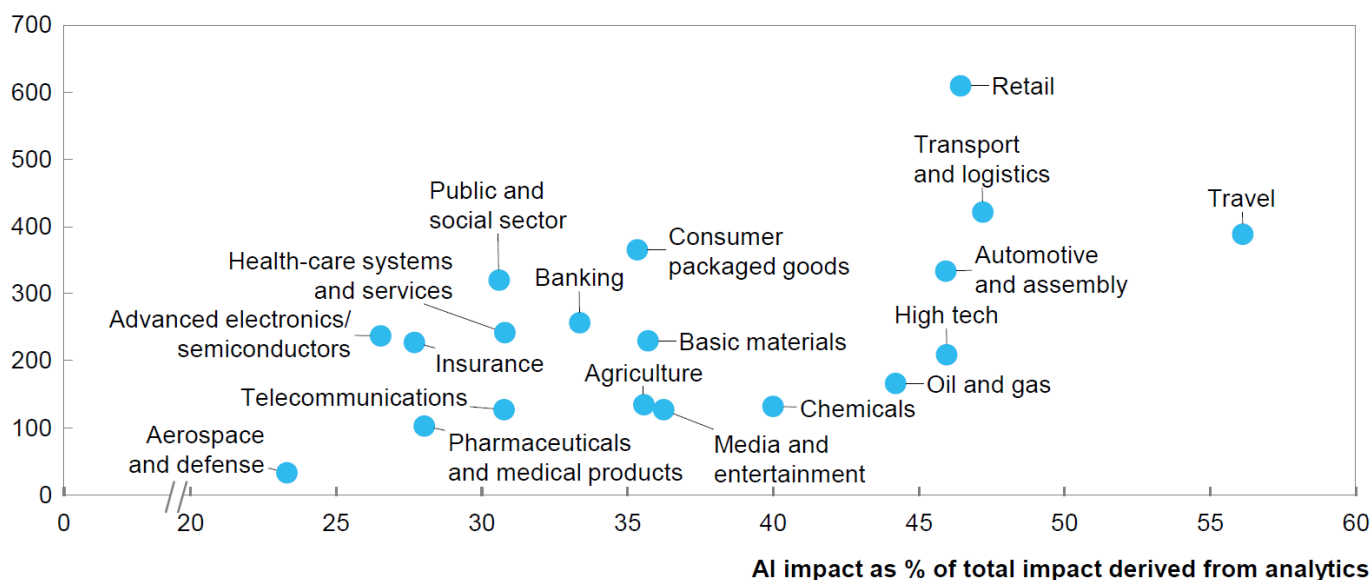
AI Impact and Value

According to McKinsey's report in Figure 1, the total annual value potential of AI alone across 19 industries and nine business functions in the global economy came to between \$3.5 trillion and \$5.8 trillion. This constitutes about 40 percent of the overall \$9.5 trillion to \$15.4 trillion annual impact that could potentially be enabled by all analytical techniques. For the potential value of AI in travel sector, the aggregate dollar impact is \$0.3~0.5 trillion and about 7.2~11.6% impact of industry revenues; for the potential value of AI by transportation and logistics, the aggregate dollar impact is \$0.4~0.5 trillion and about 4.9~6.6% impact of industry revenues (McKinsey & Company, 2018).

The US government had counted traffic statistics in Pittsburgh, about 42 hours per person per year is spent on traffic jams, generating \$160 billion in losses and 25 billion kilograms of carbon emissions. This is undoubtedly a huge cost. After implementing intelligent traffic control, there is a significant improvement that it can be effectively shortened 40% congestion time and 25% reduction in commuting time and a 21% reduction in carbon emissions. Understanding the traffic information, the government can change the traffic number or road plan according to the statistical results. For example, the traffic time ratio of the main road and the branch line, whether the traffic lane should be added, whether the traffic plan should be set, or the traffic plan can be set (Patel, 2016).

AI impact

\$ billion



Source: McKinsey & Company (2018).

Figure 1: AI impact.

AI, Neural Networks and Deep Learning

It is too early to write a complete history of deep learning, and some of the details are controversial. However, we can trace back a well-recognized overview of incomplete origins and identify some pioneers. can already trace an admittedly incomplete outline of its origins and identify some of the pioneers. They include Warren McCulloch and Walter Pitts, who as early as 1943 proposed an artificial neuron, a computational model of the "nerve net" in the brain. Bernard Widrow and Ted Hoff at Stanford University, developed a neural network application by reducing noise in phone lines in the late 1950s (McCulloch & Pitts, 1943). Around the same time, Frank Rosenblatt, an American psychologist, introduced the idea of a device called the Perceptron, which mimicked the neural structure of the brain and showed an ability to learn (Goldstein, 1997). MIT's Marvin Minsky and Seymour Papert then put a damper on this research in their 1969 book "Perceptrons", by showing mathematically that the Perceptron could only perform very basic tasks (Rosenblatt, 1958). Their book also discussed the difficulty of training multi-layer neural networks (Minsky & Papert, 1969). In 1986, Geoffrey Hinton at the University of Toronto, along with colleagues David Rumelhart and Ronald Williams, solved this training problem with the publication of a now famous back propagation training algorithm— although some practitioners point to a Finnish mathematician, Seppo Linnainmaa, as having invented back propagation already in the 1960s. Yann LeCun at NYU pioneered the use of neural networks on image recognition tasks and his 1998 paper defined the concept of convolutional neural networks, which mimic the human visual cortex (Rumelhart, Hinton & Williams, 1986). In parallel, John Hopfield popularized the "Hopfield" network which was the first recurrent neural network (LeCun, Haffner, Bottou, & Bengio, 1999). This was subsequently expanded upon by Jurgen Schmidhuber and Sepp Hochreiter in 1997 with the introduction of the long short-term memory (LSTM), greatly improving the efficiency and practicality of recurrent neural networks (Hopfield, 1982).

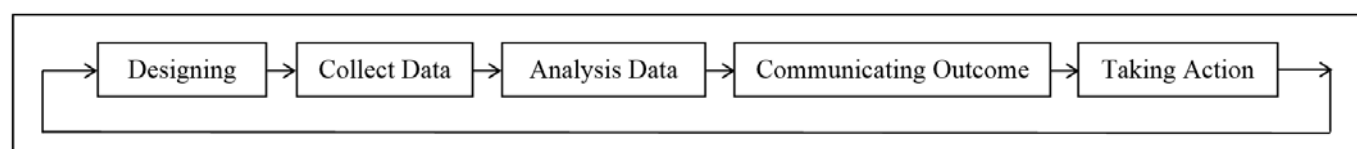
Hinton and two of his students in 2012 highlighted the power of deep learning when they obtained significant results in the well-known ImageNet competition, based on a dataset collated by Fei-Fei Li and others (Hochreiter & Schmidhuber, 1997). At the same time, Jeffrey Dean and Andrew Ng were doing breakthrough work on large scale image recognition at Google Brain (Krizhevsky, Sutskever & Hinton, 2012). Deep learning also enhanced the existing field of reinforcement learning, led by researchers such as Richard Sutton, leading to the game-playing successes of systems developed by DeepMind (Dean *et al.*, 2012). In 2014, Ian Goodfellow published his paper on generative adversarial networks, which along with reinforcement learning has become the focus of much of the recent research in the field (Sutton & Barto, 1998). Continuing advances in AI capabilities, experts are focus their research on different domains in various industries.

Neural networks are a subset of machine learning techniques. Basically, they are based on simulating connected “neural units” AI systems that loosely modeling how neurons interact in the brain. Since the 1940s, computational models inspired by neural connections have been studied and re-emphasized as computer processing capabilities have increased and large training data sets which have been used to successfully analyze input data such as images, video, and speech. AI practitioners refer to these techniques as “deep learning,” since neural networks have many (“deep”) layers of simulated interconnected neurons. Before deep learning, neural networks often had only three to five layers and dozens of neurons; deep learning networks can have seven to ten or more layers, with simulated neurons numbering into the millions.

AI practitioners refer to these techniques as “deep learning,” since neural networks have many (“deep”) layers of simulated interconnected neurons. Before deep learning, neural networks often had only three to five layers and dozens of neurons; deep learning networks can have seven to ten or more layers, with simulated neurons numbering into the millions. In this paper, we only analyzed the developments and applications instead of neural network techniques.

METHODOLOGY

Application of the IoT technology based on WiFi, 3G/4G and NB-IoT was conducted gradually in key demonstration roads and cities worldwide, and the development and evaluation results were aligned to an action research framework. Figures 2 shows the five phases in the action research included designing, collect data, analysis data, communicating outcome, and acting phases. During the first two phases, problems of functional operations in traffic were verified and designed for network services by ICT and IoT technologies to collection traffic big data. In the third phase, stakeholders may use basic statistic or further deep learning methods to solve traffic scheduling, order and road safety issues. During the fourth and fifth phases, the roles and benefits of stakeholders participating in the service models were evaluated, and issues and knowledge of the whole application process were derived and summarized from technological, economic, social and legal perspectives, respectively. From an action research perspective, AIoT-based intelligent traffic solutions were developed and verified and it enables MOTC and stakeholders to acquire traffic big data for optimizing traffic condition using technology enforcement.



Source: This study.

Figure 2: Action research study framework.

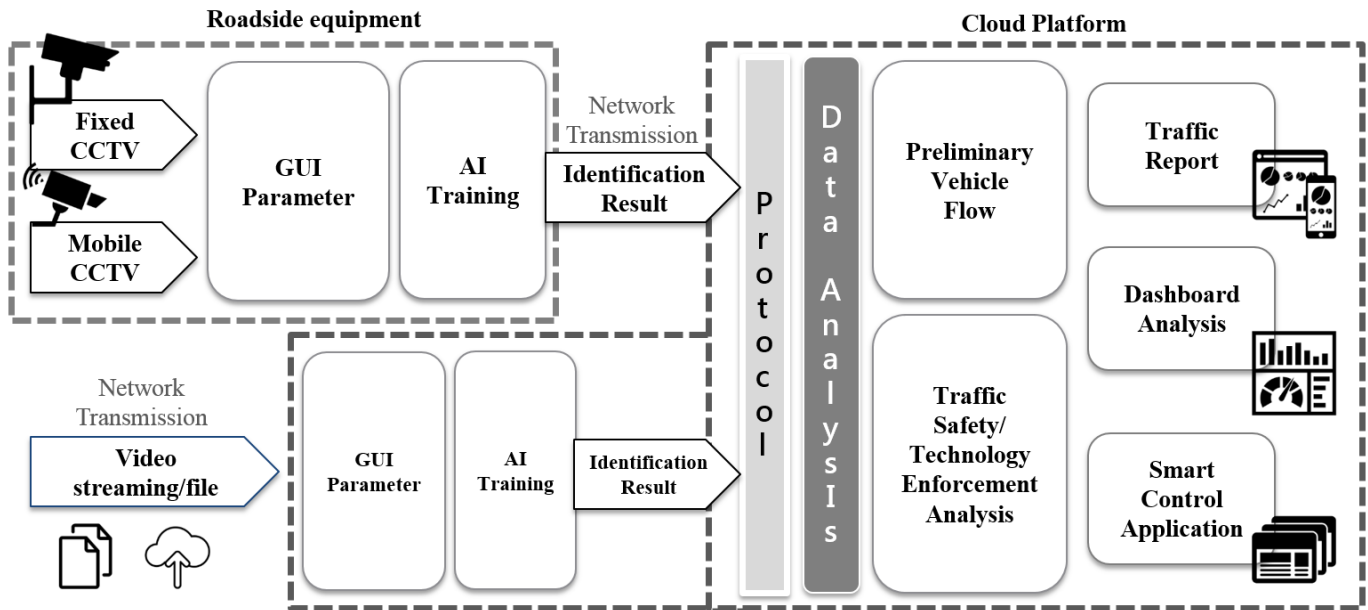
Baskerville and Wood-Harper (1996) suggested that action research was ideal as a systems development methodology for information systems research. We adopted a five-phase, cyclical process, which can be described as an ideal exemplar of the original formulation of action research (Susman and Evered, 1978) to development of an intelligent traffic flow solution architecture as shown in Figure 3. At the analysis and action taking phase, we collaborated in active intervention with stakeholders. We summary AI video solutions include two parts as show in table 1: 1) video capture part included capture, recording and streaming, 2) deep learning part included people counting, traffic monitoring and law enforcement.

Table 1: AI video soliton of video capture and deep learning SDK.

AI Video Solution	Video Capture	Capture	cropping, scaling, resizing, OSD blending	NVIDIA GPU / INTEL
		Recording	H.264/H.265 Metadata	
		Streaming	RTMP/RTSP/TS/HLS	
	Deep Learning	People Counting	enter/exit/dwell time, crowd counting	NVIDIA

		Traffic Monitoring	vehicle types, vehicle counting, waiting time	TensorFlow / TensorRT
		Law Enforcement	illegal parking, wrong direction, cross lane	

Source: This study.



Source: This study.

Figure 3: Intelligent traffic flow solution architecture.

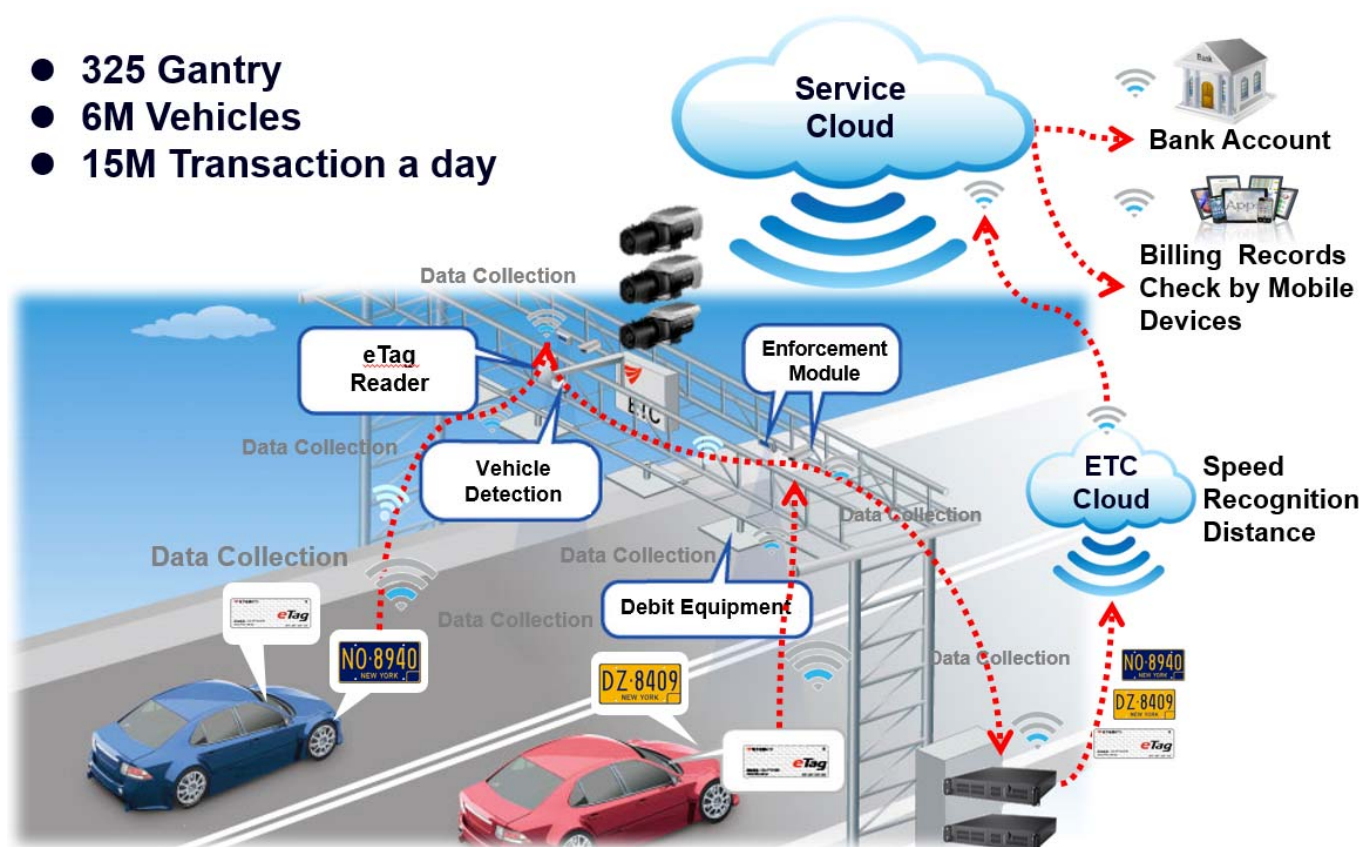
IMPLEMENTATION AND PRACTICE

Figure 4 shows Taiwan started to use infrared sensing to radio frequency identification (RFID) mode with free installation of e-Tag and it began to operate in Keelung. In 2017, it has not only accumulated more than 6 million customers, the usage rate is as high as 94%, and the license plate identification and deduction accuracy were close to 99.99%. At the same time, it saves the time for users to decelerate and inductive deduction and reduces carbon emissions (CO₂) and fuel consumption every year with the amount of 42% and 32% respectively. Taiwan and other countries' ETCs are different in that the e-Tag supply chain can find synergies in Taiwan and upstream and integrate one-stop integration. It integrates all the charging and law enforcement equipment into a single gantry project, and it takes only a short period of time. It will be completed in 9 months, and now even the whole factory can be exported overseas.

Due to the importance of traffic flow monitoring, the US Federal Highway Administration published a white paper on traffic flow monitoring in 2016, which lists several devices such as coils, microwaves, infrared, ultrasonic, etc., but one of them is counting traffic. Not only can it detect the number of cars, but also include the functions of vehicle identification and steering counting, which is the image detector. In fact, this 2016 report does not yet include AI image recognition technology, but since the arrival of 2018, AI's recognition ability is able to accurately and accurately count vehicle types.

Artificial intelligence image recognition advantage: 1) car model identification – high correct rate models and vehicle identification to provide accurate traffic data, 2) traffic count – vehicle type, traffic flow direction and counting, providing road junction number adjustment system reference, 3) parking management – use identification and counting to control vehicles in the yard and provide parking space information, 4) technology enforcement – if not drive by lane, illegal turn, road shoulder, red line violation, etc.

- 325 Gantry
- 6M Vehicles
- 15M Transaction a day



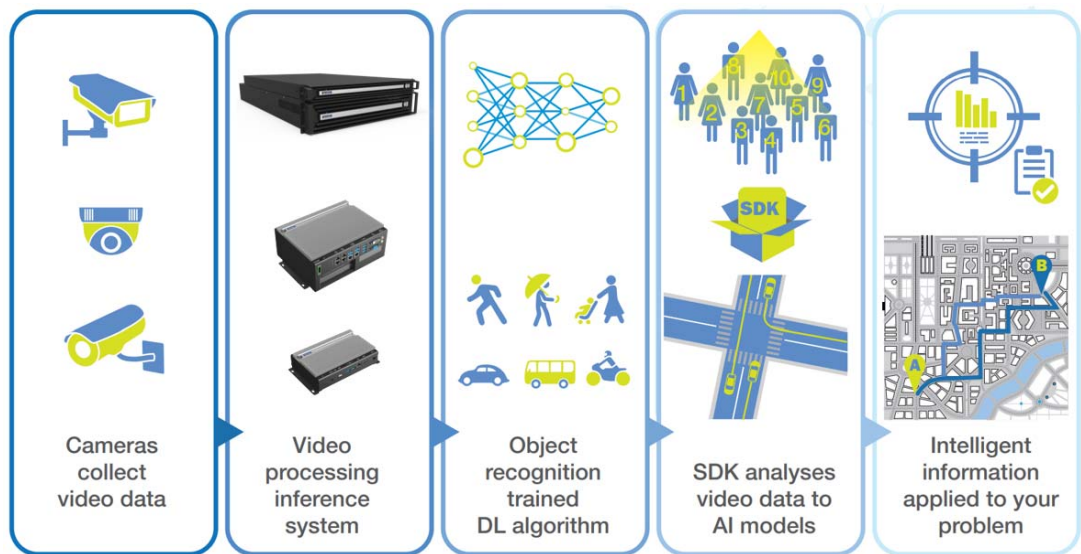
Source: This study.

Figure 4: Taiwan ETC practice.

RESULT

In the first stage of designing phase, difficulties and problems in current functional operations in traffic were identified by interviewing with stakeholders and police authorities. In the second stage of collect data phase, we can use ICT and IoT technology for collecting required and identifying data by leverage sensing device and various network transmission technology. In the third stage of analysis phase, we can use basic statistic or further deep learning methods to solve traffic scheduling, order and road safety issues. After analysis and communicating outcome with stakeholders, we design the scenario of traffic inference applications shown in Figure 5 and summarized two modules of AI video solutions shown in Figure 7 and 8: [1] vehicle counting modules: 1) section vehicle counting, 2) road dwell time & occupy rate, 3) intersection vehicle counting, 4) parking lot management. [2] people behavior modules: 1) people counting, 2) electronic fence and platform falling detection, 3) dwell time, 4) crowd and queue detection. Traffic inference system covered from notes to cloud server shown in Figure 6, and it can be remote control online by stakeholders to optimize traffic condition. In the fourth stage of communication outcome, we may review the performance with stakeholders. We will move to stage fifth of acting and implement it once it comforts to the requirements and regulations. If not, it will move in endless cycles until usefulness and effectiveness.

From an action research perspective, AIoT-based intelligent traffic solutions were developed and verified and it enables MOTC and stakeholders to acquire traffic big data for optimizing traffic condition using technology enforcement. With its implementation, it will ultimately be able to go one step closer to smart city vision. The derived service models could provide stakeholders, drivers and citizens more enhanced traffic services and improve polices work efficiency and effectiveness.



Source: This study.

Figure 5: Scenario of traffic inference applications.



Source: This study.

Figure 6: Traffic inference systems covered from notes to cloud server.



Source: This study.

Figure 7: Traffic counting modules.



Figure 8: People behavior modules.

DISCUSSION

Prohibiting traffic violations has always been a very important thing in traffic management, but we can't always send polices to stand at the intersection to see if anyone is going backwards, if anyone runs a red light, and if anyone has stopped in a red line. Therefore, the implementation of a technology for law enforcement is very important.

There was a serious car accident before, but the accident vehicle should not be driven at that time. Because it is unlikely that there will always be police forces picking up there, some companies or drivers happen to be illegal at that time. It caused a serious car accident but this should be avoided. For example, if an illegal truck or gravel car is found on the road at the entrance and exit, the system will send a message to the background of the IoT platform. The mechanism to deal with, such as connecting to the police unit to ask the police to ban, or the traffic information panel along the road to warn the driver has been banned in violation of the rules if these companies and driving know, even if the intersection does not stand the police, their violation will be fine. If unlawful driver is punished, no one will dare to do it, and the accident will be reduced.

CONCLUSION

From an action research perspective, IoT-based intelligent traffic services were developed and verified. AIoT services enable intelligent traffic to acquire traffic information from node to server and build an inference system from server to mode. It will ultimately be able to go one step closer to provide optimized traffic suggestions. The derived service models could provide citizens more enhanced convenient traffic services and improve its efficiency and effectiveness in smart city.

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AI City's Solar Energy Collaborative Commerce and Sharing Economy

(Full Paper)

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ABSTRACT

The advent of artificial intelligence has brought many changes in people's lives, and because of the rise of artificial intelligence, the city has gradually become a smart city. Smart City, as defined in Wikipedia, is an urban area that uses different types of electronic data collection sensors to supply information which is used to manage assets and resources efficiently. It is evident that the city cannot function without water, electricity and air. Especially electricity, due to the development of technology and the internet, has been the most important origin of resource in the city. Under such resources, two important groups are generated: the sharing of people and the resources of electricity. People represents the grouping benefits, which made the sharing economy more rationalized and creative because of the internet platforms. As stated in Wikipedia, sharing is to fully utilize resources for more efficient use, so to raise up the overall efficiency of the resources. So as solar energy, a natural resource, has existed on the earth for a long time like the air. These will be the most important components in a smart city. However, with the current Internet technology platform, the artificial intelligence, AI, will be a tool under the system we are already familiar with. Artificial intelligence such as AI uses the knowledge that the machine obtains from the use of input data and information. It's a way to let machine learn from the data first and then allows the machine to automatically calculate and judge the corresponding results. Such artificial intelligence is applied in the computing system of many industries, it reduces many possible errors, and relatively improves the efficiency of problem solving, and significantly increased the efficiency of obtaining new messages and information to users. Both supervised and unsupervised learning methods will be applied to the case study of this study. How to make the relationship between platform and consumer supervised, let AI artificial intelligence because supervised learning is only given some training samples of the machine, and inform the sample category, allowing AI judge automatically the conclusion of the samples, and accurately pass it to create information on the shared solar business platform.

Consumer psychology is also the focus of this research. Investors' transparency and simplicity in the application of goods, as well as the most important investment rewards and independency of consumers, will also be a discussion focus of this study. In this paper, the smart city of AI artificial intelligence allows the solar energy to create a business-style analysis of the economy, design, finds a platform model to establish Internet sharing, and achieve a large circulation and sharing of demanders and suppliers. This article uses the traditional field of goods, combined with the needs of multiple resources sharing and co-creation, combined to solve the existing information shortage and cross-domain strangeness. Utilizing the case study of solar energy company's discussion method, the smart city solar energy will create a commercial business entity, so that people can participate and identify with such industry, and then find more business models to create and share, and the realization of smart cities as a sharing platform mechanism all people shall be involved.

Keywords: smart city, solar energy, resource sharing, sharing economy, AI

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INTRODUCTION

With the changes of the times, the development of computer technology and Internet technology is booming and rapid. The universalization of the Internet has affected all levels of society as the rapid growth of the Internet relatively directly and indirectly let the Internet of Things centralizes the management and control of objects, devices, and people, so that it can integrate a large amount of information and data, so that the global information of the entire city has revolutionized the way and use of the Internet. In the same way, it has changed the lives of people, the society and the usage behaviors. However, the birth of Smart City is an ingenious mechanism and information to apply Internet of Things, big data, cloud computing as core. No matter if there are the communication between the government and people, or the intercommunication and connection between people, nature disaster, crime prediction, and control of a large number of epidemics, etc., they shall be fully integrated because of the birth of Smart City.

These integration shall have the support of the overall economic planning of the government. Taking Taiwan as an example, the resource gaps between urban and rural areas, local financial problems, tax burdens and disputes over the sharing of common facilities, and political issues (Xu, 2014). These are the problem to be solved before the birth of a Smart City, the overall planing, environment and economy, politics, etc., however, there are two major roles, the people and the electricity. If human behavior changes but there is no electricity, everything will go back to starting point. Therefore, this study will explore and analyze based on these two important roles, so people would start to understand that themselves are playing an important role in creating or

supporting a Smart City. In the current situation of sharing the economy as the starting point, we utilize the sharing and co-creation method, so that participation is no longer just observing, it is a kind of authentic participation in the interests of one's own life.

RESEARCH MOTIVARION

The original thought of Smart City is to promote the city to a state of sustainable development, however, to have a sustainable development it ought to have a balanced relationship between being environmental friendly and progress, so that the Smart City has a smart environment. The government has developed long-distance 24-hour monitoring, urban weather conditions, transportation, resources, air pollution and other emissions data through the internet. These are the basic factors the AI built intelligently in a Smart City. The direct and indirect relationship that these elements can perform is the platform, how the network platform connects these data and the circulation to the database of the demand side. In addition to the technological transformation, electricity is the most important part.

Based on the aforementioned research motives, this study intends to clearly find the relationship between solar energy and consumers based on the existing large amount of solar energy advocated in Taiwan, clearly find the positioning of cities and citizens, and plan to improve the general public's direct improvement of the city. Working with indirect construction of a smart city, such research can be organized into the purpose of two studies:

1. Put forward the economic benefits generated by solar energy, how can such economic benefits affect the citizens in this city, analyze the fields such as AI smart cities by analysis, from the platform, environment and space needed for solar energy production, and a complete model under Taiwanese regulations
2. The role of the sharing economy and the co-creation of the economy in the smart city, the use of interest distribution and innovative thinking in solar energy, the important role played by the platform.
3. Realize the commercial style of smart city solar energy to create economy, how to use platform resource sharing, and benefit sharing mode, find a co-creation of a solar economy business model, the relationship between supply and demand, let the role of the bilateral market sharing and co-creating another business model under the sharing of solar energy resources.

RESEARCH

The sharing economy is a resource that drives from a limited resource to a complete and sufficient benefit. The sharing economy is a term that emphasizes the diffusion and reuse of resources. This is a strategic thinking of having resources to use resources. There are many real cases to share in the current market to analyze the sharing economy, like the well-known Uber and Airbnb are structured upon the logic of sharing economy. Nowadays, the sharing economy is not enough for the use and spread in more innovative industries and ideas. Therefore, thanks to the Internet, value creation will be the core value of the sharing economy. The characteristic of value creation is the process of understanding the true value. This perception of value will be in the individual's emotions and personalization. This is a kind of cognition. This kind of cognition is the creation of value. This kind of connection includes the connection of problems between people, that is, the relationship between interests, and the connection of resources, because through the interaction of people, the exchange of information and the movement of information between each other, generate bigger cognition and the value of knowledge is elevated. In simple terms, useful value are created because of a kind of interactive communication. In today's society, because of the basic concept of sharing economy, the participation of the public in such a market behavior mechanism, requires only to increase the motivation and convenience through the platform. However, the economic core of the platform is that it can be used to create greater value. The concept of a bilateral market comes from 1833. Such a B to C (B2C) sales model, whether it is a bilateral market or a multilateral market theory, defines a bilateral market from an academic perspective. A market has two different users or industries, the interaction among two or more economic groups needs to be traded through one platform, while the overall decision of the user will affect the outcome of the other seller or consumer, and the platform will offer both parties different needs, one party's income will come from the number of another party's participants. Such a transaction can be a service or a commodity, or it can be a concept of co-creation. Of course, in order to attract the participation of both users, and the persistence of adhesion, the bilateral effect is still maintained and operated by the current market platform. It is usually seen that platform pricing has become a core issue of bilateral long-term bilateral market theory must achieve a major consensus, and the price of the platform to the other side of the user is not only related to its marginal cost, but also an external benefit. However, in the bilateral market, we can say that it is a buying and selling act, but perhaps he is actually a demand side provided by products and services, and the platform is transparent, so that the platform enterprises include products and services with value, and such value will make consumers or sellers generate a lot of trust and adhesion. Because of the extensive use of such internet and platform and the rapid timeliness, such a platform will play an important role in the network industry of all kinds of industries, with the maturity of the current global platform, regardless of It is the cash flow, logistics, security, communication, artificial intelligence AR and brand positioning, which can make consumers or investors feel comfortable using and recommending. Therefore, the platform is no longer just a page, and its multi-function has replaced many marketing roles in today's society.

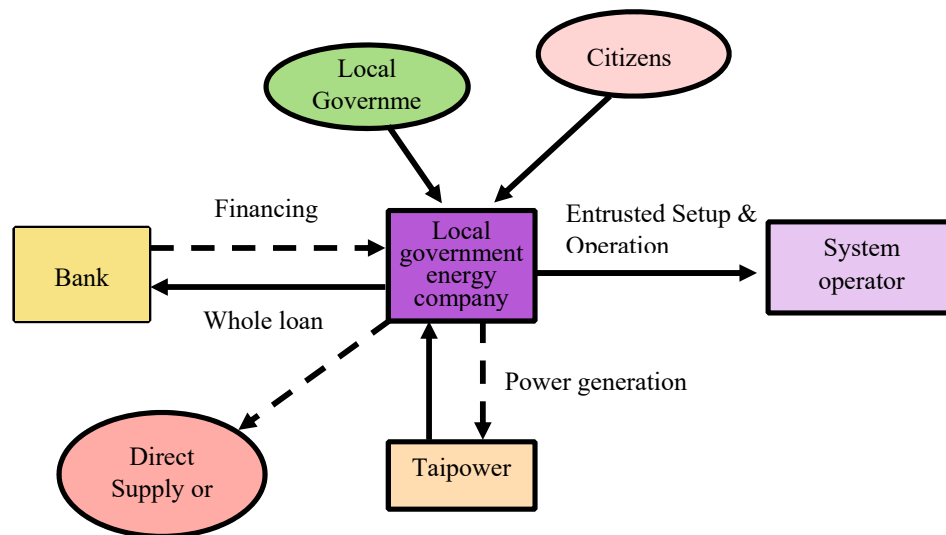
After all, in the overall sharing economy, sharing, co-creation, and platform, these three necessary factors must be combined to produce sustainable value. As mentioned above, the birth of the platform is a series of bilateral or multilateral markets. Such combination, linkage, and connection of resources in sharing to generate valuable knowledge and resources, that is, co-creation. This is an ecology will also increase the relative adhesion due to the sharing of benefits and resources, and the sense of identifying and awareness will increase. This is a model of achieving value co-creation, and is also a model of how to make smart cities in solar power generation, because the co-creation of value realized the co-creation model.

As for the role of consumers, we know that thanks to the Internet, consumption is no longer being passively informed or believing in sellers and advertising, and proceed to make purchase. The transparency of the Internet allows consumers to find what they need outside of the information, they can also give feedbacks and comments regarding to the product they choose. Under such information, Internet, artificial intelligence, service satisfaction, information transparency, etc., are important factors for a product or industry to survive, especially for experience marketing, current consumer experiences, commodities, platforms, services, and real experiences are the most important aspects for consumers to own this item, and to whether agree with the product.

EXPECTED FUTURE RESEARCH

The Core Elements of Sharing and Co-creating

This research mainly propose an integrated business platform though the model of co-creation of the economy, utilizing solar power, to realize the concept of citizen power station, and realize the commercial style of the smart city solar energy co-creation of the economy. The so-called people's power station, mentioned in the energy transformation white paper stacking program published by the Ministry of Economic Affairs on December 14th, 2017, the definition and connotation of the citizen power plant, the so-called citizen power plant is through the participation of citizens in renewable energy generation. It is a principle of self-sufficiency, autonomy and autonomy of real estate electricity and electricity in the local area, with the goal to help achieve good energy and encourage renewable energy development and promote the so-called energy transformation goals. The current model of operation is dominated by local governments, calling on the industry and the public to buy shares, or setting up energy companies by the people to set up a renewable energy power generation industry, as shown in Figure 1, investors will use the concept of raising capital and buying stocks. Shareholders can recover electricity bills according to their holding ratio. Such a beginning model, let the researcher think about the platform and the co-creation of the tandem platform to be more in line with the citizen's position.

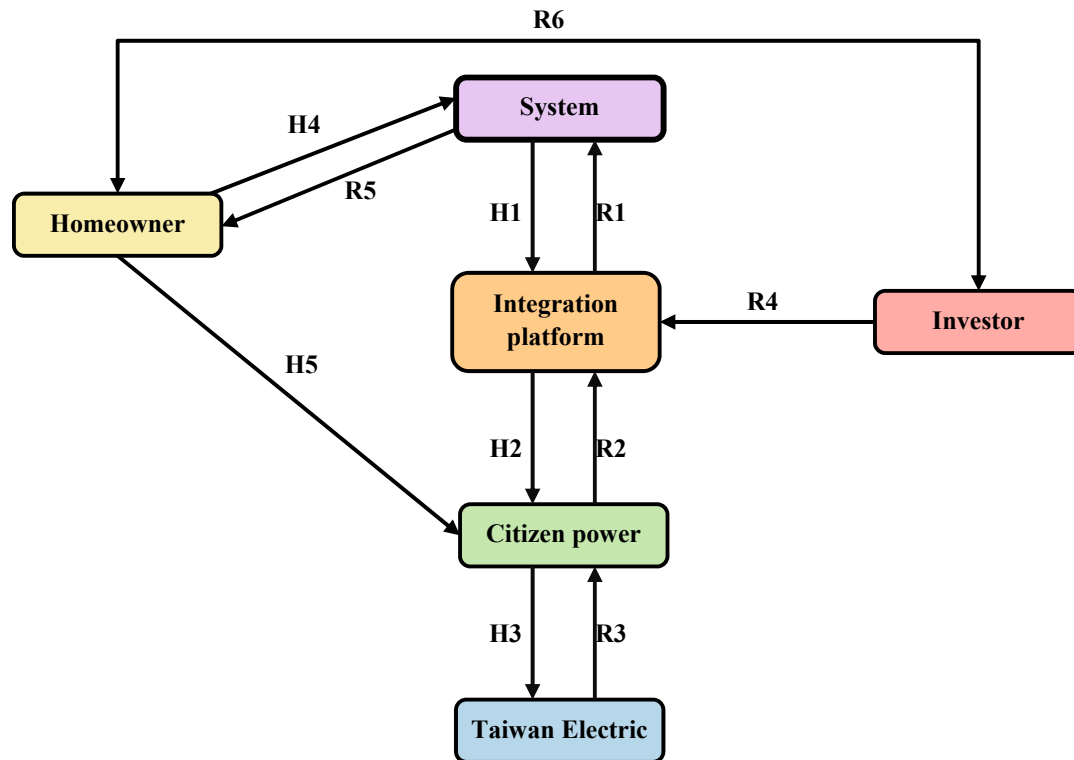


Source: This study.

Figure 1: Current Taiwan solar business model

Citizen power plants are converted into individual power stations of the power station, the same theory, but different business models, so that all citizens can participate in the birth of smart cities. We can see from the information of the Ministry of Economic Affairs, there are many large and small developers of solar power systems in every corner of Taiwan. Every solar system developer belongs to an independent entity. They all need customers to provide roofs, banks for financing, report to the government, pass the regulations, and bring power to Taipower, negotiate with Taipower, and sell the solar power to Taipower in exchange for cash. Then these are the same problems solar system developers in various regions of Taiwan have to face: the regulations, where the

building is located, the knowledge of solar power generation, and the maintenance of 20 years, etc. As mentioned above, how to integrate the entire developer and investors would be a business model that is based on a platform that integrates a multi-body system, collectively referred to as the integration platform, which is the most important core of the overall operation. As the previous research finds, because of the convenience of the Internet, the platform can connect investors and operators, that is, a series of platforms between production and use. The following explains each role separately.



Source: This study.

Figure 2: Vendor and industry related links

This study has six roles and structures

1. System Developer: Solar power must be performed by professionals and installed and maintained for 20 years.
2. Integration Platform: A complete integration platform that includes rectification of upstream and downstream vendors, Taipower, and investors' funding and investment plans.
3. Citizen Power Station: Collection point that integrates electricity into a physical but institutionalized location.
4. Taipower : Legal purchase of electricity to convert into cash.
5. Investors : General public, company number, legal person.
6. Homeowner: Homeowner and landlord with legal roof or factory.

Such a platform needs to achieve the overall power generation and profit-making search function according to the link of the foot speed relationship

H1 The system developer building solar panels in a building or the roof of the factory according to the regulations.

H2 Giving the citizens a power station after the integration platform system developer has completely completed the relevant solar energy system power plant elements.

H3 Selling the electricity generated by the solar power system to Taipower

H4 The homeowner must be the owner of the legal land and the land to entrust the roof to the system developer to build the solar system power station.

H5 The homeowner's electricity will directly transmit electricity to the citizens' power station.

R1 The integration platform converts the sold electricity into a fee format to the system developer.

R2 The citizen's power station convert into Taipower amount after integrated sales.

R3 Amount after sale.

R4 Investor, general public or entity group °

R5 System developers can invest in their own to find constructable buildings °

R6 Homeowners can be investors.

Sharing economy from solar power generation to resource sharing

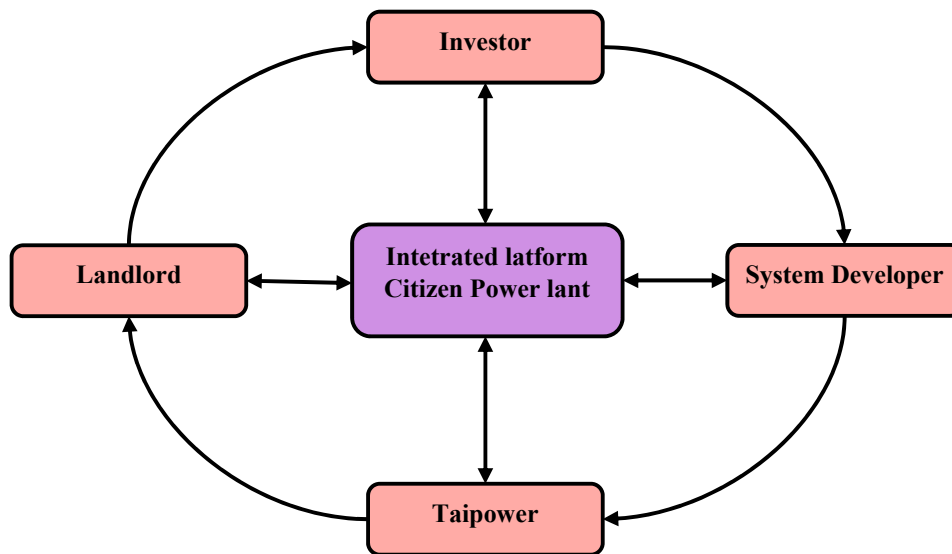
At present, the total number of solar power system developers in Taiwan, the quantity and quality and the size of the company are very different. Relatively in the system engineering of solar power generation, there will be a big difference in price. The specifications of the solar panels themselves must be consistent and the price difference will not be too high. In the case of a relatively high gap between the overall cost and the profit, it is necessary to discuss the current sources of industry differences, most of which must be cost generated during the establishment. Even though in the end, solar power is denominated in watts, but because of the different roof sizes and forms, the functions that the homeowners want to retain, etc., additional construction costs will incur. These costs and construction time will become the format of the system developers. The maintenance costs included in the 20 years after completion of the work, of course, also include the tangible and intangible expenditure costs, which will be the reason for the relatively large price difference between the relevant system developers in the industry. Therefore, the integration platform will enable such large and small system developers to integrate the electricity generated by the solar system power plants developed by individual system developers into the platform for the platform to sell to investors. Such an integrated platform approach will make the price of the market transparent. After all, the solar panels required for solar power generation and the cost figures generated by the surrounding construction can be calculated. However, the service surface is the biggest difference that cannot be controlled. Such a solar panel covered on the roof will give a good feeling and income of appearance and actual power generation due to weather, environment, air, etc. However, this is a 20-year service, so a complete platform system is needed to make each link transparent and complete. This will be a complete platform to create a basic infrastructure for the sharing economy. In the homeowner's part, in the case of Taiwan, small-area roofs have a lower market share in solar power generation. However, due to the manpower and time required by the operators, the construction costs are high, so they are currently large. Large-scale construction projects such as farmhouses, houses, buildings, hospitals, and schools to set up solar panels. Take Kaohsiung, Taiwan as an example. Kaohsiung's Government Public Works Department promoted the Kaohsiung 2016 Green Light Roof Project and provided many subsidy programs, such as the Kaohsiung City Public Works Department's 2018 annual three-dimensional green energy and green roof subsidy program, and green renovation. Government subsidies such as the highest subsidy of 800,000 rooftop high-rises, and the green rooftop farm of the Kaohsiung Medical University have promoted the incentives for many buildings to increase solar power generation. Behind such incentives, they will definitely their own interests.

Through the incorporation of AI co-create value to increase the value of investors and system developers and house owners, a three-win situation.

In the construction of a solar power station, in addition to the basic roof and system developer, the most important thing is the funds. With the funds to buy all the materials and the system developers, currently the majority uses bank loans to implement. But if such a source of funds is from a consumer that is, an investor, playing a small role in the whole process, stacking out shades after shades of solar energy panel, and sale the power generated by solar energy to Taipower, the integration platform clearly divides the relationship between the three roles. In other words, investors who have no real estate, factories or even land can buy monolithic solar panels because of such platform. Relatively, there are real estate owners who want to build solar power plants can also buy other solar power station developed by the system developer, these roles will change at any time because of personal needs. Similarly, because of their own preferences, they will exchange their solar panels for sale on the platform. Taking advantages of the security of the platform, the autonomy of funds on the platform is increased. It is different from the way the fund is purchased. It is only waiting for it to rise in the sell-off, but every investor can overdo the solar energy of his own commission. In addition to investing in countless single-chip solar panels, the generated electricity can also use the solar power generated by everyone to generate electricity. Such power generation can be calculated and used in units like a centralized station. The same is true for the membership card, you can see the amount of electricity generated by your own mobile phone, tablet, computer, and the amount of power generated by your own investment.

AI Smart City, platform, co-creation, sharing.

When every citizen is an investor, a consumer, or a business operator, for such an issue, they will relatively begin to care about and pay attention to all the things that are invested in. However, in addition to the large amount of electricity, the Internet, and the platform, the smart city itself is the most important common interest. In addition to the real money, the common interest is the subject and consensus of participation. This is a clustering effect. When the aggregation effect reaches a certain amount, the economies of scale effect will occur. Such economies of scale will not be based on regional restrictions, but the combination of knowledge and capital of each individual. You are a doctor, a lawyer, a small business boss, an office worker, a student, or a housewife, can all participate in such a solar power industry. When everyone is eager in certain events, there will be a common connection between people. The use of modules of interest, plus the maturity of the Internet and platform integration have allowed the solar power to play a common win-win role in both implementation and economics. Like Figure 3 illustrates the role of integrated platform includes the citizen power plant.



Source: This study.

Figure 3: Overall operating structure

DISCUSSION

Most of the energy on Earth comes from solar energy, coal, oil, water, wind and so on. According to the Global Renewable Energy Reactor Group, the total investment in renewable energy in 2014 was US\$270 billion, solar energy was US\$177 billion, and solar power generation increased by 40GW. In 2014, global renewable energy generation reached 312GW, ranking among the top five were the countries of Germany, China, Japan, Italy and the United States. Currently, the global solar energy generation accounts for 3.9 of renewable energy, and the total global power generation is 0.9% (Xu & Cai, 2018). The solar industry has always been called green energy, energy-saving industry, solar power generation, and Sola Power is a renewable and environmentally-friendly power generation method. It does not generate carbon dioxide in the air during power generation, and it will not pollute the whole environment. The history of power generation can be traced back to the 19th century. A French discovered the phenomenon of photoelectricity, which was less than 1% at that time (Li, 2012). With the advancement of technology, the successful development of solar panels with raw materials, which uses sunlight to convert into electrical energy, is a lens or mirror, plus a tracking system that uses optical principles to focus large areas of sunlight onto a relatively small Light and bend. The concentrated heat is then used as a heat source for conventional power plants. These heat sources are the source of power generation.

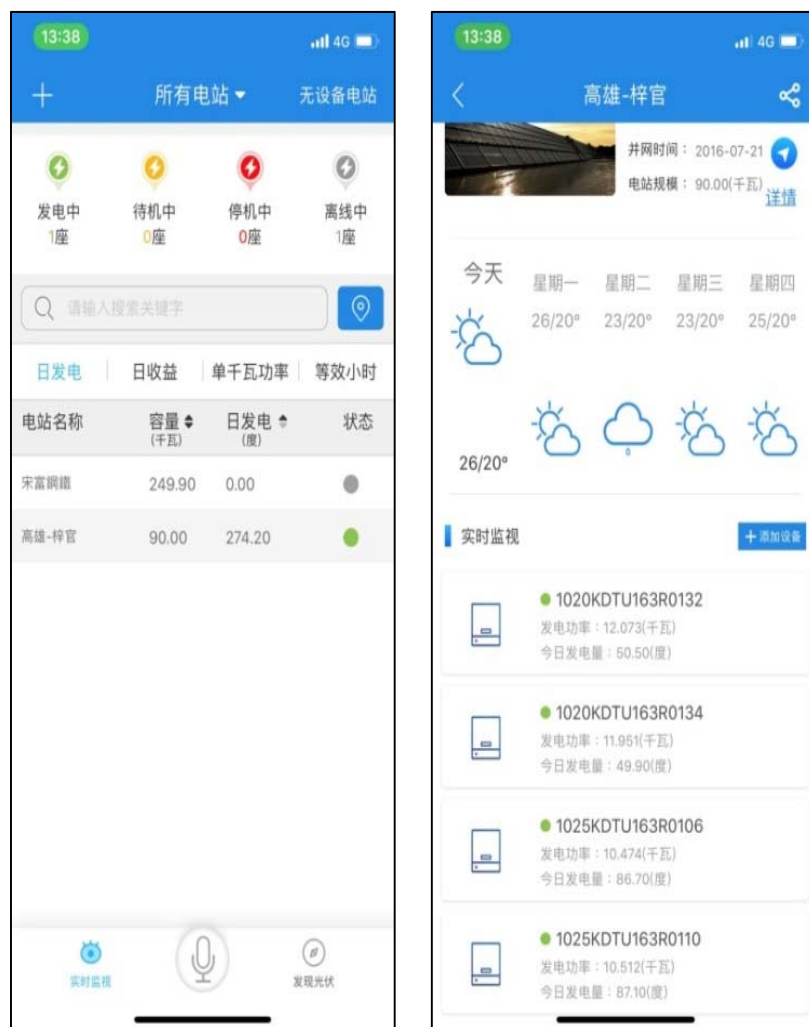
According to the Taiwan Enterprise Performance Journal (Wang, 2008), the performance evaluation of the solar power industry in the Asia-Pacific region, with a growth rate of more than 40% per year, is one of the fastest in all industries in the world. According to the study, the top three cumulative devices in Japan, Germany, and the United States account for nearly 90% of the total global installed capacity. Currently, the capacity of solar cell devices continues to grow. In Taiwan, the Taiwan solar cell industry is also great growth in recent years

Judging from the current situation in Taiwan, the government plans to promote the solar photovoltaic two-year promotion plan (2018-2020) to promote the roof line setting, including the central public roof, factory roof, farmhouse thinking and other roofs (data source : Solar photovoltaic Information Network). Such an idle space, because of solar power generation, generates extra income other than environmental protection. Currently, the implementation methods are divided into two types. The electricity generated by daytime solar power generation equipment is sold to Taipower, and the other way is to use surplus electricity to sell electricity. This is to give priority to the electricity generated by daytime solar power generation equipment. For home or homeowners, the remaining electricity is sold to Taipower. However, the solar power system built on the roof by solar power is not a solar-powered solar energy system. It does not have the function of tracking the angle of the sun. Such solar power generation will be limited to twin crystal solar panels, which include single crystal germanium solar panels and polysilicon solar panel (Xu & Cai, 2018). The 100% of single crystal is high in twin crystal structure, polycrystalline 80% twins 20% other master alloy. Single crystal is higher in cost, high power generation per unit area; polycrystalline is lower in cost, better market price acceptance. The conversion rate of these solar panels and the design specifications of the modules, the cost recovery period, the cost of the overall module includes the conversion efficiency, the cost per turn, the cost per kWh, and the actual conditions of the installation, etc.,

basically solar panels' life span can be up to 35 years in theory, but the guarantee issued by the industry can be for 25 years, and actually will be 20 years of economic life. Therefore, Taiwan's Taipower's contract to sell electricity to the homeowner will be rented for 20 years. The area of each solar panel is 1.65m². The current mainstream single-chip 300w module in Taiwan is calculated based on the total power generation of Taipower for 20 years. The analysis of the North and South report is different (it differs in sunshine hours North 2.8-3hr South 3.6-4hr). If the number of power generation hours is less than 20kw in Hsinchu, the electricity price of solar photovoltaic power generation is NT\$107.08/degree. The annual electricity generation hours are 2.8 hours*365 days=1,022 hours. Electricity revenue: The first year electricity income is: NT\$7.008 * 1,022 hours *15.6kw = NT\$1111, 730 / year.

The use of AI intelligent monitoring allows the platform to have complete monitoring, in order to be fully satisfied in many aspects. At present, there are many solar energy production teams in Taiwan industry. It has already used AI in the overall maintenance system, including artificial intelligence AI capabilities. Highly scalable, O&M for single system, simple setup and one-line diagram for instant data. The focus is on the ability of AI, which allows the engine to learn historical and real-time sensor data, help the power plant to implement protection and timely maintenance needs, and comprehensively assist the relevant information of the needs and maintenance of the power station.

At present, a large number of companies in Taiwan already have complete monitoring system development and use, such as Rishan Energy and Hyelin Technology. These monitoring systems collect Inverter data and upload it to the cloud. For example, Hyundai has developed PHOTON intelligent monitoring software. Operators can monitor the damage at any time and remind the industry of the best time to clean the solar panels. Such a research and development and research, using artificial intelligence and other means to assist data and report analysis, so that the industry's case power generation revenue is on schedule, can use AI technology to convey the best power generation to the industry and the surrounding data.



Source: This study.

With complete data, AI can be used as the role of communication and monitoring. The functionality and transparency of the platform will have more trust. This transparency and trust will make the platform more valuable, and more convenient. This study found that such a phenomenon of solar energy income and the way of investing in the face of increasing global warming, solar power will be one of the important energy sources in the future. However, Taiwan will also encounter relative problems: capital costs, land costs, regulations, solar conversion rate, residual value, and most important economies of scale, these are the problems faced by current solar companies, whether they are homeowners or assisted erected solar companies. But we all know, electricity is the most important role in smart cities. If there are no citizens with roof tops or factory roofs, there won't be any solar power. Thus through this research, I would like to study and create a business model that allows people who do not have any real estate to invest in an industry like solar power.

CONCLUSION

Corporate Social Responsibility in Smart Cities

The ultimate goal of a smart city is that the people have a perfect living space and of quality. The researcher suggests that such an integration platform is best ran by the government and the private sector altogether. This way of doing business will permit many minority groups in Taiwan also be able to participate in or share the value generated by such a platform. Because of such a platform, mainly based on solar power, more public activities can be planned allowing more young children to participate in the matters of nature, environmental protection, internet trust, investment, economic scale, and social pulse are all social education courses for personal education. Let solar power generation no longer be just a proper noun. It is a gift of nature as familiar as the air. We must understand the protection of environment and pass on a good environment to the next generation. We can educate the next generation in the simplest way with solar power generation, smart city, internet, platform integration. Let solar power bring out the power of smart city.

Due to the gradual popularity of AI artificial production and the increasing convenience of its usage, the creation of such a platform for sharing creates more opportunities and possibilities, whether it is scholars' research or collecting research materials. It can be seen that when solar energy is used as a product in the operation, the sharing mechanism will be a win-win trend. We can take advantage of the improvement of technology, and use artificial intelligence to integrate business opportunities so that bilateral effects are no longer just bilateral profit generation, but an increase of multilateral opportunities, the combination of business behavior and environmental protection and the basic needs of the city's survival, resulting in a permanent concept of ecological cycle.

In the current overall environment of Taiwan, the relationship between the three parties of solar power generation, consumers, and owner of assets, in addition to the application of the platform and the artificial sharing of AI artificial intelligence, can be used in small areas, so the planning of taking advance of small facilities should be an important issue. How to generate sustainable benefits will be the highlight of every member of the city.

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A Conceptual Artificial Intelligence Application Framework in Human Resource Management

(Full Paper)

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ABSTRACT

This study proposes a conceptional framework of artificial intelligence (AI) technology application for human resource management (HRM). Based on the theory of the six basic dimensions of human resource management, which includes human resource strategy and planning, recruitment, training and development process, performance management, salary evaluation, and the employee relationship management, is combine with its potential corresponding AI technology application. With the cases analysis on recruitment of leap.ai and online training of Baidu, the recruitment dimension and training dimension with AI are further explored. Finally, the practical implication and future study are supplemented. This AIHRM conceptual model provides suggestions and directions for the development of AI in enterprise human resource management.

Keywords: Six dimensions of human resources management, artificial intelligence technology, intelligent recruitment system, intelligent training system

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INTRODUCTION

With the development of Artificial Intelligence (AI) technology, a new generation of labor, such as the human intelligence of artificial intelligence, has become the key factor for enterprises to survive and transform in a changing environment (Ertel, 2018). Since Google's Alpha Go system has won an overwhelming victory in the battle with South Korean player Lee Sedol, artificial intelligence has attracted attentions of both researchers and practitioners (AlphaGo, 2016). Artificial intelligence, also known as machine intelligence, is an interdisciplinary science that mimics human capabilities and intellectual behavior. Elaine Rich define AI as "Artificial Intelligence is the study of how to make computers do things at which, at the moment, people are better" (Rich, 1983). In the process of simulating the information process of human consciousness and thinking, it can quickly retrieve the database, extract information, answer our doubts efficiently, and provide the best answer directly and rationally. Artificial intelligence theory and technology applications are also expanding, and many artificial intelligence tools, such as artificial neural networks, intelligent decision systems, and fuzzy sets, are used in various fields (Holland, 1992). Among them, the application of AI in the field of human resource management is still in the exploration stage (Sheila, 2018).

AI has been gradually applied to enterprise management decision making, taking on and helping managers to speed up their tedious and repetitive daily work. It provides powerful database and analytical support, allowing managers to get out of mechanical work and engage in more valuable work (Partridge & Hussain, 1992). According to the Accenture strategic report, for coordination and governance, problem solving and collaboration, employee and community, strategy and innovation work, the utility and impact of intelligent systems can change the manager's work contents. Artificial intelligence can undertake and help managers speed up their daily tedious and repetitive work. It can also provide powerful database and analytical support, so that managers can get away from the repetitive work and get devoted to more valuable work. Human resource management refers to a series of human resources policies and corresponding management activities of enterprises. These activities mainly include the formulation of corporate human resources strategies, recruitment and selection of employees, training and development, performance management, compensation management, employee mobility management, employee relationship management, employee safety and health management (Noe *et al.*, 2006). In the process of human resource management, the use of artificial intelligence technology can bring greater economic benefits. Improving the efficiency of human resource management through the application of AI technology has become an important trend in the future development of human resource management.

However, in the research area of human resource management, there is still a lack of an overall AI application framework, combined with the specific dimensions of human resource management, to analyze its specific application. Therefore, based on the six dimensions of human resource management and the main technical applications of AI, this paper proposes a conceptual AI application to HRM model to guide enterprises how to use AI technology to assist human resource management. Based on the

analysis of the Leap.ai and Baidu industrial cases, we discuss the AI application practice of recruitment and training. The proposed AIHRM framework provides theoretical guidance and application recommendations for the combination of human resource management and AI technology. Potential future research areas are also proposed.

The next part of this paper discusses the relevant theoretical literature. The third part presents the conceptual framework model of AI in HRM application. The fourth part is a case study in conjunction with Leap.ai. The last section is the conclusion.

LITERATURE REVIEW

Artificial Intelligence

The status quo of artificial intelligence technology can be analyzed from three levels, the basic support layer, the platform framework layer and the domain technology layer (Brooks, 1991).

The Basic Support Layer

The three major factors in the success of this layer of AI technology are big data, computing power and new models. Big data provides fuel for the development of AI. In recent years, the new enhanced algorithm model has greatly improved machine learning capabilities. A typical representative of this aspect is deep learning. It performs well in tasks such as supervised learning, unsupervised learning, and intensive learning.

Platform Framework Layer

Internet companies such as Google, Facebook, Microsoft, Baidu and Amazon, as well as universities such as the University of California at Berkeley and the University of Montreal in Canada have launched their own deep learning framework. Advanced deep learning technologies are expected to be applied with a small amount of customization and deployment, greatly reducing the burden on developers and businesses.

The Technology Layer

Artificial intelligence technology has been applied to various fields. The technology application network is shown in Figure 1. Depending on the problem domain, the main technologies include the computer vision and natural language processing technologies. At present, more mature technologies include face recognition technology applied in the airports and payment, such as Alipay. Natural language processing programs computers to process and analyze large amounts of natural language data. Related technologies have been widely used in translation software (such as correct translation), search engines, question and answer systems (such as knowledge), sentiment analysis and automatic answering; speech recognition and so on. For example, voice assistants represented by Apple Siri, Microsoft Cortana and Google Now has be setup on the user's mobile phone and computer. Smart speakers represented by Amazon Echo, already have tens of thousands of family-users. Speech recognition technology is one of the core technologies of these devices.

Six Dimensions of Human Resource Management

The six dimensions of human resource management are interconnected and interact to form an effective human resource management system, as shown in Figure 2. Among them,

- (1) Human resource planning is the starting point of human resource management. It mainly helps the organization to predict the future needs of personnel and the basic qualities of personnel through the plan.
- (2) Recruitment and deployment, with human resource planning as input, is equivalent to the organization's blood, providing nutrition to the organization, solving organizational staffing and staff matching issues.
- (3) Training and development, the theme is "education";
- (4) Performance management is the core of the six dimensions. It is also the main input for other dimensions.
- (5) Compensation management aims to motivate employees to solve problems in the company.
- (6) Employee relationship management aims to manage personnel and help the company form an effective cycle of rational allocation of human resources (Noe *et al.*, 2006).

AI Study in Human Resource Management

The development of Human Resource Information System (HRIS) has provided a foundation for AI application. HRIS With the development of human-computer interaction functions of AI, there is also possibilities for managers to improve management efficiency by using AI. "HRIS is a procedure for collecting, storing, maintaining, retrieving and validating data needed by an organization about its human resources, personnel activities, and organization unit characteristics"(Kovach & Cathcart, 1999; Lippert & Michael Swiercz, 2005). HRIS can assist the strategic planning with information for labor force supply and demand forecasts; dealing with applicant qualifications; development with information on training; and evaluating performance with information and so on. However, compared with AIHRM, the information system is more dealing with data input and storage, the intelligence decision assistance function is still limited. The artificial intelligence can further strengthen the business analytic abilities of the system to provide further references output for decision making. Data mining methods are also proposed for scanning the e-resume. Expert systems are proposed to solving the knowledge management in the enterprises. The controversy on

whether AI can replace the human resources is also discussed (Turban & Frenzel, 1992; HRP, 2017). There is still a research gap between the AI technology application study in HRM fields.

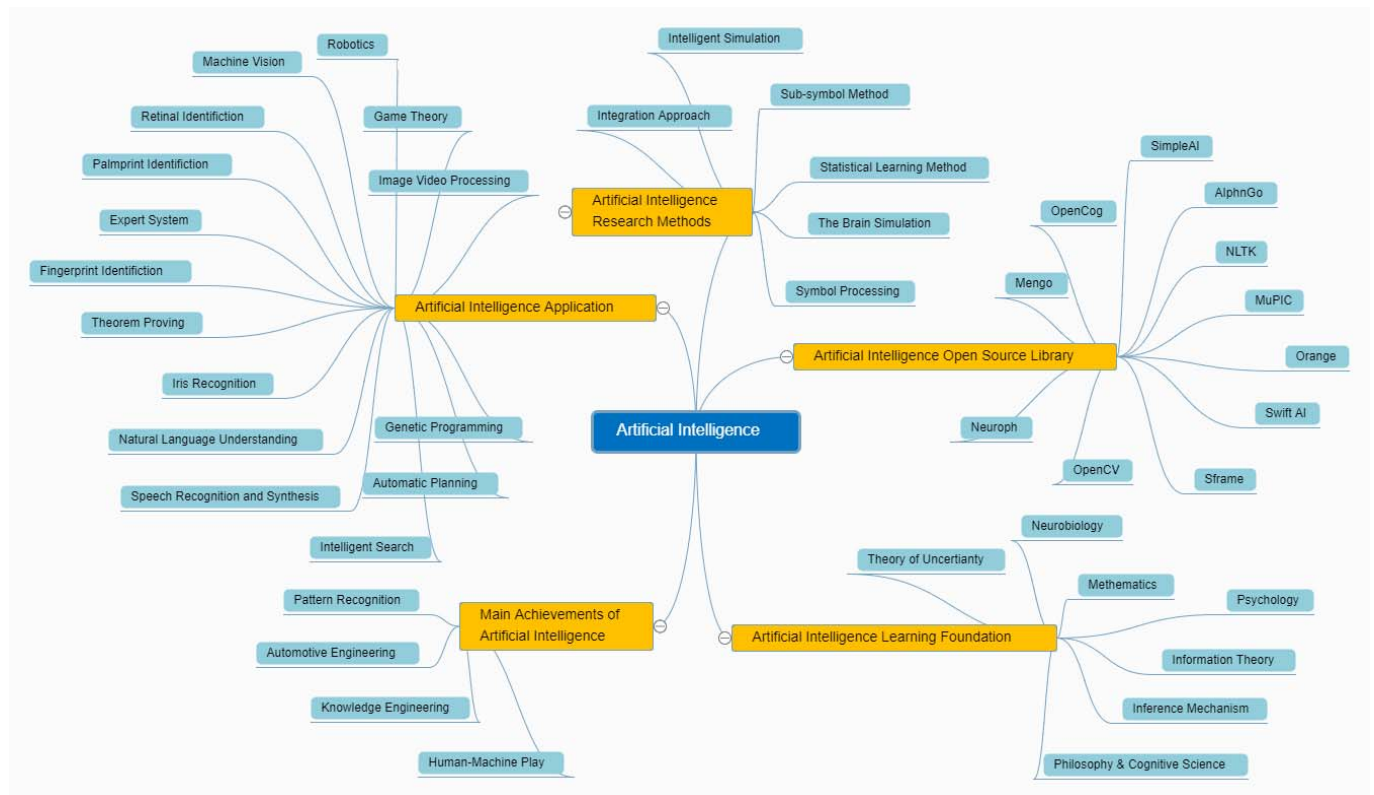


Figure 1: The AI technology network.



Figure 2: Six dimensions of human resource management.

CONCEPTUAL AI APPLICATION MODEL FOR HRM

The design of the "AI+HRM" model framework is mainly to assist the human resource managers to make better decisions more efficiently facing large amount of information. The framework answers how the AI can be combined with Human Resource Management. The corresponding relations among the human resource management, AI detailed technology, and the formed Intelligent System are described and explained, as shown in Figure 3.

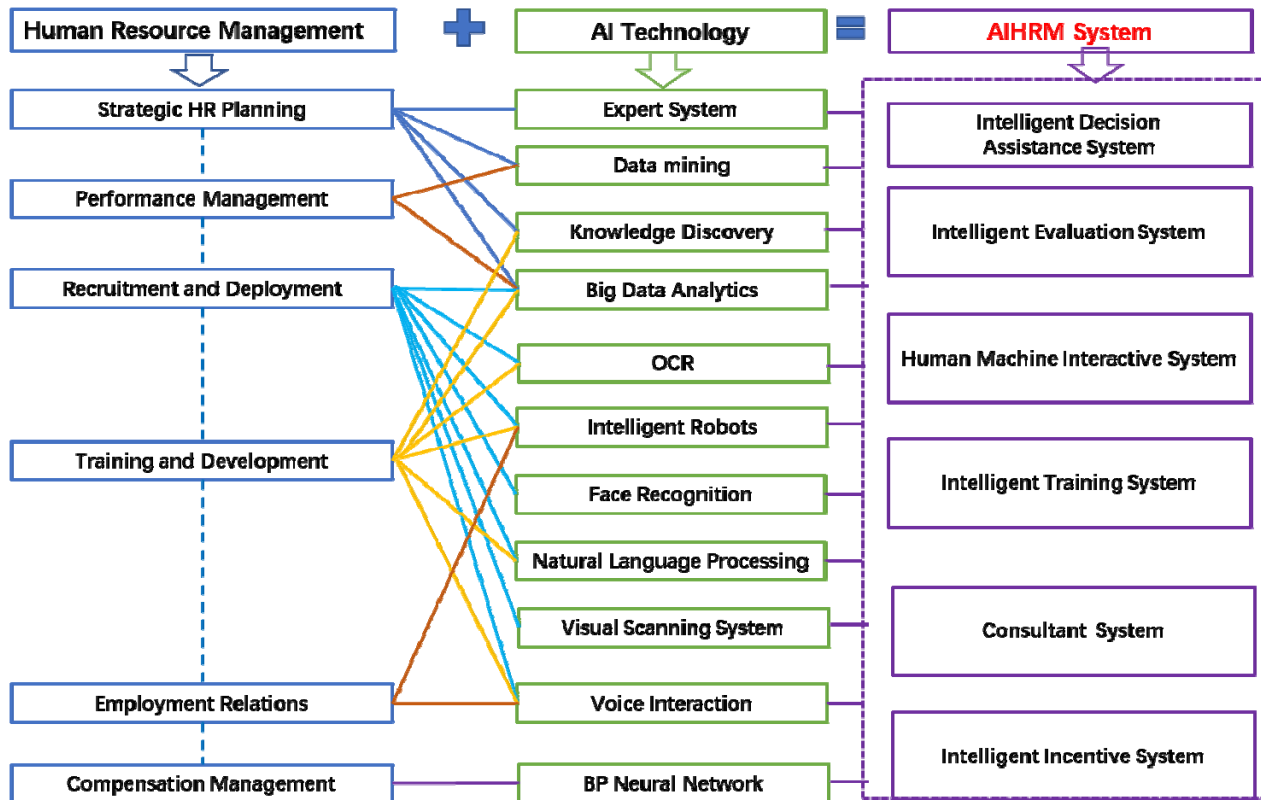


Figure 3: A conceptual model for artificial intelligence application in human resource management .

Human Resources Strategy and Planning

Human resource strategic planning is the starting point of HRM. Managers use artificial intelligence technology as an auxiliary decision-making system, which can carry out strategic planning more comprehensively. First, technologies such as data mining and knowledge discovery are needed to collect global information and combine with existing internal and external information. After summarizing the information, we can understand the current rationality of the human resources situation and forecast, evaluate and adjust the company's future management. Relying on the statistical and modification functions of the intelligent decision support system, the report is finally provided with various required information.

Recruitment and Deployment

As an important part of the system, the recruitment process includes review, screening resumes, interviewing candidates, matching suitable positions, etc. Ideal Corp, a software company that uses artificial intelligence to automate recruitment tasks, its CEO Somen Mondal says that the biggest impact of artificial intelligence is to automatically screen candidates and reduce bias. Artificial intelligence can learn the qualifications for successful employees in a particular position and apply this knowledge to select qualified candidates and score and rate candidates. According to Mondal, the company used artificial intelligence software to recruit, with a 71% reduction in recruitment costs and a threefold increase in recruitment efficiency (Denise, 2017).

First, the Optical Character Recognition (OCR) is used to identify paper resumes and pictures, or use the big data method to filter electronic resumes, analyze resumes, combine the characteristics of resume and text information extraction techniques, through matching, correlation analysis and statistical analysis. The database can be converted into a structured resume in seconds and push the candidate's resume to the company accurately and quickly. At the same time, through the analysis of resume and job matching,

the system can recommend suitable positions to candidates, especially for some high-end talents. In this process, AI has the characteristics of screening the candidates without prejudice (Hutson, 2017).

During the interview process, the company set up a recruitment model and the robot asks questions to the candidate. The enterprise can set the corresponding problem of matching posts and the keyword extension problem from candidates' answers. For example, if the candidate has engaged in data development related work, the robot will query the operation flow, and query which database to use according to the answer. The answer can be evaluated by collecting the keywords and similar word meanings. If the interviewer has doubts, he can re-watch the video. Artificial intelligence converts a 15-minute video interview into a set of 20,000 data points for facial movements, intonation and word selection. The system can help the interviewer greatly improve the efficiency of the interview without reducing the quality of the interview.

Face recognition techniques can be used in the exam to determine if the candidate is consistent with the document, thereby preventing others from taking the test instead of the candidate (Jain & Li, 2011). The use of natural language processing technology eliminates the need for typing, and the conversion from speech to text does not require much time, which will greatly improve the efficiency and accuracy of the recruiter's work. In addition, the system can also choose a reasonable interviewer by using the voice test method to carry out effective recruitment. After that, the big data method is used to collect candidate information, screen vacancies, match the interview results of the hired personnel, analyze their personality characteristics, advantages and disadvantages, and match the corresponding positions through analysis of personality and IQ/EQ test. At the same time, employees can be tested regularly (such as the annual). Using artificial intelligence can help managers to identify new employees with the greatest potential for success and deploy them in the right team. The intelligent system can also help employees to matching the right supervisors, recommend learning opportunities and career paths, and even suggest that they are at risk of leaving. It can also help to re-match jobs for employees who have a willingness to change jobs.

Training and Development

In the process of continuous development, both internal development and external impacts continue to push employees forward. Using a variety of artificial intelligence technologies, it can be more comprehensive to help enterprises to form a learning organization culture, which avoids the ordinary teaching design model based on the traditional gap analysis of the ability model. (Human resources managers need to conduct research and identify gaps of employees and group them through various analysis methods such as questionnaires, interviews, job observations, assessments, and job data analysis.)

First, training instructors can be artificially intelligent. During the training process, the robot training instructor can use the visual scanning system to observe the daily learning status of each student, accurately calculate the average value of all students' attention, and then retrieve the teaching events of different stimulation levels through data analysis. The instructors can also adjust the level of relaxation and the teaching rhythm according to students feedback. The curiosity of these students who interacts frequently with robots is also enhanced (Oshima *et al.*, 2012). In addition, through big data analysis, enterprise training can extract the part of employees who need to learn from the vast knowledge base, form a customized employee curriculum, comprehensively test and locate the staff level through technical means, and intelligently promote tailor-made courses.

In the training process, artificial intelligence technology can help the students to automatically record training data. The intuitive data is analyzed to show the degree and effect of employee learning, which saves time for training managers and allows managers to quickly learn about training results. In addition, companies can use voice technology, learning content database, and core algorithm to achieve a fast and efficient learning experience. AI teachers can not only improve the quality of learning and learning efficiency, but also significantly reduce the operation and management of online and offline training. AI teachers can also become an all-round assistant, from statistical learning data to outputting high-quality learning reports; from supervising students to learning automatic rankings. AI teachers will redefine the basic logic of instructional design. The employees can Simply enter the learning objectives, the archives and learn key points, and the course will be completed automatically by the AI teacher. In order to realize the core work from the definition of learning methods to the definition of problem-solving knowledge transfer, the "intellectual" construction will become the core content of the AI era curriculum designers.

Performance Management

In performance management, the performance appraisal model can be embedded into the system with collecting and analyzing the information about employees' work performance. Using the intelligent decision support system, some scientific evaluation methods, such as 360-degree performance evaluation methods, can be used more automatically and quickly (Otley, 1999). These assessment methods are programmed and entered into the decision support system to more effectively count employee evaluation results.

At the beginning of the year, the business objectives of each department of the company can be setup. The system can evaluate the individual performance targets, access control punch card system records, resignation system, department manager score, personal score, peer score, customer score and make other comprehensive analysis and evaluation. With the AI assistance, the decision-

makers can analyze the achievement of each indicator, propose the defects of the failed indicators, formulate and implement practical new indicators, and propose upgrade plans. The future performance objectives can also be setup with forecasting the future trend.

Compensation Management

Compensation management, or salary management is a dynamic management process which determines, assigns, and adjusts employee compensation principles, strategies, levels, structures, and factors that with the guidance of organizational development strategies (Henderson, 2003).

AI application can assist to facilitate fairness of the compensation management. BP neural network is a supervised artificial intelligence technology based on biology, neurology, psychology and statistics. It can imitate the human brain nervous system, establish a regular computing model, and integrate multiple neural network nodes (Richard & Lippmann, 1991). BP neural network system can be used to design an intelligent decision support system to form a fair salary evaluation system with the input of the big data .

Employee Relationship Management

Employee relationship management includes corporate culture and labor relations, coordinating the relationship between employers and employees. In terms of labor relationship management and communication management, artificial intelligence technology can be used as an auxiliary system to solve many complicated process stereotypes, undertake management tasks, and act as performers, assistants, and consultants.

The assistant primarily supports the manager and his team, such as recording, scheduling, reporting, or maintaining a scorecard. Examples of artificial intelligence applications in this area include the "Virtual Assistant System", which organizes meetings by reading and composing emails, coordinating participants, and managing calendars. In the process, these intelligent systems will gradually improve relevant knowledge and expand service areas by absorbing the experience of themselves and their colleagues. These systems extend the definition of workplace artificial intelligence and become the so-called "advisor system".

CASE STUDY

Leap.ai

Leap.ai was founded in the United States in 2016 by Yunkai Zhou (Leap.ai co-founder and CTO) and others, focusing on building a career development platform for all positions in high-tech companies. They match job seekers and recruiters in a high-quality manner through the use of artificial intelligence technology (Denise, 2017).

Business Model of Leap.ai

First, job seekers make related applications on the website and improves relevant information, including professional experience, advantages, career preferences, etc.. The platform uses artificial intelligence algorithms to compare the resumes uploaded by individual users with the corporate recruitment criteria. The final recommended positions will be further confirmed to improve accuracy. Most of the recruitment-related companies in the market mainly emphasize what the job seekers have done. In contrast, Leap.ai not only presents the job experience of job seekers, but also integrates factors such as work ability and job search preferences to job seekers to recommend more matching job opportunities.

Although Leap.ai's business model is the same as that of traditional headhunting companies or recruitment websites, Leap.ai leverages artificial intelligence to provide customized, refined, and standardized services. For example, if a job seeker looks for a product manager position on a traditional recruitment website, the general process is to first search for "product manager", and then the website extracts all product manager related information from the database according to keyword extraction. Then the user may receive thousands of results even they don't have time to read. Leap.ai analyzes the user based on the data and directly presents the required results, providing users with efficient and convenient choices. In addition to providing accurate choices for job seekers, it also provides targeted guidance and feedback, and helps establish standardized builds and transform them into high-quality resume formats. At present, Leap.ai has accumulated tens of thousands of end users, mainly in the United States, and its cooperative companies include technology giants such as Baidu, Alibaba, Didi, Uber and Ant Financial.

Matching AIHRM Mechanism of Leap.ai

Leap's key AI solution is subtly referred to as JUMP - Job User Matching Forecast. The team uses a variety of artificial intelligence techniques, including natural language processing, to understand each job and each user, and then predicts the likelihood that the user will be hired to work. For example, Leap considers the user's values, skills, strengths, location, company and job preferences, recruiting company requirements and culture, and uses machine learning to determine the best match for each user.

The team also uses AI technology throughout the product experience. For example, users can upload resumes on the welcome page and immediately get real-time results to determine which positions match may be appropriate for the system. After the artificial

intelligence system is matched, there is also a human review of the matching results by the human expert before the notification is obtained. Results are available within one business day.

Users can also try to use AI's Leap Resume to get real-time feedback on improving resume strength and improvement. By intelligently matching resumes, users get the best chance, and leap also introduces users directly to partner companies to streamline the entire job search process. By understanding each other's matching reasons, users can explore their own strengths and weaknesses hidden in them, and even explore more hidden opportunities and better present them on their resumes.

Leap.ai mainly uses ai technology, which simplifies the matching of job seekers and corporate talent needs. In countless resumes or job requirements, it screens out several candidates matching each other and provides them to cooperative enterprises, which greatly simplifies recruitment. The process better presents the advantages and individuality of the job seekers and recruits the right talents for the company. The company uses professional experience, work ability and corporate culture as three key factors to explore talent preferences and personality characteristics, and combine with the company's cultural background to achieve the needs of both parties.

Baidu University

Introduction to Baidu University

The division of labor between humans and machines is undergoing different changes. Baidu University is trying to use AI to build enterprise online learning, and let AI be used by corporate employees. On the Baidu AI open platform, everyone can use AI to learn more abilities, and the frontier experimenters who combine human intelligence and artificial intelligence effectively reserve more potential for their future career development (Wu, 2018).

AI and Training of Baidu University

Using artificial intelligence technology, attendants can empower your business, accelerate the growth of your business and employees, and quickly acquire more fresh knowledge. The voice automatic recognition technology can directly add letters to the video when learning online. The collected tens of thousands of student research reports can be quickly analyzed using natural language processing. For example, in a survey of open student questions at Baidu University, a total of 220,000 words of text were collected. It takes at least 5 hours to read by hand, but with artificial intelligence, it takes only 5 seconds to get clear results. This helps employers to better understand the employers needs and categorize and tailor to adequate curriculum.

IBM AI Driven HR

As a pioneer, IBM is arranging A.I. for its HR department with different functions, including measuring employee sentiment, increasing engagement, enhancing employee education, customize and design job requisitions, and acquiring new, diverse talent (Verne, 2018)

IBM provides HR solutions with its IBM Talent Management system to help enterprises to acquire, assess, and develop employees. Talent acquisition, talent assessments, talent development are the three subdivided modules of their solutions for improving HR in enterprises. Each modules are assisted with AI technology. For talent acquisition, IBM Watson candidate assistant is provide as an AI and cognitive talent management solution. Fitting the job seekers skills and the organization's needs, the AI robots in the systems interact with the job seekers and engage them by chatting in system. This assistant in the framework also identifies the skills needed for jobs in different industries and define the best practice for each job, including interview questions, coaching tips, SMART goals and prescriptive learning suggestions(IBM, 2018; Eric 2017).

FUTURE STUDY AND PRACTICAL IMPLICATIONS

The Collaboration of Human and Machine

The future trend of the AI for HRM is still the collaboration of human and machine with the existence of confliction. The McKinsey Global Institute believes that "more than 30% of activities in 60% of occupations can be replaced by artificial intelligence"(Chui & Francisco, 2017). According to a research report from the University of Oxford, in the next 10 to 20 years, half of the 702 jobs in the United States will disappear under the influence of IT, and nearly 47% of US employees will be employed. Based on these data, how to elevate the competitive intelligence of human resource managers and deploy the human resources efficiently may be very difficult to handle with.

How to collaborate the human and machine with using the developing technologies is also an important question. The large-scale rise in unemployment rate also will cause opposition and resistance. In detail, in each dimension of human resource management, there are worthy researching questions to be answered. For example, the process design for the matching between job seekers and providers based on HR model and AI. The intelligent performance evaluation system combined with the AI algorithms and performance evaluation standards (Dom, 2018).

Data Driven Human Resource Management Analytics and Information System

To maintain the competitive advantages, enterprises can make strategic plan for the AI transforming by gradually building the internal data analytical system and improving information system. This will provide foundation for embedding with AI system. For each dimension of the HRM, the new AI technology can be attempted. Recruiting and Training can be the starting points as shown by cases analysis. The machine learning techniques for the employees' performance prediction can also be applied for practice and research. The analytics of AI can also be applied for understanding organizational behaviors with data input.

Real Application Process, Advantages, and Risks

AI and HR combination has been undeniable trend in the HR revolutions. The current mature application is for recruiting, using chatbot and machine learning. Machine learning and augment learning algorithms are being developed to provide smart solutions for human resource management (Jill, 2018). However, most enterprises now are still not ready for AI application in HR. This process is not only a technology diffusion, but also a merge with strategy, organizational behaviors, enterprise culture and management process in the enterprise. So how to design and implement the AI technology into HR practice gradually is still worth exploring. Except for the advantages of AI brings to HR, there are also risks may exist, such as data exposure and inadvertent misuse (Josh 2018). How to avoid such risks is also an interesting topic.

CONCLUSIONS

This study proposes a conceptual AI framework for HRM, based on the six dimensions of HRM and status quo of AI technologies. Human resource strategy and planning combined with data mining and knowledge discovery can form a corresponding intelligent decision support system; The recruitment process is combined with face recognition and natural language processing technologies to establish an interview system; During the training and development process, intelligent robots and visual scanning technologies can assist people to teach and learn; The performance management procedure can be utilized with data mining technology, forming an intelligent incentive system; An intelligent salary evaluation system can be constructed by applying neural network system; Finally, the employee relationship management can be assisted with robot and voice interaction technologies to form a corporate advisory system. With the cases analysis on recruitment of leap.ai and online training of Baidu, the recruitment dimension and training dimension with AI are further explored. Finally, the practical implication and future study are supplemented. This AIHRM conceptual model provides suggestions and directions for the development of AI in enterprise human resource management.

ACKNOWLEDGMENT

This work was supported by National Natural Science Foundation of China [Grant No.71702045, 71872061]; Fundamental Research Funds for the Central Universities [Grant numbers 2013B18020206, 2014B14414]; Jiangsu Provincial Natural Science Foundation of China [Grant number BK20150823] and the Humanities and Social Sciences Foundation of the Ministry of Education in China [Grant number 16YJC630028, 17YJC630047].

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An Empirical Investigation of Culture's Influence in Online Service Ratings: From the Perspective of Uncertainty Avoidance

(Full Paper)

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ABSTRACT

In order to figure out the influence of consumers' cultural background on their online review generation behavior, this study aims to investigate how consumers' uncertainty avoidance values influence their online ratings. Utilizing data collected from a major travel review website, TripAdvisor, we find a negative relationship between uncertainty avoidance degree and online review rating. Consumers' travel type and hotel star are found to have a moderating effect between consumers' uncertainty avoidance and their online ratings. Moreover, the negative effect of uncertainty avoidance value on review rating is weaker for consumers on business travel, and this effect also decreases for upscale hotels. The results are further confirmed by a robustness check using another method. From a theoretical perspective, our study enriches existing literature dealing with online reviews. From a practical perspective, our research findings provide helpful insights to hotel practitioners.

Keywords: Service evaluation, online ratings, cultural differences, uncertainty avoidance, hotel industry.

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INTRODUCTION

With the fast development of information technologies, the role of consumers as receivers of online information has changed. Nowadays, numerous online platforms allow consumers to post online reviews about the merchant, products or service, enabling consumers to share their experiences and opinions with others (Burtch & Hong, 2014). Consumers are increasingly interacting with the Internet as creators by generating user-generated content rather than just accessing the content on the Internet (Gretzel, Fesenmaier, & O'leary, 2006). Online reviews have become to play an important role in consumers' travel-related decision making, especially in hospitality sector (Mauri & Minazzi, 2013) because their products are intangible products, which are more difficult to evaluate before consumers' consumption (Litvin, Goldsmith, & Pan, 2008). Hence, online reviews have been generally accepted as a new marketing strategy (Chen & Xie, 2008). Typically, an online review includes a numerical star rating (usually ranges from 1 star to 5 stars) and an open-ended text comment about the experience of using a product or service and the critique of product or service features (Mudambi & Schuff, 2010). The review ratings are a timely reflection of consumer satisfaction online, usually quantified on a five-point scale from 1 (i.e., very unsatisfied) to 5 (i.e., very satisfied) (Schuckert, Liu, & Law, 2015). Review rating given by a consumer can be used to indicate his or her overall satisfaction with the product or service (Yin, Zhang, & Li, 2014), therefore, review rating can be regarded as a proxy measure of consumers' satisfaction.

According to Hofstede's cultural theory (Hofstede, Hofstede, & Minkov, 2010), the culture of a nation differs from that of others in five dimensions, namely, power distance, long-term orientation, masculinity, uncertainty avoidance, and individualism. A new dimension called indulgence is added to Hofstede's cultural theory recently (Geert Hofstede). Large volume of online reviews enables researchers to investigate consumers' satisfaction, which is reflected by online ratings, through big data analytics. However, scarce research has studied how consumers' cultural background determines consumers' online rating behavior. Gao *et al.* (2018) investigate the influence of consumers' power distance on online ratings in the hotel sector. Hong *et al.* (2016) find that consumers' individualism affects their propensity to conform to the emotionality of prior opinion. Investigating the influence of consumers' cultural background on consumers' rating behavior is particularly important in the hotel industry as the hotel industry has a high level of globalization and involves consumers with different cultural background (Gao *et al.*, 2018). Our work will focus on how the customers' cultural background affects their online rating behavior. Using online hotel review data obtained from TripAdvisor, our study tries to investigate the antecedents of online ratings by figuring out the following two research questions: (1) Will consumers' uncertainty avoidance impact consumers' post-consumption behavior (i.e., consumers' online rating behavior)? (2)

Will hotel class and consumers' travel type moderate the relationship between consumers' uncertainty avoidance and online rating behavior?

The rest of this paper is structured as follows. We first review existing studies related to travelers' behavior and consumers' online review behavior, and then put forward our research hypotheses in Section 2. In Section 3 we present our research methodology and data collection process. In Section 4, we report the empirical results and discuss our main findings. In the final section, we conclude our paper by discussing the contributions, limitations, and future directions of our study.

THEORETICAL BACKGROUND AND HYPOTHESES DEVELOPMENT

The Impact of Uncertainty Avoidance on Online Ratings

Uncertainty avoidance is the degree to which members of a nation feel afraid with the uncertain or unknown situations (Hofstede, 1985). It was introduced as one of the five dimensions (i.e., power distance, long-term orientation, masculinity, uncertainty avoidance, and individualism) of individuals' national culture value (Hofstede *et al.*, 2010). Hofstede (2001) uses a scale ranged from 0 (i.e., very low) to 100 (i.e., very high) to measure the degree of a consumer's uncertainty avoidance. Customers from cultures with a relatively high degree of uncertainty avoidance have a much lower tolerance for ambiguity (Hofstede, 1980, 2001). In contrast, customers coming from cultures with a relatively low degree of uncertainty avoidance have a much higher tolerance for ambiguity (Hofstede, 1980, 2001). Consumers with higher level of uncertainty avoidance would expect more from the service provider.

According to expectation-confirmation theory (ECT) (Oliver, 1980), which is widely used in the consumer behavior field, it is easier for consumers with high expectation to be disappointed. Consumers with too high expectations are easier to be disappointed and feel disconfirmation of their expectations. For example, Wang *et al.* (2008) find Asian travelers usually travel to more developed countries and may have higher expectations of hotel service, the gap between their expectations and the service delivered may lead to lower ratings. Travelers from different cultures have different expectations (Schuckert *et al.*, 2015). Given their high expectations and tougher evaluations, consumers with higher uncertainty avoidance level usually perceived lower product or services quality (Raajpoot, 2004). This will lead to lower consumer satisfaction, which is reflected by lower review rating. Therefore, we put forward our first hypothesis:

H1: Consumers with higher uncertainty avoidance values tend to provide lower review ratings than those with lower uncertainty avoidance values.

The Moderating Role of Hotel Class

Hotel class is an official indicator of a hotel's quality and it may serve as a reference for consumers to adjust their product and service expectations (Xie, Zhang, Zhang, Singh, & Lee, 2016). Generally, all hotels can be divided into five categories ranging from 1 star to 5 stars to indicate the degree of the service that a guest can expect. Mobil Travel Guide clearly defines that can be expected for different levels of hotels (Guide). A Mobil One-Star Lodging Establishment is a limited service Hotel/Motel that is considered a clean, comfortable and reliable establishment. A Mobil Two-Star Lodging Establishment is a Hotel/Resort that is considered a clean, comfortable and reliable establishment, but also has expanded amenities, such as a full-service restaurant on the property. A Mobil Three-Star Lodging Establishment is a Hotel/Resort which is well-appointed, with a full-service restaurant and expanded amenities, such as, but not limited to: fitness center, golf course, tennis courts, 24-hour room service, and optional turndown service. A Mobil Four-Star Lodging Establishment is a Hotel/Resort/Inn which provides a luxury experience with expanded amenities in a distinctive environment. Services may include, but are not limited to: automatic turndown service, 24-hour room service, and valet parking. A Mobil Five-Star Lodging Establishment provides consistently superlative service in an exceptionally distinctive luxury environment with expanded services. Attention to detail is evident throughout the Hotel/Resort/Inn from the bed linens to staff uniforms. Zhang *et al.* (2012) divide hotels into three major categories: economy hotels with 1 star to 2.5 stars, midscale hotels with 3 and 3.5 stars, and luxury hotels with 4, 4.5, and 5 stars. Consumers tend to expect a higher level of service expectations for upscale hotels than low-tier hotels while booking hotels (Zhang *et al.*, 2012).

There is no doubt that consumers' expectations would influence consumers' satisfaction, consequently, Xu and Li (2017) find that consumer satisfaction and dissatisfaction may vary among various types of hotels. Schuckert *et al.* (2015) find that lower class hotels are more likely to generate different satisfaction degrees, indicating hotel class may influence the relationship between consumers' culture values and review ratings. Upscale hotels are believed to have more chance to accommodate travelers from different countries. For example, only hotels with no less than 3 stars are allowed to accommodate foreigners in China. Hence, upscale hotels have more experience in dealing with cultural issues to satisfy consumers. Consequently, the negative influence of consumers' uncertainty avoidance level on online ratings will decrease for upscale hotels. On the other hand, upscale hotels have more support for staff culture training, so employees of upscale hotels have access to knowledge about handling different demands of consumers from different countries. Hence, we propose the following hypothesis:

H2: Hotel class mitigates the negative influence of consumers' uncertainty avoidance on their review ratings.

The Moderating Role of Travel Type

A common method to segment travelers is based on their purpose for traveling, such as business or leisure (Liang, Schuckert, & Law, 2017). Many studies compare travelers for different purpose and find that hotel attributes have different effects on the selection made by travelers with different purpose (Ananth, DeMicco, Moreo, & Howey, 1992; Clow, Garretson, & Kurtz, 1995). Radojevic *et al.* (2015) explore the characteristics of four different categories of hotel consumers including solo travelers, groups of friends, couples, and families, and find that solo travelers assign higher ratings than family travelers. The influence mechanisms of customer satisfaction are different for travelers with different travel purpose (Ye, Li, Wang, & Law, 2014). Travelers for business may pay more attention to work instead of the hotel service they experience, and thus they are less responsive to the uncertainty during their stay in the hotel. In contrary, hotel staying is an important part of travel experience for travelers with leisure purpose, and they are much more sensitive to the uncertainty in the service process. Hence, it is reasonable to argue that the influence of consumers' uncertainty avoidance value on consumers' rating behavior may be different for consumers with different travel purpose. Consequently, we put forward the following hypothesis:

H3: The negative influence of uncertainty avoidance on review ratings is weaker for consumers on business travel than those on leisure travel.

Our research model and hypotheses that explain how uncertainty impacts consumers' online service ratings are shown in Figure 1.

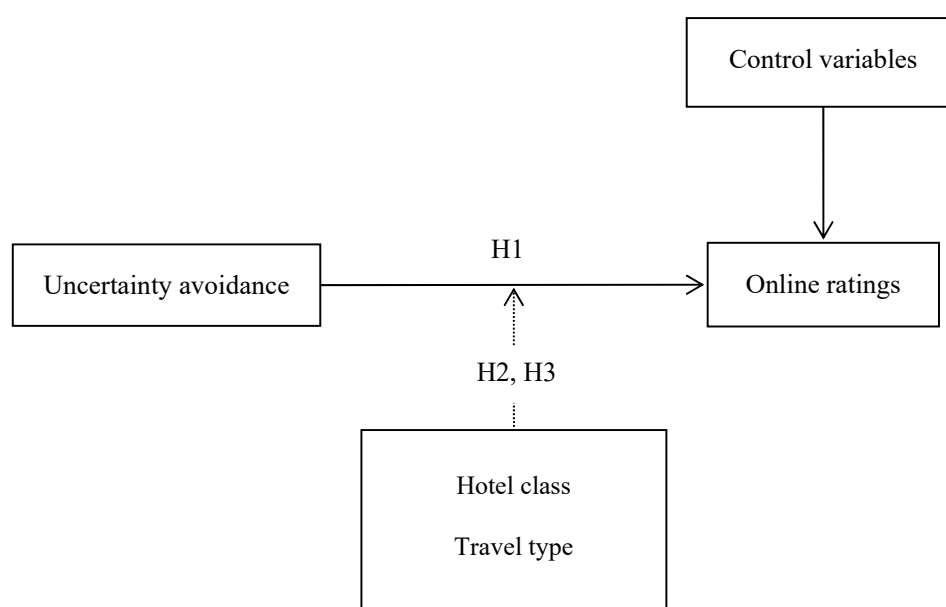


Figure 1: Research Model

RESEARCH METHODOLOGY

Data

TripAdvisor (www.tripadvisor.com), which provides travelers with the wisdom of the crowds to help them make better travel decisions, enables us to investigate our research question. TripAdvisor was founded in 2000 and has become the world's largest travel website with 630 million reviews and opinions covering approximately 7.5 million accommodations, airlines, experience, and restaurants (TripAdvisor). In this research, we developed a crawler to collect review data of hotels from TripAdvisor. In this research, we developed a crawler to collect data of hotel reviews for a matched set of hotels from TripAdvisor. We randomly selected hotels in Texas as our research sample. The data collection procedure was conducted in September, 2017. Every consumer review for a hotel since the hotel joined TripAdvisor was collected. The data contain time stamps and review content (ratings and texts), in addition to reviewer profile and hotel information. We obtained 545,443 reviews in total and the data set includes reviews posted from October, 2002 to April, 2017. As most of reviews are written by reviewers from USA, in order to balance the reviewers' culture background in our data set, we decide to delete observations written by American reviewers. After deleting observations with missing data and reviews written by American reviewers, 30,306 reviews were included in our study. Uncertainty avoidance index data for reviewers were obtained from "The Hofstede Centre" (geert-hofstede.com). The data sources for this study are summarized in Table 1.

Table 1: Data Sources

Data	Data Source
Review, reviewer, hotel data	TripAdvisor
Uncertainty avoidance index	The Hofstede Centre

Main Variables

Dependent variable

Review rating is an integer, ranging from 1 star to 5 stars based on the five-star rating scale of TripAdvisor. Review rating given by a consumer indicates his/her evaluation score for a specific product or service and it can be used to indicate his or her satisfaction with the product (Yin *et al.*, 2014). Theoretically, the higher the rating of a product is, the more positive the consumer's attitudes towards the product is (Lu, Ba, Huang, & Feng, 2013).

Independent variable

Uncertainty avoidance means a society's tolerance for uncertainty and ambiguity (Hofstede *et al.*, 2010). It deals with anxiety and distrust in the face of the unknown, and conversely, with a wish to have fixed habits and rituals, and to know the truth (Hofstede *et al.*, 2010). The uncertainty avoidance level of a country can be determined by the uncertainty avoidance index, which can be obtained from "The Hofstede Centre" (Hofstede). Reviewers' home country data were extracted from self-reported personal information on TripAdvisor.

Moderating variables

We treat hotel class and consumers' travel type as moderators in our study to how they work collectively with consumers' uncertainty avoidance value for impacting consumers' review behavior. *Hotel_Class* is the diamond star of a hotel that indicates the grade of hotels, ranging from 1 star to 5 stars. *Travel_Type* is a reviewer's self-reported travel type for a focal review, including business, family, couple, and so on. Following Ye *et al.* (2014), we divided consumers' travel types into two categories: business travel and leisure travel. Therefore, *Travel_Type* is binary variable with 1 indicating business travel and 0 otherwise.

Control variables

To robustly test the research hypotheses, we also included a comprehensive set of review-, hotel- and reviewer-related control variables.

Review-related control variables include the average rating observed by the reviewers before writing online reviews (*Obs_Avg_Rating*), mobile review, and the observed review volume. The observed average rating is treated as a control variable for studies on online rating behavior because it can be used to capture the effects of social influence among users (Gao *et al.*, 2018; Hong *et al.*, 2016; Ma, Khansa, Deng, & Kim, 2013; Sridhar & Srinivasan, 2012). Mobile review is dummy variable used to measure whether a review is submitted via a mobile device or not, and it equals 1 if the review is written by a mobile device and 0 otherwise. Burch and Hong (2014) find a variety of differences in reviews that are submitted via mobile devices; hence, we take *mobile review* as a review-related control variable. Reviewers' observed review number is also controlled, and the observed review volume (*Obs_Rev_Num*) must also be controlled according to attention-grabbing theory (Shen, Hu, & Ulmer, 2015), which contends that reviewers tend to deviate from the average rating when the review volume of product is large.

Reviewer-related control variables include member age or reviewer tenure, reviewer's review number or reviewer experience, reviewer's power distance and identity information disclosure. *Member_age* is measured by the time interval days between the time when the reviewer registered to become a Dianping user and the time when he/she posted the review, and we controlled for consumer tenure because consumers may grow more positive or negative as they accumulate review experience (Hong *et al.*, 2016). Reviewer's review number (*Reviewer_Rev_Num*) is measured by the number of reviews the reviewer has posted on TripAdvisor. Given that the reviewers' rating behavior may vary as their online experience increases (Goes, Lin, & Au Yeung, 2014; Janze & Siering, 2015), it is reasonable to control reviewers' online experience which is measured by historical review number. Reviewer's *power distance* is defined as "the extent to which a society accepts the fact that power in institutions and organizations is distributed equally" (Hofstede, 2001). Gao *et al.* (2018) confirm that the reviewers from countries with higher power distance tend to provide lower online ratings. Therefore, we take reviewers' power distance value as a reviewer-related control variable. On TripAdvisor, reviewers can decide whether to disclose their personal information, including their location, age, and gender. Given that whether a reviewer disclose his or her identity information may affect the reviewers' online rating behavior (Forman, Ghose, & Wiesenfeld, 2008; Gao, Hu, & Bose, 2017), we used a dummy variable, *Identity_Disclosure*, to denote whether the reviewer has disclosed their gender or age. This variable is equal to 1 if the reviewer has disclosed his/her gender or age, while it is equal to 0 otherwise.

We also include a hotel-related variable, hotel price, as a control variable. Price is found to not only influence consumers' pre-purchase perceptions but also their post-purchase satisfaction (Ye *et al.*, 2014). Hotel price is the average cost per person for the dinner in the restaurant and it is self-reported by restaurants on TripAdvisor. Table 2 provides a summary description for the variables included in our study.

Empirical Model

The Ordinary Least Squares (OLS) estimates are biased because the dependent variable, online rating, is an ordered and censored variable. Consistent with existing literature, we employ the Ordinal Logit model (Gao *et al.*, 2018; Hu & Li, 2011; Huang, Burtch, Hong, & Polman, 2016; Sridhar & Srinivasan, 2012).

Table 2: Variable Description

Variable Type	Variable	Description
Dependent variable	<i>Rating</i>	The overall rating of the hotel given by the reviewer (ranges from one star to five stars).
Independent variable	<i>Uncertainty_avoidance</i>	Hofstede uncertainty avoidance value for a reviewer from a country.
Moderating variable	<i>Hotel_class</i>	The class level of the hotel, ranging from one star to five stars.
	<i>Business_Travel</i>	A binary variable with 1 indicating the reviewer was on business travel and 0 otherwise (for leisure).
Control variable	<i>Obs_Avg_Rating</i>	The average rating of a hotel at the time just before a reviewer posted the review.
	<i>Hotel_Price</i>	Hotel price is the average price of a hotel. It is self-reported by hotels.
	<i>Mobile_Review</i>	A binary variable indicates whether the review was written through a mobile device.
	<i>Obs_Rev_Num</i>	The total number of reviews for a hotel at the time just before a reviewer posted his or her review.
	<i>Identity_Disclosure</i>	A binary variable indicates whether a reviewer disclose his/her identity information.
	<i>Power_Distance</i>	Hofstede power distance value for a reviewer.
	<i>Reviewer_Rev_Num</i>	Up to the time we collected data, the total number of reviews the reviewer has posted on TripAdvisor.
	<i>Member_Age</i>	The number of days in the interval between the day when reviewer was registered to become a TripAdvisor user and the day when he/she posted the review.

RESULTS

Descriptive Analysis

Table 3: Descriptive Statistics of Key Variables

Variable	Obs#	Mean	Std. Dev	Min	Max
<i>Rating</i>	30,306	3.972	1.080	1	5
<i>Uncertainty_Avoidance</i>	30,306	52.075	18.886	8	112
<i>Hotel_Class</i>	30,306	3.155	0.740	1	5
<i>Hotel_Price</i>	30,306	194.651	104.362	42	1196.5
<i>Mobile_Review</i>	30,306	0.130	0.337	0	1
<i>Obs_Rev_Num</i>	30,306	422.483	562.110	1	4001
<i>Obs_Avg_Rating</i>	30,306	4.006	0.567	1	5
<i>Identity_Disclosure</i>	30,306	0.515	0.500	0	1
<i>Power_Distance</i>	30,306	46.585	18.302	11	104
<i>Reviewer_Rev_Num</i>	30,306	67.268	117.873	1	1840
<i>Member_Age</i>	30,306	1207.621	1076.971	0	5305
<i>Business_Travel</i>	30,306	0.353	0.478	0	1

Table 3 reports the descriptive statistics of key variables in our study. As we can see from Table 3, the average value of *rating* is 3.972; *Uncertainty_Avoidance* ranges from 8 to 112, and the mean and standard deviation value of it are 52.075 and 18.886;

Hotel_Class ranges from 1 star to 5 stars and the average value is 3.155; *Hotel_Price* ranges from 42 dollars to 1196.5 dollars with the mean value of 194.651; About 13% reviews are posted through mobile devices; The average value of observed review number is 422.483 and the average rating of observed reviews is 4.006; More than half (51.5%) of reviewers disclose their identity information; *Power_Distance* ranges from 11 to 104, and the average value of it is 46.585; There are large differences in reviewers' online experience, which is measured by *Reviewer_Rev_Num* and *Member_Age*; 35.3% of reviews are written by reviewers on business travel. In order to reduce the skewness of *Reviewer_Rev_Num*, we use its logarithm value in the correlation matrix and regression analysis.

Table 4 provides the correlation matrix and Variance Inflation Factor (VIF) values of main variables in our main study. All the correlations are smaller than 0.7 and all VIFs are smaller than 5, therefore, multicollinearity is not a threat to our study (Mason & Perreault Jr, 1991).

Table 4: Correlation Matrix and VIF Values of Key Variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	1.00													
2	-0.03	1.00												
3	0.16	-0.06	1.00											
4	0.19	-0.09	0.71	1.00										
5	-0.03	-0.00	0.03	0.03	1.00									
6	0.10	-0.04	0.46	0.39	0.11	1.00								
7	0.38	-0.04	0.33	0.33	0.04	0.24	1.00							
8	-0.01	-0.10	0.05	0.05	-0.02	-0.05	0.01	1.00						
9	-0.03	0.49	-0.04	-0.09	-0.02	-0.05	-0.04	-0.07	1.00					
10	-0.03	-0.12	0.08	0.09	0.14	0.00	0.05	0.54	-0.13	1.00				
11	-0.02	-0.09	0.06	0.07	0.12	0.14	0.08	0.32	-0.09	0.44	1.00			
12	-0.00	0.02	0.22	0.13	-0.05	0.04	0.10	-0.03	0.09	-0.07	-0.09	1.00		
13	0.03	-0.03	-0.00	-0.00	0.02	0.01	0.02	0.02	-0.06	0.05	0.02	-0.01	1.00	
14	0.00	0.62	-0.04	-0.05	0.01	-0.01	-0.01	-0.04	0.20	-0.05	-0.04	0.02	0.16	1.00
VIF		2.16	2.31	2.09	1.05	1.36	1.16	1.45	1.37	1.64	1.31	1.08	1.06	1.76

Notes: 1: *Rating*; 2: *Uncertainty_Avoidance*; 3: *Hotel_Class*; 4: *Hotel_Price*; 5: *Mobile_Review*; 6: *Obs_Rev_Num*; 7: *Obs_Avg_Rating*; 8: *Identity_Disclosure*; 9: *Power_Distance*; 10: *Ln_Reviewer_Rev_Num*; 11: *Member_Age*; 12: *Business_Travel*; 13: *Uncertainty_Avoidance * Hotel_Class*; 14: *Uncertainty_Avoidance * Business_Travel*

Table 5: Effects of Uncertainty Avoidance on Online Ratings

Variable	Coef.	Std. Err.	z	P> z
<i>Uncertainty_Avoidance</i>	-0.002***	0.001	-2.65	0.008
<i>Uncertainty_Avoidance * Hotel_Class</i>	0.002***	0.0008	2.97	0.003
<i>Uncertainty_Avoidance * Business_Travel</i>	0.003***	0.001	2.81	0.005
<i>Hotel_Class</i>	0.011	0.022	0.50	0.614
<i>Hotel_Price</i>	0.002***	0.0002	12.55	0.000
<i>Mobile_Review</i>	-0.161***	0.032	-4.96	0.000
<i>Obs_Rev_Num</i>	-0.0001**	0.00002	-2.91	0.004
<i>Obs_Avg_Rating</i>	1.249***	0.022	57.75	0.000
<i>Identity_Disclosure</i>	0.054**	0.026	2.11	0.035
<i>Power_Distance</i>	-0.0002	0.007	-0.34	0.737
<i>Ln_Reviewer_Rev_Num</i>	-0.123***	0.008	-15.58	0.000
<i>Member_Age</i>	-0.00007***	0.00001	-6.24	0.000
<i>Business_Travel</i>	-0.314***	0.023	-13.39	0.000
Cut 1	1.309***	0.101		
Cut 2	2.255***	0.100		
Cut 3	3.552***	0.101		
Cut 4	5.278***	0.104		
Obs#	30,306			
LR Chi ²	5178.71***			
Pseudo R ²	0.0642			

Notes: *: $p < 0.1$; **: $p < 0.05$; ***: $p < 0.01$.

Main Analysis

Stata 14.0 is used to process our data set, and the final results are reported in Table 5. As shown in Table 5, the coefficient of uncertainty avoidance on ratings is significantly negative, supporting the hypothesis of the negative relationship between uncertainty avoidance and online ratings (*H1*). Both interaction terms are significantly positive, indicating hotel class and the reviewer's travel type (whether he or she is on business travel) mitigate the negative influence of uncertainty on online ratings. Hence, *H2* and *H3* are supported.

Robustness Check

We also check the robustness of our findings using an alternative estimation method, which is ordinary least square (OLS) regression. Table 6 presents the results of robustness check. The results are consistent with those of our main analysis. Therefore, the various estimation methods demonstrate robustness of our study.

Table 6: Results of Robust Test

Variable	Coef.	Std. Err.	t	P> t
<i>Uncertainty Avoidance</i>	-0.002***	0.0004	-3.68	0.000
<i>Uncertainty Avoidance * Hotel Class</i>	0.001***	0.0004	2.82	0.005
<i>Uncertainty Avoidance * Business Travel</i>	0.002***	0.0006	3.41	0.001
<i>Hotel Class</i>	0.016	0.012	1.37	0.171
<i>Hotel Price</i>	0.001***	0.00008	10.76	0.000
<i>Mobile Review</i>	-0.106***	0.017	-6.12	0.000
<i>Obs Rev Num</i>	-0.00003***	0.00001	-2.67	0.008
<i>Obs Avg Rating</i>	0.683***	0.011	63.06	0.000
<i>Identity Disclosure</i>	0.038***	0.011	2.76	0.006
<i>Power Distance</i>	-0.0001	0.0004	-0.35	0.728
<i>Ln Reviewer Rev Num</i>	-0.029***	0.004	-7.06	0.000
<i>Member Age</i>	-0.00004***	0.000006	-6.07	0.000
<i>Business Travel</i>	-0.132***	0.012	-10.63	0.000
Obs#	30,306			
F (13, 30292)	427.19***			
Adjusted R ²	0.1546			

Notes: *: $p < 0.1$; **: $p < 0.05$; ***: $p < 0.01$.

CONCLUSIONS AND DISCUSSIONS

Conclusions

The main purpose of this study is to figure out the collective influence of consumers' culture value, hotel class, and consumers' travel type on rating behavior. The results of the hypotheses testing are reported in Table 7. Our findings show that consumers' uncertainty avoidance degree has negative influence on consumers' online rating behavior. Moreover, the negative effect of uncertainty avoidance on review rating is weaker for consumers on business travel, and this effect also decreases for upscale hotels.

Table 7: Summary of Hypotheses Testing

Hypothesis	Result
<i>H1: Consumers with higher uncertainty avoidance values tend to provide lower review ratings than those with lower uncertainty avoidance values.</i>	Supported
<i>H2: Hotel class mitigates the negative influence of consumers' uncertainty avoidance on their review ratings.</i>	Supported
<i>H3: The negative influence of uncertainty avoidance on review ratings is weaker for consumers on business travel than those on leisure travel.</i>	Supported

Implications

Our study has both theoretical and practical contributions. From a theoretical perspective, our study offers insights for existing literature dealing with online reviews. First of all, our study focuses on online review generation mechanism, which is often neglected by researchers. Second, our work demonstrates the value of consumers' uncertainty avoidance on consumers' online review writing. From a practical perspective, our research findings provide helpful insights to hotel practitioners. Given that consumers' uncertainty avoidance value has a negative impact on consumers' online ratings for hotels, hence, hotel managers should pay more attention to online reviews written by reviewers from higher uncertainty avoidance value nations and provide

timey managerial response to the negative reviews. Also, in order to obtain accurate and objective feedback from consumers, hotel managers must synthesize the online ratings provided by reviewers from countries with various levels of uncertainty avoidance values.

Limitations and Future Work

This study inevitably is subject to some limitations. First, a convenience sampling method was used. We used hotels in Texas as our research sample, which is just a small part of hotels registered on TripAdvisor. Future work should include more hotels from cities worldwide to improve the generalizability of the results. Second, we test our hypotheses only in the context of hotel business and in other platform of TripAdvisor, and we can empirically test our research model in other domains such as catering industry and in other online review platforms to obtain better external validity in the next step. Third, besides consumers' travel type and hotel class, other factors related to consumers or hotels may also have moderating effect for the relationship between consumers' uncertainty avoidance and online ratings. Therefore, it is advisable to consider more factors and conduct a more comprehensive research model to investigate consumers' online rating behavior during travel to enrich our study.

ACKNOWLEDGMENT

This work was partially supported by the China Postdoctoral Science Foundation (Grant # 2018M640300) and the National Natural Science Foundation of China (Grant # 71671153, 71801063, and 91746103).

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Artificial Intelligence in Smart Tourism: A Conceptual Framework (Full Paper)

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ABSTRACT

Smart tourism destination as: an innovative tourist destination, built on an infrastructure of state-of-the-art technology guaranteeing the sustainable development of tourist areas, accessible to everyone, which facilitates the visitor's interaction with and integration into his or her surroundings, increases the quality of the experience at the destination, and improves residents' quality of life. Lopez de Avila (2015). Smart tourism involves multiple components and layers of "smart" include (1) Smart Destinations which was special cases of smart cities integration of ICT's into physical infrastructure, (2) Smart experience which specifically focus on technology-mediated tourism experience and their engagement through personalization, context-awareness and real-time monitoring, (3) Smart business refer to the complex business ecosystem that creates and supports the exchange of touristic resource and the co-creation of tourism experience. Gretzel et al, (2015). Smart tourism also clearly relies on the ability to not only collect enormous of data but to intelligently store, process, combine, analyze and use big data to inform business innovation, operations and services by artificial intelligence and big data technique. The rapid development of information communication technology (ICT) such as artificial intelligent, cloud computing, mobile device, big data mining and social media cause computing, storage and communication relevant software and hardware popular. Facebook, Amazon, Apple, Microsoft and Google have risen rapidly since 2000. In recent years, Emerging technologies such as Artificial Intelligence, Internet of Thing, Robotic, Cyber Security, 3D printer and Block chain also accelerate the development of industry toward digital transformation trend such as Fintech, e-commerce, smart cities, smart tourism, smart healthcare, smart manufacturing... This study proposes a conceptual framework that integrates (1) artificial intelligence/machine learning, (2) institution/organizational and (3) business processes to assist smart tourism stake holder to leverage artificial intelligence to integrate cross-departmental business and streamline key performance metrics to build a business-level IT Strategy. Artificial intelligence as long as the function includes (1) Cognitive engagement to (voice/pattern recognition function) (2) Cognitive process automation (Robotic Process Automation) (3) Cognitive insight (forecast, recommendation).

Keywords: Smart tourism, smart cities, artificial intelligence, digital transformation and big data

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INTRODUCTION

According to United Nations World Tourism Organization (UNWTO: Tourism Highlights 2017 Edition) report released, the total world tourism revenue in 2017 was \$1.34 trillion US dollars, an increase of about \$94 billion US dollars from 2016. In 2017, the total number of international tourists reached 1.323 billion up 7% from the previous year. The forecast average annual growth rate of global international visitors will be about 3.3% between 2010 and 2030. In 2020, it will reach 1.4 billion, and in 2030 it will reach 1.8 billion. In terms of regional market development, the Asia-Pacific region is still the region with the strongest growth. The average growth rate in the Asia-Pacific region is 4.9%, which will increase from 204 million in 2010 to 535million in 2030. Estimated to grow from 21.7% in 2010 to 29.6% in 2030.

In recent years, countries around the world have prioritized tourism as a key economic sector to help the country's overall economic development. "Sustainable Tourism" is now the top priority for all countries to develop tourism. The Asia-Pacific Economic Cooperation (APEC) meeting in this year (2018) under the leadership of the host economy Papua New Guinea, pays more attention to "smart tourism" One of the key points: the use of digital technology for digital connections will help to develop inclusive tourism and promote the connection of people in the Asia-Pacific region to promote sustainable tourism. In this regard, Every Country has formulated specific strategies and actively promoted it.

Smart tourism involves multiple components and layers of "smart" include (1) Smart Destinations which was special cases of smart cities integration of ICT's into physical infrastructure, (2) Smart experience which specifically focus on technology-mediated tourism experience and their engagement through personalization, context-awareness and real-time monitoring, (3) Smart business refer to the complex business ecosystem that creates and supports the exchange of touristic resource and the co-creation of tourism experience. Gretzel et al, (2015). Smart tourism also clearly relies on the ability to not only collect enormous of data but to intelligently store, process, combine, analyze and use big data to inform business innovation, operations and services by artificial intelligence and big data technique.

The rapid development of information communication technology (ICT) such as cloud computing, mobile device, big data mining and social media cause computing, storage and communication relevant software and hardware popular. Facebook, Amazon, Apple, Microsoft and Google have risen rapidly since 2000. In recent years, Emerging technologies such as Artificial Intelligence, Internet of Thing, Robotic, Cyber Security, 3D printer and Block chain also accelerate the development of industry toward digital transformation trend such as Fintech, e-commerce, smart cities, smart tourism, smart healthcare, smart manufacturing.

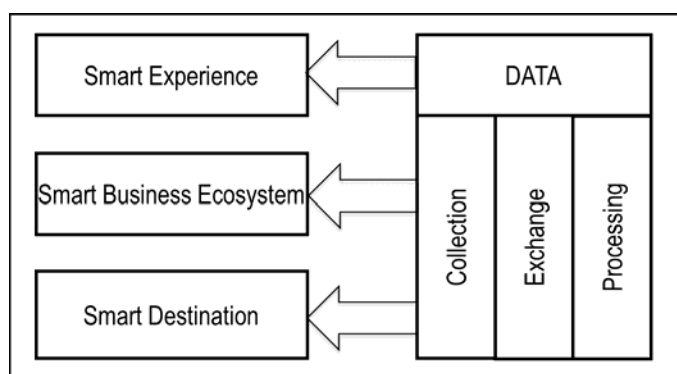
This study proposes a conceptual framework that integrates (1) artificial intelligence/machine learning, (2) institution/organizational, and (3) business processes to assist smart tourism stake holder to leverage artificial intelligence to integrate cross-departmental business and streamline key performance metrics to build a business-level IT Strategy. Artificial intelligence as long as the function includes (1) Cognitive engagement to (voice/pattern recognition function), (2) Cognitive process automation (Robotic Process Automation), and (3) Cognitive insight (forecast, recommendation).

LECTURE REVIEW

Smart Tourism

Lopez de Avila (2015, n.p.) defines the smart tourism destination as: an innovative tourist destination, built on an infrastructure of state-of-the-art technology guaranteeing the sustainable development of tourist areas, accessible to everyone, which facilitates the visitor's interaction with and integration into his or her surroundings, increases the quality of the experience at the destination, and improves residents' quality of life. Gretzel *et al.* (2015) Define smart tourism as "tourism supported by integrated efforts at a destination to collect and aggregate/harness data derived from physical infrastructure, social connections, government/organizational sources and human bodies/minds in combination with the use of advanced technologies to transform that data into on-site experiences and business value-propositions with a clear focus on efficiency, sustainability and experience enrichment."

According to Gretzel *et al.* (2015) define smart tourism components and layer as Figure 1. Smart tourism involves multiple components and layers of "smart" include (1) Smart Destinations which was special cases of smart cities integration of ICT's into physical infrastructure, (2) Smart experience which specifically focus on technology-mediated tourism experience and their engagement through personalization, context-awareness and real-time monitoring, (3) Smart business refer to the complex business ecosystem that creates and supports the exchange of touristic resource and the co-creation of tourism experience. Gretzel et al, (2015).



Source: Gretzel U, Sigala M, Xiang Z, Koo C (2015)

Figure 1. Components and layers of smart tourism

Smart Destination

Smart destination are special cases of smart cities: they apply smart city principles to urban or rural areas and not only consider residents but also tourists in their efforts to support mobility, resource availability and allocation, sustainability and quality of life/visits. Destinations are typically the concern of government tourism organizations who invest in their promotion. Even though government funds are often limited due to necessary budgetary constraints there is a substantial multiplier effect to investment in tourism promotion. An interesting study by Webber Quantitative Consulting carried out in 2014 estimated the multiplier for return on marketing investment for Australian Inbound to be between 13 and 15. That is, for every Australian Dollar invested there was a return of between 13 and 15 Dollars.

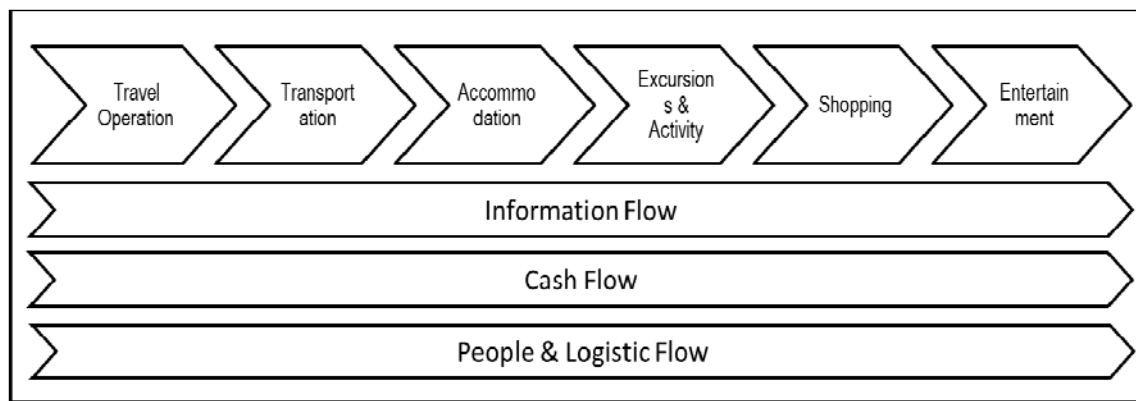
Smart Tourism about in the 21st Century if it is not about providing bookability? It's as being about the application of technology to provide a satisfying and frictionless tourism experience from the very start of the tourism life cycle, ie. researching the destination through trip planning, to the in-trip experience where tourists need the tools to access the information and services they require whilst in the destination.

Lopez de Avila (2015, n.p.) defines the smart tourism destination as: an innovative tourist destination, built on an infrastructure of state-of-the-art technology guaranteeing the sustainable development of tourist areas, accessible to everyone, which facilitates the visitor's interaction with and integration into his or her surroundings, increases the quality of the experience at the destination, and improves resident's quality of life.

Smart Business Ecosystem

Refers to the complex business ecosystem that creates and supports the exchange of touristic resources and the co-creation of the tourism experience. Buhalis and Amaranggana (2014) describe the business component of smart tourism as being characterized by dynamically interconnected stakeholders, the digitalization of core business processes, and organizational agility. A distinct aspect of this smart business component is that it includes public-private collaboration to an extent that is unusual and results from governments becoming more open and technology-focused as providers of infrastructure and data. In addition, smart tourism recognizes that consumers can also create and offer value as well as monitor and therefore take on business or governance roles.

The traditional tourism business ecosystem included tourism operators, airline or local bus transport operators, hotel or local homestay accommodation operators, attraction, historic scenery excursion and activity operators, shopping department or mall operators, entertainment operators, etc. as Figure 2.



Source: This study

Figure 2. Smart Tourism Business Ecosystem Value Chain

Smart Experience

The smart experience component specifically focuses on technology-mediated tourism experiences and their enhancement through personalization, context-awareness and real-time monitoring (Buhalis and Amaranggana 2015). Neuhofer *et al.* (2015) identify information aggregation, ubiquitous connectedness and real-time synchronization as the major drivers of such smart tourism experiences.

With the focus on the traveler as the user of these systems, these systems aim to support travelers by: 1) anticipating user needs based upon a variety of factors, and making recommendations with respect to the choice of context-specific consumption activities such as points of interest, dining and recreation; 2) enhancing travelers' on-site experiences by offering rich information, location-based and customized, interactive services; and 3) enabling travelers to share their travel experiences so that they help other travelers in their decision making process, revive and reinforce their travel experiences as well as construct their self-image and status on social networks. From the industry perspective, the emphasis is on the potential contributions of these smart systems in terms of process automation, efficiency gains, new product development, demand forecasting, crisis management, and value co-creation (Werthner 2003; Wöber 2003; Sigala 2012a and b; Yoo *et al.* 2015).

ICT and Smart Tourism

With the focus on the traveler as the user of these systems, these systems aim to support travelers by:

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Table 1. ICT and Smart Tourism

Technology	Function	Smart Tourism scenario
Mobile Device/Wearable	Mobile Phone for Web, multimedia, eMail, Apps	Smart Tourism App, Location base App, Target Marketing Device
Cloud	Cloud for Iaas, PaaS, SaaS, IoTaaS, AIaaS	Smart Tourism cloud infrastructure services for XaaS.
Social Media	Online Social engage platform	Smart Tourism social media for smart destination
Big Data	Collect online data for exchange and process	Big Data for Smart Tourism analytic, prediction
AR/VR	Augmented Reality/Virtual Reality	AR/VR for smart destination promotion
Robotic	Robotic for human interaction assistance	Robotic for helpdesk, customer service in destination
IoT	Internet of Thing	Location based service for tourism, transportation
Block Chain	Open distributed ledger technology	Smart contract for tourism, food quality record tracking
Artificial Intelligent	AI/ML provide analytic algorithm	Cognitive engagement, process automation, insight
3D Printer	Transferring image onto a 3D surface	Destination 3D landscape demonstration, Customize souvenir product
Cyber Security	Internet, IoT security	Provide all tourism big data security such as GDPR compliance
5G/NB-IoT, Wifi	5G next generation transmitting technology	Smart Tourism data transmitting backbone

Source: This study

Artificial Intelligence and Machine Learning

Artificial Intelligence (AI) was first proposed by John McCulloch in 1955 as "science and engineering to make smart machines." It refers to the wisdom expressed by machines made by humans. Usually artificial intelligence refers to human intelligence technology realized by ordinary computer programs.

Supervised learning: Supervised learning algorithms use training data and feedback from humans to learn the relationship between a given input and a given output. Know how to classify the input data and the type of behavior you want to predict, but you need to use algorithms to calculate new data for you. 1. Humans mark input data and define output variables. 2. Train the algorithm to find the connection between the input variable and the output. 3. Once the training is complete - usually when the algorithm is sufficiently accurate - the algorithm is applied to the new data. The most commonly used supervised learning is: 1. Linear regression. 2. Logistic regression. 3. Naive Bayes. 4. Linear/quadratic discriminant analysis. 5. Support vector machine. 6. Decision tree. 7. Random forest. 8. Simple neural network.

Unsupervised learning: Unsupervised learning algorithms probe input data without giving explicit output variables. When a lot of training data is not available; that is, the ideal final state cannot be clearly defined; or the only way to understand the environment is to interact with the environment. 1. Unsupervised learning algorithms accept unlabeled learning data. 2. The algorithm learns the inferred data structure from the data. 3. The algorithm learns to identify data sets that exhibit similar behavior. The most commonly used unsupervised learning is: 1. K-means clustering. 2. Hierarchical clustering. 3. Gaussian mixture model. 4. Recommender system.

Reinforcement learning: Enhanced algorithm learning how to perform tasks simply by trying to maximize their behavior and reward rewards. When there is not a lot of training data, and the ideal final state cannot be clearly defined, or the environment is known in advance, the only way to interact with the environment is to interact with the environment. 1. The algorithm takes action on the current environment. 2. If the action gets the maximum reward available, it will receive reward feedback. 3. The learning algorithm optimizes the best set of actions by correcting its own mode over time. Enhanced learning is custom-made, integrating various algorithms and optimization. Commonly used enhanced learning applications are: 1. Google AlphaGo 2. Optimize the trading strategy of the options trading portfolio. 3. Optimize the load on the power grid during different demand cycles. 4. Use robots to pick warehouse products and optimize inventory. 5. Optimize the driving behavior of self-driving cars.

Artificial Intelligence and Machine Learning application solution

Cognitive engagement: To engage tourism using AI natural language processing and pattern recognition capability to provide real-time 7*24 services capacity. The available product in market such as Chatbot, voice customer assistant,

Starbucks in 2016 began using AI for serving personalization recommendation, Lowe's bringing AI to three-dimensional space with LoweBots. These machines can navigate stores and understand what customers say, and if they favor a particular item. They

also keep track of inventory levels for best-possible service and use analytics to study the flow of store traffic and when it occurs. The North Face, using IBM Watson's AI to bring in-store boutique service to the internet. Its personal shopping tool, XPS, acts as a digital brand expert. The tool helps shoppers navigate the online experience like an educated in-store associate to help with shopping cart abandonment and relieving shoppers of the conflict caused by choice. Vanguard is piloting an intelligent agent that helps its customer service staff answer frequently asked questions. The plan is to eventually allow customers to engage with the cognitive agent directly, rather than with the human customer-service agents. SEBank, in Sweden, and the medical technology giant Becton, Dickinson, in the United States, are using the lifelike intelligent-agent avatar Amelia to serve as an internal employee help desk for IT support. SEBank has recently made Amelia available to customers on a limited basis to test its performance and customer response.

Cognitive automation is based on software bringing intelligence to information-intensive processes. It is commonly associated with Robotic Process Automation (RPA) as the conjunction between Artificial Intelligence (AI) and Cognitive Computing. By leveraging Artificial Intelligence technologies, cognitive automation extends and improves the range of actions that are typically correlated with RPA, providing advantages for cost savings and customer satisfaction as well as more benefits in terms of accuracy in complex business processes that involve the use of unstructured information.

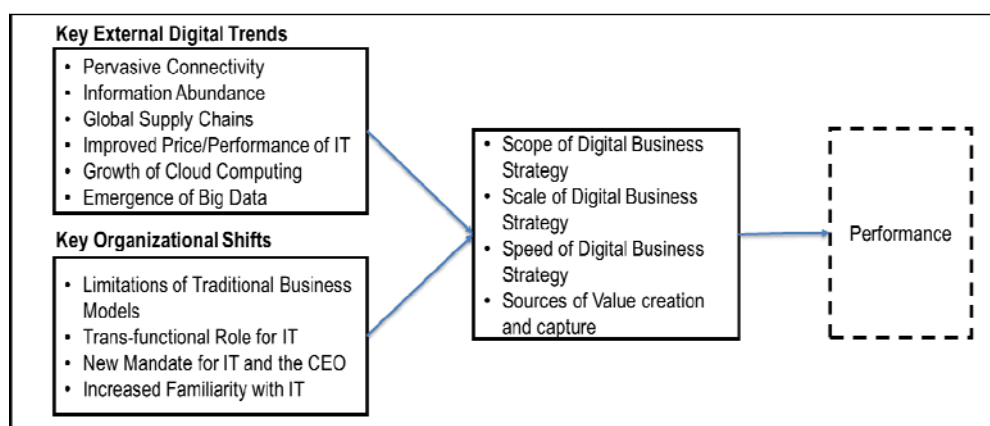
NASA, cost pressures led the agency to launch four RPA pilots in accounts payable and receivable, IT spending, and human resources—all managed by a shared services center. Swedish bank, Skandinaviska Enskilda Bank (SEB), deploy cognitive robotic process automation software from one of the leaders in the industry, IPsoft, for improving its customer service. AXA Group, French insurance companies, deploying intelligent automation for improving its underwriting. Ascension Health is non-profit health organization in the U.S. already using RPA platform to automate its repetitive manual tasks including, transactions and maintaining patient records.

Cognitive insights provided by machine learning differ from those available from traditional analytics in three ways: They are usually much more data-intensive and detailed, the models typically are trained on some part of the data set, and the models get better—that is, their ability to use new data to make predictions or put things into categories improves over time.

GE has used this technology to integrate supplier data and has saved \$80 million in its first year by eliminating redundancies and negotiating contracts that were previously managed at the business unit level. Similarly, a large bank used this technology to extract data on terms from supplier contracts and match it with invoice numbers, identifying tens of millions of dollars in products and services not supplied. Deloitte's audit practice is using cognitive insight to extract terms from contracts, which enables an audit to address a much higher proportion of documents, often 100%, without human auditors' having to painstakingly read through them. IBM Watson Health had provided cognitive insight to hospital doctor by digest patients treatment papers with AI/ML.

Smart Tourism Initiative business strategy

Information technology is critical to business success because it directly impacts the mechanisms that create and capture value for profit: IT is therefore part of the company's business strategy. However, a large body of existing research on IT/strategic relationships does not accurately target IT as a functional level strategy. This general undervaluation of the role of the IT business layer suggests that there is a need to re-edit its role in the strategy, and the complex and interdependent relationship with the organization requires the company to create profits. We use a comprehensive framework of potential profit mechanisms and believe that although IT activities are still part of the company's functional level strategy, they also play a major role in business strategy and have a huge performance impact. Information technology affects the structure of the industry and the range of business-level strategic choices and value-creating opportunities that the company may pursue. Through complementary organizational change, IT can both enhance the company's current (ordinary) capabilities and achieve new (dynamic) capabilities, including the flexibility to focus on rapidly changing opportunities, or to abandon the loss of initiative while recovering significant asset values. This digital attribution also determines how much value a company can capture - once it is digested by competition or through the power of value chain partners, the governance of these partners is itself dependent on IT. We explore these business-level strategic roles in information technology and discuss some of the provocative and future research directions in the convergence of information systems and strategies.



Source: Bharadwaj, Anandhi and El Sawy, Omar A. and Pavlou, Paul A. and Venkatraman, N. Venkat, (2013)

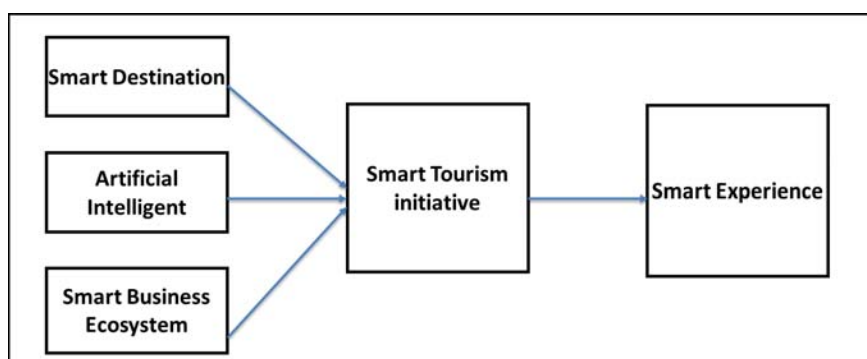
Figure 3. Drivers of the Four Key Themes of Digital Business Strategy

We identified four key themes to guide our thinking about digital business strategies and provide a framework to define these four themes: (1) the scope of the digital business strategy Scope, and (2) the scale of the digital business strategy Scale, (3) Speed Speed of Digital Business Strategy, and (4) Source of Value of Business Value Creation and Capture in Digital Business Strategy. After elaborating these four topics, we will discuss the success indicators and potential performance impacts of pursuing digital business strategies.

RESEARCH

Conceptual model of AI/ML in Smart Tourism

This research proposes a conceptual framework that integrates (1) artificial intelligence/machine learning, (2) Smart Business Ecosystem and (3) Smart Destination to assist smart tourism stake holder to leverage artificial intelligence to integrate cross-departmental business and streamline key performance metrics to build a business-level IT strategy to achieve tourism smart experience. The proposed conceptual model as figure 4.



Source: This study

Figure 4. Conceptual model of Smart Tourism with AI/ML

The smart tourism AI/ML conceptual model describe as following:

Smart Experience

AI/ML could help traveler to enhance travel experience by the function of engagement, process automation and insight as

1) Anticipating user needs based upon a variety of factors and making recommendations with respect to the choice of context-specific consumption activities such as points of interest, dining and recreation. By tourism big data collection, AI/ML could learn tourist behavior to predict habit/interest, provide airline, hotel, restaurant recommendation and social group promotion. Also, By RPA process automation could integrate tourist application or inquiry process to automation to provide one-stop-shop process. Robotic, Chatbot could assist tourist for travel information inquiry, online helpdesk nonstop every day.

2) Enhancing travelers' on-site experiences by offering rich information, location-based and customized, interactive services: Robotic and Chatot provide tourism destination, information inquiry, location promotion by analysis GPS and shopping data. NLP

natural language process could provide instant language translation to assist tourist get travel information. Also image recognition could enhance destination rich content information.

3) Enabling travelers to share their travel experiences so that they help other travelers in their decision making process, revive and reinforce their travel experiences as well as construct their self-image and status on social networks: AI/ML could enhance tourist experience by auto bookmark photo with location information and generate photo book automatically. Also, tourist could upload photo to social media group sharing to promotion travel experience with family and friends.

Smart Business Ecosystem

Smart Business Ecosystem include tourism value chain participate provider not only physical provide but also online services provider. The physical tourism business ecosystem includes tourism operators, airline or local bus transport operators, hotel or local homestay accommodation operators, attraction, historic scenery excursion and activity operators, shopping department or mall operators, entertainment operators, etc. Also, there are lots of on-line service provider provide ticket resignation or recommendation such as tourism online service provider (TripAdvisor, GoogleMap), transportation online service provider (Ctrip, Skyscanner, Uber, DiDi, Grab), online accommodation service provider (Airbnb, Trivago), online payment (Alipay, Linepay, Applepay) and social media platform (Facebook, Instagram, WeChat, Weibo, etc.).

Government tourism department or online tourism service provider could build up a smart tourism platform to integrate all physical and online ecosystem to provide one stop shop portal. The smart tourism platform could leverage Cognitive engagement: leverage Robotic, Chatbot, facial/Voice recognition AI/ML for online help desk to help tourism information inquiry, recommendation, etc.

Cognitive process automation: Robotic process automation RPA to automate tourism online or paper process by integrate business ecosystem (include tourism operators, transportation operators, accommodation operators, excursion and activity operators, shopping operators, entertainment operators) internal ERP, ecommerce data.

Cognitive insight: Collect tourism big data with AI/ML for demand forecast, schedule simulation, product development, social media trend prediction, target marketing, sales promotion.

Table 2: Smart Tourism business ecosystem provider

	Travel Operation	Transportation	Accommodation	Excursions & Activity	Shopping	Entertainment
Off-Line	Travel agency	Airline, Local bus transportation provider	Hotel and local apartment Provider	Destinations, Disneyland...	Departments, Mall	Casino, Movie theater
On-line Platform	GoogleMap, TripAdvisor, online travel services provider	Ctrip, SkyScanner, UBER, Grab, DiDi...	Airbnb, Trivago	Online destination ticket services.	e-Commerce, Amazon, eBay, Taobao, JD, PCHome..	Online ticket commerce, Netflix, FOX+
Cash Flow	Apple Pay, AliPay ..					
Information Flow	Facebook, Instagram, WeChat, Weibo...					

Source: This study

Smart Destination:

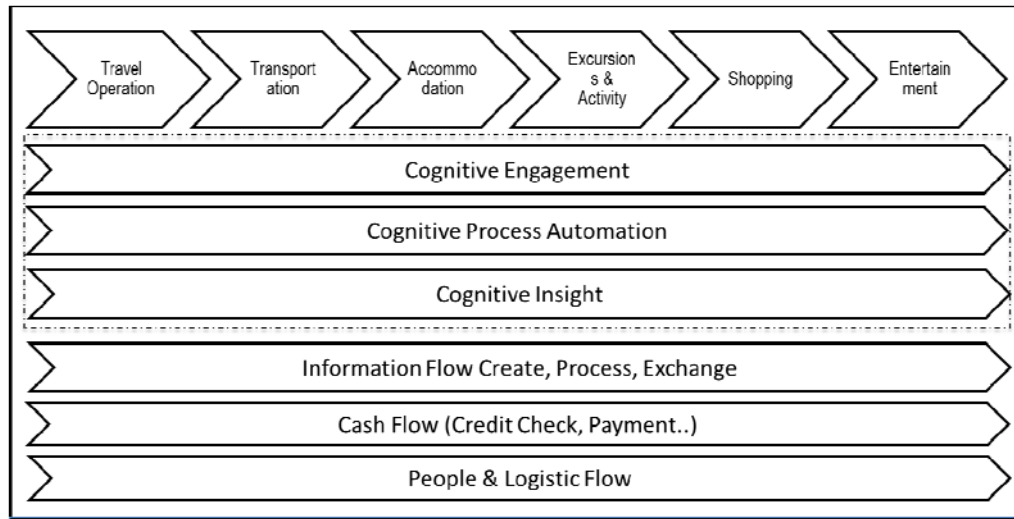
Smart destination are special cases of smart cities: they apply smart city principles to urban or rural areas and not only consider residents but also tourists in their efforts to support mobility, resource availability and allocation, sustainability and quality of life/visits. Destinations are typically the concern of government tourism organizations who invest in their promotion. Lopez de Avila (2015, n.p.) defines the smart tourism destination as: an innovative tourist destination, built on an infrastructure of state-of-the-art technology guaranteeing the sustainable development of tourist areas, accessible to everyone, which facilitates the visitor's interaction with and integration into his or her surroundings, increases the quality of the experience at the destination, and improves resident's quality of life.

Cognitive engagement: Smart destination government promotion department could leverage Chatbot and Robotic to provide single contract window to support tourist travel information and registration across business ecosystem. Also, for the purpose of collect

all destination information, government could fund smart tourism cloud service for IaaS, PaaS, SaaS and AIaaS for all travel business ecosystem operator.

Cognitive process automation: Smart destination are special cases of smart cities. Smart cities include smart transportation, smart healthcare, smart public safety, smart building, smart energy...etc. Robotic process automation RPA could link all public smart cities services with one single contact window to provide emergency safety, hospital and transportation information and services. Also streamline with all online and physical travel business ecosystem (include tourism operators, transportation operators, accommodation operators, excursion and activity operators, shopping operators, entertainment operators) together.

Cognitive insight: Collect tourism big data with AI/ML for destination development, transportation demand forecast, schedule arrangement, destination flow control, public surveillances monitor.



Source: This study

Figure 5. Smart Tourism initiative with AI/ML

Smart Tourism Digital Business Strategy

Based on value chain of exist tourism business ecosystem (tourism operators, transport operators, accommodation operators, excursion and activity operators, shopping operators, entertainment operators, etc.), it can be seen that their information flow and logistics was information islands which cause lack of interconnection and interoperability. There is not only cannot provide one-stop smart services for tourists also no big data collection, analysis, and recommendation/decision-making capabilities. Therefore, three application functions of artificial intelligence and machine learning (cognitive engagement, cognitive process automation, and cognitive Insights) could be leverage to integrating cross-value chain ecosystems, integrating information to develop a smart travel business strategy to differentiate in the global travel market.

The smart tourism business strategy need to consider following:

1. Scope of the initiative business strategy:

Different from the existing tourist value chain, the business function of the business is differentiated. The smart tourism business strategy should distinguish the project scope with smart destinations, integrate all eco-industries across the tourism value chain, and integrate information flow, cash flow and logistics to avoid information island.

2. Scale of the initiative business strategy:

Because the smart tourism project smart project big data learning provides recommendations, analysis, forecasting and other functions, the project scale should be based on plan big and start small, and consider the project planning team personnel artificial intelligence and solution providers. The ability is gradual.

3. Speed of the initiative decision making:

In addition to considering data collection and technical capability, machine learning and training time should be considered for overall project schedule.

4. Source of value creation and capture:

Integrating information flow, cash flow and logistics data to provide recommendations, analysis and forecasting will create valuable big-data assets. It's not only enhance the tourist smart experience but also improve business ecosystem operation

performance and increase profit. Also government policy maker and tourism promotion departments can also use those big data to plan for develop smart destinations effectively and optimize tourism resources.

CONCLUSION

This paper attempted to provide a smart tourism with artificial intelligent digital business strategy conceptual framework. The practice implication is simplify AI sophisticate technology into cognitive function for smart tourism industry digit business initiative. Due to artificial intelligent is emerging technology, the tourism adoption reference is scarce. There is no reference case to experiment and verify. Based on the proposed conceptual framework need further work as 1) Collect use case to verify performance and impact. 2) Further study smart tourism business ecosystem business model. 3) AI cognitive engagement, process automation, insight technology acceptance model verification. 4) Further study smart tourism big data issues (include GDPR, open data).

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Automatic Extraction of Theft Judgment Information in Natural Language (Full Paper)

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ABSTRACT

Recently artificial intelligence technology replaces traditional manual methods in many fields. Especially the application of artificial intelligence in the legal field liberates legal people from tedious work. For example, crimes are automatically classified based on the facts of the crime, such as the crime name and sentence prediction. However, the premise of these applications is based on the establishment of case bases. Therefore, this paper studies the issue of automatic extraction of verdict information in natural language. Due to the verbal writing specification, we use regular expressions to construct extraction rule templates for template matching. At the same time, we also use natural language processing technology to extract the relevant semantic information accurately. For further similar case searching. The research focus of this paper is on the theft verdicts, and establish a database of records for the theft of the theft and the prediction of the theft of the theft.

Keywords: Natural language processing; knowledge acquisition; database.

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INTRODUCTION

With the arrival of the Internet era, the data on the Internet has formed the age of big data, but most of these data are unstructured data. The current situation of data is huge, fast changing, various forms of existence, such as pictures, audio, and video, and many data are of poor quality. The dramatic increase of information quantity highlights the importance of information processing and application in many fields. In the field of justice, legal cases have constituted a fairly large set of cases, but many of them exist in paper documents or text form, from which that is not easy to search or find the information too messy, this makes it unnecessary difficult to automatically judge cases, retrieve similar cases and forecast sentences in the future. These case sets contain the evaluation standards and results of different cases by different legal institutions and lawyers, and contain rich legal knowledge. By extracting and sorting out the information related to the case, and artificial intelligence can be facilitated the retrieval of similar cases of legal institutions, and the recommendation of similar cases can better realise the value of previous cases. How to extract and sort out the massive and jumbled judgment information and build case base is the foundation of artificial intelligence.

To this end, this paper adopts the method of using regular expressions and judgment of part of speech based on natural language processing to extract information about the text features of the formal judgment of theft, and sorts the extracted information into the database to build case base for further use. So, the contribution of this paper is to establish the information database of judgment, so that information retrieval and application become more convenient and fast. Provide more convenient data support to similar case pushing and sentence prediction.

The structure of this paper is: Firstly we describes in detail the structure of the system and the principle of the technology used. The second section we present our prototype system and structure as follows illustrates the operational process and details of the system. Thirdly we explain the experimental results. Fourthly we discuss the content of this paper and finally, it is very important to point out the work that could done in future.

PRINCIPLE

The system structure

First, the original text is obtained from the web page or local file, and then the text is particized. Regular expressions are used to obtain the text and determine the type of words, and finally the corresponding fields are stored in the database.

The system structure is shown in Figure 1.

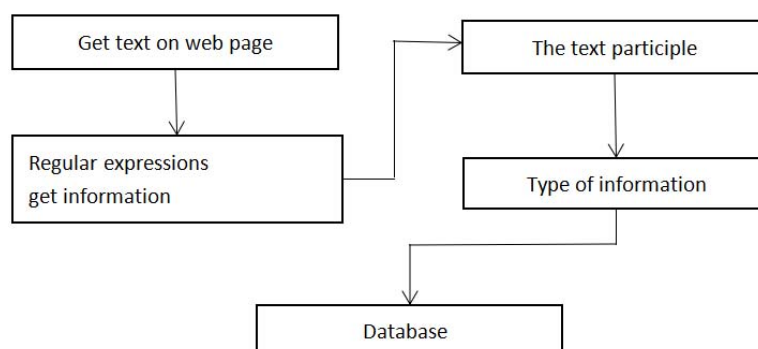


Figure 1: System structure diagram

1. Text segmentation: the first step of text processing is word segmentation. The original corpus is continuous sentences. Chinese word segmentation has its unique difficulty compared to English word segmentation. Most of Chinese word segmentation is based on word frequency statistics (Fei, Kang & Zhu, 2005). But there are many Chinese word packets in python, and this article USES python's third-party library, jieba. The original corpus was segmented by direct use of jieba (Chinese text segmentation: built to be the best Python Chinese word segmentation module.).

2. Judgment of information type: the corpus must be used when processing Chinese text, whether it is word segmentation, part-of-speech tagging or word classification. What is stored in the corpus is the language materials that appear in the actual use of the language. The corpus is the basic resource that carries the language knowledge with the computer as the carrier, while the real corpus needs to be analysed and processed to become a useful resource. Natural language processing is based on corpora. In this paper, WordNet (Fellbaum, 2012) is adopted. WordNet is a tree structure, and each node of it corresponds to a synonym set. The edge represents the upper or lower word relation, i.e., the superior or subordinate relation. The hierarchical fragment of WordNet is shown in figure 2.

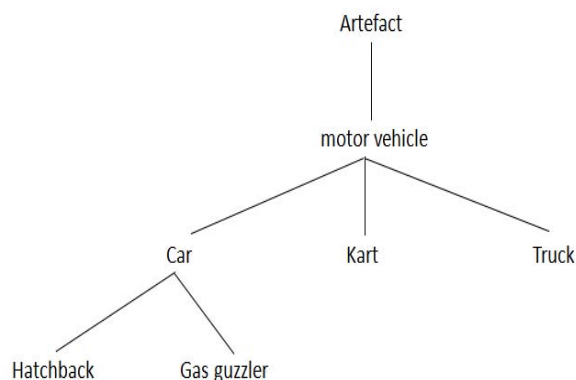


Figure 2: Wordnet hierarchy fragment diagram

3. Regular expressions: regular expressions (Hu, Qin & Zhang, 2011) are a concept in computer science and are commonly used to retrieve and replace text that meets specified pattern rules. In this paper we use regular expressions to retrieve information that needs to be met, such as dates. The way to construct a regular expression is the same as the way to create a mathematical expression, with multiple meta characters combined with operators to constitute longer expressions. A pattern of text consists of characters in a regular expression. When retrieved with a regular expression template, the template is formed with one or more characters. The template is matched with the string searched, and all matched strings are recorded. In the pattern matching, it is divided into greedy matching or non-greedy matching, which should be handled carefully when searching.

Algorithm

The main algorithm steps of the system are as follows:

```

1 : for i in file
2 :   flag=flag+file[i]
3 :   fun1(flag)
4 : p1=r" \d*year\d*month\d*day"
5 : flag.jieba(cut)
6 : flag.cutsy()
7 : for i in flag
8 :   flag[i].root_hyponyms()
9 :   update(flag[i])
10 : end

```

First, It gets the text and stored it as file and store it into flag word by word. When reading the line feed, call the corresponding paragraph processing function and extract the information in the paragraph. (lines 1-3 of the algorithm). For example, the processing function for the first paragraph, the regular expression gets the time axis, and then the word segmentation function is used to divide the paragraph text. and then filter the punctuation, (line 4-6 of the algorithm). For each word in flag, the function is used to find the upper word of the word, the type of the word is found by the upper word, and the corresponding field is stored in the database (lines 7-10 of the algorithm).

The detail function above only gives the first paragraph, and the following paragraph function is different from the details above.

Criminal judgment on theft

The criminal judgment is a written decision of the people's court on the conviction and sentencing of the defendant based on the facts and evidence ascertained in the end of the trial of the criminal case in accordance with the procedures provided for in the criminal procedure law (Zhang, 2009). After the conclusion of the trial of a criminal case, the people's court will, on the basis of the ascertained facts and the applicable law, make a legally binding judgment on the criminal act committed by the defendant. The judgment clearly state the basic information of the defendant, including the name, gender, age, domicile of origin, address, position, previous experience with criminal punishment, arrest and date of custody of the defendant, and so on. The situation of counsel and prosecutor; determine the facts, reasons and applicable legal basis of the judgment; the judgment and the duration of the appeal and the court of appeal. As soon as the criminal judgment takes legal effect, it has legal binding force.

In this paper we only discuss the verdict of larceny. The main factor in the measurement of theft is the value of stolen goods. Some judgments indicate clearly the total value of stolen goods before the judgment, but some do not. At this time, the part of the description of the crime be analysed by natural language processing technology, and the value of all cash and goods will be added and the total value will be obtained.

There are many cases in the case library, and the amount of larceny is changed with time, because the purchasing power of RMB keeps changing (Yuan, 2011). So time is also a factor in sentencing. The same provinces, nationalities, and so on. And the occupation and education also can influence, and knowing but still break the law to break the law is even more serious. There are also factors that can directly affect the sentence, such as recidivism, surrender, and adulthood. These factors can be used to the determinant the predict similar cases and sentences, but the weights are different, so these are also the information to be extracted.

Information type judgment

When we get the information of the defendant, we get the written information. We do not know whether this information is the educational background, occupation or native place of the defendant, how to judge which type of information is obtained, then we should use corpus or professional documents. The method of professional documents is to list all occupations, provinces, educational backgrounds and so on separately. When getting information, search the corresponding documents one by one. However this method is troublesome and inaccurate and prone to errors that cannot be found. This is the time to use the corpus method.

Wordnet is a tree corpus. The parent node is the big category of the child node. For example, the father node of apple is fruit, and the father node of banana is also fruit. When used, you can find the information word in the corpus and its parent node on the Internet. For example, if the information word is "doctor", the word on the parent node of the doctor can be found to be occupation.

In Python, there is a package called NLTK which can use wordnet directly, and you can simply call the function to get the contents of the parent node. However, wordnet is translated from English, and some words are too specialised to be one-to-one

corresponding. Therefore, we should combine the methods of professional documents and corpus, making up for each other to obtain accurate information classification.

The information type judgment of other literatures is realised by the method of part-of-speech annotation and automatic learning of machine learning, but the combination of natural language processing and professional documents in fixed fields can easily judge the information type.

Regular expression

Regular expressions are especially effective in obtaining information with fixed patterns, such as time, format must be yyyy year mm month and dd day. Regular expressions can be used to obtain all the information in the text that matches the template. Especially the main greedy match and the non-greedy match. Greedy matches match text messages as long as possible, so select the non-greedy pattern.

When obtaining the list of criminal facts, we can use time matching to obtain the list of criminal trends and time clues of the accused. According to the time, the criminal facts of the accused are listed one by one according to the time axis. When the judgment does not specify the total value of stolen properties, the value of stolen ones must be obtained and added to the list of criminal facts to obtain the total value of stolen properties.

Store the data

The storage of data is in MySQL database. The way to store data is to store pages and files. Python3.6 has the pymysql package, which enables the operation of the database. The data is stored in the web page. Django (Django is a high-level Python Web framework that encourages rapid development and clean, pragmatic design. Built by experienced developers, it takes care of much of the hassle of Web development, so you can focus on writing your app without needing to reinvent the wheel. It's free and open source.) is used to obtain the input data through the web page and save it to the local database.

Due to some of the information by calling the function, therefore cannot insert a to all the information, can only be inserted into the court, such as the number of first simple information, and to automatically generate information ID, the ID again passed as a parameter to the function, finally in function with updata instruction update assigned ID data, the function of information in the database. That is, one insert operation, multiple updata operations and one complete data storage.

Some data verdicts are missing, so some database fields may be empty. In the later sentencing prediction, the null field is likely to be divided into zero. If multiple null fields may affect the case reference value, the priority of this data is relatively low.

The data obtained are all strings, but some fields are converted into numeric types, such as the value of stolen properties, sentences, and so on. Converted into Numbers and stored in the database to facilitate the promotion of similar cases and prison term prediction in the future. After conversion into figures, it is convenient to calculate the similarity of average sentence and amount of theft.

Prototype system example

The original text of the judgment is first obtained from the web page, This is the original text of a simple criminal conviction for theft. This example happened in 2017, which is closer to the present. Therefore, this case is used as a simple example to illustrate the research of this paper. The example as Table 1.

The detailed implementation steps are as follows:

1. Get information from the web page; the original text in a file; retrieve the content of each segment in a loop; use different fun() functions to handle flag for different sections.
2. Call fun1(flag) to process the first paragraph. First, use the flag = jieba.cut(flag) text participle to obtain the segmented flag. The flag after the segmentation.

Defendant Du, male, December 8, 1993 born in Jingxing County, Hebei Province, Han, Mass, secondary school culture, jobless. On suspicion of theft, by the Zhanhuang County Public Security Bureau decided, on November 18, 2016 by the Zhanhuang County Public Security Bureau criminal detention; December 2016 2 was arrested.

Table 1: Judgment

<p>Zanhuang County People's Court</p> <p>Criminal judgements</p> <p>(2017) Ji 0129 at the beginning of the sentence No. 6th</p> <p>Public Prosecution agency Zanhuang County People's Procuratorate, Hebei province.</p> <p>Defendant Du, male, December 8, 1993 born in Jingxing County, Hebei Province, Han, Mass, secondary school culture, jobless. On suspicion of theft, by the Zanhuang County Public Security Bureau decided, on November 18, 2016 by the Zanhuang County Public Security Bureau criminal detention; December 2016 2 was arrested.</p> <p>The Zanhuang County People's Procuratorate of Hebei Province filed an indictment with the court on January 4, 2017 on charges of theft on behalf of the defendant, (2017)7, for pleading guilty to prosecution. The court opened the case on January 4, 2017 and applied summary procedure in accordance with the law, with a single trial and a public hearing of the cases. Zanhuang County People's Procuratorate assigned the prosecutor Zhang Limei appeared in court to support the public prosecution, the defendant du appeared in court to participate in the lawsuit, has now heard the end.</p> <p>After the trial found that November 18, 2016 1:40, the defendant du in Zanhuang County film Internet Café when the theft of the victim Xu a golden oppor9plus mobile phone, after forensics, the price of 2610 yuan.</p> <p>The above facts are confirmed by the following evidence in court and with proof of quality:</p> <p>Surveillance video; On-site identification of photos; Zanhuang County Price Bureau Prices Certification Center price verification conclusion; Zanhuang County Public Security Bureau Criminal Police Brigade proof material; defendant du a household registration certificate; Victim Xu's statement; Defendant Du's confession.</p> <p>The evidence listed above is sufficient to substantiate the fact that the public Prosecution service has accused Du of being guilty of theft.</p> <p>The Court held that the defendant du for the purpose of illegal possession, the secret theft of other property, and the amount of large, his behavior has constituted the crime of theft, punishable by law, the Public Prosecution Service was charged. In view of the better guilty plea of the accused Du, a lighter penalty may be imposed at his discretion. In accordance with articles No. 264 and 64th of the Criminal Code of the People's Republic of China, the judgment is as follows:</p> <p>First, the defendant du committed the crime of theft, sentenced to three months ' detention, and a fine of 2000 yuan. (Penalty is payable within 10th after the entry into force of this judgment)</p> <p>The Court held that the defendant du for the purpose of illegal possession, the secret theft of other property, and the amount of large, his behavior has constituted the crime of theft, punishable by law, the Public Prosecution Service was charged. In view of the better guilty plea of the accused Du, a lighter penalty may be imposed at his discretion. In accordance with articles No. 264 and 64th of the Criminal Code of the People's Republic of China, the judgment is as follows:</p> <p>First, the defendant du committed the crime of theft, sentenced to three months ' detention, and a fine of 2000 yuan. (Penalty is payable within 10th after the entry into force of this judgment)</p> <p>(if the sentence is calculated from the date of enforcement of the sentence and is held in advance before the execution of the judgment, the day of detention is discounted from the date of the sentence, that is, from November 18, 2016 to February 17, 2017.))</p> <p>Second, the defendant du a illegal income of 2610 yuan, in accordance with the law to recover.</p> <p>If you are not satisfied with this judgment, you may, within 10th from the second day of receipt of the judgment, pass through the court or appeal directly to the Shijiazhuang Municipal Intermediate Court, and a written appeal shall be submitted with one original copy and four copies.</p> <p>Judge Zhao Ruiying</p> <p>January 17, 2017</p> <p>Clerk Wang Zhiwei</p>
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3. Repeatedly take the words of flag, read "defendant", and save the next word to the variable name. When you read "male", our system can directly save the gender variable. When our system read "1993", the system can judge it as the date of birth. The next word "Yu" is "Hebei province", which can be found in the professional documents of place names, so it is decided as the address, and the word in front is "birth" and "yu", so it is decided as the native place. When "Han nationality" is read, it can be found in the "nationality" professional document, which exists in the nationality field. When you get the word "unemployed" and look for the word "unemployed" in a professional document, look for synonyms and the word rank in Wordnet. From this position, you know that "unemployed" is a profession, and you store it in the accused's occupation field. When words are not found in professional documents, and the upper word in Wordnet is not required information, so no processing is done.

4. In dealing with the paragraph of criminal facts, the defendant's criminal timeline list is first obtained by using the regular expression "\d* year \d* month \d* day". Each string in the list starts with \d* year \d* month \d* day, and each string represents a criminal fact. When the following paragraphs do not mention the total value, the value of the items in each of the criminal facts in the list is used to obtain the total value of the items. While obtaining the digital amount, and whether the amount of the item is double calculated. Only sum up the value of the non-duplicated stolen item and the cash.

5. The other paragraphs are the same as above. The amount of money obtained, sometimes written in Chinese, is treated as the price of the number type. The digital amount is also converted from character type to numeric type and stored in the database. The database entry is shown in Table 2.

We tested our system with 100 samples convictions for theft, and successfully extracted relevant information. These verdicts include a first offense, a second offense, a repeat offense, and the amount and length of the sentence vary from xx to xx. The database storage is shown in Figure 3.

Table 2: Database case field

The court	People's court of Zhanhuang county
The letter of judgment	6 at the beginning of sentence ji 0129
Name of defendant	Du Mou
Nationality	Han
Profession	Unemployed
Native place	Hebei province
Crime or not	0
Criminal facts	After the trial, it was found that on November, 2016, at 1:40 am, when the defendant Du was surfing the Internet at the Ying Le Internet cafe in Zhenhuang county, he stole a gold OPPOR9PLUS mobile phone belonging to the victim Xu, which was verified to be worth 2610 Yuan.
Purpose	For the purpose of illegal possession
Surrender or not	No
Years in prison	0
Penalty	¥2000
Date of judgment	January 17, 2017
Type of judgment	Criminal judgment
The indictment	People's procuratorate of Zhanhuang county, Hebei province
Sex of defendant	man
Birth of the defendant	8 December 1993
Cultural level of the accused	Technical secondary school
Accusation	Larceny
Inspectors	Limei Zhang
Objections	
The total value	2610
Breach of law	Article 264 and 64 of the criminal law of the People's Republic of China
Months in prison	3
Judges	Judge Ruiying Zhao
The clerk	Clerk Zhiwei Wang

ID	fayuan	panjueshu	panjueshuID	gongsujiguan	name	sex	minzu	birth	zhijie wenhu	jiguan	crime	cen	jianchay	fanzuishishi	isyoujiy	mudi	zongpr	iszish	weifantiz	panxin	panx	fajin	shenpanyue	panjuetime	shujiyuan	
1	四川省高级人民法院	刑事判决书	(2017)川3337刑	松潘县人民检察院	土登曲扎	男	藏族	1997/	农民	小学文	四川省	盗窃罪	0	汪前鑫	公诉机关指控:被告	无异议	以非法占有	16576	自首	《中华人	1	0	3000	审判员丁真	二〇一七年十月二	书记员安清琼
2	福建省惠安法院	刑事判决书	(2018)闽0521刑	惠安县人民检察院	张汉江	男	汉族	1976/	无业		福建省	盗窃罪	1	陈华南	经审理查明:1、	无异议	以非法占有	6245	没有	《中华人	0	9	3000	审判员陈添	二〇一八年一月二	书记员李玲
3	北京市密云法院	刑事判决书	(2018)京0118刑	北京市密云区人民法院	郭某	男	汉族	1965/	初中文			盗窃罪	1		公诉机关指控:被告	无异议	以非法占有	1940	没有	《中华人	0	6	1000	审判员单青	二〇一八年二月十	书记员尹丹梅
4	福建省南靖法院	刑事判决书	(2017)闽0921刑	南靖县人民检察院	黄勇	男	汉族	1965/	无业		重庆市	盗窃罪	1	詹志华	南靖县人民检察院	无异议	以非法占有	11470	没有	《中华人	1	0	5000	审判员钟凌	二〇一七年九月十	书记员汤晶晶
5	四川省叙永法院	刑事判决书	(2014)叙永刑初	叙永县人民检察院	张某某	男	汉族					盗窃罪	0		上述事实,被告		以非法占有	2000	没有	《中华人	0	8	4000	代理审判员	二〇一四年八月七	书记员曾丽
6	广东省广州法院	刑事判决书	(2016)粤0106刑	广州市天河区人民	罗德顺						湖南省	盗窃罪	1	张广斌	广州市天河区人民	无异议	以非法占有	3060	没有	《中华人	1	2	2000	审判长方洪	二〇一六年十二月	书记员李丹丹
7	四川省西昌法院	刑事判决书	(2015)西昌刑初	西昌市人民检察院	邓某某	男	汉族	1994/	农民	初中文		盗窃罪	0	王元、黎	经审理查明:201	无异议	以非法占有	12300	没有	《中华人	0	8	10000	审判长何要	二〇一五年十二月	书记员仁薇
8	河南省偃师法院	刑事判决书	(2015)偃刑一初	偃师市人民检察院	任小娃	男	汉族		农民	小学文		盗窃罪	1	高强	偃师市人民检察院	无异议	以非法占有	1100	没有	《中华人	0	6	2000	代理审判员	二〇一五年八月二	代理审判员周
9	赞皇县人民法院	刑事判决书	(2017)冀0129刑	河北省赞皇县人民	杜某	男	汉族	1993/	无业	中专文	河北	盗窃罪	0	张丽梅	经审理查明:201		以非法占有	2610	没有	《中华人	0	3	2000	审判员赵瑞	二〇一七年一月十	书记员王智伟
10	山东省临沂法院	刑事判决书	(2015)临兰刑初	临沂市兰山区人民	王延东				无业			盗窃罪	1	朱丛丛	临沂市兰山区人民	无异议	以非法占有	21783	没有	《中华人	1	3	15000	审判员董沂	二〇一五年一月二	书记员徐守丽

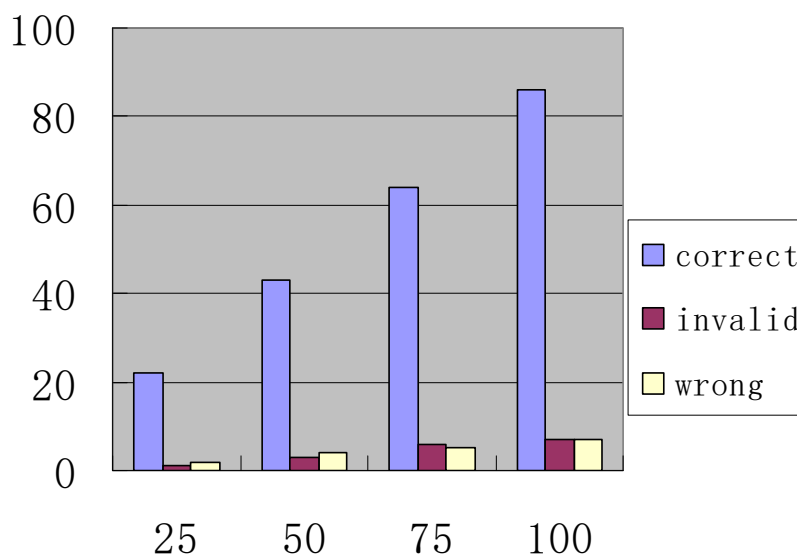
Figure 3: database memory map (in Chinese)

The experimental results

In this experiment, 100 cases of theft were randomly selected from the Chinese judicial network. The contents shown in Table 1 were extracted manually and stored in the database. The case is then copied into the web page one by one, and the application stores the case in database 2 for comparison one by one. Among the 100 samples tested, seven did not run properly because the judgment was not written in strict accordance with the specification. For example, the first four lines of a normal judgment are the court, the type of judgment, ID of judgment and the public prosecution authority. And the case that these cannot run normally is to write public prosecution organ inside the body.

In addition, 86 out of the 93 operational cases were the same as the manually extracted database. Most of the errors were on the theft amount. Many of the final statements do not indicate the total amount of the theft, which can only be found in the facts of the crime, and sum up the amount of the stolen goods according to the time clues obtained from the regular expression. However the description of criminal facts will be mixed with the number of non-theft items, such as the return of part of the money, distribution of stolen goods, and so on. These also need to be subdivided. If the cases that cannot run normally are valid cases, the correct rate is 86%. If the cases that cannot run normally are invalid cases, the correct rate is 92.5%. The distribution of each case is shown in Table 3.

Table 3: Case map



Data would be better obtained if all judgments were written in strict accordance with the standard of writing. Getting the total amount from the facts of the crime, but, requires more elaborate treatment. To distinguish the value of stolen properties, stolen cash, online money transfer, distribution of stolen goods, recovery and other involved amounts of various complex situations, the proper handling is to add data, subtract data, or do not operate data, to get an accurate theft amount.

In addition to the error of the amount, there is also the first time to make the mistake of drawing. Among the one hundred cases, there were two cases where the defendant was recidivist, but the procedure judged as the first offense. Because the description of the criminal record of the defendant was not written in the general position, but in the paragraph of the judgment result, the

criminal record of the defendant was not extracted, so it was judged as the first offense. Therefore, the judgment of "crime or not" should be based on the full text of the judgment.

RELATED WORK

Information extraction technology is applied in various fields. Bao, Huang, and Zhang (2018) studied information extraction in the medical field. In 2018, Luo and Huang (2018) extracted financial events from financial news. Sun and Guan (2004) and Sakamoto and Honiden (2018) studied information extraction methods. Neither has used information extraction techniques in the judicial domain. However, the judicial field has huge data, so it is very troublesome to apply them. The huge original judgment book library and the chaotic sorting are doomed to be useful in the judicial field.

Liu *et al.* (2018) abstracted the information of the accused in a broad way, and did not specifically extract the information of the value of stolen goods in the crime of punishment or theft, as well as the corresponding sentence and fine. The work of Chen (2011) is to extract the information and time and place of the accused, mainly by the characters, time and place of the event.

A study on the extraction method of judicial case information based on GATE (Song, 2016) is to extract the case text information to be used in business and save manpower. This paper is about the crime of theft category case push and prison sentence prediction. Jackson *et al.* (2003) analysed the case and found all relevant historical cases. In this paper, all historical cases are automatically extracted to the database for further inquiry, such as convenient case pushing and sentence prediction.

In the work of Xu and Xu (2018), computer-assisted sentencing has been mentioned and the premise of computer-assisted sentencing is to obtain enough and orderly historical case data are available. Bai has studied sentencing prediction based on the collective experience of judges (Bai, 2016). In fact, the judge's collective experience in sentencing can be added to the computer automatic recommendation of similar cases and sentencing prediction, and then the judge can use the experience to carry out fairer sentencing.

The text extracts information based on the sentencing. For the prediction of the sentence, the sentencing standard of the crime of theft is changing every year. Therefore, not only the value of articles can affect the sentence, time, surrender or not, first offense or recidivism, etc., but also the factors that can affect the sentencing. By getting as much information as possible, similar case push and sentence prediction can be more accurate.

CONCLUSION

In order to forecast the prison sentence of theft crime, this paper studies the problem of extraction automatically. This study is conducive to the efficiency of relevant personnel in sorting out and analyzing larceny cases, and builds a database for category case push and sentence prediction, providing data support.

In future, it is worth applying the information extraction technology to other types of crime cases, extract the key information of different types of crimes by classification, and finally establish a judgment information extraction system applicable to all types of crimes. For example, in cases involving drugs, the amount of drugs sold, transported and produced by the accused shall be extracted; regarding cases involving intentional injury, the degree of injury to the victim should be obtained; and cases involving bribery, the amount of bribery shall be obtained. These are the main factors that determine sentencing. Since it is only information extraction for specific fields and aspects, it does not employ any machine learning method, but natural language processing method. The advantages of natural language processing methods are high accuracy in specific areas, but the disadvantages are poor portability and require a large amount of professional documentation. These can be addressed in future.

ACKNOWLEDGMENT

This work was supported by the National Natural Science Foundation of China No. 61762016

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Bibliometric analysis of social commerce research

(Full Paper)

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ABSTRACT

Recently, social commerce has attracted the attention from both academics and practitioners and became a significant emerging research area. In this paper, bibliometric analysis has been applied to identify the characteristics and the developments of social commerce research. Based on the definition, we conduct a systematic review of social commerce research by synthesizing 1900 publications published between 2003 and 2018 in Web of Science. The 1900 publications cover 4033 authors, 724 journals, 79 countries or territories, and 1648 institutions. Furthermore, 'Computers in Human Behavior' is the key journal publishing on social commerce research, and the USA, China and England are the countries that dominate the publication production. It can be concluded that there is much collaborative research in the social commerce domain as multi-authored publications make up the majority of all publications. In addition, three main research areas can be distinguished based on LLR (log-likelihood ratio): (1) the development trend of social commerce, (2) the relationship between customers and vendors, and (3) consumer trust in the context of social shopping. We believe that this review can provide some guidelines for future research.

Keywords: Social commerce, bibliometric analysis, systematic review, reciprocal relationship, initial trust.

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INTRODUCTION

Social commerce was introduced by Yahoo in 2005, and quickly became a means for adding value to e-commerce services (Wang & Zhang, 2012). From then on, an increased attention in the research area of research area of social commerce can be observed. This has led to a continuously growing publication rate regarding social commerce, which makes it difficult to obtain a comprehensive overview on the topic. Until today, little consensus has been reached on the concept of social commerce. As social commerce involves multiple disciplines, a variety of definitions is proposed from different perspectives (Han et al., 2018). We synthesize the relevant articles and provide a list of different definitions of social commerce. (See Table 1)

In sum, most definitions refer to two components: social media and e-commerce. Therefore, we can conclude that social commerce is the mode of engaging in e-commerce activities with social media. There are some main streams of social commerce: (1) the development and mode of social commerce (Hajli, 2014; Wang & Zhang, 2012); (2) the characteristics and elements of social commerce (Huang & Benyoucef, 2013; Liang & Turban, 2011); (3) the theme frame (Liang & Turban, 2011; Zhou et al., 2013) and various specific problems under the framework, like drivers of social commerce development (Kim, 2013; Liang et al., 2011); classification, measurement and prediction of customer behavior in social media (Chen et al., 2014; Liu et al., 2015); the mechanism of customer participation and purchase behavior in social commerce (Zhang et al., 2014); and information communication in social commerce (Jiang et al., 2014), etc.

The aim of this descriptive paper is to present a macroscopic overview on the main characteristics of social commerce literature. However, the amount of publications available on a research topic is so overwhelming that makes it challenging to have a structured overview of relevant information. Many scholars proposed that bibliometric methods is based on quantitative data and can reduce reviewers' subjectivity and bias, which have already shown the usefulness in the management research (Marzi et al., 2017). Therefore, bibliometrics has been applied to assess the performance of authors, journals, countries and institutes, and identify cooperation patterns of them in this paper. Furthermore, bibliometrics also reveals the latest advances, research directions and leading topics in the field of social commerce research.

Table 1: Literature on social commerce definitions

Author	Term	Definition
Leitner & Grechenig (2007)	Social shopping	In the shopping platform, customers seek out the suggestions of others, find out the products they need, and make purchases.
Hsiao et al. (2010)	social shopping	A new e-commerce method combining social networking with shopping.
Kim & Park (2013)	social commerce	A new business model of e-commerce driven by social media (e.g., SNSs) that facilitates the purchasing and selling of various products and services.

DATA AND METHODS

We choose Web of Science Core Collection as database to retrieve data because

Esmacili et al. (2015) social commerce

As an Internet-based commercial application that makes use of technologies and social media, and it supports user-created content and interactions.

Han & Trimi (2018) social commerce

social commerce is a new business model of e-commerce, which combines web 2.0 technologies and social media to support social-related activities.

it is the most widely accepted and frequently used search engine for analysis of scientific publications (Yang et al., 2013). The last updated date for the data was July 28, 2018, and the term “social commerce” was used as search topic. This topic search means that the term “social commerce” is identified in the title, the abstract or in the keywords of the publications. Quotation marks have been included in the search term. This tighter condition ensures the robustness of the search results (Liu et al., 2013). The time span was set from 2003 to 2018 included. In total, 1900 publications related to social commerce were identified. All types of document were included in the search. The majority is article ($n = 1770$) and review ($n = 97$). The other document types, such as proceeding paper, editorial material and book review, are all less than fifty.

We export the preliminary statistics of 1900 publications stored in Web of Science to Excel. Both Excel and the freely available software program Citespace (V5.3R2) were used to analyze and visualize the following topics: (1) publication output and cited analysis, (2) authors and their cooperation, (3) journals publishing on social commerce, (4) geographical and institutional distribution and cooperation, (5) co-citation analysis.

RESULTS AND DISCUSSION

Publication Output and Cited Analysis

The number of peer-reviewed publications is an important indicator to measure the achievement of a scientific research discipline or subject. As displayed in Fig. 1, the number of social commerce publications increased since 2003. There were only 42 publications on social commerce in 2003. Until 2006, the publications on the topic remained limited (less than fifty publications each year). From 2012, an increasing number of publications could be observed every year, and a peak of publications is reached in 2016 ($n = 259$).

The cited analysis gives the number of times the publications on social commerce has been cited by other publications listed in Web of Science. In total, all 1900 publications were used 36,034 times as a reference in other publications. The average citation per publication is 18.97. 22.89% ($n = 435/1900$) was cited zero times at the time of the data extraction. Of the 1900 publications on social commerce, 9.58% ($n = 182/1900$) was cited 50 times or more, and 3.84% ($n = 73/1900$) was cited 100 times or more. It should be noted that there is a general assumption that the number of citations reflects a publication's influence and notoriety and, hence, its quality.

Based on the exponential functions of the number of publications and the sum of times cited (Fig. 1) with R^2 were 0.9244 and 0.8702 respectively, it can be stated that the publication output and the times cited of social commerce research both follow an exponential growth.

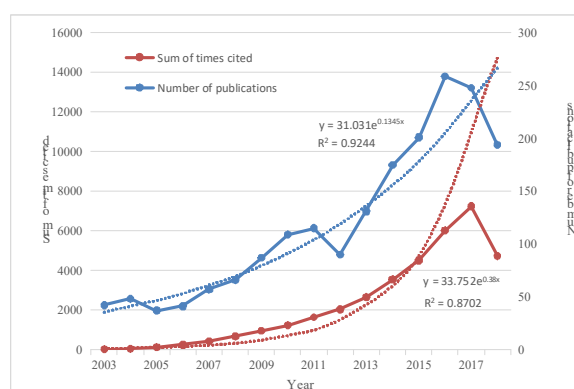


Fig 1: Number of social commerce publications and sum of times cited by year

Authors and Their Cooperation

The 1900 publications were written by a total of 4033 different authors. The largest proportion of the authors (86.96%; $n = 3,507/4033$) is only credited in one publication on the topic of social commerce. 4.81% ($n = 194/4033$) is credited in at least three publications, and 0.17% ($n = 7/4033$) is credited in ten or more publications.

Table 2 shows the core author publishing on the topic of social commerce. The core author refers to researchers who have much output and influence in a certain research field. Price's law in bibliometrics can be used to identify core authors in a research field:

$$M = 0.749\sqrt{N_{\max}} \quad (1)$$

N_{\max} is the most productive authors's total number of publications, M is the minimum number of published papers for determining the core authors. Ooi is the most productive author on the topic of social commerce with nineteen publications, so $N_{\max} = 19$. $M = 4$, that is, the author who published more than 4 papers is the core author. It can be concluded that there are 105 core authors who totally published 587 papers, accounting for 30.89% of the total in the field of social commerce. It is consistent with observations in other fields (Liu et al., 2012), that only a small group of productive authors contributes to a significant share of publications on a specific topic.

Table 2: Core authors publishing on social commerce

Author	Number	Publication number	Percentage
Ooi, KB	1	19	1.00%
Chong, AYL; Lu, YB	2	13	1.37%
Hajli, M. N; Lin, BS	2	11	1.16%
Gupta, S; Lowry, PB	2	10	1.05%
Benbasat, I; Gefen, D;...; Shin, DH	5	9	2.37%
Cheung, CMK; Hsu, CL;...;Tan, GWH	5	8	2.11%
Cyr, D; Davison, RM;...;Pavlou, PA	5	7	1.84%
Dinev, T; Ghose, A;...;Zhao, L	14	6	4.42%
Benyoucef, M; Chen, XY;...;Zhou, T	20	5	5.26%
Ainin, S; Bai, Y;...;Zhu, DH	49	4	10.32%
Total	105	587	30.89%

The average number of authors per publication was 2.12 and it can be concluded that there is much collaborative research in the social commerce domain. A high number of co-authored publications indicate a closer relationship among the authors within the same domain and a greater opportunity for future collaboration.

The cooperation pattern (i.e. co-authorship) of the authors publishing on social commerce was analyzed with Citespace. The result of this author cooperation network is presented in Fig. 2. The size of the circles represents the amount of publications, and the line between two authors represents the cooperation between them. The colors represent the collaboration clusters. In the cooperation network, the major researchers can be distinguished, like Ooi, Chong, Lu, and other researchers are linked to one of these main researchers.



Fig 2: Authors cooperation network in social commerce research

Journals Publishing on Social Commerce

In total, the 1900 publications were published in 724 different journals. This high number indicates a wide variety of research themes, and the multidisciplinary character of social commerce research. Of the 724 journals, 486 journals (67.13%) published only one publication and 128 journals (17.68%) published only two publications on the topic of social commerce. 34 journals (4.70%) published ten publications or more on the topic.

Table 3 gives information of the top-10 most active journals publishing on social commerce research. These ten journals (or 1.38% of all journals publishing on social commerce) have published more than one fifth of all social commerce publications (21.84%; $n = 415/1900$). Key journals in the field are 'Computers in Human Behavior' and 'Electronic Commerce Research and Applications', with 85 and 54 publications on the topic, respectively. The subject category 'Computer Science' appears five times in the top-10 of most active journals and 'Information Systems' appears four times.

Table 3: Top-10 of most active journals publishing on social commerce

No.	Journal title	Number of publications	Impact factor*	Subject category of the journal*
1	Computers in Human Behavior	85	3.536	-Psychology, Multidisciplinary, Experimental
2	Electronic Commerce Research and Applications	54	2.582	-Computer Science, Information Systems, Interdisciplinary Applications
3	International Journal of Electronic Commerce	42	2.514	-Computer Science, Software Engineering
4	Decision Support Systems	40	3.565	-Computer Science, Artificial intelligence, Information Systems -Operations Research & Management Science
5	Information Management	39	3.890	-Computer Science, Information Systems
6	International Journal of Information Management	37	4.516	-Information Science & Library Science
7	Internet Research	34	3.828	-Computer Science, Information Systems -Telecommunications
8	Behavior & Information Technology	30	1.380	-Ergonomics
9	Journal of Electronic Commerce Research	28	1.667	-Business
10	International Journal of Mobile Communications	26	1.742	-Communication

* Impact factors and subject categories were retrieved from the 2017 Journal Citation Reports®.

Geographical and Institutional Distribution and Cooperation

Countries and territories

Social commerce publications originate from 79 different countries or territories. Fig. 3 shows the top-10 of most productive countries and territories on social commerce research. Economic development seems to contribute to scientific and academic investment, as all of the 7 major industrialized countries of the world (G7: USA, Japan, Italy, Germany, UK, Canada and France) were ranked in the top-15 of most productive countries publishing on social commerce research. The pattern of domination of the G7 has occurred in most scientific fields, reflecting the high economy activity and academic level of these countries (Liu et al., 2012; Yang et al., 2013).

The cooperation network between countries and territories publishing on social commerce was analyzed with Citespace and the result is presented in Fig. 4. The size of the circles represents the amount of publications, and the thickness of links represents the strength of collaborations. The colors represent the collaboration clusters. Some major clusters can be distinguished: one gathering around USA, one around the China and other major contributors: England, Taiwan, South Korea,

Australia and Canada. As found in other scientific research domains, collaborative countries tend to center around the most productive countries in terms of publication output (Zheng et al., 2016).

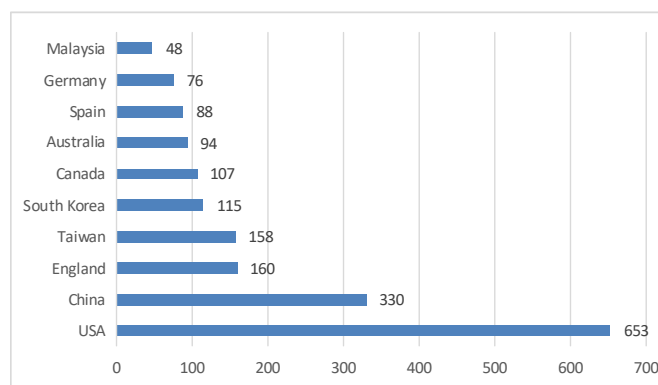


Fig 3: Top-10 of most productive countries and territories on social commerce research



Fig 4: Cooperation network between countries and territories in social commerce research

Institutions

1648 different research institutions participated in the 1900 publications with institution information (one institution can be affiliated to more than one publication). Table 4 gives information on the top-10 of most productive institutions publishing on social commerce. The three most productive institutions were located in the China. The institution which published the most publications on the topic ($n = 55$) is the City University of Hong Kong. The vast majority of the top-10 institutions are Asian universities.

The result of cooperation network between institutions publishing on social commerce is presented in Fig. 5. It can be seen that collaborative institutions also center on the most productive institutions like City University of Hong Kong, Huazhong University of Science and Technology and University of Science and Technology of China. Numerous institutions of North America and Europe are willing to cooperate with Asian institutions in the field of social commerce.

Table 4: Top-10 of most productive institutions publishing on social commerce

No.	Institution	Country	Number of publications
1	City University of Hong Kong	China	55
2	Huazhong University of Science and Technology	China	23
3	University of Science and Technology of China	China	23
4	University Tunku Abdul Rahman	Malaysia	20
5	The University of Maryland	USA	17
6	The Hong Kong Polytechnic University	China	16
7	Pennsylvania State University	USA	16
8	Sungkyunkwan University	South Korea	16
9	The University of Illinois Urbana	USA	16
10	University of Malaya	Malaysia	16



Fig 5: Cooperation network between institutions in social commerce research

Co-citation Analysis of Social Commerce Research

Co-citation analysis

Co-citation analysis focuses on the relationship or interaction between two publications, reveal the theoretical foundations of the research field by assessing the similarities among cited articles (Boyack & Klavans, 2010). The more two publications are cited together, the more similarities between them can be assumed (Li and Hale, 2015). Citespace was used to analyze and visualize the co-citation. To ensure the clarity of clusters, the whole sample is divided into several sub-samples of 4 years from 2003 to 2018. Totally, 79,506 references were used by the 1900 publications on social commerce, and the final data set contained 78424 references.

Fig. 6 shows the bibliographic network based on co-citation analysis and reveals the theoretical cornerstones of social commerce research.. The size of the circles represents the number of citations, so the more a publication has been cited in the social commerce publications, the larger a circle, and it can be more possible a Landmark node. The line between two publications suggests they have been cited together before. The color of line and circle distinguishes references in four time period. It can be seen from Fig.6 that many publications (from 2011 to 2014) with yellow circles are landmark nodes.

Pivot node is the point connecting two clusters. The emergence of the Pivot node often leads to the transformation of the research focus in a certain field, which is an important node of the discipline development and evolution process. Pivot node and Landmark node can be automatically identified by calculation in CiteSpace and highlighted in purple circles, such as Gefen (2003) in Figure 6.

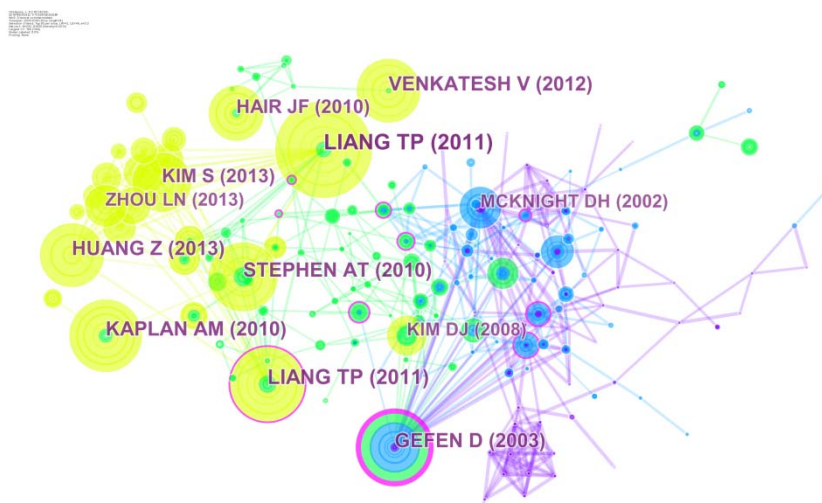


Fig 6: Co-citation analysis of highly-cited references used in publications on social commerce

Cornerstones of social commerce research

CiteSpace was used to cluster the sample, and a total of 50 clusters are generated. Citation cluster analysis mainly uses the co-citation intensity as the basic unit and classifies a given collection of citation documents. This analysis can aggregate the papers with close content into a cluster of documents, calculating the degree of connection among clusters according to the network indicators, and then generate a cluster analysis network of a certain field. The node with purple in Figure 6 is the Pivot node calculated by betweenness centrality (greater than 0.1). Betweenness centrality is an indicator to discover and measure the importance of the literature. Silhouette Coefficient is an evaluation method of cluster effect. It was first proposed by Rousseeuw in 1986 that combines two factors of cohesion and resolution. It can be used to evaluate the impact of different algorithms, or different operating modes of the algorithm on the cluster results based on the same raw data. The closer the Silhouette value to 1, the more reasonable the cluster is.

In Figure 7, the labels with "#" are generated by extracting the eigenvalue from the subject terms according to the log-likelihood ratio. Only six clusters have sufficient similarity (Silhouette value is close to 1) and enough nodes (greater than 10). Table 5 shows the specific information of six clusters.

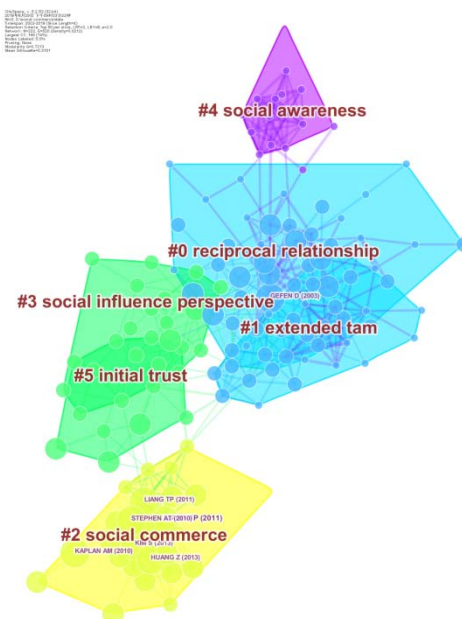


Fig 7: Co-citation cluster of highly-cited references used in publications on social commerce

Table 5: The information of main co-citation cluster

No.	Silhouette coefficient	Top term	size
0	0.653	Reciprocal relationship	44
1	0.820	Extended TAM	26
2	0.933	Social commerce	26
3	0.818	Social influence perspective	19
4	0.957	Social awareness	15
5	0.744	Initial trust	12

To facilitate interpretation of the clusters, we restricted the focus to references that are Landmark node, Pivot node or citation bursts. This helps us to focus on the most important publications and facilitated interpretation of the identified clusters in the network.

Cluster “#0”, which includes 44 articles, can be labeled as “reciprocal relationship”. The cornerstone of this cluster is “Trust and TAM in online shopping: an integrated mode”. The research is the Landmark node, Pivot node (Betweenness Centrality is 0.40) and Citation burst (from 2006 to 2011). It was not only the foundation and basic literature of social commerce research, but also a hot research topic at that time. This study shows that consumers’ trust in the e-vendor influences their purchase intentions in online commerce. Based on the widely accepted TAM use-antecedents, the authors provide evidence that online trust is built through the interaction between vendors and customers, safety mechanisms, typical interface and ease of use.

Cluster “#1” is labelled as “extended TAM” and it encompasses 26 publications. Kumar and Benbasat (2006) filtered the content of Amazon.com to empirically test the influence of recommendations and consumer reviews on the social commerce. The results demonstrate that the provision of recommendations and consumer reviews increases both customer perceived usefulness and social presence in the shopping context. The study was heavily quoted from 2009 to 2014, and as a Pivot node (Betweenness Centrality is 0.11) triggered a new exploration of the factors influencing consumer behavior in social commerce.

Cluster “#2” is labeled “social commerce” and includes 26 publications. A framework was presented including research theme, social media, commercial activities, underlying theories, outcomes and research methods to define the scope of social commerce research (Liang et al., 2011). This article has not only received a lot of attention from scholars, but also provides a reference for identifying potential research issues in social commerce (Betweenness Centrality is 0.11).

Cluster “#3” is labelled as “social influence perspective”, encompassing 19 publications. The principal-agent perspective was extended to propose a set of four antecedents of perceived uncertainty in online buyer-seller relationships and a set of four uncertainty mitigating factors (Pavlou et al., 2007). The proposed structural model is empirically tested and the result implicated that through mitigating consumers’ uncertainty perceptions, online exchange relationships for different of purchases can be better understood and online transactions can be facilitated. This cluster is a further in-depth study of Cluster “#0”.

Cluster “#5” includes 15 articles and captures research that we labelled: “initial trust”. Trust directly and indirectly affects a consumer's purchase decision in combination with perceived risk and perceived benefit, and also that trust has a longer term impact on consumer e-loyalty through satisfaction (Kim et al., 2009). The research recognizes the crucial roles of trust plays in the business-consumer social commerce. Betweenness Centrality of this study is 0.10 that brings a change in research direction.

In the cluster analysis report generated by CiteSpace, there is no Landmark node or Pivot node in the cluster “#4”. Therefore, we filtered the literature with citation burst - “Information Privacy Concerns, Procedural Fairness, and Impersonal Trust: An Empirical Investigation”. This research illustrated that customer relationships are characterized by social distance, so the firms should observe procedural fairness to let customers depend on strangers to act on their behalf. Though hypothesis and empirical test, the study addressed the tensions that arise between the collection and use of personal information that people provide in the course of most electronic transactions.

The analysis of timeline

As shown in figure 8, the documents of the same cluster are placed on the same horizontal line. The time of the document is placed at the top of the view. The more the literature in the cluster, the more significant this cluster is. Through the timeline view, the time span of various types of literature and the rise, prosperity and decline of a certain research field can be obtained. In addition, important documents in each cluster can be measured by the indicators of Citation Burst and Betweenness Centrality.

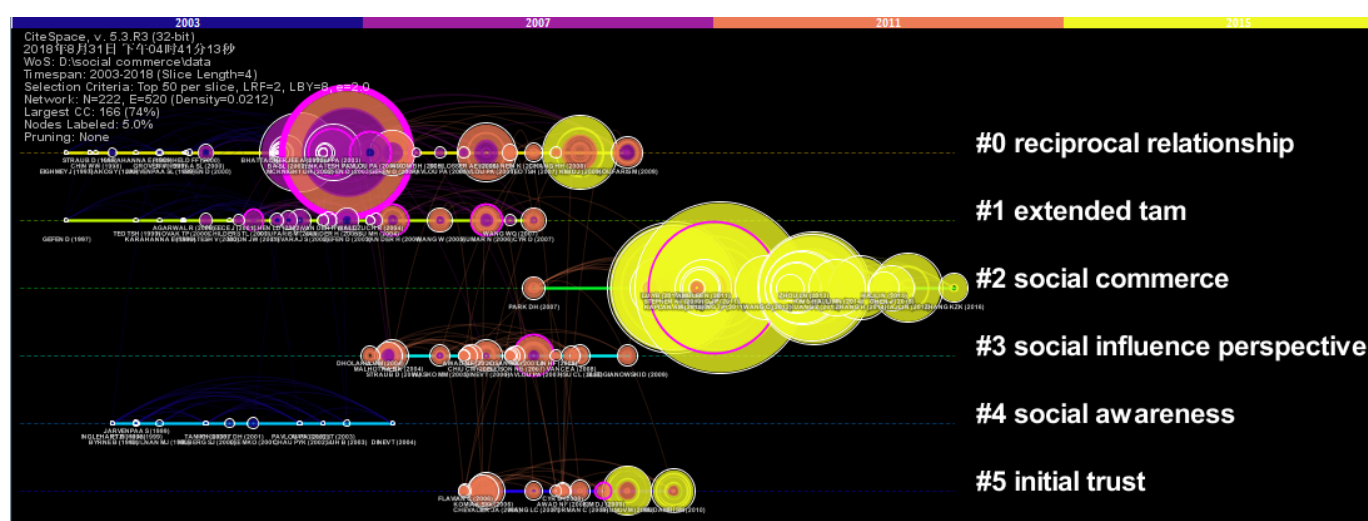


Fig 8: Timeline of highly-cited references used in publications on social commerce

It can be seen from Fig. 8 that the literature in cluster “#1”, “#3”, “#4”, and “#5” have received relatively little attention in the past fifteen years, and especially cluster “#4”, almost has no concern. Cluster #0 showed more Landmark nodes and Pivot nodes around 2007, but after 2015, the trend has weakened and fewer large nodes have appeared. In contrast, in cluster “#2” and cluster “#5”, before 2011, only a small number of documents marked as Landmark nodes. However, after 2011, the attention to these two topics was not reduced. In particular, a large number of important documents have emerged in Cluster “#2” within the past five years, and has led to new changes in research.

Based on co-citation network and cluster analysis, we can conclude that clusters “#0”, “#2”, and “#5” are the most important clusters in the co-citation network because the literature of these three clusters still has contributions after 2015. Therefore, these three clusters represent the frontier research issues of social commerce, that is, the research hotspots in this field are concentrated on the development trend of social commerce, the relationship between customers and vendors, and consumer trust in the context of social shopping.

CONCLUSIONS

Summary

In the previous sections, we presented a systematic and comprehensive review of the bibliographic literature from 2003 to 2018 in social commerce research. The topic of social commerce has been a field of extensive research during the last fifteen years and its publication output is characterized by an exponential growth. The study includes 1900 publications on social commerce covering 4033 authors, 724 journals, 79 countries or territories, and 1648 institutions.

Some positive aspects could be derived from the bibliometric analysis. Firstly, it can be concluded that there is much collaborative research in the social commerce domain, as multi-authored publications make up about a significant share of all publications. Secondly, many different journals publish on the topic and a wide range of subject categories is assigned to the social commerce publications, which indicates a wide variety of research themes, and the multidisciplinary character of social commerce research. Thirdly, regarding organizational social commerce, it seems that there is a movement away from human aspects towards more technical aspects. It should be acknowledged that technological aspects remain important, as social commerce represents a holistic, comprehensive term that comprises a totality of technological, organizational and human factors.

Also, some points of concern could be concluded. A geographical inequality, which is related to economic development, can be seen in social commerce research. The share of South America and especially Africa is very limited.

Future Research and Limitations

In this section we firstly present several important areas in the field of social commerce that merit future research: (1) the development trend of social commerce, (2) the relationship between customers and vendors, and (3) consumer trust in the context of social shopping. The co-citation review revealed that the research area of initial trust seems to be a more theoretical, where mediating reciprocal relationship between customers and e-vendors has a more practical-oriented emphasis. The research in the domain of the development trend of the social commerce stands in a dominant position in social commerce research nowadays.

Finally, some limitations of this bibliometric study should be addressed. First of all, the search was limited to publications listed in Web of Science. Although Web of Science is among the largest global databases, it does of course not contain all publications in the field of social commerce research. Other international databases such as Scopus could have been used. However, Web of Science is the most widely accepted and frequently used database for analysis of scientific publications (Yang et al., 2013). Another limitation of bibliometrics is that analysis can only be done for the existing classifications included in Web of Science. This leads to the omission of other valuable information, such as the distinction between theoretical and empirical papers and more details on the context in case of empirical research (for instance the sectors or the countries in which the study was conducted). Based on these limitations characterizing bibliometric analysis, a deeper content analysis is recommended for further research.

ACKNOWLEDGMENT

This work was supported by Chinese Fundamental Research Funds for the Central Universities [No. JB1606096]; and Chinese Ministry of Education Humanities and Social Sciences project [No. 16YJC630038].

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APPENDIX A: The information of landmark node, pivot node and citation bursts

Author and journal	Title	Cluster	Landmark node	Pivot node	Citation bursts
GEFEN D, 2003, MIS QUART	Trust and TAM in online shopping: an integrated model	0	•	•	•
Pavlou PA, 2003, INT J ELECTRON COMM	Consumer acceptance of electronic commerce: Integrating trust and risk with the technology acceptance model	0		•	•
Pavlou PA, 2004, INFORM SYST RES	Building effective online marketplaces with institution-based trust	0		•	•
Mcknight DH, 2002, INFORM SYST RES	Developing and validating trust measures for e-commerce: An integrative typology	0	•		•
BAKOS Y, 1998, COMMUN ACM	The emerging role of electronic marketplaces on the Internet	0			•
van der H, 2004, MIS QUART	User Acceptance of Hedonic Information Systems	1		•	•
Kumar N, 2006, INFORM SYST RES	Research note: the influence of recommendations and consumer reviews on evaluations of websites	1		•	•
Moon JW, 2001, INFORM MANAGE	Extending the TAM for a World-Wide-Web context	1		•	•
VENKATESH V, 2000, MANAGE SCI	A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies	1			•
Lu HP, 2010, INFORM MANAGE-AMSTER	The influence of extro/introversion on the intention to pay for social networking sites	2		•	•
Liang TP, 2011, INT J ELECTRON COMM	Introduction to the special issue social commerce: a research framework for social commerce	2	•	•	•
Liang TP, 2011, INT J ELECTRON COMM	What drives social commerce: The role of social support and relationship quality	2	•		•
Kaplan AM, 2010, BUS HORIZONS	Users of the world, unite! The challenges and opportunities of Social Media	2	•		•
Stephen AT, 2010, J MARKETING RES	Deriving value from social commerce networks	2	•		•
Huang Z, 2013, ELECTRON COMMERCIAL	From e-commerce to social commerce: A close look at design features	2	•		•
Kim S, 2013, INT J INFORM MANAGE	Effects of various characteristics of social commerce (social commerce) on consumers' trust and trust performance	2	•		•
Pavlou PA, 2007, MIS QUART	Understanding and Mitigating Uncertainty in Online Exchange Relationships: A Principal-Agent Perspective	3		•	•
CULNAN MJ, 1999, ORGAN SCI	Information Privacy Concerns, Procedural Fairness, and Impersonal Trust: An Empirical Investigation	4			•
Kim DJ, 2009, INFORM SYST RES	Trust and satisfaction, two stepping stones for successful e-commerce relationships: A longitudinal exploration.	5		•	•

Big data values deliverance: OSS model

(Full Paper)

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ABSTRACT

Open source software (OSS) repositories, like GitHub, conjointly build numerous big data projects. GitHub developers and/or its responders extend/enhance a project's software capabilities. Over time, GitHub's repositories are mined for new knowledge and capabilities. This study's values-deliverance staging system data mines, isolates, collates and incorporates relevant GitHub text into values deliverance model constructs. This suggests differential construct effects influence a project's activities levels. The study suggests OSS big data platforms can be software data mined to isolate and assess the values embedded. This also elucidates pathways where behavioral values deliverance improvements to GitHub can likely be most beneficial.

Keywords: GitHub, value; open source; big data; values deliverance; text data mine; MapReduce

*Corresponding author

INTRODUCTION AND MOTIVATION

Big data generation exceeds 2.5 Exabytes per day (IBM 2015). Big data accumulates from information generation sources including: sensors, climate, health-fitness activities, transport, processing, logistics, financial actions, social media, knowledge accumulation and research. In the last 2 years 90 per cent of all data has been accumulated.

Big data views by Gartner (2012) and Schroeck *et al.* (2012) offer the definition: big data is 'uncertainties-embedded (veracity), high-volume, high-velocity, high-variety information assets that collectively demand cost-effective, innovative forms of uniform processing for enhanced insight and decision making.

Today the uniform processing of big data analysis still remains a misnomer. Big data is often mined for specific new-knowledge purposes such as: productivity and profitability (McAfee and Brynjolfsson 2012) competitiveness (Davenport 2006), advertising (Trattner and Kappe 2013), health (Bodanar and Salathe 2013; Chen *et al.* 2016), retailing (Bradlow *et al.* 2016), or investigations (Gerber 2014).

Big data mining techniques are also diverse and purpose-driven - with libraries like Mahout and SparkMlib utilizing targeted, machine-learning, efficiency-related applications. The combination of big data and traditional machine learning is also generating challenges within the social big data spectrum - with data-patterning trialed across fields including behaviors, visualizing and tracking (Bello-Orgaz *et al.* 2016).

GitHub

GitHub is a big data storage site that accepts or rejects global developer contributions into its embedded private or public (free) projects repositories (Badashian *et al.* 2015). It houses over 20M users and 57M repositories. It is the largest open source software (OSS) of communities that combine their talents to develop software (Cosentino *et al.* 2017). It promotes rapid software development projects. GitHub incorporate collaborative development features including: bug-tracking, feature-requests, task-management and wikis (Williams, 2012; Marlow *et al.* 2013). This on-line platform hosts, and permits the building of collaborative OSS development projects.

GitHub mixes traditional software capabilities (like version control, free hosting and project storage) with an extended social reach (Squire 2014). Here, crowd-sourced coding contributors also participate indirectly through microblogs, and other websites (like Hacker.com). These crowd-sourced coding contributors comment on projects, analyze the merits of a project or possibly refine a specific project component coding modification and so add value towards an ongoing GitHub software development project (Taay *et al.* 2014).

GitHub's big data is stored in projects within its data storage repository. GitHub allows the use of restrictive API's to investigate information within these repositories. Project developers can use these API's to follow the relative activities contributions around their project. To support such project developer knowledge acquisitions this study investigates big data analytics and the deliverance of values.

Hence, this study investigates the first question:

RQ1: Can the OSS big data platform GitHub be data mined to assess the values embedded within its participant's actions.

ANALYSING BIG DATA: GITHUB

Big Data

GitHub's big data varies across time depending on project: (1) type, (2) scale, (3) duration, (4) team strength, (5) language, and (6) complexity (Cosentino *et al.* 2017). It is a multi-repository site where motivated contributors or responders can: (1) join a chosen harmonious community, (2) engage with others, (3) test the fit of their intentions, and (4) possibly be further motivated when other responder additions also provide unique personal value adds.

Analyzing Data Streams

GitHub offer API's (<https://developer.github.com/v3/>) that allow its contributors to mine and retrieve the contents of files within a big data repository as Base64 encoded content. This allows its contributors to mine, investigate, and then develop effective, enhanced systems. These, in-turn, drive: (1) advanced project operational efficiencies, (2) project responsiveness, (3) expansion of project communities' interactive connectivities, (4) teams of global social-communities (developers, contributors/responders, assessors, and marketers), and (5) lower project completion times.

Those researching GitHub big data continually add new understanding into this global open source software (OSS) community. Approaches vary from: (1) mathematical data mining techniques (Cosentino *et al.* 2017), (2) investigating readme files (Weber and Lou 2014), (3) tracking lines-of-code, forks, pulls, watchers, stars, reviews and relating these project additions/subtractions (Aggarwal *et al.* 2014; Borges *et al.* 2015; 2016; Xavier *et al.* 2014), (4) modelling the factors effects delivering project popularity and/or project activities levels (Aggarwal *et al.* 2014; Alshomali *et al.* 2017; Cosentino *et al.* 2017), (5) specific software/language studies, (6) social network studies (Jiang *et al.* 2017; Ma *et al.* 2016; McDonald *et al.* 2014; Sheoran *et al.* 2014; Singer 2014), (7) global software and economic trends (Grewal *et al.* 2017), and (8) behavioral studies (Phipps *et al.* 2013).

GitHub is also a social network, and it services its OSS communities (Lima *et al.* 2014). Here, its project hosting programs promote their collaborative software, and the activities/interests of one developer are promoted through to other developers (Thung *et al.* 2013). Thus, GitHub is a social interactive platform that interconnects all its stakeholders. Hence, although many different approaches are used to mine its big data, GitHub likely acts as a services business, and so likely provides a source of values deliverance similar to what is found in service business.'

Analyzing for Value

The Oxford Dictionary (<https://en.oxforddictionaries.com>) considers value as a verb as something holding economic value, being deemed important/beneficial; or generating a high opinion. This is a values acquisition process. In contrast value as a noun is something (in one's judgment) that is held of importance, of worth, or of usefulness. This is a post-event measure.

The Collins dictionary (<https://www.collinsdictionary.com>) sees value as a verb as 'if you value something (or someone) you think it is holding personal importance, and you appreciate this.' This is a values acquiring process. Value as a noun is seen as 'the value of something such as a quality, an attitude, or a method is its importance or usefulness' to you. This is an established or after-the-event measure.

Merriam-Webster (<https://www.merriam-webster.com>) defines value as a measurement outcome (noun): 'a monetary worth of something; a fair return in goods, services, or money; relative worth, utility, or importance; something intrinsically valuable/desirable, sought material values; a numerical quantity assigned or determined; a musical note; relative color or picture part lightness or darkness.' Merriam-Webster gives scant consideration to value as verb, but does indicate that value is a complex mix that is determined over time.

On closer examination such definitions suggest value as something currently being built (verb) around an item, and as something already gauged as present in an item (noun), and as a multi-dimensional consumer perception of an item.

Like the above definitions, Boksberger and Melsen (2011) recognize value (value as a noun) as a preferential, after-event judgment involving a single transaction or end-state. They also recognize that the term values (value as verb) represents a series of criteria, norms or ideals that are framing towards a deduced or derived value position.

Value is a perception framed through Equity Theory, where consumer's outcomes-versus-inputs are gauged against the service provider's outputs-versus-inputs (Oliver and DeSarbo 1988). The consumer determines a value by evaluating what is fair, correct, and/or deserved against some perceived net-worth (Bolton and Lemon 1999). This net-worth is the values being acquired by the consumer - possibly as: (1) time being consumed; and/or (2) energies/actions being applied; and/or (3) rewards being acquired; and/or, (4) perceived sacrifices being incurred, and/or (5) feelings being incurred; and/or (6) affordability of costings incurred (Yang and Petersen 2004).

Parise *et al.* (2012) enlist a four quadrant model (performance management, data exploration, social analytics, and decision science)

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to: (1) integrate big data strategies, (2) build a data capability, and (3) be proactive in creating big data policies. They recognize the real value of big data (transactional and non-transactional) and related strategies, offers a pathway towards competitive advantage. They recognize the cost of data capture/acquisition is continually decreasing, and that big data value extends business capabilities to: (1) answer known questions, (2) experiment, (3) discover trends and opportunities, and (4) help managers in their decision making in ways never previously imagined.

LaValle *et al.* (2011) see value from big data as a value creation that occurs early in the business's development of analytics sophistication. Gandomi and Haider (2015) recognize the massive volumes of unstructured text, audio and video heterogeneous data (big data) can be efficiently text-mined with structured computational algorithms, delivering to the business a unique set of value characteristics.

Sivarajah *et al.* (2017) conclude big data holds the potential to release knowledge and value insights without loss from unstructured data. This values extraction then offers advanced business opportunities including: (1) strategic decision making, (2) improved strategic operational efficiency, (3) new revenue streams and (4) competitive business advantages. However such business values competitive opportunities remain complex.

Bradlow *et al.* (2016) adopt a knowledge investigation process to extract new predictive value components from retail-related big data sources and against five dimensions: (1) the customer, (2) the product, (3) the time, (4) the geo-spatial location and (5) the channel.

Erevelles *et al.* (2016) consider analyzing consumer-related big data as a pathway towards transforming tomorrow's marketing approaches. They propose tapping big data through: (1) physical resourcing - utilizing evidenced consumer activities; (2) human resourcing - extracting embedded consumer commentary perspectives; and (3) organizational capital resourcing - engaging embedded consumer insights. This process is contextualized against each firm's unique big data resourcing requirements.

Thus value can be something already present (noun), or something currently being built (verb) through multi-dimensional consumer perceived compilations around an item. In addition, a value perspective can change (or develop) over time as new valuing perspectives are being acquired (or are developing further), and this is time-line development represents an ongoing 'values deliverance' approach.

Hence, this study pursues a multi-dimensional, ongoing values deliverance approach. Firstly, it aims to extract values indicator items from the OSS big data contributions provided by the GitHub repository contributors. Secondly, it aims to group these values indicator items against consumer literature-supported (and ongoing) perceptive behavioral values dimensions. Finally, this study aims to add further big data contributor insights into the retail business domain.

Hence, this study investigates the second question:

RQ2: Can the relative strength of behavioral value dimensions support pathways to improve GitHub as an OSS services provider.

VALUES DELIVERANCE

Bradley *et al.* (2012) see values deliverance as a dynamic construct encapsulating valuing across several dimensions and as changing over time. Sanchez *et al.* (2006) notes values deliverance as a dynamic acquisition process occurring across time and in stages. Values deliverance also involves the consumer in perceptive and behavioral considerations. Here a consumer extracts item valuing whilst considering what they are requiring of an item against their pre-conceived expectations of this item. This links into Aijen's Theory of Planned Behavior, and into the Theory of Reasoned Action. This implies that where values deliverance is mapped behaviorally it can result from a consumer's planned engagements and expectations, then into the consumer's actioning and trialing, and then through to the consumer's deductively reasoned concluding decisions.

Initially, values deliverance arises through the consumer's prior experiences around a desired item (ref). This pre-event knowledge can be sufficient to motivate the consumer into an item valuing pathway that assesses the items value dimension possibilities. Here the motivated consumer moves to a consumptive processing. This at-event item processing sees the consumer considering and trialing the item's potential values combinations against: (1) delivering performance, (2) delivering qualities, (3) delivering servicing, (4) delivering suitable economic-worth, and (5) delivering internal emotive-satisfier capabilities (Hamilton and Tee 2013). Eastman and Eastman (2015) also support behavioral motives as pre-cursors to delivering consumptive actions. Thus, in the value as verb phase of values deliverance, a Motivation Theory phase drives the consumer into a Consumption Theory phase.

The consumptive valuing perceived by the consumer also acts as a behavioral regulator (Sirdeshmukh, Singh, and Sabol 2002). At this point, the values deliverance process extends further - into the value as a noun phase. Here, the consumer's consumptive item valuing translates into their adopted reflective, after-use, self-gratification perspectives (Phipps et al 2013). This part of the values deliverance process is similar to a User Gratification theory approach, and it incorporates Goal Theory and Action Identity Theory.

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This reflective value as a noun approach also allows for a re-motivation feedback loop that can then deliver further ongoing (loyal) consumer engagements around the item (Yang and Petersen 2004).

Rintamaki and Kirves (2017) also adopt reflective item considerations when developing value model feedback loops between a business' proposed values and its consumers' perceived values. They contextualize (country, channel, product-category, and competitive situation) their feedback loops against economic value, functional value, emotional value, and symbolic post-considerations of value acquired (gauged as reflective satisfaction and word-of-mouth comments).

Thus, values deliverance is a dynamic occurrence that builds behaviorally within the consumer across a period of time. It builds from the consumer's pre-event expectation and engagement motivational perspectives (Hamilton and Tee, 2013). Where the consumer accepts these motivations as sufficient the consumer then engages in at-event consumptive values experiencing actions. These then lead to the consumer generating post-event gratification reflections regarding their valuing experiences. These post event measures are typically gauged as satisfaction, and/or trust, and/or loyalty (Hamilton and Tee, 2013). Finally, values deliverance is also a dynamic process, and it embeds feedback loops between the post-event gratification decisions, at-event consumptive actions, and pre-event motivations (Hamilton *et al.* 2013). This values deliverance process is displayed as Figure 1.

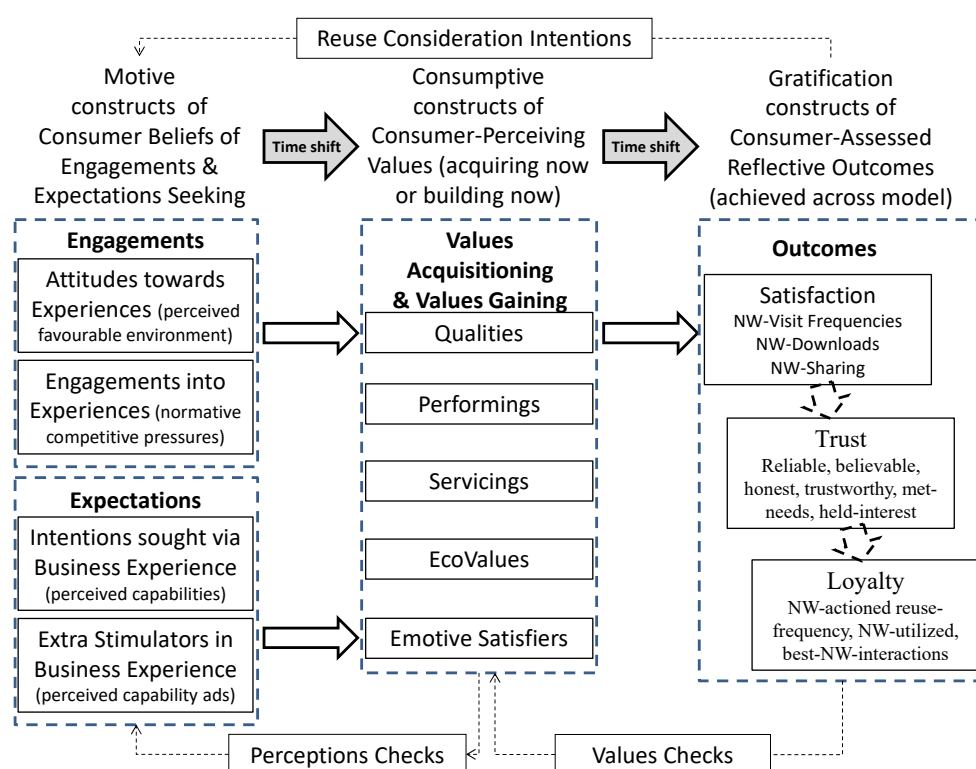


Figure 1: Values deliverance framework (adapted from Hamilton *et al.* 2013; Hamilton and Tee 2013)

Values deliverance is by nature multi-dimensional. Values deliverance is an acquisition process involving perceptions, and inducing actioning and trialing behaviors, and reflective summations. These can also be tangible, and/or intangible, and/or emotive, and they can be positive, or neutral, or negative.

Behavioral Values in Service Business'

The literature offers many variants when modelling values deliverance, but a sequential time-line and multi-dimensional approach offers a solid behavioral framework. Figure 1's values deliverance approach enlists the three stage, theoretically-supported construct blocks (West and Turner 2010).

Considering service business' Woodruff (1997) believes values are hierarchically developed, and they can be progressed from a consumer's desired values perspective (as pre-event expectations) through to the consumer's post-event perceived values deliverance outcomes. Mattson (1991) adds that these value dimensions can exist as mixes of emotional, practical and logical values.

Sheth *et al.*'s 1991 Theory of Consumptive Value delivers five value dimensions: (1) functional (performance), (2) social (servicing), (3) emotional (satisfiers), (4) epistemic (economic-worth of some novel item), and (5) conditional (quality). Sweeney and Soutar (2001) refined this behavioral work using: (1) price/value-for-money, (2) quality/performance, (3) social value and (4) emotive value, as their values measures. Roig *et al.* (2009) followed a similar path, measuring behavioral value across services through: (1) social, (2) emotive, and (3) functional (performance/reputation, qualities delivered, servicing, and economic) component measures. These value components also modelled into the deliverance of satisfaction and then loyalty.

Boksberger and Melsen (2011) offer values as multi-dimensional, and encompassing social behaviors including: (1) attitude, (2) ideology, (3) beliefs, and (4) justifications - but they recognize values must be set against rules, criteria, norms or ideals and preferential judgments.

Parente *et al.* (2015) support the behavioral perception of value - using a service's: (1) quality (quality experiences), (2) reputation (performing), (3) convenience (servicing), and (4) monies committed (economic-worth) measures. Hamilton *et al.* (2013) build behavioral values from pre-event motivational factors through to five at-event consumptive values, and then through to reflective post-event gratifications. Here, value acquisition is a real-time trialing and 'occurring-now' suite of the consumer's actioning experiences - gauged against the various dimensions of the business' service offering. Thus the value being derived is actually the net combination of the Figure 1 suite of 'at-event' consumer actioning (experiential) investigations.

Over time, these, and other researchers, have literature-developed, and empirically-tested, various consumptive consumer behaviors regarding the business' specific service offerings. Many have modelled the input and output constructs that contextualize the consumer's perceived value acquisitions. The input and output constructs of these research works are summarized in this study into Figure 1's Value Deliverance framework.

West and Turner (2010) support that real-time values acquisitions by the consumer are consumptive behaviors which in-turn deliver reflective gratification outcomes. Hamilton and Tee (2013) add that the values acquisition process commences when pre-event motives are sufficient to then stimulate a consumer to action their consumptive trialing processes - checking (1) performance, (2) quality, (3) economics, (4) servicing, and their (5) emotive satisfier feelings.

Thus, the Figure 1 progressive timeline-shift likely occurs from the consumer's pre-event item motives, through to their at-event consumptive item trialing behaviors, and then through to their resultant post-event item gratification conclusions (Sanchez *et al.* 2006; Bradley *et al.* 2012), and this values deliverance process has embedded feedback loops that update (and reengage) the at-event, or the pre-event constructs (Hamilton and Tee 2013).

Researchers support behavioral motives as delivering consumption (Eastman and Eastman 2015), such reflective behavioral and conjoint value approaches offer pathway inclusions into a consumer's 'post-event' reconsideration intention feedback loop, and/or into a values checking feedback loop. However, they do not capture the values acquiring processes that comes through a service experience, such as occurring in continual big data contributions processes or in a service experience process. Thus, as shown in Figure 1, the deliverance of value remains an ongoing, and cyclical process arising through continuing accumulations across the suite of values deliverance measures.

Value resulting from an available service remains the accumulative processing of consumer's behavioral consumptive actioning 'now.' It occurs at the time it is being consumed or experienced. Thus, accurate value measures are actually behaviorally consumptive measures and vice-versa. The key Figure 1 consumer-assessed, post-event, reflective outcomes in value deliverance fit under the satisfaction, loyalty, and trust construct domains.

SERVICE BUSINESS' APPROACH

Services business' deliver valued actions, deeds, efforts, costs or qualities that target satisfying a consumer's: (1) needs, (2) wants, (3) demands, (4) desires, and (5) fun. Such services can be highly-skilled, and can involve intangible and tangible expert solutions. Services business' also spread across sectors including: accounting, banking, benchmarking, consulting, consumer management, education, insurance, operations, OSS development, professional services, social networking, retailing, tourism, and transport.

Locating GitHub Behavioral Values

Big data OSS developer sites like GitHub behave as a development and storage hub for all aspects of a software project's development. Thus, GitHub acts somewhat like a service business.

Hence, a service business research approach may offer useful insights into the values building in repositories, and this approach may indicate how big data can be analyzed from a values deliverance perspective. In GitHub the consumer's role in values deliverance is replaced by the contributions of those participating. These OSS developers, and their associated responders add value into the GitHub repositories through: (1) their comments, (2) their 'readme' contributions, (3) their internal/external

assessments and (4) their code development additions or deletions contributions.

Today, those working in the big data behavioral values field are now considering service business' values-related issues including: (1) approaches to extract data, (2) purposeful data extraction techniques, (3) values measurement, and (4) new business engagement opportunities (Bradlow *et al.* 2017; Cosentino *et al.* 2017; Erevelles *et al.* 2016; Grewal *et al.* 2017; Hamilton *et al.* 2017). However, the extraction of the participant-contributed value items from within a big data development and storage hub like GitHub still remains unfocussed, and big data values deliverance remains an ongoing domain of research investigation.

Applying Behavioral Values to Big Data Streams

The above values delivery systems are actually survey based and point-in-time text response models. With big data providing the input constructs to Figure 1's Value Deliverance Model. GitHub projects continually acquire text information from multiple sources - stars and watchers are attitudinal; pulls and forks are engagements; contributors and commits are intentions; and project releases are stimulators. These all link to the 'text' values capture and then culminate in project activities levels. The linking of big data text storage to values deliverance offers an opportunity to recompile the values system for: (1) a business, and/or (2) a service, and/or (3) a developer/R&D environment. Many big data mining approaches exist (Bello-Orgaz *et al.* 2016; Cosentino *et al.* 2017). Several text mining approaches also exist. Dean and Ghemawat (2004; 2008), Zaharia *et al.* (2008), and Shim (2012) mine large scale data-intensive applications in clusters using MapReduce algorithms.

MapReduce algorithms often engage with large (terabyte) data sets and can generate intermediate value pairings as a reduced function containing all the intermediate value pairings against a selected intermediate key. Google uses query languages built into various parallel databases systems to execute over 100,000 MapReduce tasks per day. MapReduce uses Hadoop OS algorithms to delivers on small pieces of data including: (1) large-scale graphics, (2) text, (3) machine learning, and (4) statistical machine translation (Pavlo *et al.* 2009; Fernandez *et al.* 2014) - with multi-data assessments processing in-parallel at the working node.

In text mining GitHub repositories, MapReduce parallelizes and executes across selected repositories and it runtime solves: (1) input-data-partitioning, (2) repository-execution-scheduling, (3) repository-handling-failures, and (4) inter-repository-management-communications (Dean and Ghemawat, 2010).

MapReduce uses 'map' functions to deliver each chosen word aligned to a paired count-of-occurrences. It splits text data into small, independent, intermediate, key word/value pairs (or 'subset chunks'). The 'reduction' functions then shuffle and combine these key words/values at the same working node. Word counts and a common concept/output are generated. Next, an execution wrapper reduces these words/concepts into a sorted output list of words/values counts (Fernandez *et al.* 2014). Each output count can then be collated (or word-parceled) into its specific value construct, and analyzed using the Figure 1 values deliverance system. This staging system is shown in Figure 2 – with the values deliverance included during stage 3.

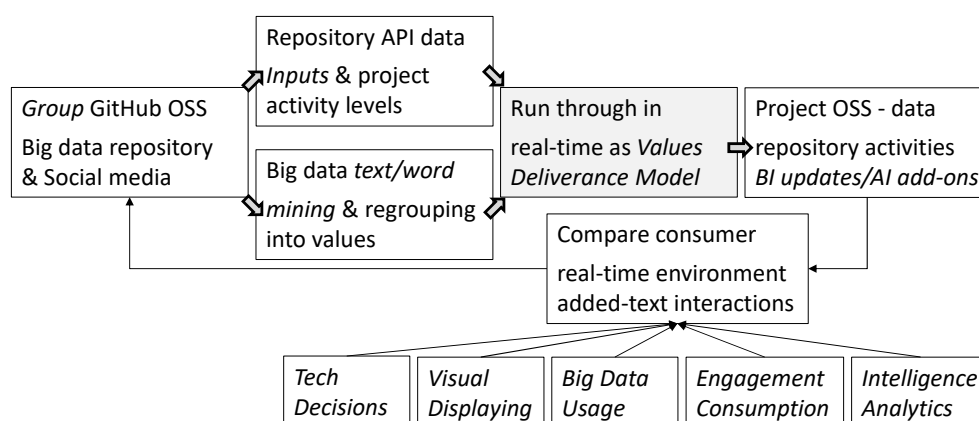


Figure 2: Values deliverance: Big data staging system

The specifically-targeted consumer-business engagement environment, and its chosen service offering, is first defined. In this case, it is GitHub JavaScript, and the strength of the values deliverance system mined from within its repository projects. Next, the values deliverance system construct items are added (and can be extended by co-tracing and adding word synonyms). Then, a reduction algorithms approach is applied at the working node. Measurement of these reduction outcomes then allows application through real-time mechanistic path models.

Considering Figure's 1 and 2, the emergent individual construct items within the values delivery system can be selectively gauged against the above gratification groupings, and/or against activities outcomes measures such as GitHub project activities levels

(Hamilton *et al.*, 2017). Interpretable, standardized path strengths, and standardized total effects then offer insights into business-applicable outcomes. This is shown in Figure 3. Here the gratification post-event measures are encapsulated through the project's activities levels. Other measurement items involved can also MapReduce into satisfaction, trust, loyalty, and feedback measures in a similar way to the motive and consumptive MapReduce measures discussed across Figures 1 and 2.

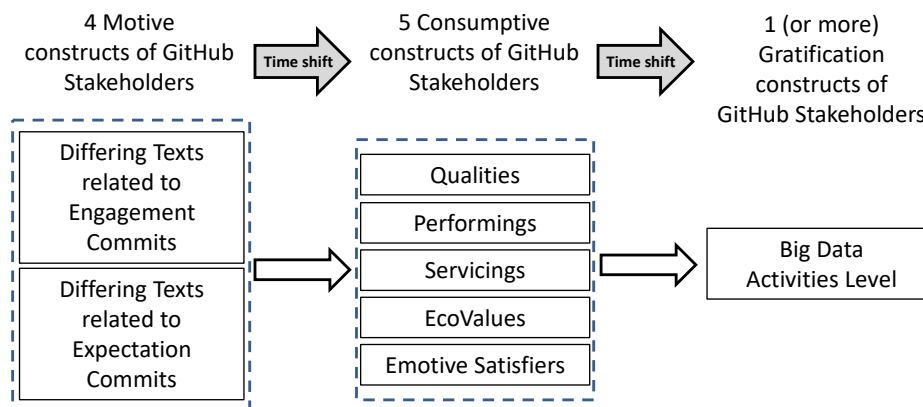


Figure 3: Values deliverance model

This real-time analysis can also incorporate artificial intelligence and machine learning responsive solutions. For example, Grewal *et al.* (2017) link retail consumer engagement decision making to a raft of mineable considerations: (1) technologies-deployed, (2) aesthetic visual displays, (3) big data usage, (4) activities analytics levels, and (5) consumptive engagements. These can be intelligently-designed to behaviorally-monitor (and respond to) external interactors, and they can be incorporated via feedback loops into Figure 2's value deliverance staging system. This adds further intelligences towards determination and provision of near-real-time, business-relevant, consumer-targeted, value deliverance system outputs.

CONCLUSION

Our approach suggests the OSS big data platform GitHub can be data mined to assess the values embedded within its participant's actions (RQ1), and that the relative strength of behavioral value dimensions likely does support pathways to improve GitHub as an OSS services provider (RQ2).

Hence, this study now follows Figures 1, 2 and 3 to API extract information within chosen GitHub repositories, and to assess the relative activities contributions into a GitHub project. Like Google, we now deploy the values deliverance framework measures using MapReduce to text mine the projects' information (previously extracted through GitHub's restrictive API's). These text components are generated by GitHub's OSS developers and their associated follower ecosystems. This approach allows the extraction and collation of the text components (text comments, their text 'readme' contributions, their internal/external text assessments, and their text code development additions or deletions contributions).

Data mined text items are collated, regrouped, and deployed into the values deliverance model (Figure 3) as motive, consumption and gratification constructs. The values-deliverance model allows GitHub and its project creators (and their core team of lead developers) to better understand the significant path relationships that exist within GitHub's ecosystem, and within its projects and their communities of stakeholders.

The values deliverance model exposes the significant total effects pathways. These can be interpreted by GitHub and its project creators (and their core team of lead developers). Decisions can then be applied towards influencing GitHub project activities. This can expedite GitHub project release solutions delivering enhanced qualities, efficiencies, cost savings, and time reductions.

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Cold Chain Logistics Management

(Full Paper)

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ABSTRACT

Cold chain logistics is a very complicated issue. Many foods are picked up when meat is slaughtered from animals, there is a certain S.O.P. to save. But because the whole industry chain is very long, many step will affect the safety of food. Whether it is eating fresh food, or using vaccine drugs, it needs to be transported through the cold chain.

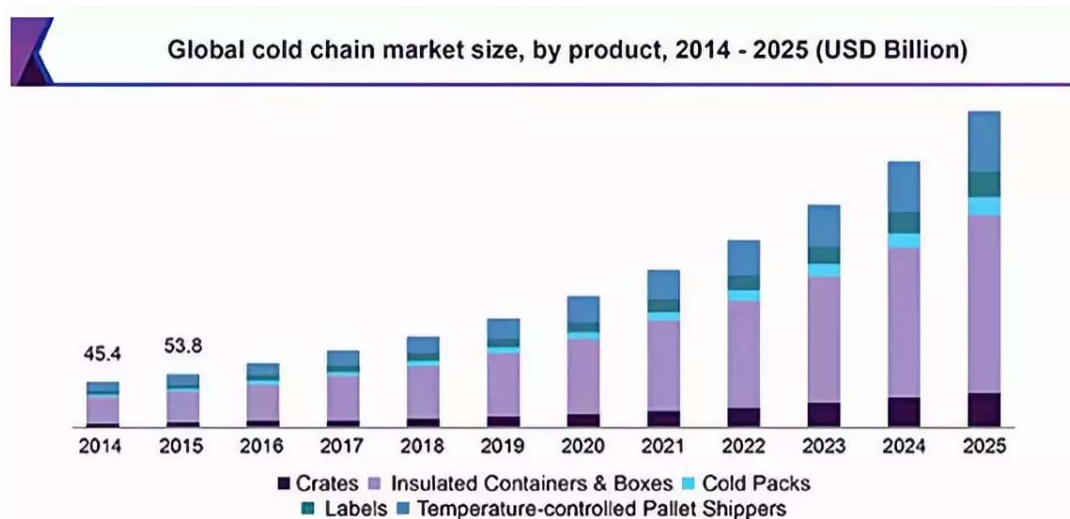
Keywords: Cold chain logistics, fresh e-commerce logistics, halal logistics, ASEAN cold chain logistics, cold chain globalization

*Corresponding author

INTRODUCTION

How big for the market?

In 2017, the global cold chain market shown in Figure 1 is valued at \$147.55 billion, and will reach \$447.05 billion by 2025, with \$18 billion coming from the food and grocery markets and more than \$17 billion from health care products. And the biopharmaceutical cold chain is a product that is estimated to be \$16.6 billion by 2021. The market is expected to continue to grow at a rate of 15.0% per year at a compound annual growth rate. Take example: Fresh E-commerce Logistics: Amazon Acquires US Organic Fresh Food Whole Food Supermarket for US\$13.7 Billion, Fresh e-commerce is the last major retail battlefield that Amazon has yet to conquer. Global fresh-keeping e-commerce still lacks high-quality and efficient cold-chain logistics service solutions.



Source: This study.

Figure 1: Global cold chain market value.

Halal logistics

According to estimates by the World Bank, halal foods have a global business opportunity of \$600 billion a year. It accounts for 16% of the global food market. The halal market is huge, but there are relevant norms and standards to be observed from raw materials, processing processes, logistics, storage and sales.

ASEAN cold chain logistics

Southeast Asia has a tropical climate. In the summer, the demand for cold chain logistics is urgent. The cold chain foundations in Southeast Asia are mostly poor, and the space for improvement is large. The expenditure on food in Southeast Asia is increasing by more than 10% every year.

Cold chain globalization

As more and more food and medical product manufacturers are globalizing, their supply chains must be global. As manufacturers move around the world, these manufacturers must increasingly focus on their products because their products are sold all over the world. If the product goes wrong, it will seriously affect the operation of the entire enterprise. The globalization of the cold chain, and food safety, have prompted governments in the streets to strengthen their regulation of production and supply chains. And various preventive measures and regulations have been established. Take the pharmaceutical industry as an example. For many years, pharmaceutical requirements in most countries have to keep products in the guidelines developed by manufacturers. In 2011, United States passed "The Food and Drug Safety Modernization Act". This mainly for recording every step of the food supply chain, and the product must be traced back to the original point. And its recycling system must be reliable and efficient, and all products listed are the rule must be observed.

In Nov, 2013, the EU has also officially implemented drug regulation, including so-called over-the-counter drugs. The temperature requirements will be extended throughout the delivery process. In the European Union, 80% of medicines require temperature-controlled transportation. Therefore, many drug manufacturers take the same approach when exporting invitations to the United States. Under such circumstance and supervision, logistics is a common issue. Manufacturers are also setting more stringent requirements, so their third-party logistics and other suppliers are adding additional investments to be certified by all relevant agencies by 2020.

BACKGROUND

China Federation of Logistics and Purchasing and Planning Institute, http://www.cflpla.com/index_en.asp, this organization was incorporated in 2002, to provide professional logistics consulting services to governments and businesses. Headquartered in Beijing. Since its establishment ten years ago, it has successively worked with various government ministries (such as the National Development and Reform Commission, the Ministry of Commerce, the Ministry of Communications, the Ministry of Science and Technology, the Ministry of Agriculture, the Forestry Bureau, etc.), local governments, large and medium-sized enterprises, logistics enterprises, and international organizations (Asia Development Bank, APEC, etc.) Research institutions in other countries have formed close partnerships with more than 600 cooperative projects. The Planning Institute has continuously developed and expanded, and has developed into a leading domestic logistics planning consulting company with a wide range of business, strong professional technology and strong social influence. Under China government, we established "Cross-Strait Cold Chain Logistics Alliance" in two years ago. I am the current chairman of this organization.

The main purpose of establishing the "cross-strait cold chain logistics alliance" is because China's cold chain logistics is generally backward, China has a large market demand, and Taiwan has mature cold chain technology. At this moment, China's cold chain logistics is still in its infancy, and there is still a big gap between the level of cold chain logistics and European and American countries. According to the research report, at present the cold chain circulation rate of advanced countries such as the United States and Japan is over 95%, the loss rate is less than 5%, and the profit rate of the cold chain can reach 20% to 30%.

But Chinese cold chain logistics is still transported at normal temperature. The integrated cold chain circulation rate is only about 20%, and the loss rate is more than 20%, the cold chain profit margin is only about 8%, lower than the normal temperature profit rate is only 2%, showing a low proportion of cold chain circulation, loss Large, high-cost situation. In 2014, China's cold storage area was 0.058 cubic meters per person, compared with USA, 0.357 cubic meters per person in the same period. In the same year, China's road refrigerated trucks were 76,000, Japan was 150,000, and the United States was 250,000. The total population of Japan is 126.8 million, the total population of the United States is 325.7 million, and the total population of China is 1.386 billion. These figures can relatively describe the size of China's cold chain, so there is no doubt that China will be the world's largest cold in the future. Chain business Third-party logistics providing cold chain logistics is already emerging opportunities.

Third-party cold chain logistics service providers to the professional logistics mode that is specially developed for the needs of the cold chain logistics industry. It specializes in providing professional high-performance cold chain logistics services and solutions.

Responsible for third-party cold chain logistics service providers, which enables production, processing, sales and other enterprises to focus on their own operations, without using a large amount of fixed assets, manpower and material resources, to enhance the competitiveness of enterprises, so that enterprises can concentrate on improving their own fields. Market. Especially for small-scale, relatively weak or newly established enterprises, due to limited logistics resources and insufficient logistics personnel, it is necessary to outsource the logistics business to professional units for implementation. According to research data, although the third-party cold-chain logistics service providers in the market currently account for less than 25% of the logistics market, third-party cold-chain logistics service providers are developing rapidly, and more manufacturers will choose in the future. Outsourcing its own cold chain logistics business to third party cold chain logistics service providers.

The problems encountered by the development of cold chain logistics service providers:

- 1) Cold chain logistics costs are too high.
- 2) Large refrigeration demand.

- 3) Customers do not pay attention to cold chain transportation, which makes the whole process of cold chain monitoring difficult to achieve.
- 4) Insufficient cold chain logistics infrastructure in the current market.
- 5) Product market standardization is not yet fully standards.

Improvements:

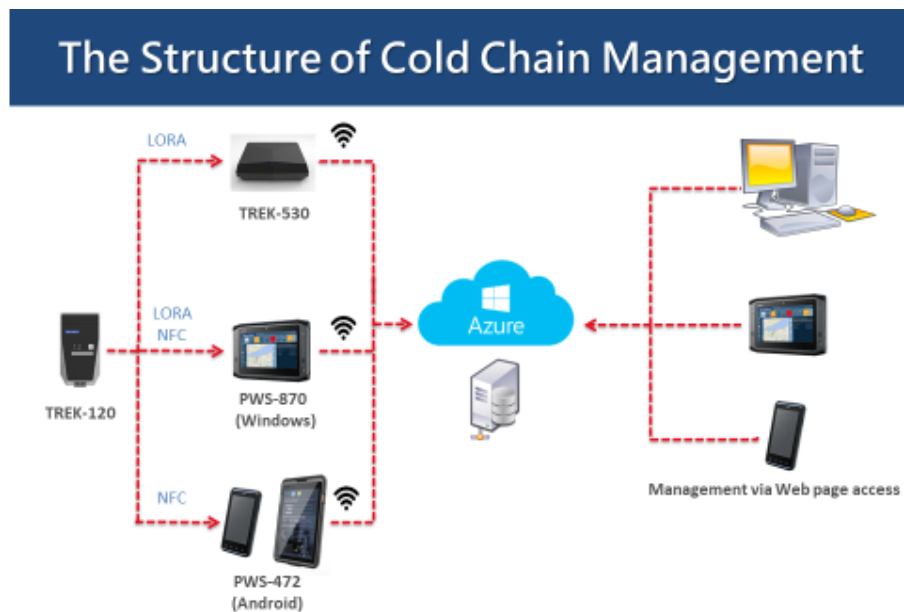
- 1) Strengthen cold chain logistics management.
- 2) Establish and promote product traceability management.
- 3) Strengthening technological innovation of cold chain logistics.
- 4) Public companies must enforce product standardization.
- 5) Strengthen the promotion of cold chain logistics knowledge.

RESEARCH METHOD

Our research is happening at this stage, Using Analysis level program method (AHP) analysis, The key success factors of the current successful operation of the low temperature logistics center.

EMPIRICAL RESEARCH AND RESULTS

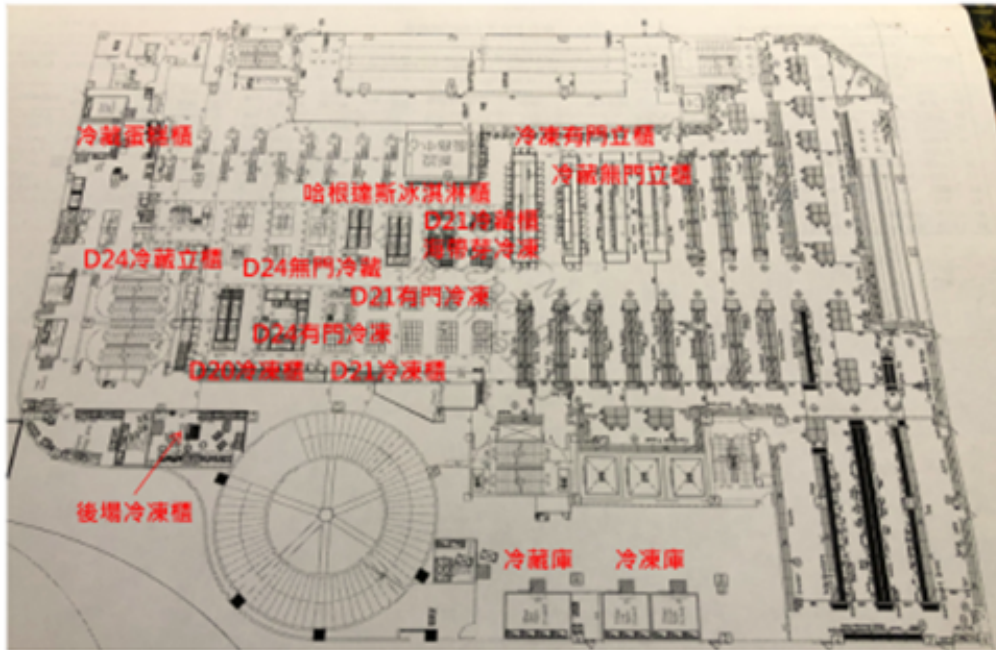
The following case is a supermarket installation temperature SENSOR to control the temperature. The structure of cold chain management and its related works as show in Figures 2 to 10.



Source: This study.

Figure 2: The structure of cold chain management.

Sensor Map



Source: This study.
Figure 3: Sensor map.

2018-03-20 DC 2F00 Freezer area



Source: This study.
Figure 4: Freezer area.

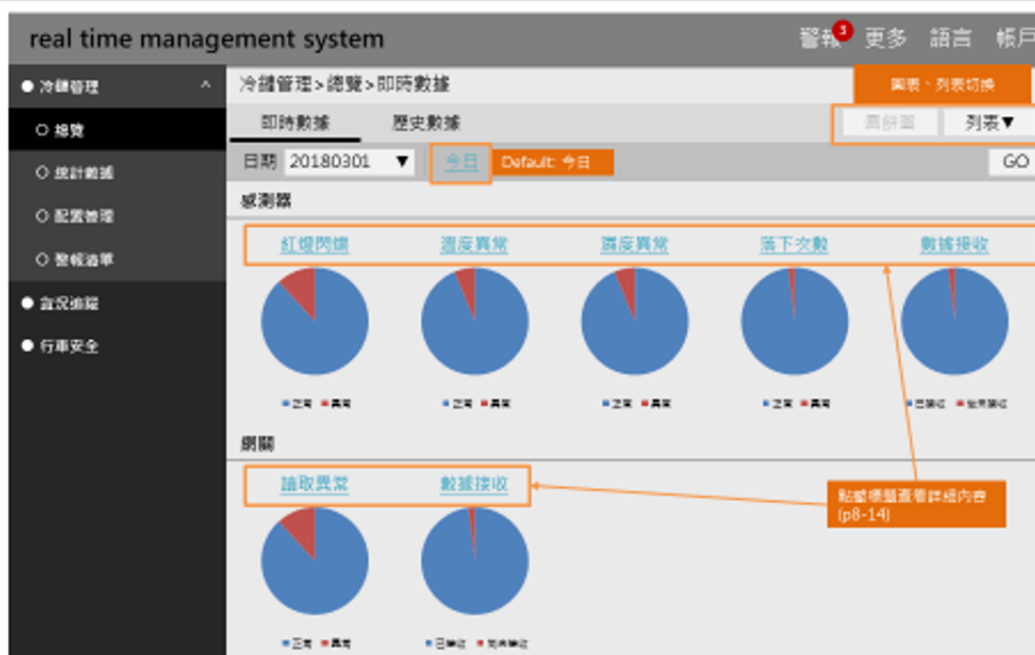
2018-03-18 Replace the sensor



Source: This study.

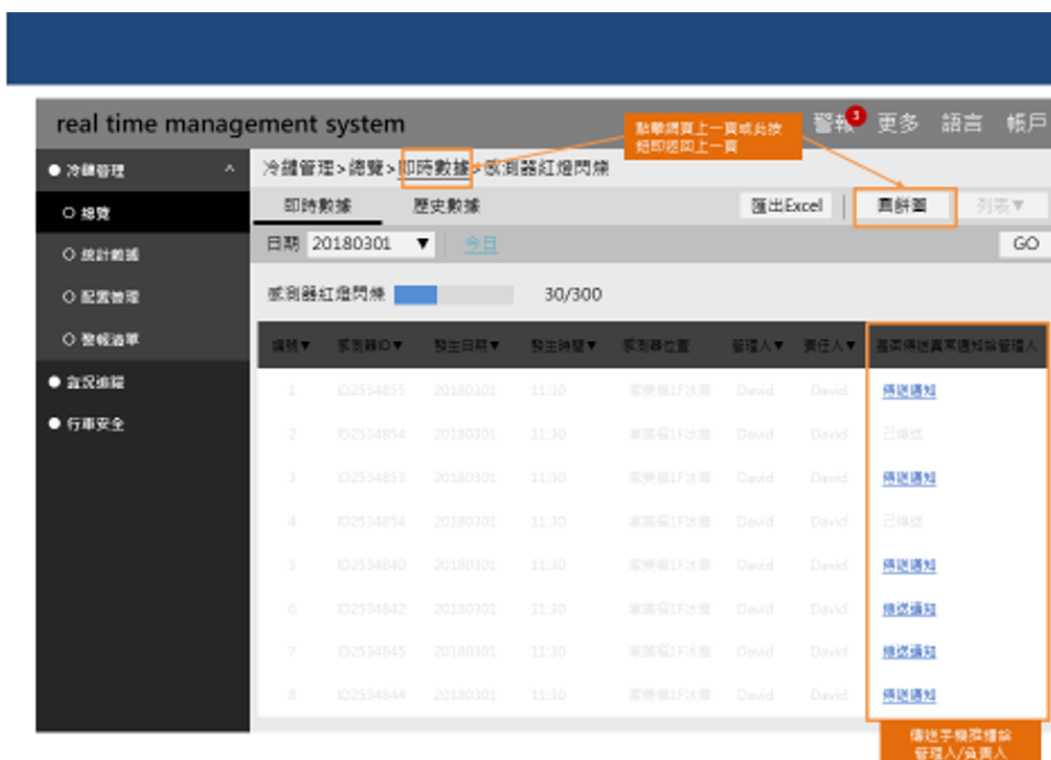
Figure 5: Use sensor to monitor temperature for cold chain management.

Cold chain management real time data



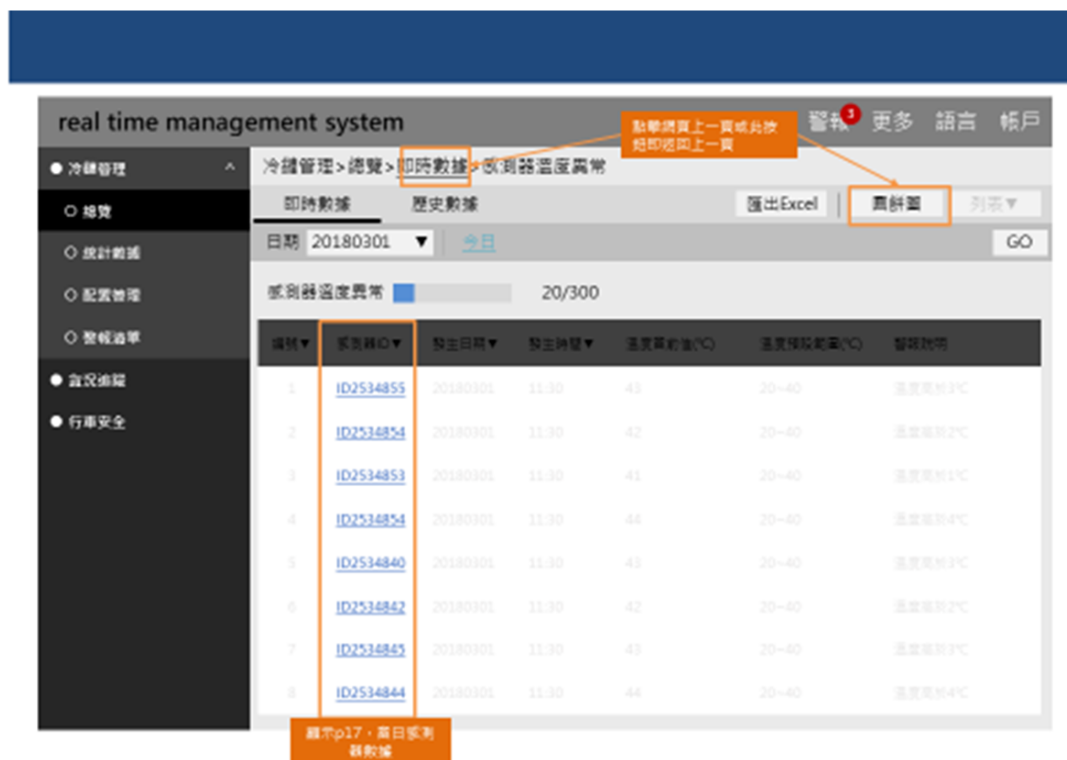
Source: This study.

Figure 6: Use IoT cloud platform for cold chain management.



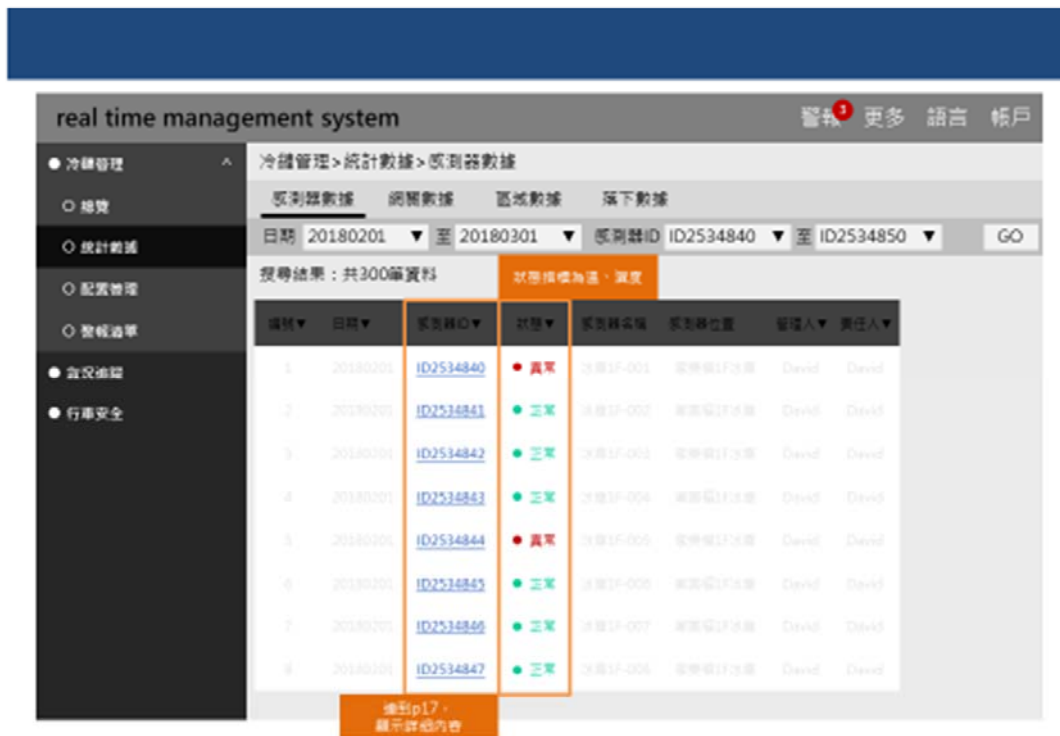
Source: This study.

Figure 7: Use IoT cloud platform for cold chain management.



Source: This study.

Figure 8: Use IoT cloud platform for cold chain management.

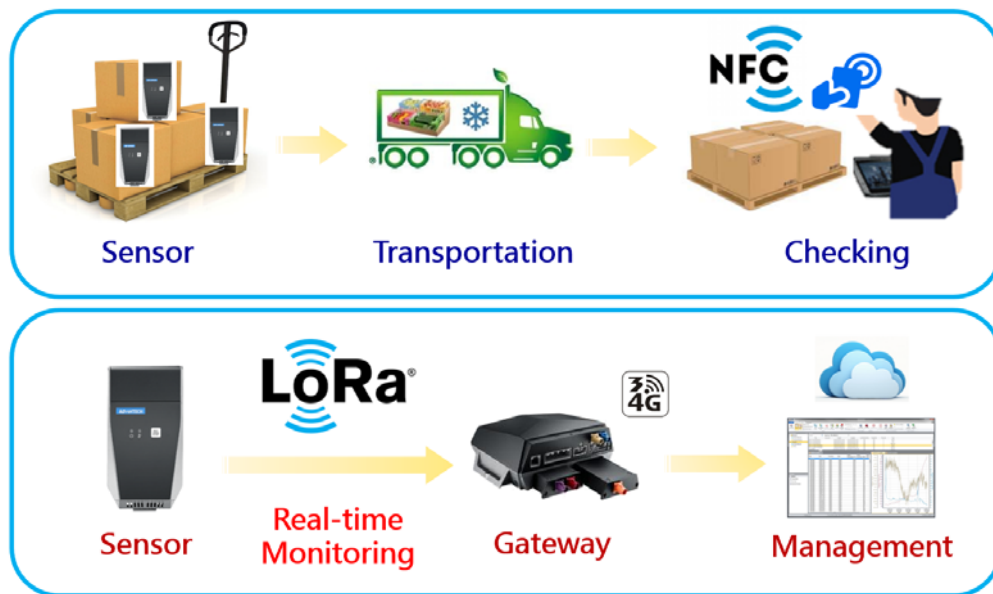


Source: This study.

Figure 9: Use IoT cloud platform for cold chain management.

CONCLUSION

- The cold chain is globalizing.
- Product sensitivity and quality requirements are getting more and more attention.
- Various rules are changing and improving.
- More and more outsourcing more and more processes to third-party logistics companies.
- Cold chain is undergoing mode conversion.
- Marker forcing cold chain more efficiency.
- Packaging is evolving to meet new demands.
- Customer behavior are still the most difficult part of the cold chain.
- Financial support is very important.



Source: This study.
Figure 10: Cold chain user scenario.



Source: This study.
Figure 10: Cold chain solution.

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Construction of A Personalized Service Model of ABC Community Fresh E-commerce Based on Small Data

(Full Paper)

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ABSTRACT

The homogenization of products and services in the development of community fresh e-commerce is more serious, and providing personalized services to community customers has become a new development key point. From the perspective of small data research, this paper proposes an e-commerce service model that uses small data to provide personalized fresh products for community customers. Taking ABC community convenience store as the research object, the paper analyzes the application of community customer small data in the personalized service of community fresh convenience store to improve the loyalty and satisfaction of community customers and promote the development of community fresh e-commerce.

Keywords: small data, personalized service, mode, community fresh e-commerce.

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INTRODUCTION

According to the Ministry of Civil Affairs' "Urban and Rural Community Service System Construction Plan", the construction of smart communities in China has begun to explore in some areas, and the integration of informationization and community services has improved the satisfaction and comfort of community users. In the future, the development of urban and rural community service informationization in China will gradually form a pattern of network connectivity, application integration, information sharing, and rapid response. Community information construction promotes the development of various forms of community-based e-commerce. The development of community fresh e-commerce can provide community users with convenient and personalized fresh product personalization services. On the other hand, it also contributes to the improvement of community city management and community governance, and the development of community fresh e-commerce, Bring new business opportunities and profit growth points for property service units (Lu, 2017).

Community information construction has promoted various forms of community-based e-commerce. With the gradual improvement of the logistics and warehousing system, the community fresh e-commerce market has become the blue ocean, and emerged some O2O brands such as Bee Quick, Beiquan, 58 home and Hema stores. At the same time, the role of data is increasingly evident in the development of community-based e-commerce and the informatization of community services. The development of mobile networks, the popularity of sensor terminals such as smart phones and wearable sensing devices, make it easier to collect user behavior data (Qin & Zhen, 2017). Through intelligent devices, it is easy to record user's activity information and personal small data, which brings opportunities for the use of small data for community fresh e-commerce personalized services, and also promotes the transformation of community e-commerce personalized service model.

RELATED CONCEPTS

Small data

The concept of small data was first proposed by Professor Estrin, D., a computer professor at Cornell University in the United States (Estrin, 2014). By analyzing the social behavior data of his father before his death, he found that his father's life was different from usual, and inspired Estrin, D. to start research. Small data, looking for anomalies from the small data of daily life, puts forward the importance of small data, and uses small data as a new medical evidence (Chen, 2015).

Small data refers to all kinds of data generated by individuals in their daily production and living processes, including the customer's daily living habits, health change data, sports activities, social interpersonal situations, personal preferences, and other comprehensive data. The development of small data is inseparable from the maturity and perfection of personal data collection equipment such as monitoring equipment, sensor equipment and wearable equipment. Through the collection and analysis of small data generated by customers in e-commerce activities. Using small data to carry out user portraits of individual customers, to achieve the prediction of the user's social relations, purchase needs and life behavior. In the community fresh electronic commerce

activities, we can use the idea of small data analysis to collect personalized data from customers by collecting small data from community customers. The community's e-commerce customers' small data analysis framework is shown in Figure 1.

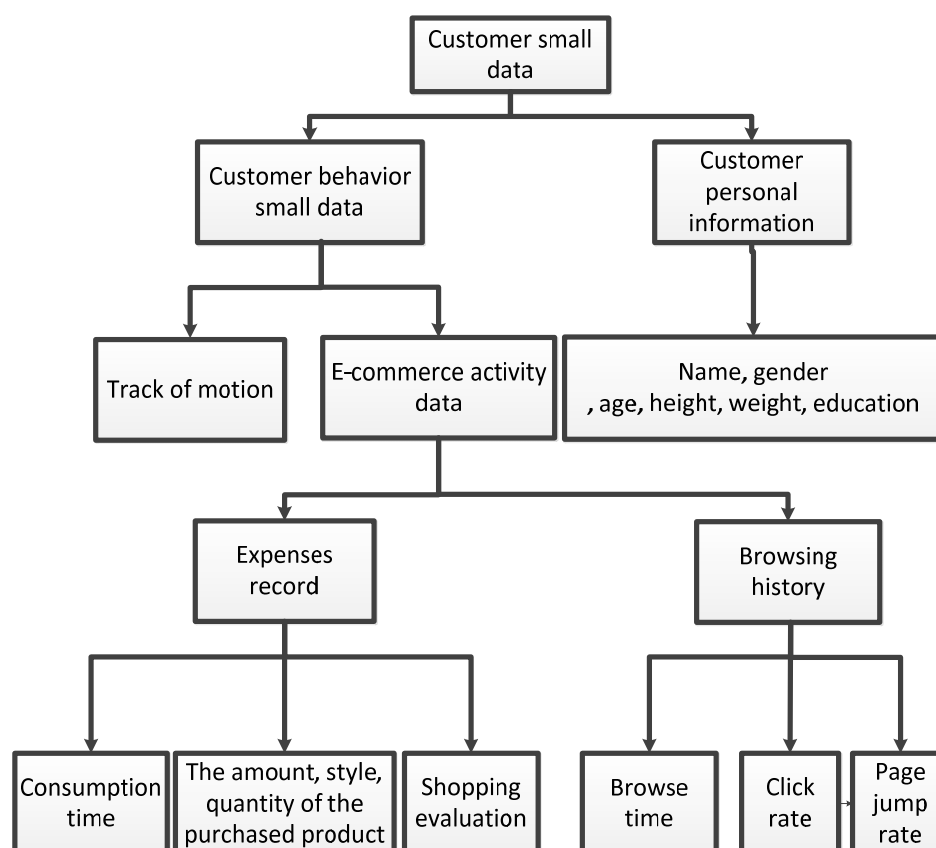


Fig. 1 Community E-commerce Client Small Data Analysis Framework

Community Fresh E-Commerce

The community refers to a community of social life formed by a certain number of population, a certain scale of facilities, and a certain characteristic of culture within a certain geographical range. The currently mentioned communities include naturally formed communities such as urban street communities, townships, natural villages, and urban-rural combinations, as well as communities formed by professional functions, such as university campuses, military garrisons, mining districts, etc (Lao, Zhong, & Tan, 2007). Community fresh e-commerce refers to the use of an e-commerce business platform or a combination of offline convenience stores to provide integrated services for fresh consumer products and after-sales services for customers in surrounding communities. The combination of e-commerce platforms and offline stores can provide customers with low-cost, high-performance commercial service activities, thereby better serving community customers and improving the quality of life of community residents (Zhang & Xiao, 2015).

According to the survey of China's Fresh Energy E-Commerce Industry Consumption Insight Report of 2018, at present, China's fresh e-commerce development model presents a variety of forms, mainly in the following four types: (1) Integrated e-commerce model. The integrated e-commerce platform increases the fresh product channel, adopts the traditional B2C sales model, usually adopts the platform self-operated, and also supports some third-party merchants to settle in. Representatives are Tmall Fresh, Jingdong Fresh and so on. (2) Vertical fresh e-commerce model. The vertical fresh e-commerce model is responsible for all aspects of production, processing, distribution and sales of fresh products. Although it is possible to obtain a price advantage in the supply chain of the control products, due to the heavy model and large investment, it is easy to encounter a crisis due to the problem of the capital chain. Representatives are Fruit Day, Yiguo Fresh. (3) O2O model. The community fresh O2O model is divided into two types. The first one is the offline fresh convenience store. By cooperating with the take-out platform, online sales are used as a channel for expanding business, mainly maintaining offline sales. The second is the self-built APP or the use of third-party software for the sale of fresh goods. In this mode, the merchants distribute through the distribution warehouse or the store, such as MISSFRESH, Baiguoyuan and so on. (4) Supermarket + catering model. Taking Hema Fresh as an example, this new retail model combining catering and fresh food is positioned as a mid-to-high-end customer. The main products are fresh and instant catering,

and the offline store undertakes the warehouse function, which can ensure the delivery time and reduce the cost, and also facilitate the processing of the fresh products at the end, reducing the loss. Among them, the latter two models have become the mainstream community fresh e-commerce operation mode.

CONSTRUCTION OF A PERSONALIZED SERVICE MODEL FOR COMMUNITY FRESH E-COMMERCE BASED ON SMALL DATA

The idea of constructing a personalized service model for community fresh e-commerce

Build a database layer for the community fresh e-commerce personalized service model

Build the database layer of the community fresh e-commerce personalized service model according to the behavior data and personal information of community customers. The main role of the database layer is to collect and store personal small data generated by community users in e-commerce activities through IoT devices, wearable data recording devices, mobile smart terminals, and information management service systems. The collected data is as comprehensive, accurate, and uninterrupted as possible. At the same time, it guarantees the security of data and ensures the security and availability of user data.

Building a Data Manipulation Layer for Community Fresh E-commerce Personalized Service Model

The data collected by the database layer is non-standardized data and cannot be directly used for data analysis and prediction. Need to use data fusion technology to process data, eliminate noise data, clean dirty data. Combine the data generated by customers online to carry out customer portraits to provide better decision support for consumers in the data service layer.

Build data service layer of community fresh e-commerce personalized service model

According to the customer consumption records and browsing record data in the community fresh e-commerce activities, the data service layer of the community fresh e-commerce personalized service model is constructed. Based on the processed small data, the community fresh e-commerce platform will be used at the data service layer to provide customers with personalized product customization and recommendation services. Use the information such as consumption time, amount, quantity, shopping evaluation, browsing records and other information recorded in the customer's consumption process to promote product prediction, and provide e-commerce users in the community with fresh product-related information services. At the same time, a user feedback quick response mechanism is established to solve the problems encountered by the user in the community fresh electronic commerce activities at the first time, and timely respond to the needs of the customers.

Community Fresh Food E-commerce Personalized Service Model Working Principle Based on Small Data

Customer small data collection layer

The content collected by the community fresh e-commerce customers' small data mainly includes the data generated by individuals in the community's fresh e-commerce activities and the data collected by smart terminals such as mobile wearable devices. The specific data content includes four aspects: First, the small data generated by the community in the daily production and life of users, and the tools for collecting data are mainly data collection equipment such as Internet of things devices, wearable data recording devices, and mobile smart terminals. The collected data includes user's exercise data, body blood pressure heart rate data, weight change data, etc; Second, the small data generated by users using the community fresh electronic commerce system, the collection tools mainly include the user transaction behavior record system, evaluation feedback collection system, information analysis system, etc. The collected data includes shopping records of the community users, product browsing records, consumer evaluation records, etc; Third, user data collected by the community management department collects tools mainly including community security monitoring systems, community user identification systems, and Internet of Things systems (Niu, 2016). The collected data includes the user's registered identity information, the time of use of the access control system, etc; Fourth, user data collected by social company groups, this part of the data is allowed to share by users. The collection tools mainly include network information management service systems, open service information systems, etc.

Customer small data analysis layer

The primary role of the community fresh e-commerce customer small data analysis module is to clean and integrate the data collected by the collection system. The data collected by the small data collection system comes from different collection sources. It is not standardized data and cannot be directly used for data analysis and prediction. The operation of the data processing system mainly includes four basic steps of data cleaning, data integration, data transformation, and data reduction. (1) Data cleaning is mainly to delete irrelevant data, duplicate data in the original data set, smooth noise data, filter out data unrelated to the subject, and process missing values and outliers. (2) Data integration integrates different types of data from different collection channels collected by the data collection system, logically or physically, to achieve data sharing. (3) Data transformation: When data is transferred from the data source of the collection system to the data analysis system, the data needs to be converted into a format that the system can recognize. (4) Data reduction refers to minimizing the data and improving the efficiency of the data analysis system on the premise of maintaining the original appearance of the data as much as possible.

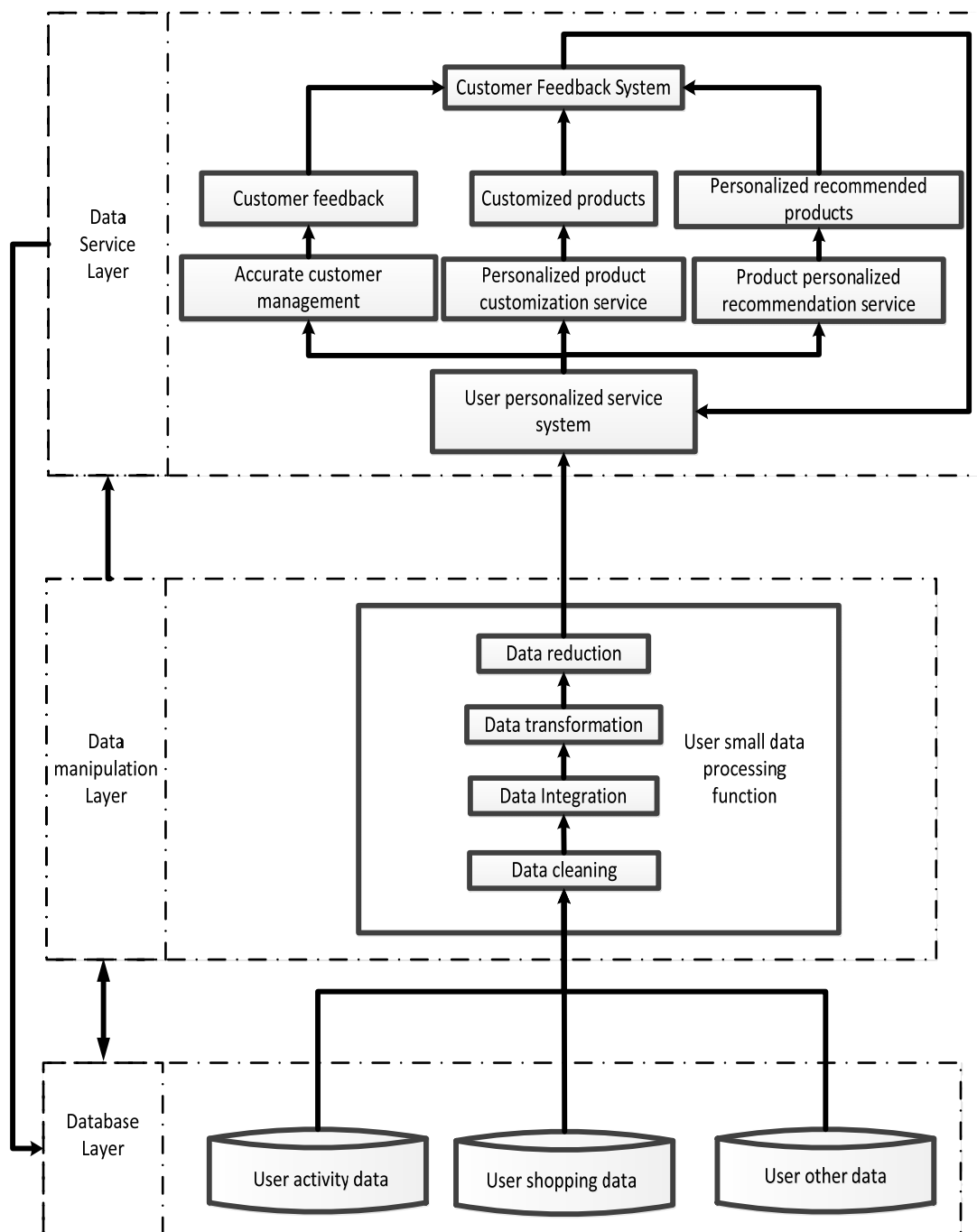


Figure 2 Community-based fresh e-commerce personalized service model based on small data.

Small data customer service feedback layer

The main task of the community fresh electronic commerce customer small data service feedback system is to carry out “one to one” service around the community customers, pass the consumer feedback information in the fresh electronic commerce activities to the analysis recommendation system, and optimize the recommendation service system. Feedback customer information is divided into positive feedback information and negative feedback information. Positive feedback information will be recorded in the personal database of community fresh e-commerce customers, positively reinforcing the forecasting effect of the data model. It will better realize personalized recommendation services for community fresh e-commerce customers and bring better consumer service experience to community customers. The negative feedback information will be used to modify the forecasting recommendation function of the data model so that the personalized service is closer to the customer's needs and the personalized product recommendation is more accurate.

ANALYSIS OF E-COMMERCE SMALL DATA PERSONALIZED SERVICE WITH ABC COMMUNITY FRESH CONVENIENCE STORE AS AN EXAMPLE

Community Fresh E-commerce User Portrait Based on Small Data

The ABC community fresh convenience store relies on a large community. The tenants of the community are mostly around 18-40 years old. They are engaged in civilian jobs, have strong spending power and have huge consumption potential. The ABC community fresh convenience store conducts online sales of fresh products through self-built APP and third-party software WeChat applets, and integrates offline consumption and online consumption data through the customer credit system.

The customer portrait is a detailed description of the customer's characteristic data. In the process of customer portraits of the ABC community fresh convenience store, including the basic characteristics and business characteristics of the community customers. ABC community fresh convenience store can collect basic characteristics data such as name, gender, age, income, and education level of community customers through the APP and WeChat client management system. The business characteristic data of community customers is accumulated in the process of community customers' shopping and shopping. The collection time is relatively long and the collection process is complicated. The collected community customer small data needs to be cleaned, integrated and analyzed with relevant data. According to the analysis results, the customer is provided with a customer portrait. The customer portrait feature description includes the customer basic feature description and business feature description. As shown in Figure 3.



Figure 3 Community Fresh E-commerce Customer Portrait

Personalized service provided by community fresh e-commerce based on small data

Customer precise management

Customers are the most valuable core resource in business activities. Community fresh e-commerce customer maintenance is a long-term, mutual process, effectively maintaining high-quality customers and exploring potential customers. It is the most concerned issue for community fresh e-commerce operators. Based on small data-based community fresh e-commerce personalized service process, the collected community customer demand small data and personalized difference data can be used to classify customers into precise service sub-groups, and different sub-groups are adopted. Customer care strategy, carrying out different customer relationship services, through deep mining and analysis of small data of community customers, building customer value evaluation model and customer sub-group relationship management model, etc., can screen out high-end customer groups with potential value (Diao & Chang, 2018). The core concept of precise management of community fresh e-commerce customers is

“one-to-one” marketing. The customer small data analysis system can track and analyze the information such as customer browsing footprints and search content in the community fresh e-commerce activities. Recording, discovering the shopping preferences and consumption levels of community customers, better stratifying customers, and establishing a precise management system for community fresh e-commerce customers, as shown in Figure 4, adopting personalized marketing for different customers at different levels of consumption. Policy and service plan for one-to-one service.

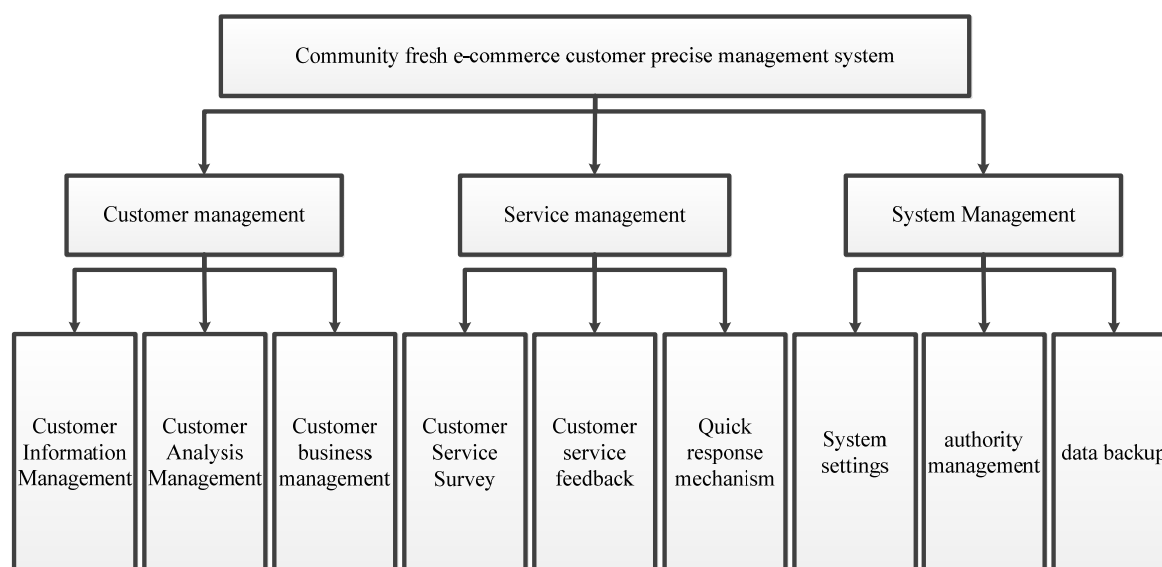


Figure 4 Precise management framework for community fresh e-commerce customers

After conducting a field visit investigation to the ABC community fresh convenience store, the fresh convenience store was managed by a third-party WeChat applet software. Through the membership card system and the offline cashier system for customer small data integration, the customer's online order information and offline consumption information are analyzed and promoted through WeChat, such as WeChat group message, WeChat private message, WeChat public article push and WeChat friends circle and so on. In terms of service management, A Fresh Convenience Store will be divided into large customers, medium customers and small customers according to the daily purchase of product points of community customers, and hierarchical management of customers, see Table 1. At the same time, the customer service personnel were trained to provide dedicated micro-signal feedback service for the customer service personnel. In the survey, 59% of the customers thought that the convenience store customer service could reply and solve the problem in time. In order to better protect customer information security, customer data of ABC community fresh convenience store is managed by small program platform, which can reduce the expenditure of data security protection and increase the profit of convenience store.

Table 1 Customer tiered management of ABC community fresh convenience store

Customer type	Member Points	Feature description	Marketing + maintenance method
Big customer	10,000 or more	The proportion of customers is generally small, but the consumption power is strong.	The store manager should record the customer information file in detail for such customers, and take the customer's birthday and special holiday as the entry point, and do regular greetings and visits, and maintain the frequency at least once a month. At the same time, parent-child activities, reading clubs and other exchange activities will be held to deepen the bonding between customers and convenience stores.
Medium customer	2000-10000	Customers should be the focus of training customers.	Create a customer WeChat group, focusing on daily WeChat interaction and daily phone calls to enhance customer loyalty. Invite customers to participate in parent-child activities, reading clubs and other exchange activities to deepen the bonding between customers and convenience stores.
Small customer	Below 2000	Customer spending is small, but the customer base is	First, the use of points redemption, deposit gifts and other forms of marketing, the second is to call by phone; the third is to use a group purchase and other forms of promotion for

		huge	customer relationship maintenance.
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Personalized product customization service

Advances in community building have made community customers less satisfied with traditional consumption patterns and are beginning to seek higher consumer experiences. Consumers have placed higher demands on the products and services of the community fresh convenience store operators. In recent years, food safety incidents have made many community customers consider not only product quality and price factors in the consumption process, but food safety and health issues have become a new focus of customer consumption. In order to meet the comprehensive consumer needs of community customers, it is necessary to develop personalized customer customization services based on small data. Through the community customer small data information and self-service Q&A robot, the customer service of the fresh convenience store can actively and quickly respond to the appeal of the community customers in the consumption process. The data sharing platform allows the customer to understand the positioning service of their products and solve the customer disputes in time, which is fast and convenient. Logistics distribution guarantees the freshness of the product, by coordinating online and offline resources, the information is guaranteed to be authentic and reliable, and the community customers' personalized product customization needs are deeply understood, and corresponding services are provided to improve the consumption viscosity of community customers and achieve sales improvement.

The customers of the ABC community fresh convenience store are mainly tenants from the surrounding communities, mostly young people aged 18-40. Mainly engaged in civilian, sales and management work, income is higher than the local average, willing to try new things, there are demand for personalized product customization. The types of goods provided by convenience stores include seasonal fruits, imported snacks, dairy products and package services. Take a customer as an example, and analyze the personalized product customization service process as shown in Figure 5.

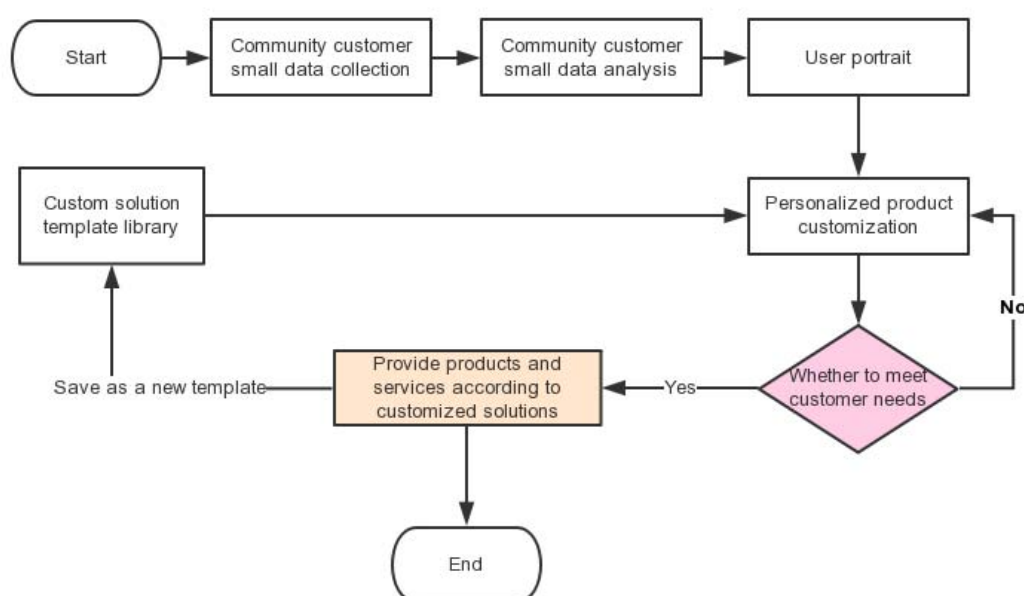


Figure 5 Customized product customization process for community fresh e-commerce customers

Personalized product recommendation service

The development of e-commerce in the community is rapid, the number of services and products offered is increasing, and the information generated is too cumbersome. In the process of facing users in the process of goods and services, customers often need to spend a lot of time to select their own needs. In order to reduce the time for community users to select products, the community fresh e-commerce personalized recommendation system can analyze the collected user data to conduct personalized product service recommendation. The personalized recommendation system is embedded in the user's e-commerce software. The user only needs to operate as usual, and the system automatically presents the required goods. Without the user input, the system can recognize the consumer preferences of the community users and provide accurate information for the community users.

Recommended service (Cong & Jiang, 2017). The personalized recommendation system is shown in Figure 6, including: user model, recommendation algorithm, and recommended target model. The user model is a user data image created by using community customer small data, and is a data collection of community customers in the network world. The recommendation algorithm is the most important part of the whole recommendation system. The quality of the recommendation algorithm directly determines the accuracy of the recommendation result (Ni, 2016). The recommended target model is the result of recommending the user model through the recommended algorithm, and is the simulation result of the computer's personalized demand for the user.

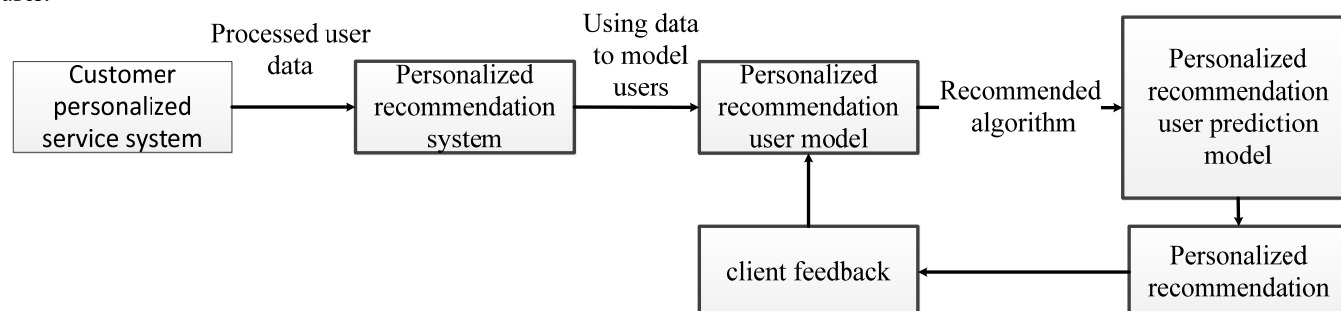


Figure 6 Personalized recommendation service model in community fresh e-commerce management

COMMUNITY FRESH E-COMMERCE PERSONALIZED SERVICE CONSTRUCTION STRATEGY BASED ON SMALL DATA

The community fresh e-commerce personalized service should be oriented to the needs of community customers, focusing on the comprehensive collection and processing of small data of community customers. Through interviews to investigate the e-commerce platform of the ABC community fresh convenience store, and found that there are some problems and imperfections. By strengthening the use of data in e-commerce activities, it will better guide community e-commerce operations and improve customer service satisfaction for community fresh convenience stores.

Strengthen the awareness of small data accurate customer service

Fully understand the importance of understanding customer small data in the community's fresh e-commerce activities. The customer small data in the community fresh e-commerce activities has always been a valuable resource, which requires deep processing and requires the corresponding team to track, integrate and develop, and form more valuable resources. It can help the community fresh convenience store more effectively to realize the personalization and precision of customer service. Provide solutions to customer problems encountered in consumer activities and push personalized services to consumer customers.

Building an Information Resource Library Based on Community Client Small Data

In the small-data-based community fresh e-commerce personalized service system, Through the comprehensive collection and processing of small data of customer groups, based on different types of small data resource bases, customer demand-oriented, through data integration, mining, encryption and other related processing processes, establish a corresponding small data information resource library. The community fresh convenience store can use the small data information resource library to communicate with customers from time to time. While providing strong data support, it can observe and tap the potential needs of customers in time to provide customers with more personalized services.

Refine classification and enhance customer care

Customer care based on small data is a long-term continuous interaction process, which requires the customer service team to communicate with the community customers continuously, so as to ensure the accurate delivery of customer service solutions and the high quality of customer service. According to the customer's demand for small data and customer group differentiation, the community customers are refined into sub-groups of precise services, and different data collection standards are adopted for sub-groups. Through in-depth mining and analysis of customer small data, build a customer value evaluation model, adopt different customer care methods for different levels of customers, maintain old customers, explore new users, and improve service quality while expanding customers.

At present, Customer-centricity has become the core content of community fresh e-commerce service system construction and service model change. It is also an important basis for community fresh e-commerce to increase customer satisfaction and loyalty. Therefore, through the analysis, prediction and judgment of community customer's small data, accurate customer relationship management has become an important factor affecting the community's personalized e-commerce service level. In order to enhance the accuracy and effectiveness of personalized recommendation services, the community fresh e-commerce platform should focus

on the individual needs of customers, constantly tap the customer's small data, optimize the recommendation algorithm, and improve the level of data analysis. Promote the in-depth development of community fresh e-commerce personalized services.

ACKNOWLEDGMENT

This research was supported partly by the following fund projects:

- (1) Shanxi Province's e-commerce specialty Jingao Jiao (2013) No. 16, Shanxi Provincial Department of Education.
- (2) Research on the development of characteristic agriculture in Shanxi based on e-commerce perspective, Shanxi Provincial Philosophy and Social Science Planning Office, Jin Regulation Office (2014), No.3.
- (3) Research on e-commerce visual design norms based on five-dimensional perspective, CCPIT commercial industry branch commercial informationization research "13th Five-Year Plan" 2016 project, commerce promotion word (2016), No. 30.
- (4) Research on e-commerce promotion project of characteristic agricultural products in Shanxi Province, research project of key projects of the Provincial Social Science Association from 2017 to 2018 SSKLZDKT2017047, Jinshe Lianzi (2017), No. 29.

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Critical Success Factors of Alignment between Websites and OCAs in the Manufacturing Industry

(Full Paper)

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ABSTRACT

In this study, a list containing twelve organizational critical activities (OCAs) of manufacturing industry is found out by the interviews with executives and revision of two experts. The analysis on secondary data and the deeper interviews are carried out to obtain the critical success factors of the alignment between websites and OCAs in the manufacturing industry. Six common critical success factors of the three companies are: Support of Executives, Excellent and Professional Team, Full Communication, Harmonic Website Build Process, Technical Support, and Complete Information System Architecture. Finally, this study hopes that companies in the manufacturing industry can improve the competitiveness according to the result of this study.

Keywords: Organizational critical activities, critical success factors, alignment, manufacturing industry and organizational success.

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INTRODUCTION

Organizations frequently carry out important and continuous activities on organizational internal operations to facilitate organizational success. These activities, called organizational critical activities (OCAs), are given abundant resources. Besides, executives supervise and guide these activities periodically. With social changes and advance, information technology has entered everyone's daily life. It brings people convenience, helps employees shorten working hours, and changes the original organizational ecology.

However, with enterprises to adopt E-ops one after another, e-commerce has been regarded as the primary corporate operational channel. In the operational process, some enterprises succeed but some fail. With the continuous advance and innovation of network technology, enterprises must think about how to adopt E-ops appropriately, especially exploring how to conduct self-evaluation of E-ops effectively. For example, Chen et al. (2017) sought to identify a set of key weighting indicators on tourist attractions in Taiwan, and develop a self-evaluation mechanism of quality control on tourism business, using the Analytic Hierarchy Process and Delphi (AHP-Delphi) approach.

Organizational Critical Activities (OCAs) were introduced by Hung in 2006, whose research emphasized the collegiate OCAs which the web supported. The research subjects on OCAs is deficient. This study adopts manufacturing industry as an example to explore the maturity of alignment between websites and OCAs to provide organizations with foundation when carrying out OCAs. In this study, the definition of OCAs is as follows:

Activities must be continuously implemented by the organization for the success in the industry. OCAs are regarded as an essential element on the short-term, mid-term, and long-term success of industry. Thus, they will receive a huge amount of resources and frequent supervision and instruction from executives.

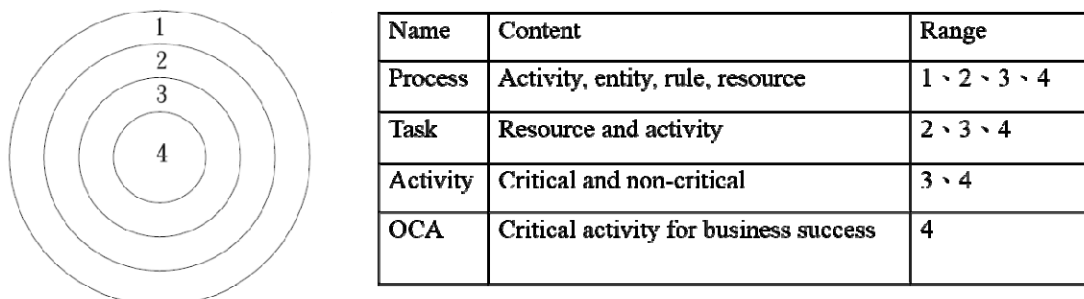
Now, there have been many different proposed evaluative mechanisms of corporate websites, which can also be used to evaluate the applicability, quality, performance, and so on of websites, but these methods or mechanisms cannot evaluate OCAs. Hung (2006) developed a set of evaluative methodology of "Organizational Critical Activity Web Support Evaluation Methodology" (OCAWSEM), which can evaluate the degree of OCAs which websites support.

Hence, this study focuses on the manufacturing industry and hopes that the following goals can be achieved: how the website aligns OCAs; what factors influence the alignment between websites and OCAs? What critical success factors (CSFs) facilitate alignment between websites and OCAs?

LITERATURE REVIEW

2.1 Organizational Critical Activities (OCAs)

Hung (2006) proposed that Activity should be different from Process and Task; Process means hierarchical interactive Activity; Task includes Activity and Resource at the same time. The differences among various terms discussed before are shown in Figure 1 below.



Source: Hung (2006).

Figure 1: The relationship among process, task, activity, and OCA.

The comparison of activity, task, process, and OCAs is shown in Figure 1 above. Organizational Critical Activities (OCAs) are activities that organizations must carry out continuously for success in the industry. Besides, OCAs are deemed factors for industrial short-, mid-, and long-term success. Moreover, Organizations will invest a lot of resources in OCAs, and executives will monitor and guide OCAs.

In this study, there is also a comparison between organizational critical activity and corporate strategy since they are easily confused. Indeed, there were some differences between them. The research of strategy started from Chandler (1962) at the earliest. Chandler (1962) defined strategy as the actions to be taken and criteria of allocation of resources to decide and achieve long-term goals, and it highlights strategic thinking as the nature of action to achieve corporate objectives. Hitt et al. (2001) indicated that corporate resources and strategy interacted to produce positive returns. Casadesus-Masanell and Ricart (2010) indicated that strategy referred to the choice of business model through which corporations would compete in the marketplace. Grover (2016) defined strategy as a pattern of plan that integrated an organization's values, major goals, policies and action sequences into a cohesive whole. In contrast, organizational critical activities are the activities to be carried out continuously by an organization to achieve success. They are the activities and essential elements for an industry to achieve short-term, mid-term, and long-term success. It only emphasized whether the activity itself can achieve the organizational success.

2.2 Website evaluation

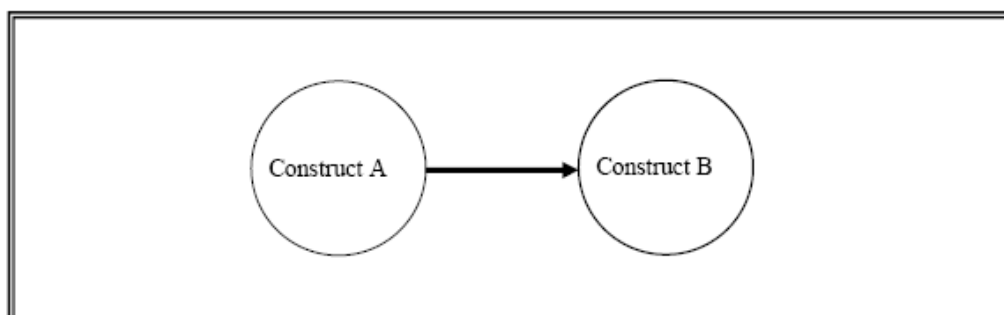
Various views of website evaluation were adopted in the literature. One is based on the evaluative standard of network type. Gregory and DiPietro (2010) proposed a conceptual model that can be used to evaluate the functional performance of hospitality and tourism websites. This model will evaluate the websites from the perspective of information provision, communication, transactions, relationships, and technological merit, and how those apply to the overall website.

Kaya (2010) proposed a multi-attribute e-business website quality evaluation methodology based on a modified fuzzy TOPSIS method. In the proposed methodology, weights of the evaluation criteria are generated by a fuzzy AHP procedure. Wani et al. (2017) proposed and tested an evaluation model for retail travel websites that combined the traditional utility-based measures with hedonic measures which collectively create a more comprehensive measure for the IS evaluation of consumers' focused websites. Zahran et al. (2014) indicated that website evaluative methods included user-based usability evaluation methods (UEMs) such as users' testing and think aloud, evaluator-based usability evaluation methods (UEMs) such as heuristic evaluation, and automatic website evaluative tools.

2.3 The concept of OCAWSEM alignment

OCAWSEM (Hung, 2006) is a website evaluation method focused on finding the alignment between websites and organizational critical activities. Tallon and Pinsonneault (2011) indicated that strategic information technology alignment remains a top priority for business and IT executives. The feature of this method is one-way alignment (see Figure 2), which is defined as Construct B offering the alignment for Construct A, while Construct A must be equipped with driving force and the capability of adjusting the alignment mode. Yet, Construct B must support the driving force of establishing Construct A. For example, Pyburn (1983) tried to align MIS plan with organizational strategies. Tavakolian (1989) aligned information technology architecture to enhance the strategy and competitiveness of organization. Ruzza et al. (2017) indicated that information architecture (IA) is an essential

component of a website. Within the complex, large-scale organizational environment, the practice of information architecture must deal with a number of critical management issues.



Source: Hung (2006).

Figure 2: One-way alignment.

The two-way alignment is to establish the relationship between two objects, while both of them are equipped with driving force. Baets (1992) suggested that the information system strategy can be included in the organizational strategy, and it must be ensured that they are parallel to each other. Tallon and Kraemer (1998) questioned to what extent the strategic alignment should support the strategy of organization. Luftman et al. (2000) thought that alignment was related to how to coordinate with organizational structure, and how the organization should respond to achieve the harmony. Kearns and Sabherwal (2006) highlighted the importance to consider the planning and implementation of IT projects when the effects of business–IT strategic alignment were examined and to share domain knowledge and planning behavior when the effects of contextual factors on business–IT strategic alignment were examined. Managers can use these results to develop more comprehensive action plans for achieving greater business–IT strategic alignment, and for translating alignment into enhanced IT effects on business performance. Ullah and Lai (2011) presented an organizational goal-oriented required elicited approach which will allow the IT department to better understand the business goals of the organization to enable them to develop an IT system which will meet business expectations.

This study emphasized the critical success factors of the maturity of alignment between websites and organization critical activities. This structure is based on the fact that the website has driving force and is capable of adjusting the alignment mode. Therefore, the two-way alignment and other alignment concepts proposed by various aforementioned studies are not applicable to this study. In this study, the one-way alignment mode has been adopted to explore the maturity of the alignment between websites and organizational critical activities, and the critical success factors can help websites and organizational critical activities to achieve higher maturity of alignment.

2.4 Critical Success Factor (CSF)

There were fewer studies on critical success factors before 1979, and there were different ideas about the name of critical success factors. Some called them strategic factors, key-result areas, strategic variables, or key activities. As more experts were dedicated to this field after 1979, the names and views on the critical success factors have been gradually consistent.

Scholars have proposed methods for finding critical success factors. For example, Hofer and Schendel (1978) in “Strategy Formulation: Analytical Concepts” indicated that critical success factors can be confirmed by the following five steps: (1) factors related to the competitive environment in the industry should be confirmed; (2) different weights should be granted in accordance with the importance of each factor; (3) the competitive situation in the industry should be evaluated; (4) the weight score of each factor needs to be calculated; (5) each factor should check the current situation of the enterprise to compare the priority and to determine whether the result is reasonable. Chow and Cao (2008) proposed a survey study on the critical success factors of Agile software development projects using the quantitative approach. Based on the existing literature, a preliminary list of potential critical success factors of Agile projects were identified and organized. Subsequently, reliability analysis and factor analysis were conducted to consolidate this preliminary list into a final set of 12 possible critical success factors for each of the four project success categories – Quality, Scope, Time, and Cost. Zhou et al. (2017) proposed a new method called D-DEMATEL which combines D number theory and decision-making trial and evaluation laboratory (DEMATEL) to identify the critical success factors (CSFs) in emergency management.

Saaty (1980) proposed that the confirmation of critical success factors can be analyzed by the “Analytic Hierarchy Process” (AHP), which is to collect opinions from scholars, experts, and participants via group discussion, and to simplify the complicated problem assessment data into concise element hierarchy system. The contribution or priority of the composition elements of each level on a certain element of the previous level can be calculated in accordance with experts’ assessment result; the AHP method provides an effective structure for group decision making in order to regulate the process of group thinking. A numerical value must be

assigned to every variable of the related problem to help the decision maker maintain a cohesive thinking style to get a conclusion and to enhance the reliability of AHP by group decision making. For example, Sambasivan and Fei (2008) explored the factors and sub-factors critical to the successful implementation of ISO 14001-based environmental management system (EMS) and benefits that can be reaped from the implementation. An empirical study using the analytic hierarchy process (AHP) was carried out to find the relative weights and priorities of these critical success factors and benefits. Garg et al. (2012) has used analytic hierarchy process (AHP) in order to evaluate the identified 14 critical factors of customer experience (CE) and to find their priorities for success in banking organizations. Saaty (1980) believed that there were four steps in the use of AHP for dealing with the decision-making problem: to establish hierarchy, to establish paired comparison matrices, to calculate priority and eigenvalue, and to examine the consistency of matrices.

Bullen and Rockart (1981) proposed by interview to find out critical activities from practical operations of organizational management in different levels. Objectives and tasks of department managers can be confirmed in accordance with management procedure after objective interviews of related department managers, and then individual critical success factors can be provided in accordance with their practical experiences and needs. The corporate critical success factors for achieving this goal can be organized via analysis and screening, and they can be prioritized to determine the development of corporate activities and information so that corporate resources can be effectively distributed among critical activities, and evaluation indicators can be established in allusion to the implementing effect.

In literature, it has been revealed that methods of AHP, interview, market analysis, and so on can be used for the research of critical success factors. Most methods emphasize industrial and environmental related factors, and different scores must be given in order to obtain critical indicators on different scores. They must be compared with the current situation of the company to confirm the rationality. The advantageous activities will be regarded as the source of critical success factors.

In accordance with the aforementioned perspectives of critical success factors proposed by many scholars, this study adopted Rockart' (1979) definition on critical success factors: "A set of finite elements, which can be confirmed to achieve the success if these conditions are satisfactory. It also provides senior managers with the most important information source, and this information can provide decision-makers to make effective judgement and decision". Rockart (1979) also thought that critical success factors only exist in certain limited items in an enterprise, and the competitive edge of this enterprise can be assured if these items are satisfactory. Critical success factors belong to special categories in an enterprise, and the success of these categories can help enhance organizational performance. The so-called special categories also mean that an enterprise must focus on the correct key area in order to succeed. The continuous growth of an enterprise will rely on its effort dedicated to these key areas, otherwise the expected goals cannot be achieved.

RESEARCH DESIGN AND METHOD

This study adopted the design of qualitative research, in which the methods of the data collection and analysis of case study, AHP, and so on were adopted. Current research process could be divided into three main stages, including revision of assessment methods, search of research cases, and analysis of critical success factors. The main objective of revision of the assessment method of the first stage was to establish a method to help manufacturing industry identify and list organizational critical activities. The OCAWSEM assessment methodology was adopted by this study, so it must be modified to be applied to helping manufacturing industry search for organizational critical activities and the list of the organizational critical activities. The following steps were adopted in this study for revision of the assessment method in the first stage, and the detailed content of each step was described as follows:

Step 1 was about semantic correction. Organizational critical activities are the activities to be implemented continuously by the organization for the success in the industry. In this study, the organizational critical activities of manufacturing industry were discussed by interview to find organizational critical activities of manufacturing industry. Supervisors of manufacturing industry were respondents for the interview. The semantic correction of OCAWSEM assessment methodology was carried out with two experts on OCAWSEM assessment methodology to discuss and correct item by item in order to confirm the assessment process and interview questions, and then it was converted into the OCAWSEM assessment methodology of manufacturing industry.

Step 2 was about industrial modification. In this step, the in-depth case study on manufacturing industry was carried out, and we did the interview with two experts in this field. The case study was conducted via the semi-structural approach to achieve the following objectives: to correct the definition and the list of organizational critical activities to be applicable to the manufacturing industry, and to modify the interview questions of organizational critical activities. As for the case selection, we found out the contact information of two companies in the manufacturing industry. The interview was carried out after contacting these companies to explain the objective of this research and to obtain the consent of these companies. As for the data collection, in-depth data collection was carried out on each case company. The list of organizational critical activities was corrected as the list of organizational critical activities of manufacturing industry after senior members of the managerial team were interviewed.

Step 3 was about the correction of ease of use. This step was to test and correct the definition of organizational critical activities and the list of organizational critical activities of manufacturing industry developed by the previous step. The main content of correction included whether the wording of the interview was in line with the professional standard of industry, whether the list of organizational critical activities was complete, and so on to make the result generated by the content of organizational critical activities more complete and rigorous.

Step 4 was about personnel interview. This step was mainly the preliminary interview of the supervisors in manufacturing industry on the corrected list of OCAs. On personnel interview, a huge amount of contact information of domestic manufacturers was found from the Internet, news, and magazines, and so on. Then, convenience sampling in the same area was adopted to select objectives of research. Researchers contacted supervisors one by one by phone or in a written way and inquired their consent. These supervisors were notified about the procedure, importance, and the purpose of this research when they were contacted. The time of interview, their consent to voice recording, and the guidelines of interview would be confirmed.

In this stage, there were a total of 15 supervisors who participated in this interview with voice recording from 14 domestic manufacturing companies. The corporate basic information, corporate background, and personal information of respondents were shown in the following table. Researchers interviewed these 15 supervisors, asked them to provide organizational critical activities of their companies, and to correct and confirm the lists of OCAs.

Table 1: Basic information of Respondents.

Respondents' Code	Years of Service	Position	Industry
I1	7	Chief of Safety, Health, and Environmental Protection Section	Electronic Parts and Components
I2	10	Section Chief of IT Department	Retail Sale of Motor Vehicles, Motorcycles and Related Parts and Accessories in Specialized Stores
I3	16	Manager of R&D Center	Retail Sale of Motor Vehicles, Motorcycles and Related Parts and Accessories in Specialized Stores
I4	9	Group Leader of IT Department	Storage/Transportation Logistics Industry
I5	12	Assistant Vice President of Procurement Department	Machinery and Hand-tool Industry
I6	13	Manager of Business Department	Chemical Raw Material Manufacturing Industry
I7	10	Manager of Sales Department	Electronic Parts and Components
I8	8	Section Head of Production Department	Electronic Parts and Components
I9	12	Deputy Section Manager of R&D Department	Manufacture of Chemical Raw Material
I10	15	Manager of Management Department	Electrical Machine Manufacturing and Repair Industry
I11	6	Section Chief of General Affairs and Procurement Department	Storage/Transportation Logistics Industry
I12	8	Assistant Manager of Business Department	Chemical Raw Material Manufacturing Industry
I13	9	Manager of Sales Department	Chemical Raw Material Manufacturing Industry
I14	9.5	Section Chief of Production Management	Electronic Parts and Components
I15	9.5	Section Chief of Factory Affairs	Chemical Raw Material Manufacturing Industry

Step 5 was about the process of interview. In this study, the one-to-one interview was adopted with the semi-structural interview topic and open questions. Before start of the interview, the research objective was introduced again, the related things of interview were explained, and the consent of voice recording was confirmed before the start of voice recording. During the interview, the researchers didn't provide information related to OCAs, asked respondents how his/her company defined success, gradually guided respondents to describe OCAs of the company, and asked respondents to respond the content and practice of OCAs of the company. After receiving the answer, the researchers provided the list of OCAs to be confirmed and corrected by respondents in order to obtain the updated list. The interview of the following respondents would be carried out via this approach, so the list of this study

was corrected according to the opinions of 15 respondents to ensure reliability and validity. After the interview was completed, researchers appreciated respondents again, told respondents that a face-to-face or phone interview would be conducted if necessary, and informed that the result would be notified to respondents after the research was complete.

Step 6 was to organize verbatim transcription. After the interview was complete, researchers listened to the content of voice recording detailedly and repeatedly and wrote verbatim transcription according to the content of voice recording and the notes. The parts which were unclear or questionable in verbatim transcription were confirmed with respondents by phone interview in order to obtain the most complete and correct data.

Step 7 was about the subject analysis. The content of verbatim transcription was detailedly and repeatedly read, and the key words related to the research subject in the verbatim transcription were marked by a fluorescent pen as the important descriptive sentences. The marked content was numbered and classified before coding. The digital way was adopted as the coding way to find out OCAs mentioned by respondents during the interviews.

Step 8 was about an expert's correction. There was a preliminary list of OCAs after the interviews of 15 respondents were finished. However, for the completeness of this study, there would be an expert assigned to confirm whether the content and texts of this list of OCAs needed to be corrected. After the correction was finished, there would be a discussion with another OCAWSEM expert on this list of modified OCAs in order to ensure the completeness of this list and the method of OCAs.

The list of OCAs was corrected and confirmed after the aforementioned interviews of 15 supervisors. Then, there would be the suggestions and corrections of two experts to ensure that we could obtain the most appropriate list of OCAs of manufacturing industry.

The second stage was to find out the research case. In this stage, the corrected assessment methodology in the first stage was used to be applied to looking for the cases of successful alignment between websites and organization critical activities in the manufacturing industry. In this stage, preliminary interviews would be conducted on several companies in the manufacturing industry, and three companies with successful alignment between websites and organization critical activities would be selected as the objects of case analysis of critical success factors in the third stage.

The following steps were adopted in this study in the stage of finding research cases: selection of the research case and confirmation of the research case. Three appropriate cases at least would be selected in this study for the analysis of critical success factors of the case in the third stage. The selection of the research case was based on the following selection standards: (1) willing to cooperate and participate in the interview; (2) websites had a certain amount of investment and the scale; (3) companies was above small and medium-size enterprises (SMEs); (4) there was operation of websites; (5) better performance of alignment between websites and organizational critical activities in the manufacturing industry. In this study, manufacturers in southern Taiwan with more successful E-ops were found out, and the CEO or executives in the company were the targets of preliminary interviews. The data of preliminary interviews would be organized and assessed to see whether they were suitable for this study.

The third stage was the analysis of critical success factors. The main purpose was to carry out analysis of critical success factors of the case according to the three proper successful cases found in the second stage. In this stage, there would be in-depth analysis of each successful case to obtain CSFs on the alignment between websites and organizational critical activities.

This study adopted the following four steps to analyze critical success factors in the third stage. The detailed content of each step was described as follows. Step 1 was collection and analysis of secondary data. In this step, the related secondary data collected according to each research case, such as industrial monographs, newspapers and magazines, and corporate quarterlies, would be analyzed separately in order to find out the initial possible critical success factors with high alignment between websites and organizational critical activities. Step 2 was on selection of respondents. The main purpose of this step was to find out respondents adopted for the in-depth interview in this stage, such as the personnel related to the alignment between corporate websites and organizational critical activities. In this step, initial interviews were expected to be carried out on Chief Information Officer and webmasters of the research case separately, and then in-depth interviews would be carried out on a few recommended employees. In the end, the research data of in-depth interviews of each case would be collected and organized. Step 3 was on triangulation. This step was mainly on mutual comparison between both data to provide the reliability and validity of the research result in this stage. This step would generate secondary data and analytical result of each case, and triangulation among data was conducted in order to enhance the reliability and validity of the results generated in this stage of this study. Step 4 was on integrated analysis of data. The main purpose of this step was to find out the critical success factors, subfactors, and aspects of factors of the research case effectively. The coding in this step was carried out via thematic analysis proposed by Boyatzis (1998). Reading original data carefully and repeatedly was to look for the themes which appeared again and again and were closely related to respondents' lives, and the methods proposed by Kvale (1996) were used to find out critical success factors of the case effectively.

This study adopted Thematic Analysis on verbatim transcription of the interview to find out the critical success factors affecting the alignment between websites and OCAs. In-depth interviews would be implemented in accordance with aforementioned structure of interviews, and critical success factors would be divided into three categories, which are CSF aspect-personage aspect, CSF aspect-organizational aspect, and CSF aspect-technical aspect according to the views of Wang et al. (2016). The critical success factors of alignment between websites and OCAs were discussed via aforementioned three aspects.

RESEARCH RESULTS

4.1 Organizational Critical Activities of Manufacturing Industry

The result of interviews of this study in the initial stage reveals a total of 12 organizational critical activities of manufacturing industry. The content is as follows. The first organizational critical activity is to develop new products. The respondents indicated that the development of new products is a very important activity for the domestic manufacturing industry. The timely development of new products and new technologies can make the company expand its business scope for corporate continuous operation. The detailed implementation methods of such activities in the manufacturing industry are different in different companies. Some companies adopt the industry-university cooperative method; some companies develop new products by proposing sample tests via monthly new product R&D seminars.

The second organizational critical activity is to develop new technology. It is also one of the very important activities for domestic manufacturing industry. New technology can decrease the production cost of the company, reduce the process cost, make customers get products in the shortest time, and create more profits for the company in order to reach the goal of helping organizations succeed.

The third organizational critical activity is to conduct market survey, which is also an important activity in the manufacturing industry. The unit price of the product in the manufacturing industry is usually not very high, so mass production must be adopted. Improper production of products due to failure in understanding market demand will result in products which need to be scrapped and the loss of the company. Respondents indicate that consumers' demand changes continuously, so companies must understand the variation of the purchase trend of the market and customers' actual demand in the fastest way. Therefore, market survey, cooperation of stores, and customized products are implemented to understand consumers' demand, create more profits for the company, and achieve organizational success.

The fourth is to expand domestic and foreign customer bases. Most companies of manufacturing industry focus on domestic customer bases. In addition to maintaining existing customers, companies must also aggressively expand their customer bases. The range which products of companies can reach is relatively broad by expanding customer bases, and companies can gain more market information by expanding customer bases.

The fifth organizational critical activity is to maintain existing customers. It is also very important for the manufacturing industry. The recommendation through existing customers can not only expand new customers but also acquire new business opportunities at the same time in this way, and can also save the cost of developing new customers and reduce unnecessary expenditures for the company. For the manufacturing industry, the advantages to maintain existing customers also include that existing customers already knew and understood the company and both had tacit understanding on cooperation, thus leading to higher probability of success for promotion of new products. And it can be easier for new customers to accept products of the company via introduction of existing customers, which can create more sales for the company. This is also a way leading to organizational success.

The sixth is to provide differentiated services. The market competition varies drastically, and only satisfying customers' demand can compete in the market. The differentiated services by make-to-order is also one of the strategies adopted by the company. The real-time personal service and product differentiation strategy create more advantages for the company to achieve organizational success.

The seventh is to guarantee product quality. Most companies strictly check every product via quality control department and quality control process, and the aforementioned step is carried out via a system to guarantee product quality. Some companies adopt their own quality control processes to guarantee product quality to make customers have more confidence in their products. Product quality is vital to a company, and good and stable product quality can contribute to organizational success.

The eighth is to control the quality of raw material. The quality of raw material has impact on corporate products. Poor quality of raw material has an influence on the quality of corporate products. Therefore, it is also an important critical activity for manufacturers. To select suppliers is based not only on price but also on coordination and quality stability.

The ninth organizational critical activity is to enhance product production efficiency. The product production efficiency is related to the shipment speed and also has an influence on whether delivery is as scheduled. If the delivery of products cannot be on time as promised, returning and destroying goods can happen in addition to failure in collecting payment. Good product production

efficiency can be approved by customers, and the higher customers approve, the more possibly organizational success can be achieved.

The tenth is to provide employee training. The quality of employees is related to the professional skill on products and the attitude of dealing with various situations. The better the professional knowledge of employees is, the lower the probability of errors is, and the company is still the biggest beneficiary. The lower probability of errors will result in higher production efficiency of the production line, faster shipment speed, and thus better profitability. Therefore, the higher the personnel quality is, the faster the organizational expected success is achieved.

The eleventh is to enhance the working efficiency of internal staff. The working efficiency of internal staff has an influence on the overall work flow. Higher working efficiency will shorten the finished time of products and the time of delivery of products, and customers' confidence on the company will be improved. Therefore, the enhancement of working efficiency of internal staff is vital to companies in this industry.

The twelfth is to control cost. The gross profit margin of the product of manufacturers is usually not high, so they must reduce cost via mass production. Therefore, the cost control is the decisive factor for profitability. Better cost control will lead to increase of profit, so cost control is a very important organizational critical activity for manufacturers.

4.2 Introduction of Companies of Case Study

Company A is the leader in production of EMI (Electromagnetic Interference) shielding material, which is applied to the soft composite laminated packaging materials of cables and wires, 3C products (computer, communication, and consumer electronics), food packaging, and medical equipment. Main products are all developed by R&D department of company, which can also customize products via its own production line in accordance with customers' demand. This company has innovative capability on products. In addition to the corporate websites, internal staff also use the ERP (Enterprise Resource Planning) system and forum to carry out procurement and production management activities of the company. Company B is in the upstream of electronic technology industry. Company B got the technical support from the parent company in Japan since the plant was built and operated. Besides, the management system of Company B is based on international business management system of AlliedSignal, Inc. in US and Asahi Kasei in Japan. Because of the effort of the entire staff, the performance, quality, and productivity of Company B have been dramatically improved and well recognized by customers and the investing parent company. Company C is a professional OEM (Original Equipment Manufacturer) and ODM (Original Design Manufacturer) production company. Company C has established a scientific, bio-technological, and digital production and sales platform connected to the international market and synchronized with the world, and the platform provides the strong support for product development of Company C. Company C currently owns three major plants. Company C owns an excellent management team and maintains the operation philosophy, "Product Quality of Naturalization, Manufacturing Technology of Scientization, and Healthy Food of Popularization" to pursue corporate continuous operation and growth.

4.3 Result of Website Alignment of Companies of Case Study

These three companies are all in the manufacturing industry. However, the degree of emphasis of each company on 12 organizational critical activities of the manufacturing industry is different due to different product categories, and the result of alignment between OCAs and websites in each company is different. Website evaluation of Company A, Company B, and Company C is in Table 2 below.

Table 2: Website Evaluation of Company A, Company B, and Company C.

Item No.	OCA	Website Support / Interview Company / Difference		
		Company A	Company B	Company C
1	Develop New Products	3/7/-4	9/9/0	7/1/6
2	Develop New Technology	6/5/1	6/10/-4	6/2/4
3	Conduct Market Survey	10/6/4	10/7/3	10/8/2

4	Expand Domestic and Foreign Customer Bases	5/12/-7	3/3/0	1/7/-6
5	Maintain Existing Customers	4/11/-7	4/2/2	2/6/-4
6	Provide Differentiated Services	2/10/-8	1/12/-11	3/12/-9
7	Guarantee Product Quality	1/1/0	5/4/1	5/4/1
8	Control Quality of Raw Materials	8/4/4	7/5/2	4/3/1
9	Enhance Product Production Efficiency	7/3/4	8/6/2	8/11/-3
10	Provide Employee Training	12/8/4	11/11/0	12/9/3
11	Enhance Working Efficiency of Internal Staff	9/9/0	2/1/1	9/10/-1
12	Control Cost	11/2/9	12/8/4	11/5/6

On the results of alignments of these three companies, there are different reasons why they failed. Some factors are based on technical consideration, some factors are based on consideration of risk management, and some factors indicate that website support is not the most appropriate method. The following factors have been found out after induction and collation:

The first factor is due to the difficulty in breakthrough of current technology. Organizational critical activities about products, such as guaranteeing product quality, controlling quality of raw materials, enhancing product production efficiency, and so on, are supported by internal system. The website only shows the result of this kind of information, but the internal entire operational process is not shown on the website. The second factor is consideration of risk control because cost control belongs to important confidential information of the company. The third factor is that some activities cannot be carried out via virtual methods, such as conducting market survey, accepting an order of customers' customized products, or understanding variation of the current market. The effectiveness that websites support OCAs is not significant. The fourth factor is that the market technology is not mature. The displayed information and support technologies on the website are based on most customers' demand and can't provide differentiated services on different customers. The fifth factor is that some activities cannot be implemented by adopting the same method. Different customers have different needs, and the methods to provide customers services are diversified, such as email, phone call, FAX, face-to-face, and so on communication. Websites cannot conduct different strategic services on new and old customers so the customer service via the website is usually not very effective.

DISCUSSION OF RESEARCH RESULT

5.1 Research Discussion

In this study, interviews are conducted on three manufacturing companies in southern Taiwan, and research methods are in-depth interviews and literature analysis. How can websites be aligned with OCAs? What are factors of successful alignment? These issues can be discussed from personage aspect, organizational aspect, and technical aspect. The common factors of these three companies are shown in Table 3.

Table 3: The common parts of three companies.

Item No.	CSF Aspect	Common part
1	Personage Aspect	Support of Executives
2	Personage Aspect	Excellent and Professional Team
3	Organizational Aspect	Full Communication
4	Technical Aspect	Harmonic Website Build Process

5	Technical Aspect	Technical Support
6	Technical Aspect	Complete Information System Architecture

First of all, these three companies have two common parts on personage aspect: Support of Executives and Excellent and Professional Team. On Support of Executives, all executives of these three companies attach importance to Website Build Process, but their attitudes are different. Executives of Company A prefer to authorize internal staff to deal with things of Web Build; executives of Company B dominate while employees assist executives; executives of Company C also prefer authorization, but the difference from Company A is that executives of Company C only care about the result while executives of Company A provide guidance in time during the build process.

The main purpose is to make customers find out us by website hopefully. For example, one American big company recently found out us. After we contacted it, we realized that it found out us by website (executive of Company B).

The second common factor of Personage Aspect is Excellent and Professional Team. Instructors or leaders of websites of these three companies are all executives, who often discuss current progress and offer suggestions and website build directions via meetings during website design process, but frequencies of participation are different. The degree of participation of executives of Company A is very high in the early stage of website design, and the website team includes personnel of Administration Dept. and MIS; executives of Company B participate in the entire build process, and the website team includes executives and personnel of MIS; the degree of participation of executives of Company C is high only in the early stage of design, and the website team includes employees of Planning Department and IT Department. Therefore, the degree of emphasis of executives of these three companies on the website build is that Company B is highest, Company A is medium, and Company C is lowest.

In the design stage, there are meetings for discussion with Planning Department regarding markets, plans, and sales methods of new products because the main purpose of websites is to interact with consumers. After websites are online, the information on the website is adjusted in time in accordance with market reaction to make consumers be able to get the latest information (executives of Company C).

The common factor in the organizational aspect, the CSF aspect of the second category of these three companies, is Full Communication. The communication of Company A is via face-to-face discussion, the communication of Company B is via E-mail, and the communication of Company C is via video, E-mail, information sharing of Intranet, and regular meetings. On the communication frequency, Company B is highest, Company C is medium, and Company A is lowest.

This activity is carried out mainly by discussion via video, E-mail, information sharing of Intranet, and regular meetings. However, these methods are only to assist personnel to develop and to make us update data or speed up and achieve the goal of control and management during the process of development of new technology. If control and management in this aspect is proper, the company will have profits (executives of Company C).

The common factors of the technical aspect in the CSF aspect of the third category are: Harmonic Website Build Process, Technical Support, and Complete Information System Architecture.

First, on Harmonic Website Build Process, when employees of these three companies build websites, build directions emphasize current and future operational needs, corporate operational directions, expected goals, and making consumers find out companies quickly, but details vary. Company A emphasizes that the most competitive products are online; Company B hopes to advocate the philosophy and contribution of this company to the society via the websites; Company C emphasizes making customers purchase products online. These three companies have different expectations on websites. Company A emphasizes the part of the products, Company B makes people understand this company, and Company C emphasizes consumers' shopping convenience.

The company mainly hopes to emphasize various dimensions. It is not only on customers but also hopes to have contribution to this society. Information about rewards to the community is shown on websites, and we hope that websites can show this thought. Websites of the company not only have information of products but also market other dimensions of the company. (Assistant Manager of IT Department of Company B).

The second common factor is Technical Support. Intranet and Website Build of these three companies are all complete. On Intranet, Intranet of these three companies all has ERP, but there are differences on other systems. Intranet of Company A is mainly on employee training and improvement of working efficiency of internal staff. Intranet of Company B is to make customers understand order progress and data access via encrypted VPN (Virtual Private Network). Intranet of Company C is based on SAP and PDM systems. In addition, Intranet of these three companies emphasizes different parts. Company A is on improvement of personnel quality, Company B emphasizes customers' need, and Company C emphasizes cost control.

The internal staff of the company uses ERP more frequently than forums, and ERP has built-in customers' data. Salespeople often place orders in accordance with built-in customers' data (IT personnel of Company A).

The third common factor is Complete Information System Architecture. The system architecture of Company A includes knowledge management system, and different business groups can share via this way; Company B emphasizes security to make customers' information gain effective protection and security; Company C built a complaint system on problems of customers' complaints about products to understand and respond on customers' problems and to improve products. These three companies emphasize different points. Company A builds the system on corporate internal personnel use, Company B is on convenience and security of customers' data, and Company C is to understand customers' problems.

To trade with customers by encrypted VPN is mainly based on the consideration of Internet Security. Of course, the company also hopes to provide this kind of service directly by Internet without the consideration of security. On MIS, we decided to adopt such mechanism according to security concerns (Assistant Manager of IT Department of Company B).

5.2 Discussion of Differences between This Study and Literature

Prior research is mainly on BS IT Alignment, and the content of the literature is on how BS is aligned with IT. There is no literature on website alignment. Only Hung (2006) proposed four perspectives of website evaluation. These four perspectives are discussed from users' and evaluators' perspectives but different from WWW OCA Alignment. Differences are as follows:

After integration, literature of BS IT Alignment organizes 21 factors, which are divided into four aspects: systematic aspect, communication aspect, organizational aspect, and environmental aspect. The four major perspectives of website evaluation proposed by Hung (2006) are organizational providers' perspective, customer providers' perspective, organizational users' perspective, and customer users' perspective. WWW OCA Alignment is divided into three aspects: CSF aspect-personage aspect, CSF aspect-organizational aspect, and CSF aspect-technical aspect.

BS IT Alignment is to discuss the impact of business strategy on alignment of information technology. The literature reveals that corporate competitive strategies, business plans, and ways of cooperation (alliances, horizontal alliances, and so on) all influence IT Alignment. The communication method of commercial and IT managerial personnel has a significant influence. Good business communication also influences IT Alignment. The competitive strategies and business plans also influence WWW OCA Alignment, but alliances, horizontal alliances, and so on do not have a significant influence on WWW OCA Alignment. The four perspectives of website evaluation proposed by Hung emphasize increasing organizational and customers' value, and the range of discussion emphasizes evaluating website performance and how websites support organizational internal operation to increase value. WWW OCA Alignment discusses how websites are aligned with OCAs and what CSFs of the alignment are. Therefore, it is different from evaluating website performance and how websites support organizational internal operation to increase value. The differences between this study and literature are in Table 4.

Table 4: Differences between this study and literature.

Type	BS IT Alignment	Hung	This study
Aspect	Systematic Aspect, Communication Aspect, Organizational Aspect, and Environmental Aspect	Organizational Providers' Perspective, Customer Providers' Perspective, Organizational Users' Perspective, and Customer Users' Perspective	CSF Aspect-Personage Aspect, CSF Aspect- Organizational Aspect, and CSF Aspect- Technical Aspect
Research Topic	Impact of Business Strategy on Alignment of Information Technology	Increase Organizational and Customers' Value	How Websites are Aligned with OCAs and What CSFs of the Alignment are

CONCLUSION

This study discusses how websites are aligned with OCAs and what factors of successful alignment between websites and OCAs are. Although this study emphasizes these three companies which produce different products and have different degrees of emphasis on corporate websites, they have some common CSFs. After data analysis, the following suggestions are given to other companies which plan to build websites in the future:

The finding and suggestion of the first point is: the attitude of executives is a critical factor on the success and failure of website build, and executives' strong support can make alignment between websites and OCAs more successful. Executive's strong support and domination can make website build process go well, and the difficulty can be solved immediately if the emergency situation happened. The second point is the importance of the excellent professional team. Website build personnel must be middle

managers who are very familiar with the operating procedure of the company and cooperate with senior operators and IT personnel. This is because such personnel can understand the operating procedure of the company and the real problems and make website build meet requirements of the company. The third finding and suggestion is that the company must have clear objectives and planning before introducing websites. When websites are built, the internal staff of the company can carry out face-to-face discussion via meetings. When the prototype of websites is formed, the internal staff of the company can try out websites to examine convenience of websites for users. There should be periodic reviews and modification during the website build process in order to ensure the optimal performance of websites. The fourth is on the importance of full communication. The higher degree of communication among internal staff during website build process will result in better understanding of the purpose of the company to build websites and the effect to be achieved to enhance centripetal force and cohesion of the company. The fifth is that the rigorous process of website build will result in better alignment between websites and OCAs. In addition to attracting new customers and improving the operating process, it also has a long-term positive impact on the company. The IT Alignment factor proposed by the academia is modified by this study as the WWW OCA Alignment factor. After this study conducts case studies on three companies, it is found that a more rigorous planning process, stronger support by executives, better execution, better personnel involvement, and so on during website build process are all factors affecting the alignment between websites and OCAs, and they should be emphasized by website build personnel. The sixth is that internal staff must accept employee training. All respondents in this study all have the background of the manufacturing industry, and employees have a certain level of quality and have a high degree of acceptance and cooperation on websites and Intranet build. However, after the Intranet is built, some difficulties need to be overcome on use, such as personnel changes and changes of business process. The earlier or longer the time of employee training is, the higher the degree of the acceptance of the system is. Users can accept different employee training according to the different unit and department. Before the system is officially online, internal staff must first understand the operation of this system and propose questions immediately if having any to avoid the system modification due to inconformity with operational procedure after the system is officially online to result in extra costs.

The factors of successful alignment between websites and OCAs are related to people. Especially, whether executives give support decides whether the alignment between websites and OCAs succeeds. Thus, executives' strong support, correct policy, and cooperation of internal staff make the alignment between websites and OCAs more successful, and consequently make the company in the industry achieve the expected success later.

The research contribution can be divided into academic aspect, governmental aspect, and corporate aspect, and the contribution is described as follows. On the academic aspect, this study organized related factors of strategic alignment and IT alignment from previous literature and modified them into the factors of website alignment to make the following researchers have a research foundation on website alignment and provide issues of the future research. On the governmental aspect, this study helps the government know the current operational situation of domestic manufacturing industry more, and the government can be based on this study to propose useful public policies to help companies in the manufacturing industry succeed. On the corporate aspect, this study provides CSFs of successful alignment and gives other corporations guidance on website build by successful cases of alignment between OCAs and websites.

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Cross-border E-commerce Development Strategy Under the "Internet + Logistics Finance" Model

(Full Paper)

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ABSTRACT

In recent years, the rise of cross-border e-commerce in China has been relatively rapid, and the proportion of cross-border e-commerce in import and export trade has continued to increase. Cross-border e-commerce plays an extremely important role in promoting China's trade transformation and has become a new model of international trade. But the prosperity of any field is inseparable from the strong support of funds. This paper identifies the risk factors that may arise when cross-border e-commerce applications are applied to these models. Then analyzes and evaluates them in order to provide decision-making reference for cross-border e-commerce enterprises that have financing needs or plan to apply logistics finance.

Keywords: Cross-border e-commerce, logistics finance, model selection, analytic hierarchy process, risk assessment.

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INTRODUCTION

In recent years, the rise of cross-border e-commerce in China has been relatively rapid, and the proportion of cross-border e-commerce in import and export trade has continued to increase. Cross-border e-commerce plays an extremely important role in promoting China's trade transformation and has become a new model of international trade. But the prosperity of any field is inseparable from the strong support of funds. In the past five years, there have been more than 600 investment and financing in China's e-commerce industry. Many large-scale cross-border e-commerce companies have received huge capital support from the capital market. In contrast, China's cross-border e-commerce SMEs have been affected. Neglect. The warehousing, transportation and payment recovery of trade goods of cross-border e-commerce enterprises are long, the capital turnover cycle is long, the occupancy is large, and there is a large financing demand. The financing dilemma of small and medium-sized cross-border e-commerce enterprises has been difficult to break through, and it has become one of the main reasons hindering the healthy and rapid development of small and medium-sized cross-border e-commerce enterprises in China. This paper combines logistics finance with cross-border e-commerce to provide a new financing path for cross-border e-commerce SMEs, helping cross-border e-commerce SMEs to get out of the dilemma of lack of funds and promote their development.

This paper identifies the risk factors that may be generated when cross-border e-commerce applies the above modes, and uses the analytic hierarchy process to apply risk factors to the cross-border e-commerce application of the above several modes: spread risk, transportation risk, access The risk of the library is analyzed and evaluated, and the size of each risk in different modes is discussed. Finally, according to the analytic hierarchy process, the inventory pledge - 2 - model has the lowest risk, the confirming warehouse mode is relatively large, and the sea and land warehouse model has the greatest risk. At the same time, the greater the risk, the greater the amount of financing that can be obtained, which requires cross-border e-commerce SMEs to weigh according to their own circumstances. The conclusions of this paper can provide decision-making reference for cross-border e-commerce enterprises that have financing needs or plan to apply logistics finance.

MODELS of CROSS-BORDER E-COMMERCE APPLYING LOGISTICS FINANCE

Inventory Pledge Business Model

The inventory pledge business model is the most traditional business model in logistics finance, and it is the earliest and most widely used business model in history. The stock pledge first evaluates the value of the application to the commercial bank first. After the bank recognizes the value of the goods, it applies to the bank for financing, and then delivers the goods to a specialized logistics company for supervision. In operation, the pledge's profits = profit from the sale of goods - interest paid to the bank, profit of the bank = interest received - expenses incurred by management, profits of logistics enterprises = administrative expenses of bank delivery. The inventory pledge mode is divided into static pledge and dynamic pledge.

(1) Static pledge

The enterprises that are statically pledged to be financed first hand over the ownership of the goods to the bank, and pay the deposits, which are generally about the value of the goods, to the bank, and then hand over the goods to a specialized logistics enterprise for supervision. After the goods are put into storage, the logistics enterprises provide financing. The person issues a proof of the bill, and the financier obtains the financing service with the bill. The static pledge is when the goods are supervised,

the financier can only repay the loan in advance or partially repay the bank, and redeem the pledge in whole or in part. When the financier fails to repay the loan, the logistics company will auction the goods.

However, during the pledge period, SMEs cannot exchange goods and goods, and can only redeem the goods through repayment. Although this avoids the risk of the market, this is for enterprises with more types of products and short cycle of goods. The more inflexible form hampers the production and operation of the enterprise, so after the emergence of dynamic pledge, the static pledge is used less and less.

(2) Dynamic pledge

The difference between dynamic pledge and static pledge is that the SMEs that allow financing can replace the pledge by means of goods exchange, but two basic conditions must be met: 1) The value of the replacement goods needs to be recognized, greater than or equal to the value of the previous pledge 2) The replacement of goods must be reviewed by a regulated logistics company. In addition, the dynamic pledge can also redeem the pledge goods by replacing the goods plus cash.

Later, based on the inventory pledge business model, under the unremitting innovation and - 3 - exploration of logistics companies, they found a more flexible way of profit, and slowly began to pay attention to how to control the risk of logistics finance, in the hope of relying on innovative services to lead logistics. Status in the financial business field. Logistics companies reflect their main advantages in the following areas: expanding service depth, increasing service scope, and innovating service methods. The logistics pledge mode is the logistics financial service of today's logistics enterprises as the leading innovation model. The traditional inventory pledge mode and the logistics pledge mode are significantly different. The traditional inventory pledge mode is usually that the bank is responsible for warehousing pledge, while the logistics pledge mode is that the logistics enterprise is responsible for import and export declaration of goods, transportation supervision, warehousing supervision, accounts receivable, etc. In addition, logistics companies expand their service scope and also increase new profit channels. Traditional supervision has become a part of logistics pledge services. The above inventory pledge mode is the traditional inventory pledge mode, and the new logistics pledge mode includes the confirming warehouse business model, the sea and land warehouse business model, the customer purchasing business model, and the customer collection model.

Confirmation Warehouse Business Model

The confirming warehouse model is jointly participated by distributors, producers, banks and logistics companies. In this model, the bank stipulates that only the dealer and the manufacturer sign a sales contract, and at the same time, the logistics enterprise guarantees that the capital of the loan is safe, and then can apply for the opening of the acceptance bill. This model is a combination of bank and business reputation, which enables upstream and downstream enterprises in the supply chain to increase their own liquidity. At the same time, they do not take up capital for raw materials, goods, raw materials, etc. At the same time, they can also ensure the sale of goods and solve the problem of capital recovery. And other issues. In this business model, the four parties share the risks, improve the cash flow speed, cargo turnover efficiency, and reduce the operating costs of all parties. At the same time, banks can earn management services by earning rediscount rates and service fees. Fees, suppliers have reduced the size of the inventory, and the distributors have also eased the short-term capital turnover problem, which will enable the four parties to achieve a win-win situation.

The process is generally that the dealer relies on the goods to guarantee the logistics enterprise, and the logistics enterprise determines the insured amount based on the ratio of the actual sales volume of the goods to the inventory, and collects the supervision fee from the dealer. After the manufacturer obtains the bank acceptance bill, it delivers the goods and becomes the warehouse receipt pledge. The logistics company acts as the insurer. It should understand the basic situation of the dealers in detail and approve the underwriting ratio and the integrity of the goods according to the recommendations of the value of the pledge of financial institutions.

The confirming warehouse business model can effectively alleviate the pressure of supply chain dealers' short-term capital turnover, and the way in which their suppliers first ship and then charge, is also conducive to the sellers in the supply chain to occupy the market in advance, avoiding the delay of suppliers. The goods are either not shipped or unwilling to produce. In this - 4 - model, logistics companies play a role in the supervision of goods. At the same time, logistics companies need to choose dynamic pledge or static pledge mode according to the requirements of banks. It should be noted that banks and suppliers must rely on third-party logistics companies to strictly regulate the goods to control trading risks. There are two major support for the development of this business: dealers with strong terminal sales strength and more reputable manufacturers in the supply chain.

Sea and Warehouse Business Model

The sea and land warehouse model is a logistics finance business model that has only emerged in recent years in global international trade. It refers to the pledge of submitting some or all of its goods to financial institutions (banks, etc.) by financing individuals or enterprises. The supervisor of the goods (logistics enterprise) integrates the warehousing of goods and the transportation of sea, and the financial institutions (banks, etc.) then provide certain loans to the financing individuals or enterprises

according to the relevant agreements with the value of the pledge goods. If the logistics enterprise fails to repay the loan according to the situation of the goods, if the pledgor cannot return the loan on time, the logistics enterprise will seal the goods and keep the bank and the final disposal of the goods being pledged. In the sea and land warehouse model, banks must rely on logistics companies to control operational risks and effectively perform their duties of strict warehousing, supervision, prudent lending, and transportation.

The sea and land warehouse model is based on the combination of the advantages of customs clearance, warehousing and transportation and the characteristics of the bank's trade finance products. In this model, the logistics company can provide its original service target and scope to the supply chain. Extending the two ends and developing a business model for product supervision, warehousing and transportation, it is gradually able to provide financing companies with comprehensive service and comprehensive solutions, which in turn can greatly improve the profitability of logistics enterprises and strengthen their core competitiveness. It is valuable experience for logistics enterprises to finally develop logistics finance to create logistics banks. At the same time, it also promotes the rational distribution of their resources by upstream and downstream enterprises in the supply chain, alleviating the short-term financial pressure and realizing the optimal allocation of resources.

The main difference between the sea and land warehouse and the confirming warehouse model is that the sea and land warehouse model is the dynamic management of the operation of the pledge. The risk management is more difficult and requires more active management of the risk, because there are many in the way of cargo transportation. The factors are certain, so this model is more stringent on the requirements of the supervisors on the way. The leading role of the logistics chain in the Hailu warehouse model is more prominent, and the core competitiveness of logistics companies such as customs declaration, warehousing, transportation, inspection and customs clearance is also more obvious. In addition, in this model, logistics enterprises If the information flow can be accurately and timely, then the risk can be controlled more actively and effectively.

RISK FACTOR ASSESSMENT of CROSS-BORDER E-COMMERCE APPLYING LOGISTICS FINANCE

Risk Identification and Classification of Cross-border E-commerce in Logistics Finance Mode

External risks

External risks refer to risks caused by factors other than cross-border e-commerce companies, banks, and logistics companies, such as those caused by legal, environmental, economic, political, and cultural factors. External risks are unpredictable, and the scope is wide, and the impact is far-reaching. It is difficult for micro-enterprises to control and evade, so this article will not study.

Internal risk

Internal risk refers to risks caused by relevant factors of cross-border e-commerce companies, banks, and logistics companies, such as default, bankruptcy, or illegality of the three. Internal risks are controllable, preventable and regulated. Internal risks are mainly divided into three parties: legal risks, credit risks, and regulatory risks.

- (1) Legal risk: The main discussion is the risk of property rights and legality of pledge, which has nothing to do with the study of model selection. Therefore, this paper does not discuss this risk for the time being.
- (2) Credit risk: This risk is mainly related to the risk of the bank, and has nothing to do with the mode selection of cross-border e-commerce, so this paper will not discuss this risk.
- (3) Regulatory risk: Based on the previous research results and practical experience, this paper summarizes the regulatory risks into the following categories: transportation risk, inventory risk, loss risk, inventory risk, cargo risk, moral hazard, information risk, risk of entering and leaving the warehouse. The risk of loss refers to the occurrence of fires and other incidents due to staff mistakes, resulting in the risk of loss of goods. The risk difference is not large under different modes, so this article will not discuss. Transportation risk refers to the risk of loss of goods in the transportation of goods; inventory risk refers to the risk of policing stocks under the dynamic pledge mode is lower than the warning amount, and the logistics enterprises have not noticed the risk of supervision and loss; It is the risk that the goods will be checked for errors in the goods on a regular basis; the risk of goods difference refers to the risk, the quantity and the type of goods appearing when the quantity of goods is calculated, and the risk is incorrect; moral hazard refers to the professional ethics of the relevant employees. The risk of loss of goods caused by the lack of negligence and self-stealing; the information risk refers to the risk that the pledge enterprise, the bank, and the logistics enterprise fail to communicate accurately and timely; the risk of entering and leaving the warehouse refers to the process of entering or removing the warehouse. Risk of loss of goods due to errors in related personnel.

Construction and Analysis of Structural Models

According to the risk identification, establish a risk assessment and model selection analytic hierarchy model for cross-border e-commerce application logistics finance, as shown in Figure 1 below:

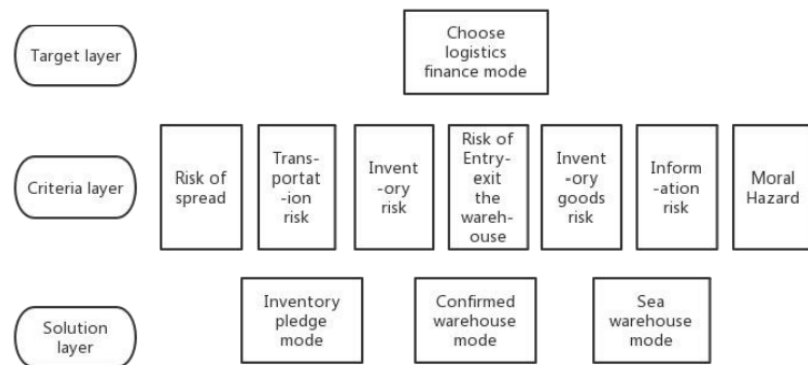


Figure 1: Cross-border e-commerce applying logistics financial risk assessment and model selection model

Level 1 indicator weight and consistency test

First of all, in order to scientifically and reasonably judge the weight of cross-border e-commerce application logistics finance related risks, the author invited three experts and scholars of cross-border e-commerce and three professionals engaged in related industries to use the nine-digit scale to put the above seven kinds. The risk is compared in pairs. After testing, it was found that two of the six questionnaires did not meet the requirements of the consistency test, and the two questionnaires were deleted. The remaining four documents were geometrically averaged and combined with expert opinions to arrive at a new matrix.

The first-level indicator judgment matrix label and its meaning are shown in Table 1 below:

Table 1: First-level indicator judgment matrix labeling and its meaning

Bi risk factor and Bj risk factor evaluation value Risk	Relatively large Risk	Very risky	High risk	Larger risk	Equal risk	Less risk	low risk	Very low risk	Extremely low risk
Bi risk factor evaluation value	9	7	5	3	1	1/3	1/5	1/7	1/9
Remarks	Take 8,6,4,2,1/2,1/4,1/6,1/8 as the median value of the above evaluation value								

The primary indicator discriminant matrix is shown in Table 2 below:

Table 2: First-level indicator discriminant matrix

Risk factors	Risk of spread	Transportation risk	Inventory risk	Risk of entering and leaving the warehouse	Inventory goods risk	Information risk	Moral Hazard
Risk of spread	1.000	0.395	6.993	2.532	2.976	2.532	5.025
Transportation risk	2.532	1.000	5.988	1.767	3.021	5.012	4.033
Inventory risk	0.143	0.167	1.000	0.221	0.286	0.532	0.532
Risk of entering and leaving the warehouse	0.412	0.556	4.532	1.000	2.012	4.033	3.012
Inventory goods risk	0.336	0.331	3.500	0.556	1.000	3.012	2.013
Information risk	0.395	0.223	2.012	0.247	0.332	1.000	2.012
Moral Hazard	0.199	0.247	2.012	0.332	0.556	0.532	1.000

Normalize each column of elements and the resulting normalized matrix is shown in Table 3 below:

Table 3: Normalized Matrix

Risk factors	Risk of spread	Transportation risk	Inventory risk	Risk of entering and leaving the warehouse	Inventory goods risk	Information risk	Moral Hazard
Risk of spread	0.201	0.140	0.269	0.367	0.296	0.152	0.286
Transportation risk	0.502	0.351	0.231	0.294	0.296	0.303	0.229
Inventory risk	0.029	0.058	0.038	0.033	0.028	0.030	0.029
Risk of entering and leaving the warehouse	0.080	0.175	0.173	0.147	0.198	0.242	0.171
Inventory goods risk	0.067	0.117	0.135	0.073	0.099	0.182	0.114
Information risk	0.080	0.070	0.077	0.037	0.033	0.061	0.114
Moral Hazard	0.040	0.088	0.077	0.049	0.049	0.030	0.057

The weight vector is: (0.245, 0.315, 0.035, 0.170, 0.112, 0.067, 0.056)^T

It can be seen that in the first-level indicator item, the difference risk accounted for 24.5%, the transportation risk accounted for 31.5%, the inventory risk accounted for 3.5%, the outbound storage risk accounted for 17%, the inventory risk accounted for 11.2%, and the information risk accounted for 6.7%. Moral hazard accounts for 5.6%.

Consistency test:

Above matrix $\lambda_{\max} \times = 7.330$,

$$CI = \frac{\lambda_{\max} - n}{n - 1} = 0.055, \quad (1)$$

$$CR = \frac{CI}{RI} = 0.042, \quad (2)$$

Therefore, there is satisfactory consistency.

Through the comprehensive scores of the above-mentioned experts and scholars and the professionals who have worked, it can be seen that experts and professionals generally believe that the risks arising from the application of logistics finance to cross-border e-commerce are mainly transportation risks, and the frequent transportation of goods will cause the loss of goods, followed by It is the risk of goods difference, and then it is the risk of entering and leaving the warehouse, the risk of inventory, information risk, moral hazard, inventory risk.

Cross-border e-commerce application risk assessment under different logistics financial models

The corresponding pattern of each row is compared with the different modes of each column, which will result in a very high risk of 5 points in the table, 3 points with a relatively high risk, 1 point with the same risk, and a small risk 1/3 points, the risk is very small, 1/5 points, and take 4, 2, 1/2, 1/4 is the middle value of the above evaluation value. The scores given by experts and professional practitioners are combined in the same way as above, and the scores are as shown in Table 4-10 below:

Table 4: Score of risk of spread in different modes

Risk of spread	Inventory pledge mode	Confirmed warehouse mode	Sea warehouse mode
Inventory pledge mode	1.000	0.286	0.221
Confirmed warehouse mode	3.500	1.000	0.334
Sea warehouse mode	4.517	2.99	1.000

Table 5: Transportation risk score in different modes

Transportation risk	Inventory pledge mode	Confirmed warehouse mode	Sea warehouse mode
Inventory pledge mode	1.000	0.395	0.235
Confirmed warehouse mode	2.532	1.000	0.288
Sea warehouse mode	4.251	3.472	1.000

Table 6: Inventory risk score in different modes

Inventory risk	Inventory pledge mode	Confirmed warehouse mode	Sea warehouse mode
Inventory pledge mode	1.000	4.716	0.882
Confirmed warehouse mode	0.212	1.000	0.222
Sea warehouse mode	1.133	4.512	1.000

Table 7: Score of risk of entering and leaving the warehouse in different modes

Risk of entering and leaving the warehouse	Inventory pledge mode	Confirmed warehouse mode	Sea warehouse mode
Inventory pledge mode	1.000	2.490	0.332
Confirmed warehouse mode	0.402	1.000	0.212
Sea warehouse mode	3.14	4.751	1.000

Table 8: Score of inventory goods risk in different modes

Inventory goods risk	Inventory pledge mode	Confirmed warehouse mode	Sea warehouse mode
Inventory pledge mode	1.000	0.497	0.321
Confirmed warehouse mode	2.012	1.000	0.212
Sea warehouse mode	3.112	4.751	1.000

Table 9: Score of information risk in different modes

Information risk	Inventory pledge mode	Confirmed warehouse mode	Sea warehouse mode
Inventory pledge mode	1.000	0.398	0.210
Confirmed warehouse mode	2.512	1.000	0.332
Sea warehouse mode	4.751	3.012	1.000

Table 10: Score of moral hazard in different modes

Moral Hazard	Inventory pledge mode	Confirmed warehouse mode	Sea warehouse mode
Inventory pledge mode	1.000	0.398	0.249
Confirmed warehouse mode	2.512	1.000	0.497
Sea warehouse mode	4.013	2.014	1.000

(1) Table 4 Matrix Risk Assessment:

Normalize each column of elements and the resulting normalized matrix is shown in Table 11 below:

Table 11: the resulting normalized matrix of table 4

Risk of spread	Inventory pledge mode	Confirmed warehouse mode	Sea warehouse mode
Inventory pledge mode	0.111	0.067	0.143
Confirmed warehouse mode	0.389	0.233	0.214
Sea warehouse mode	0.500	0.700	0.643

The weight vector is: $(0.107, 0.279, 0.614)^T$

It can be seen that experts and practitioners believe that the risk of cargo difference between Hailu warehouse is relatively the largest, followed by the risk of goods difference in the confirmation warehouse model, and the risk of inventory lag in the inventory pledge mode is the smallest.

Consistency test:

The above matrix $\lambda_{\max} = 3.081$, $CI = (3.081-3) / (3-1) = 0.040$, $CR = CI / RI = 0.0195 / 0.58 = 0.070 \leq 0.1$, so there is satisfactory consistency.

(2) Table 5 Matrix Risk Assessment:

Normalize each column of elements and the resulting normalized matrix is shown in Table 12 below:

Table 12: the resulting normalized matrix of table 5

Transportation risk	Inventory pledge mode	Confirmed warehouse mode	Sea warehouse mode
Inventory pledge mode	0.129	0.091	0.150
Confirmed warehouse mode	0.323	0.227	0.213
Sea warehouse mode	0.548	0.682	0.638

Note: After this, the author no longer repeats the consistency test and makes a statement. If the consistency test is not passed, it proves that there is a deviation in the evaluation score and needs to be re-rated.

The weight vector is: (0.123, 0.254, 0.623) T

It can be seen from this that experts and practitioners believe that the risk of transportation in the sea and warehouse mode is relatively large, the risk of the mode of the confirmation warehouse is relatively small, and the risk of transportation in the inventory pledge mode is relatively small.

(3) Table 6 Matrix Risk Assessment:

Normalize each column of elements and the resulting normalized matrix is shown in Table 13 below:

Table 13: the resulting normalized matrix of table 6

Inventory risk	Inventory pledge mode	Confirmed warehouse mode	Sea warehouse mode
Inventory pledge mode	0.455	0.476	0.450
Confirmed warehouse mode	0.091	0.095	0.100
Sea warehouse mode	0.455	0.429	0.450

The weight vector is: (0.460, 0.095, 0.444) T

It can be seen from this that experts and practitioners believe that inventory pledge mode and sea-land warehouse model have large inventory risks, and the inventory risk of the confirmation warehouse model is relatively small.

(4) Table 7 Matrix Risk Assessment:

Normalize each column of elements and the resulting normalized matrix is shown in Table 14 below:

Table 14: the resulting normalized matrix of table 7

Risk of entering and leaving the warehouse	Inventory pledge mode	Confirmed warehouse mode	Sea warehouse mode
Inventory pledge mode	0.227	0.303	0.216
Confirmed warehouse mode	0.091	0.121	0.137
Sea warehouse mode	0.682	0.576	0.648

The weight vector is: (0.249, 0.116, 0.635) T

It can be seen that experts and practitioners believe that the risk of entering and leaving the warehouse is relatively the largest, followed by inventory pledge mode and confirming warehouse mode.

(5) Table 8 Matrix Risk Assessment:

Normalize each column of elements and the resulting normalized matrix is shown in Table 15 below:

Table 15: the resulting normalized matrix of table 8

Inventory goods risk	Inventory pledge mode	Confirmed warehouse mode	Sea warehouse mode
Inventory pledge mode	0.167	0.080	0.216
Confirmed warehouse mode	0.333	0.160	0.137
Sea warehouse mode	0.500	0.760	0.648

The weight vector is: (0.154, 0.210, 0.636) T

It can be seen from this that experts and practitioners believe that the risk of inventory of the sea and land warehouse model is relatively large, the risk of the inventory of the bonded warehouse model is relatively small, and the risk of inventory pledge mode is relatively small.

(6) Table 9 Matrix Risk Assessment:

Normalize each column of elements and the resulting normalized matrix is shown in Table 16 below:

Table 16: the resulting normalized matrix of table 9

Information risk	Inventory pledge mode	Confirmed warehouse mode	Sea warehouse mode
Inventory pledge mode	0.121	0.091	0.136
Confirmed warehouse mode	0.303	0.227	0.216
Sea warehouse mode	0.576	0.682	0.648

The weight vector is: (0.116, 0.249, 0.635) T

It can be seen that experts and practitioners believe that the information risk of Hailu warehouse model is relatively the largest, followed by the confirmation warehouse mode and inventory pledge mode.

(7) Table 10 Matrix Risk Assessment:

Normalize each column of elements and the resulting normalized matrix is shown in Table 17 below:

Table 17 : the resulting normalized matrix of table 10

Moral Hazard	Inventory pledge mode	Confirmed warehouse mode	Sea warehouse mode
Inventory pledge mode	0.133	0.118	0.143
Confirmed warehouse mode	0.333	0.294	0.286
Sea warehouse mode	0.533	0.588	0.571

The weight vector is: (0.131, 0.304, 0.564) T

It can be seen from this that experts and practitioners believe that the moral hazard of the Hailu warehouse model is relatively the largest, followed by the confirming warehouse model and the inventory pledge model.

Level total ordering

The weight vector of the comparison matrix constructed by the criterion layer: $U=(0.245, 0.315, 0.035, 0.170, 0.112, 0.067, 0.056)T$;

Each weight vector of the decision layer: $W=(w_1, w_2, w_3, w_4, w_5, w_6, w_7)T$ (w_1, w_2, \dots, w_7 are the weights of each risk in different modes);

Calculate the total weight by $U*W$ and get: (0.156, 0.229, 0.616)T ;

Let $U=(a_1, a_2, a_3, a_4, a_5, a_6, a_7)T$; CI_1, CI_2, \dots, CI_7 be the CI of each risk in different modes; RI_1, RI_2, \dots, RI_7 be the RI of each risk in different modes.

$$CR = \frac{a_1 CI_1 + a_2 CI_2 + \dots + a_7 CI_7}{a_1 RI_1 + a_2 RI_2 + \dots + a_7 RI_7} \quad (3)$$

Total order consistency test:

$CR=(0.040*0.245+0.018*0.315+0*0.035+0.012*0.170+0.076*0.112+0.011*0.067+0.003*0.056)/0.58=0.064 \leq 0.1$. Therefore, there is satisfactory consistency.

From the weight of the total ranking of the hierarchy, it can be known that the risk of the inventory pledge model is the lowest in terms of the seven risks, the risk of the confirmation warehouse model is relatively large, and the risk of the sea and land warehouse model is relatively the largest.

Analysis Conclusion

Based on the analysis of the above AHP, it can be seen that the inventory pledge mode is more windy than the other two logistics financial models.

The risk is lower, the risk of the confirming warehouse model is higher than that of the inventory pledge model, and the risk of the sea and land warehouse model is relatively Speaking the highest.

Among them, the confirmation warehouse mode requires less inventory and the inventory risk is lower, but it is from the dealer, logistics enterprise, gold.If the cooperation between the institutions and the suppliers is in cooperation, more information communication is needed, which is greater than the inventory pledge model. Informational risk and moral hazard.

The sea and land warehouse model involves a wide range of transportation, and the process in transportation is also complicated, and there are many documents required. The economic and political environment facing the country is also more complicated, so it is full of greater risk of goods, information, and morality. Insurance and so on. However, although the sea and land warehouse model faces greater risks, it can provide more services and earn more profits.

CONCLUSION

In recent years, China's cross-border e-commerce industry has developed rapidly, and its position in China's import and export trade is getting higher and higher, which plays an extremely important role in promoting China's trade transformation. However, the development of any industry requires the support of funds, especially in the field of cross-border e-commerce. The warehousing and transportation funds are large, and the payment period is long, which requires financing support. Many large-scale cross-border e-commerce enterprises in China have received huge financial support, but China's cross-border e-commerce SMEs have long been neglected, limited financing channels, poor environment, high risks and difficulties, and a scientific and rational financing is urgently needed. Ways to help it grow quickly and healthily. This paper combines cross-border e-commerce and logistics finance to provide a reliable financing path for cross-border e-commerce SMEs to promote their sound and rapid development.

The second chapter of this paper discusses three types of logistics finance models that have been successfully applied: inventory pledge mode, confirmation warehouse mode, sea and land warehouse mode, and introduces the operation process, profit model and advantages and disadvantages of these three modes. The third chapter identifies and evaluates the risks associated with cross-border e-commerce application of logistics finance, and invites 3 experts and scholars and 3 professionals engaged in related industries to score through the analytic hierarchy process. Through comprehensive evaluation of seven risks such as cargo risk, transportation risk, moral hazard, information risk and inventory risk, it is concluded that the risk of the sea and land warehouse model is relatively large, followed by the mode of the confirmed warehouse and the risk of the inventory pledge model. The lowest, but the greater the risk, the greater the corresponding benefit.

When cross-border e-commerce SMEs choose the logistics financial model and formulate the development strategy under the logistics financial model, they can analyze the types and types of risks under each model analyzed according to the third-level analytical analysis method, and evade the situation according to the company's own situation. Risk, plan optimal financing solutions, and solve corporate financing problems.

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Design of Back-End of Recommendation Systems Using Collective Intelligence Social Tagging

(Full Paper)

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ABSTRACT

Recommendation systems are the tools whose purpose is to suggest relevant products or services to the customers. In a movie business website, the recommendation system provides users with more options, classify movies under different types to assist in arriving at a decision. Although, with current e-commerce giants focusing on hybrid filtering approach, we have decided to explore the functionality of Content-based recommendation system. This research paper aims to delve deeper into the content-based recommendation system and adding tags to enhance its functionality. The content-based approach is more fit to the movie recommendation as it overcomes the ‘cold start’ issue faced by the collaborative filtering approach, meaning, even with no ratings for a movie, it can still be recommended. The proposed method is to solve the less ‘data categorization’ issue in content-based filtering. Collective Intelligence Social Tagging System (CIST) aims at making a significant difference in content-based recommendation system to enrich the item profile and provide more accurate suggestions. The main gist of CIST is to involve the users to contribute in tagging to build a more robust system in online movie businesses. Tags in the millennial world are the ‘go to’ words that everyone looks up to in an online world of E-commerce. It’s the easiest way of telling a story without actual long sentences. We recommended three main solutions for the concerns of CIST, (a) clustering of tags to avoid synonymous tag confusion and create a metadata for movies under same tags, (b) 5 criteria model to motivate and give the most amount of genuine information for end users to trust and eventually contribute in tagging, and (c) clear way of distinguishing and displaying tags to separate primary tags and secondary tags and give a chance to the users to assess whether the given tags reflect the relevant theme of the film.

Keywords: digital commerce; suggestion systems; social networks

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INTRODUCTION

The business value of a recommendation or suggestion is that it helps e-commerce platforms uncover associations among large amounts of transaction information for the purpose of providing personalized shopping suggestions for consumers. Recommendation and Suggestion Systems (RSS) are therefore a source of competitive advantage in the electronic marketplace. Business Insider (see <https://www.businessinsider.com.au/>) reports that 80% of Netflix’ business comes from its recommendation system and less than 20% from searches. Netflix believes it could lose \$1 billion or more every year from subscribers quitting service if it not for its personalised recommendation engine. Google recently introduced an improved design and recommendation system to the Home screen of its YouTube app, in order to attract viewers into longer watch-sessions so as to “create the feeling that YouTube understands you.” Apple’s Watch List will recommend content and accompanying marketing messages across their Apple TV devices via a “universal search and suggestion mechanism” that delivers as fast as possible. MightyTV is a meta-RSS which allows consumers to swipe through a list of movies or shows across service-providers such as Netflix, Hulu or HBO, and consequently suggests what new ones they should watch, based on profiles. In a value-added feature known as “mash-up”, consumers can connect with friends for the RSS algorithm to model what their tastes have in common, from shows to specific actors. However, while high-quality, personalized recommendations benefit users, online businesses may violate laws if they collect too much user data or if they globalize its use. It is therefore timely to consider the design of a state-of-the-art approach that may be adopted in global, electronic markets.

In the era of digital lifestyles, there are numerous choices available to make a single decision like to select which movie or which song to watch and play. Sometimes, this information overload makes it difficult to arrive at decision. One such personalization technique that assesses search and online behaviour and helps in arriving at a decision is the recommendation system (RS). Most of the major online retailers with strong online presence like Amazon Prime, Netflix, and Hulu use RS (Advomavicius & Kwon, 2007).

Before the emergence of electronic commerce, the traditional of recommending products or services was ‘Word of Mouth’. This approach was social and had an individual experience attached to it which swayed societies (Chartron, Kembellec, & Saleh, 2014). In this fast-paced, ever-evolving world of product-related Internet offers, information has exploded exponentially. Too much of information can deteriorate the quality of messages reaching out to the customers. There has to be a set of rules and ways to filter information from this Big Data. For an end user, it is necessary to filter and pre-processes the available data prior to display to match his/her expectations (Chartron, Kembellec, & Saleh, 2014).

Social tagging has emerged as a valuable technique to tag with tools like Flickr, Furl, Del.icio.us and more. In this time of Web 2.0, users have become more active and a major source of generating new content online (foo et al., 2015). The end users are allowed to assign a personal label or tag on a site for purposes like sharing, discovering, resourcing and more. E-tailers, on the other hand, benefit a lot from this tagging behaviour as they are able to discover user behaviour at different levels to tailor services for them. Social tagging has become popular on the Internet as it provides an efficient way to organize and manage resources. The tags themselves carry useful information regarding the product: its characteristics, expression and more (Zheng & Quidan, 2011).

Boosting sales via online purchases is supported by better and more accurate recommendations. A good RS can be a reason to upscale or downscale the cart size. The recommendation system is categorized into three types – collaborative, content-based and hybrid approaches. The online players not having a huge database or warehouse depends on the content-based approach. The content-based approach sometimes leads to less than accurate recommendation results (Ziad & Najafi, 2016). Our research paper aims to address this issue and propose a revolutionary method to mitigate the weaknesses of content-based RS by combining it with social tagging based on crowdsourcing.

Studies suggest that ‘crowdsourcing’ has evolved as a methodology to gather data. The word combines ‘crowd’ and ‘outsourcing’ which indicates “more heads are better than one”. Crowdsourcing is a way to receive feedback from the community for whom the products and services are being designed (Haren, 2017). In our research, we want to gather the crowd to aid our combination approach which will secure better results. Little has been researched on how to use the collective intelligence and leverage it to gain competitive advantage. In our research, we are targeting the online movie sales platform, where not necessarily all are well established (Sharma, Soe, & Balasubramaniam, 2014). Our experiments of a focus group with end user will help users formulate a model to evaluate and examine the criteria for social tagging and hence used by content-based RS.

LITERATURE REVIEW

This section focuses on the current best practices with respect to content-based recommendation system and tagging behaviour of users.

Recommendation Systems

With the tremendous amount of choices available in almost all types of products and services online, it is a tough decision for the users to select. Tailor-made solutions are the need of the time in this world of opportunities and personalizes recommendations are a win-win for both customers and the businesses. Once such personalized tool is ‘recommendation systems’. Recommendation systems (RS) are the information tools that aim to predict suggestions, relevant searches or a filtering tool to the customers these days. It directly or indirectly hints the users of a web service to find content, products or services relevant to their search. The essence of this recommendation service is underpinned by user behaviour. Gathering and analysing this data helps in a more accurate recommendation which will lead for the user to purchase the product or service (Park, Kim, Choy, & Kim, 2012). RS helps the online retailers (e-tailers) especially in recommending right product or service to the right consumer at right time to ultimately increase the business.

Online-media services are not behind in adapting to this era of personalization. These media website caters to a diaspora of customers. The content they deliver is related to the most popular entertainment source i.e. ‘movies’. One type of personalized service the movie websites are using is the recommender system. This RS is responsible to predict ratings, and suggest similar choices depending on user browsing history.

Amongst the popular types of RS, content-based recommendation system (CBRS) approach is one of the most popular RS as it uses user preference and descriptions of the items to match with the items of the users. This approach is accurate as it considers active users and can recommend accurately even if the data from other user ratings are not large. There are drawbacks to this approach like CBRS cannot recommend items if it does not have enough information on the metadata of the item profile. There is also over specialization problem which arises due to recommendations based on selective attributes only (Son & Kim, 2017). For example, while choosing a fiction movie the banner name like Marvel or DC is more important than the director. But if more appropriate information on categorization is not available then the choices recommended are biased. There have to be more categories like actors, characters present and more. In a similar way, CF has few drawbacks like sparsity and cold start problem. Also, CF is vulnerable to frauds or fake profile injections. If the number of users’ increases the CF approach degrades as it cannot recommend accurately, hence it has to be continuously upgraded (Ziad & Najafi, 2016; Son & Kim, 2017).

Keeping in mind the drawbacks of both collaborative filtering and content-based approaches in RS, content-based approach is more effective and useful in our research as we are introducing tag-based system aided from crowdsourcing platform. This type of system will aim to mitigate the drawback of CBRS. Currently, many leading movie sales platforms like Netflix, Rotten Tomatoes, IMDB and more are using content-based approach effectively (Bergamaschi & Po, 2015).

Figure 1 shows the content-based approach explained by a diagram for movie recommendation system. The diagrams explain how tags and similar ratings help in recommending a movie to a user. It shows that if more information is collected under user profile and item profile, they can be matched efficiently. Research has shown that explanations help increases user satisfaction and acceptance of recommendations (Vig, Sen, & Riedl, 2009).

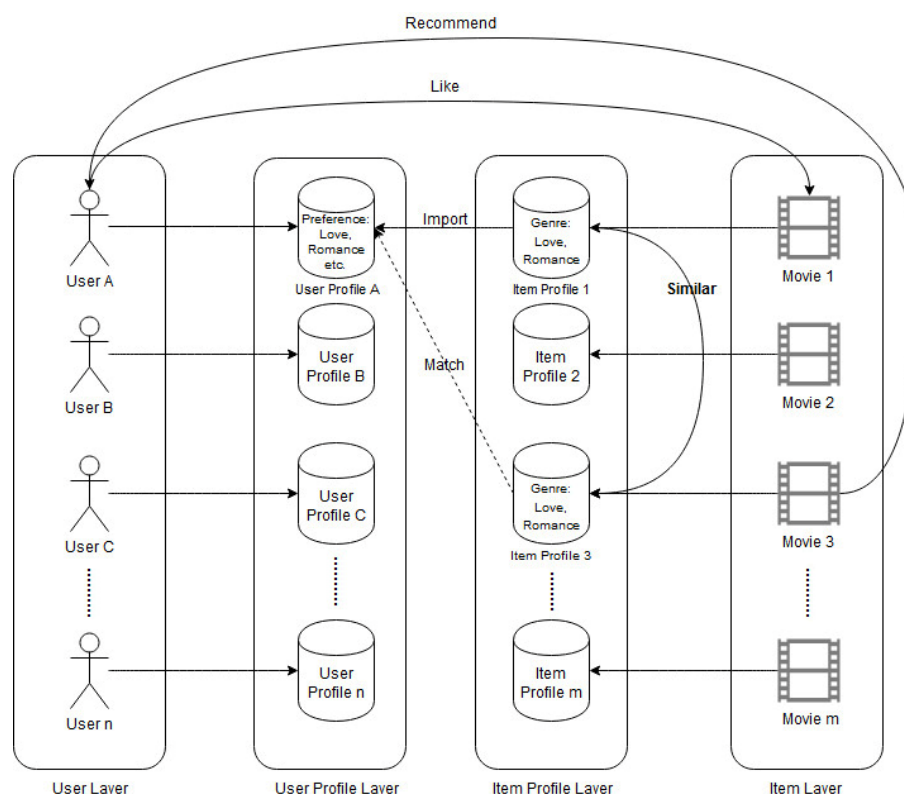


Figure1. Content-based recommendation system schema

Tagging and Crowdsourcing

In the ever-evolving era the users have become smart and, in most cases, they are the content generators. Crowdsourcing is nothing but filtered user generated content (UGC). When an appropriate content of high quality is filtered it is called as 'collective intelligence'. When more than one person contributes towards achieving an objective it creates more value and collaborative efforts take less time (Sharma, Soe, & Balasubramaniam, 2014).

Tags have become more popular with likes of Flickr, Tumblr, Amazon, Facebook, and Instagram and so on. Users like tags as they are self-explanatory, and their search purpose can be solved earliest. Tags have various characteristics attached to it like in Figure 1, the tags explain the 'film features' of the movie like *love or romance*. This helps the user to figure out themselves about what they need (Vig, Sen, & Riedl, 2009). It will be tedious on the e-tailers to have a separate army to generate tags and keep it up to date. The reason for calling them army is the online content changes daily, the trends, the types of movies, genres are new and changing rapidly. It will be a tough grind to keep updating the metadata too. Hence, crowdsourcing the tags and giving the baton in end users fingertips to generate tags will be efficient (Zheng & Quidan, 2011; Vig, Sen, & Riedl, 2009). Hence, many researchers suggest on using collective intelligence as a tool to annotate and then use systems like Amazon Mechanical Turk for multiple tagging in less time and low cost (Nguyen-Dinh, Waldburger, Roggen, & Tröster, 2013; Hsueh, Melville, & Sindhwani, 2009).

One does not have to be an expert to create tags. Hence, crowdsourcing can be perfect to also increase user-system trust in recommender systems and understand user's perspective on presentation, explanation, and priority on the website (Berkovsky, Taib, & Conway, 2017; Vig, Sen, & Riedl, 2009).

Content based recommendation system

Content-based RS are more inclined towards user preferences and ratings. It recommends items in-sync with the interest demonstrated by user in the past. CB approach analyses the underlying information, for example in Figure 1, if User A has searched and surfed movies on 'Love' or 'Romance' then similar movies will be recommended.

A significant advantage of CB recommendation system over CF recommendation system is that it does not match one user's preferences with another, each user is unique and the user profiles are matched with their own past browsing and behaviour history online (Uluyagmur, Cataltepe, & Tayfur, 2012). In a story-telling business, each user is unique and to suggest choices depending on others' preferences can be termed as 'none of the above category' and can lead on losing customers (Gomez-Urbe & Hunt, 2015). To earn loyalty from the users, trust and accuracy are the building blocks.

As mentioned earlier social tagging has become more of a need than choice. Amazon Mechanical Turk is a crowdsourcing tool to generate tags and research suggests that the accuracy rate as high as 76% (Nguyen-Dinh, Waldburger, Roggen, & Tröster, 2013). The reason for us to believe in tags is that the content on the internet is dynamic and changes rapidly. With the likes of Flickr, Amazon, and more tagging helps a user in understanding the exact items or needs of their search (Vig, Sen, & Riedl, 2009; Vig, Sen, & Riedl, 2009). Tags are those self-explanatory metadata words that will enrich the film features section. CBRS relies heavily on the data categorization part and hence, enriched item-profile is useful.

For this social tagging, the user is generating the tags and not the IT developers of the website. This is user generated content and then we intent to generate 'criteria-based model' to support this idea. This will positively impact the user-system trust and user experiences. Success of the tagging will highly depend on the user-system trust as this will trigger the decision-making process for users (Berkovsky, Taib, & Conway, 2017).

Design Challenges

Content based recommendation systems

The effectiveness of content-based recommendation system depends on the metadata. The data categorization is crucial for the CBRS algorithm to suggest accurate results. Currently, insufficient information of item profile is a major concern (Ziad & Najafi, 2016). This leads to recommending biased choices to the user (Son & Kim, 2017).

Crowdsourcing and tagging

Willingness of users of the movie website to contribute in tagging is the most critical element of crowdsourcing. The encounter of users with systems has three dimensions of trust, dispositional trust dealing with cultural situational trust is more about the work and demographic factors, situational trust dealing with intricate tasks involving systems and learned trust that develops when user interacts with the systems and builds on the experiences (Berkovsky, Taib, & Conway, 2017). The workers are untrained that will also affect with the accuracy of the tags created, the explanation and presentation of the data. Hence, to establish criteria to maintain the user-system trust for item tagging and combining those elements with the CBRS is critical.

Crowdsourcing is excellent to collect the data real time, but it also has the issue of an incompatible system available. This means to combine the real-time data and collaborating it at the same time is not easy (Gao, Barbier, & Goolsby, 2011). Identifying a criterion for the acceptable tags is a persistent issue, which requires developing a framework which will explain specific criteria and rules. Eliminating the noise level and ambiguous tags are essential (Nguyen-Dinh, Waldburger, Roggen, & Tröster, 2013; Milicevic, Nanopoulos, & Ivanovic, 2010).

Synthesis: The CIST approach

Crowdsourcing can typically establish a task in no time with the huge pool of taggers. In perspective, this data is created by low-commitment workers and hence cannot be trusted fully. AMT (Amazon Mechanical Turk) has emerged as a low-cost option and has been effective accuracy of 76% to 92%. AMT is ranked as the most popular crowdsourcing platform (Nguyen-Dinh, Waldburger, Roggen, & Tröster, 2013). Hence, it will be an achievable option to use crowdsourced tagging to enrich the item profile and ultimately to increase the accuracy of the content-based recommendation system.

Berkovsky et.al in 2009 came up with criteria on basis of crowdsourcing viz. presentation, explanation and priority. These criteria are utmost important to establish the user-system trust and positive user experience. Netflix sited the issue by proving that the consumer loses interest after 60-90 seconds of browsing and reviewing from 10-20 movie titles (Gomez-Urbe & Hunt, 2015). From a back-end perspective and pondering on the soft system methodology root definitions, adding trust and accuracy as a part of this criteria model will enhance the stickiness of an end user on the website. Hence, to accomplish accuracy and solve the data categorization problem, my Criteria model has five main criteria for the recommender algorithms to run efficiently, viz. Accuracy, Trust, Presentation, Explanation and Priority.

It is conjectured that the Criteria model along with the Accepted Tag model can resolve the issue of item profile attributes and accuracy of content-based recommendation system.

DESIGN RESEARCH APPROACH

The Soft System Methodology (SSM) is a mature approach for action research that help clarify ill-defined system requirements (Checkland 1995, 2000; Staker, 1999). It has been applied to as diverse a design challenge such as the Concorde and the National

Health Service. Specifically, SSM originated from a base in systems engineering and is a strand of research which “concentrates on situations in which people are trying to take action” (Checkland 2000, pS41). Since the research being reported in this paper proposes action that may be taken to increase opting-in, SSM was deemed appropriate for investigating design rules back-end design for recommendation systems. A key feature of the SSM is the expression of key requirements through the drawing of rich pictures, which follow the stages of the model’s root definition and model’s framework design (Checkland & Scholes 1999). The resulting artefact is then validated by testing in a production environment. The model validation in this case means conducting stakeholder interviews that examine whether the proposed blockchain-based system can improve the service levels.

Overall, the SSM consists of four stages (Checkland 2000) and seven steps (Checkland 1995), descriptions of which are beyond the scope of this paper. However, the key milestones of: i) finding out about a “problem situation” (using “rich pictures”); ii) formulating some relevant “purposeful activity” models; iii) using the models for debate and discussion (including considering changes that would be desirable and feasible as well as accommodations which will allow such changes to be acted upon); iv) taking action to improve the situation. It should be noted that the milestones of SSM are wholly consistent with processes of Design Science Research: problem identification and motivation, definition of the objectives for a solution, design and development of artefacts, demonstrations of prototypes or proofs-of-concept, evaluation against key success criteria, and communication of the design specifications to stakeholders (Peffer et al., 2008). Checkland (2000) in a retrospective journey acknowledges the holistic consistencies between SSM and other offshoots of Design Science Research such as Systems Theory and Design Thinking.

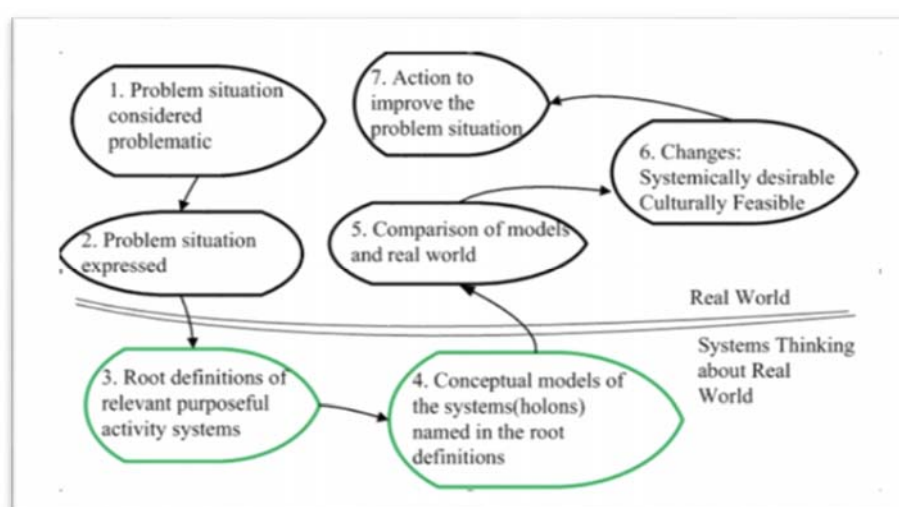


Figure 2. Soft system Methodology Overview (Source: Checkland and Scholes, 1990, p.191-242)

Model validation is a significant step in design research (Peffer et al., 2008). It checks if the design artefact is acceptable and useful for addressing the problems being addressed (Macal 2005). In SSM, relevance is the key aspect model validation (Checkland, 1995). It can be learned through listening and analysing the related stakeholders' views and perceptions about the situation and the model. Such content analysis of discussions can be assumed as a reflection of issues in the real world and the values of stakeholders (Hanafizadeh & Mehrabioun, 2018). Our design input was collected from actors in different roles in for a comprehensive insight. By drawing from the guidelines of design research, where experts and novices are sought for their comments and insights (cf. Conrath & Sharma, 1993), we conducted such design interviews to iteratively improve our design artefacts. The design interview template and guidelines may be found in the Annex to this paper.

Interview Protocol

The participants for the research are divided into three groups viz. IT developers – participants having prior knowledge of programming and working experience in recommendation systems, lead users – participants with experience in recommendation engines when using E-commerce website, and Novice users – participants fairly new to using E-commerce websites and having less knowledge on RS.

IT Developers Interview

In the pursuance of CIST and Accepted Tags Model, we will be conducting interview to get comments from IT developers. As these participants are highly knowledgeable in the area of recommendation engines, we will be interviewing five IT developers. The interview will be about 40 minutes in total.

Table 1. CATWOE for CIST system

Element	Definition
Customer (C)	Online movie sales platform
Actors (A)	Online movies sales platforms, end users, analysts
Transformation process (T)	In crowdsourcing the workers are untrained and hence a model based on important criteria will be developed for 'Accepted Tags'
Weltanschauung (W)	This system will help the CBRS to show more accurate recommendations and use collective intelligence to positively influence user satisfaction
Owner (O)	All the users who will be one of the data source to use social tagging
Environmental constraint (E)	To develop a model to accept the tags and set rules to continuously update as trends and technology changes daily

The interview will be conducted with the SSM philosophy to delve deep into systems thinking and the real world. We will be conducting semi structured open-ended interviews. The questions are structured to guide CIST and test its feasibility on back end i.e. programming side. The rich picture and CATWOE in Table 1 will guide our research in developing a new approach in RS involving crowdsourcing and tagging to increase the accuracy of content-based recommendation systems as research showed shortcomings to the current approach like less data categorization and less features.

Our proposed solution is for those online movies selling platforms using content-based recommendation systems. Amount of data available is the primary concern for them. The interview will reflect on our empirical research. The interview will start with explaining the Rich picture depicting the process of how standard RS works. The questions focus on three categories of evaluation to support the criteria model that are recommendation system accuracy, user satisfaction and user-system trust.

Lead Users and Novice Users Interview

In order to collect feedback from the actual end users we will conduct semi-structured interview. For the convenience and detail understanding the users are divided into two categories viz. Lead users and Novice users. The purpose of dividing users is to treat lead users as the 'producers' of tags and novice users as 'consumers' of the tags. The interview will be conducted for 25 minutes.

The interview will be conducted with the SSM philosophy to delve deep into systems thinking and the real world. The interview will involve 2 tasks before beginning of the questions and answers. Task 1 is to browse Tumblr and click on 2-3 tags relevant to the shown image. Task 2 is to browse Amazon or Netflix. This will give the participant a chance to understand what recommendations mean. The questions asked are to understand whether users like tagging, their thinking about presentation of the suggestions, trust on user-generated material online and accuracy.

The sequence of the interview questions is based on the technical process of Browsing-Ordering-Confirming. This is a typical process a website desires each user to go through. The feedback will help our proposed solution to be refined and practical to implement.

Design Research Steps

Step 1: Preamble

This is the first step to introduce one another and providing information about the research. This step includes a brief description of the purpose to conduct this design experiment

Step 2. Rich Picture

Let me show you a diagram elaborating about the topic of interest today. This picture will give you a general idea on today's discussion. we are really glad to talk to you today about recommendation systems. (If they say, 'I don't know how much we can help?' – showing a bit doubt and unclear on the topic)

Step 3. Conducting the Interviews

The participants for the research are divided into three groups viz. IT developers – participants having prior knowledge of programming and working experience in recommendation systems, lead users – participants with experience in recommendation engines when using E-commerce website, and Novice users – participants fairly new to using E-commerce websites and having less knowledge on RS. (Please see Annex)

DISCUSSION AND ANALYSIS RESULTS

High-Level Consolidation of Design Feedback

After finished the interviews with IT developers, lead and novice users, we did transcription for all the participants' audio recordings. As mentioned earlier, the questions in the interview belong to particular design statement and, any design statement has more than one questions. Hence, we used NVivo for Mac version 11.4.3, a qualitative data analysis software to sort out the themes from all the transcriptions. Figures 3 and Figure 4 shows all the themes for IT developers and user groups respectively created in NVivo software.

Name	Sources	References
Accuracy of recommendation syst...	5	8
Accuracy of UGC	2	3
Challenges of CIST	5	10
▼ Concerns	4	6
Algorithms	1	1
Tag clusters	2	2
Types of user	3	3
Effect of tags on accuracy	5	6
Effectiveness of CBRS	5	7
Effectiveness of tags	5	7
High quality tags increase accuracy	5	6
Motivation for UGC	5	11
Trustworthiness of UGC	5	12
UX based on UGC	5	7

Figure 3. Themes for IT developers

Name	Sources	References
Accuracy of RS	3	4
Accuracy of tags	5	13
High quality tags	4	5
Motivation to generate UGC	5	6
Potential attitude about tagging	5	8
▼ Potential attitude towards current...	5	5
Prefer Amazon	4	5
Prefer Netflix	1	1
► Trustworthiness of RS	2	2
Trustworthiness of Tags	0	0
Trustworthiness of UGC	5	6
Use of RS	5	5
Willingness to tag	3	4

Figure 4. Themes for Lead/Novice users

After the themes were sorted, the questions and design statement were allocated with the themes affiliated to them (Figure 5 and 6 below).

IT Developers			
Design statement	Questions	Themes	Main theme
1	1,2,3	T1,T2,T5	Effectiveness of Content-based recommendation system
2	4	T4,T6,T7	Social tagging as a solution for recommendation system
3	5,6,7	T6, T7, T8,T10	Attitude about user generated tags for recommendation system
4	8	T7,T10,T11	User generated tags more accurate

Figure 5. Affiliation of themes for IT developers

Lead/Novice user			
Design statement	Questions	Themes	Main theme
1	1,2,3	T1,T4,T5,T6	Accuracy level of recommendation system
2	4,5,6	T3,T6,T8,T9,T10	Attitude about User-system trust
3	7,8,9	T1,T2,T3,T6,T9	Personalized recommendations preferred
4	10,11,12	T1,T2,T9,T10	Acceptance of tagging in recommendation system

Figure 6. Affiliation of themes for User groups

The main purpose of conducting IT developers, Lead users and Novice users differently is to validate our design statement to understand the feasibility and challenges of CIST, user-system trust parameters and attitude of user generated content. The challenges and concerns raised by the participants' will be important reference for us to refine our proposed solution.

Validation of Design Statements

The design statements consisted of particular themes derived from the NVivo data analysis tool. In order to validate them, sentiment of those transcriptions had to be performed. We used IBM Watson's Natural language Understanding online tool to perform the sentiment analysis. The design statements act as a guideline to find out the underlying concerns, challenges, new ideas, about recommendations system, tags and user generated content. Themes such as, Concerns (T4) from IT developers' feedback will not be used for sentiment analysis as it talks about the challenges of CIST, the algorithm and user types. Similarly, themes like Preference of Amazon/Netflix (T6) derived from user groups help in understanding the popularity of the recommendation systems, hence, will not be considered for sentiment analysis.

The sentiment in IBM Watson tool is a numeric representation of negative, neutral and positive attitude of the text. The maximum and minimum scores are '1' and '-1' respectively. The sentiment scores for themes of IT developers are shown in Figure 7. Similarly, Lead and User groups is shown in Figure 8.

IT developers											
Theme	T1	T2	T4	T5	T6	T7	T8	T9	T12	T13	T14
IBM SCOR	0.64	0.18	0.08	0.74	0.67	0.43	0.79	-0.05	0.38	0.04	0.59

Figure 7. IT Developers' Sentiment Scores

Themes	T1	T2	T3	T4	T5	T7	T8	T9	T10	T11	T12	T13
Lead users	0.46	0.40	0.72	0.57	0.44	0.54	0	0.55	0.78	0.77	0.69	0.72
Novice users	0.24	0.55	0.40	0.37	0.57	0.68	-0.02	0.26	0.33	0.77	0.59	-0.28

Figure 8. Lead and Novice Users' Sentiment Scores

Effectiveness of Content-based Recommendation Systems

IT Developers Design statement 1 talks about content-based recommendation system. According to Figure 5 the themes affiliated to this design statement are T1, T2, and T5. Figure below shows the scores on a pie chart to clearly show that IT developers trust the CBRS and overall the sentiment about accuracy of recommendation system is positive. But, score for T2 shows less trust on user-generated content. Thus, in general, IT developers' feedback shows trust and accuracy on the functionality of content-based recommendation system but hesitation on the accuracy of user-generated content and item profile enrichment. Hence, the current state of content-based recommendation can be improved by increasing the trustworthiness of user profile and item profile.

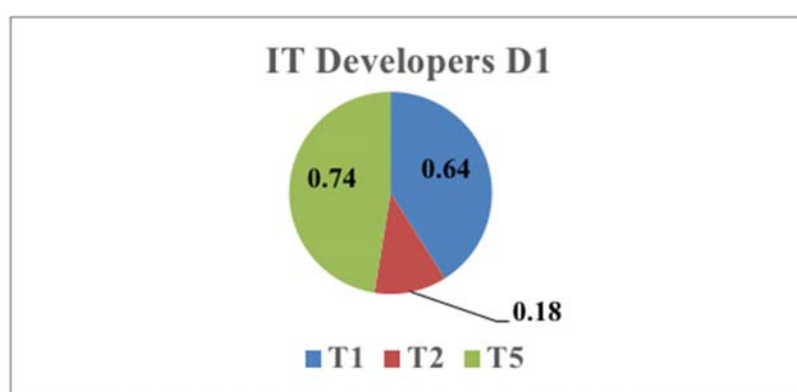


Figure 9. Sentiment Scores for D1

Social Tagging as a Solution for Recommendation System

Social tagging is common in social media. My Design statement 2 is an attempt to understand how effective it can be as a solution for Movie recommendation engines. This design statement is a part of CIST to understand its feasibility of tags. As shown in Figure 10 the scores are drastically different. T4 is almost towards negative score which depicts that all tags may or may not be the best keywords to describe the film features. However, when we look at the entire theme of D2, it shows that the feed from developers points towards 'high quality tags'. Thus, the IT developers' attitude towards tagging establishes that without any measures taken to eradicate tags, it cannot be a feasible solution. The effectiveness of tags will increase when only high-quality tags will be allowed. Also, high quality tags will ensure users will believe more and develop more trust on the website. One more point to be mentioned here is from the research by Berkovsky et.al (2017), where the Star ratings like that of IMDb ratings is a popular way to attract customers. The sense of the ratings given by 'one of them' for the users is crucial. Hence, tags can improve the functionality of the recommendation system but with the depiction of Star Ratings is compelling.

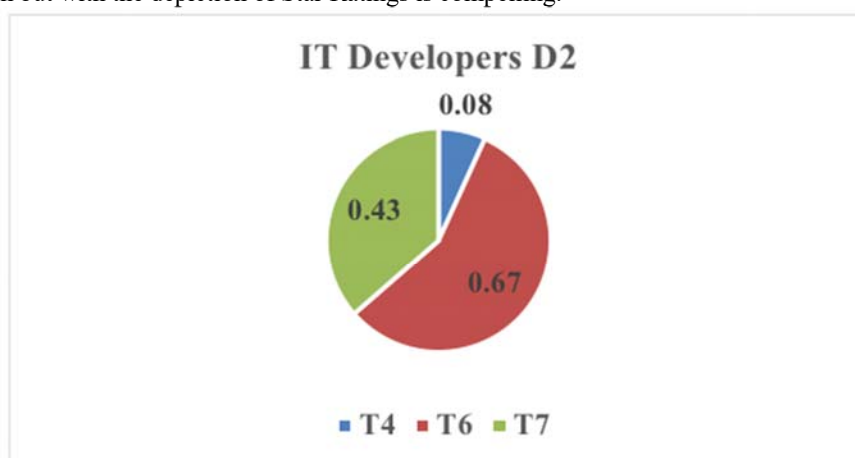


Figure 10. Sentiment scores for D2

Attitude About User Generated Tags for Recommendation System

Design statement 3 is about the potential attitude of IT developers with respect to user generated tags for recommendation system. All the four themes here are inter-related. The most shocking result was that of T8. IT developers think that users will have no motivation to generate content unless some incentive is attached. But they also think that the functionality of RS will increase if the high-quality user-generated tags are allowed as users are the best judge of the content and features of the movies. But accuracy of the RS results is something which will depend on the allowance of tags. The whole solutions of CIST become feasible if high-quality and user-generated tags are allowed. The accuracy of the engine will surely multi-fold. Thus, according to IT developers there is a positive side to CIST if quality is controlled. Essentially, CBRS can work more effectively as high-quality tags means enriched Film features, in technical terms enriching 'item profile'. (Figure 11 below)

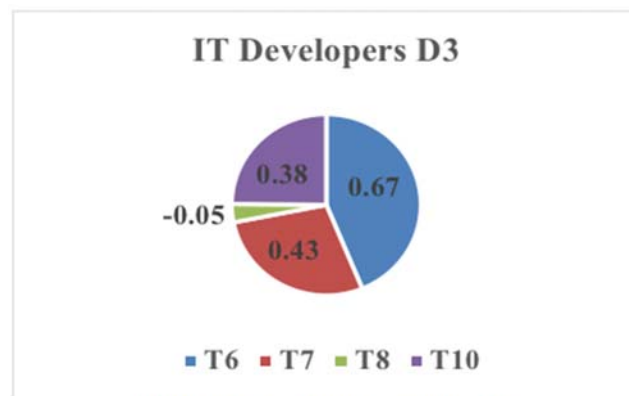


Figure 11. Sentiment scores for D3

User-Generated Tags are More Accurate

Recommendation systems depend upon user behaviour online. The more a user interacts with the website, the more patterns of his/her behaviour are saved. The more data available, the more accurate and trustable suggestions can be given. One of the important purposes of RS is to increase customer trust and loyalty. Trust and loyalty depend on numerous things like, quality of content, customer connect to the content, ratings, presentation, features, filtering options and more in case of an online Movie website (Figure 12 below)

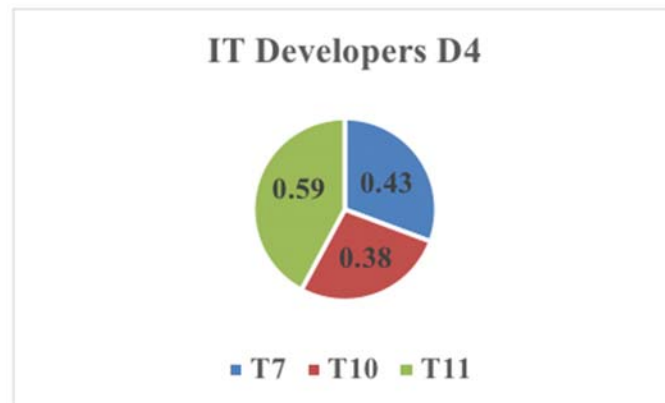


Figure 12. Sentiment scores for D4

Satisfaction Level of Recommendation System for Decision Making

Unlike IT developers' the user group has a different lens to evaluate or give feedback for recommendation system. User groups treat the recommendations system as a tool to browse more options and to narrow down choices using filter. To understand how user groups, define accuracy we had to probe them on their process of watching a movie online. The overall process for both lead and novice users of shopping online or watching movie is somewhat similar. But few differences can be pointed out like, in Figure 13, T1 scores for both lead and novice users are similar but novice users believing the RS is more accurate than lead users. For T2, the novice users believe more in RS than lead users in terms of trustworthiness. Here, the experience of the two groups in using information system as a whole comes handy. The lead users are aware about how RS works based on their browsing history and preferences, but novice users aren't aware on the technicalities of RS and they trust on the face value.

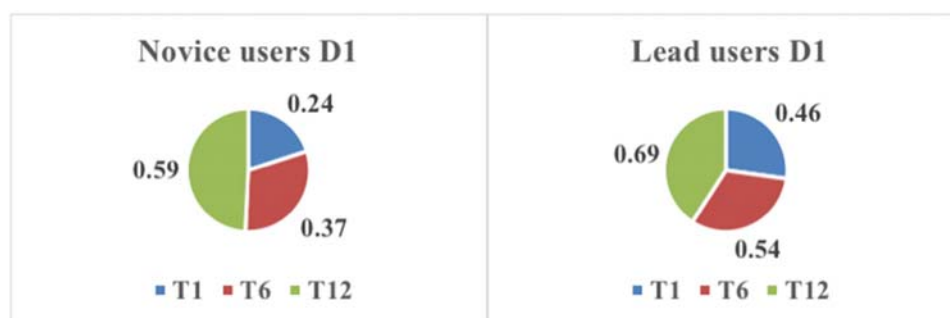


Figure 13. Sentiment scores for D1

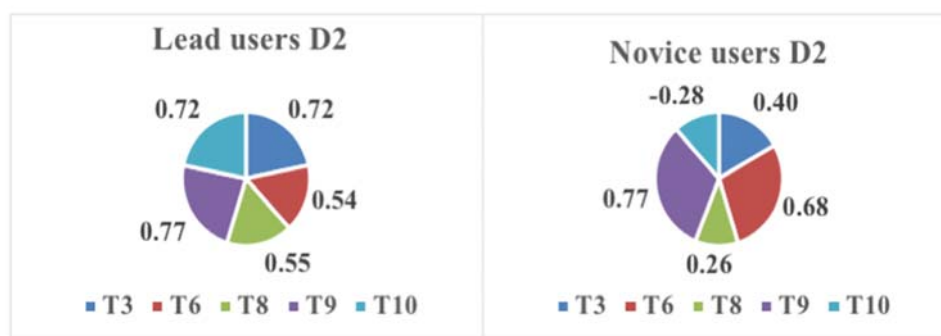
The purpose of D1 is to understand how use of RS is more satisfying and assists in decision making. The themes erupted in the answers of questions in D1 have accuracy, trust and experience in using RS. Out of the three parameters UX is the most positive, meaning the presentation, ease of use, features on the website is appealing. The user-system trust is important when examining the effectiveness of the RS. Satisfaction level of RS depends as much on trust and accuracy as on UX. Thus, to establish user-system trust, accuracy and trust plays a key role. More of this was explored in D2.

Attitude About User-System Trust

In order to evaluate CIST's main sub-part 'user-generated tags', the questions in D2 were designed to understand the trust level to generated tags on online platforms, willingness to generate tags, and the quality of the UGC. From Figure 14, T8 and T10 are the most important themes. T8 which talks about trust on UGC is less in Novice users. The one definitive reason from the transcriptions was the inexperience with the website review platforms and generating content. Also, to note was, when addressed the concerns of UGC tags with the 'Accepted Tag Model' the trust factor increased. Hence, in order for CIST to work, building on the user-system trust is the factor of accuracy and trustworthiness of UGC in addition to UX.

The most important finding from D2 was derived from T10, which talks about 'willingness to generate tags'. The enthusiasm to contribute in tagging was blunt negative (-0.28) amongst the novice user group. The reasons for this were their inexperience with the systems, confused with respect to the concept of tags, and unclear of what is expected. On the other hand, sentiment for lead users was positive with a score of 0.72. The reason is aplenty given the experience and the zeal to contribute tags, or curiosity to know about new trends and more.

Keeping in mind the concept of CIST, it needs to be fed with tags and there have to be consumers to use those tags. CIST depends on user-generated tags, hence there is a need for users to keep generating more tags, ultimately enriching the 'film-features'. Thus, the concept of 'lead users' being 'tag generators' and 'novice users' being 'tag consumers'.

**Figure 14. Sentiment scores for D2**

Acceptance of Tagging in Recommendation System

Design statement 4 consisted of the questions to understand acceptance of tags as a way to understand about a movie and convenience in browsing through suggestions. From the Figure 15, the overall concern from users was the trust and accuracy of the tags. The concept was luring to the users but the uncertainty of accuracy of those generated tags and the sureness of UGC could be sensed. As mentioned above, novice users were negative about contributing to tags as well. Over all, for the Trust and Accuracy formed a big part of users' interaction with the system. Thus, it is good to establish that user-system interaction is based on 'trust' and 'accuracy' a lot.

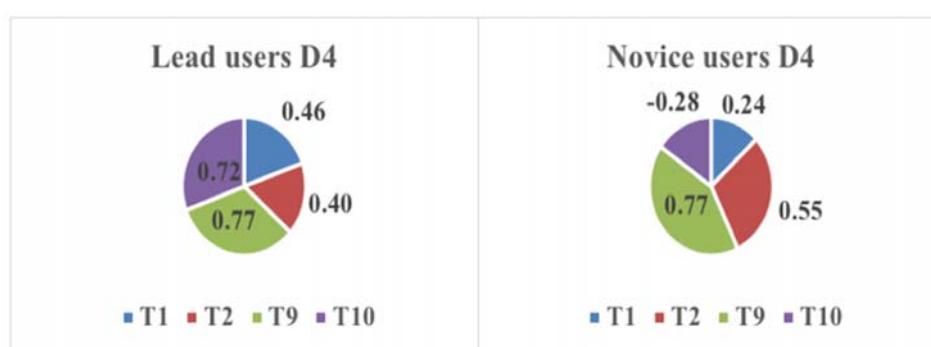


Figure 15. Sentiment score for D4

Surprisingly, security and privacy concern of the recommendation system is one of the concerns that users had. Issue like what data will be stored or shared if they contributed in online content was one main questions. As security and privacy issue was not in the scope of this research, the answer was not available.

FINDINGS AND RECOMMENDATIONS

From the analysis of the design interviews described in Section 4, the following are key findings with respect to the design statements.

1. The current state of content-based recommendation can be improved by increasing the trustworthiness of user profile and item profile
2. Tags can improve the functionality of the recommendation system but with the depiction of Star Ratings
3. Tags will definitely enrich the film features but *accuracy and trust* on user generated content is doubtful
4. More '*personalized suggestions*' are feasible if tags are distinguished clearly
5. Recommendation system is a trusted system for online shopping
6. The suggestions currently are effective in presentation, explanation and prioritization but trustworthiness and accuracy are utmost
7. Tags are effective ways of depicting personalized recommendations, but '*information overload*' has to be avoided
8. Lead users are willing to generate tags, but novice user is not in complete favour
9. Security and privacy concern of the recommendation system and the CIST approach

From the above key findings, three significant issues that could be highlighted are: trust and accuracy of UGC, personalized suggestions and information overload. For CIST to avoid this and improve the CBRS functionality we suggest the following three recommendations.

Clustering of Tags to Avoid Confusion

One of the most important concern from IT developers and User groups was that of information overload. CIST relies on user-generated tags, the number of tags will also grow as the tags are personal preferred words which will differ for each user.

Since users will be generating tags, there is a high chance that there will be synonyms, vernacular words, confusing meanings and so on. For example, for a movie *The Avengers*: the film features can have many tags like *superpower*, *super-natural*, *mission*, *objective*, *pursuit*, etc. Similarly, *Justice League*: *woman-power*, *strong*, *superman*, etc. can be added. The main problem at times the recommendation engine might face is, movies related to what content can be suggested. Hence, the solution of 'clustering the tags'. As in Figure 16, the similar movies with most common tags can be clustered. Randomness and personalization of tags is common, especially in UGC. This leads to issue of information overload, crunch in data space and semantic obstacles. For this kind of solution, three main algorithms can be used viz. MMSK (min-max similarity *k*-means), tag clustering based on semantic analysis, and LMMSK (latent min-max similarity *k*-means) (Yang & Wang, 2017).

The preferred option here can be 'tag clustering based on semantic analysis as those colloquial words, synonyms can be all bundled for better results. CIST is as of now only designed keeping in mind the movie selling platforms online. Hence, Film feature is the most important element of the content-based RS. The more item profile is built on the better will be the result.

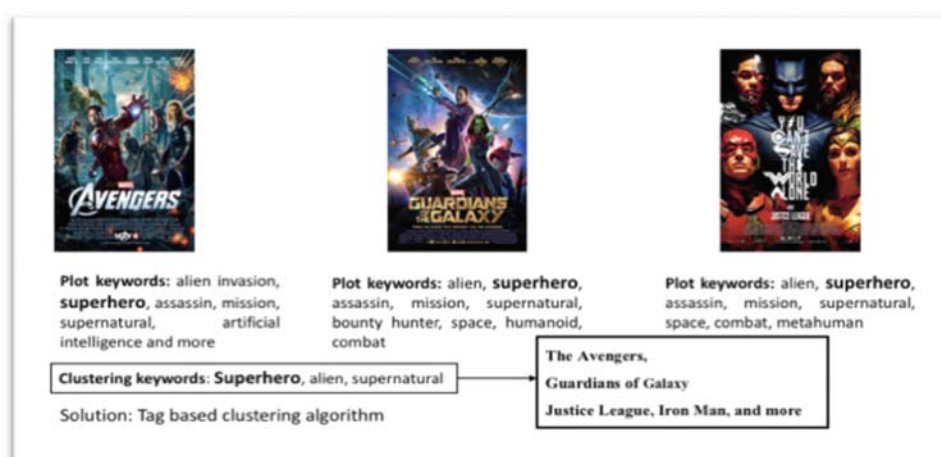


Figure 16. Clustering of tags

Five Criteria of User-System Trust

Commercial recommendation engines owe their success to the users to a great extent. It is a two-way communication, the more your exceptional data you offer on plate, and the more the customers will spend time to keep the uptake. Now, the success also depends on parameters like the freshness of content, the precise suggestions, but the most important is promising value to the customer (Berkovsky et.al, 2017). Users these days, need personalized suggestions, need more data to filter, hassle free appearance on the website. During the data analysis it was established that the correctness of the content is directly proportionate to the trustworthiness of it. Hence, we synthesized the UX factors from the previous research and added two more criteria broadly outlining the user-system trust viz. accuracy, trustworthiness, presentation, explanation and priority. Figure 17 outlines the criteria to establish user-system trust and ultimately encouraging the users to contribute in tagging and provide more functionality on the website.

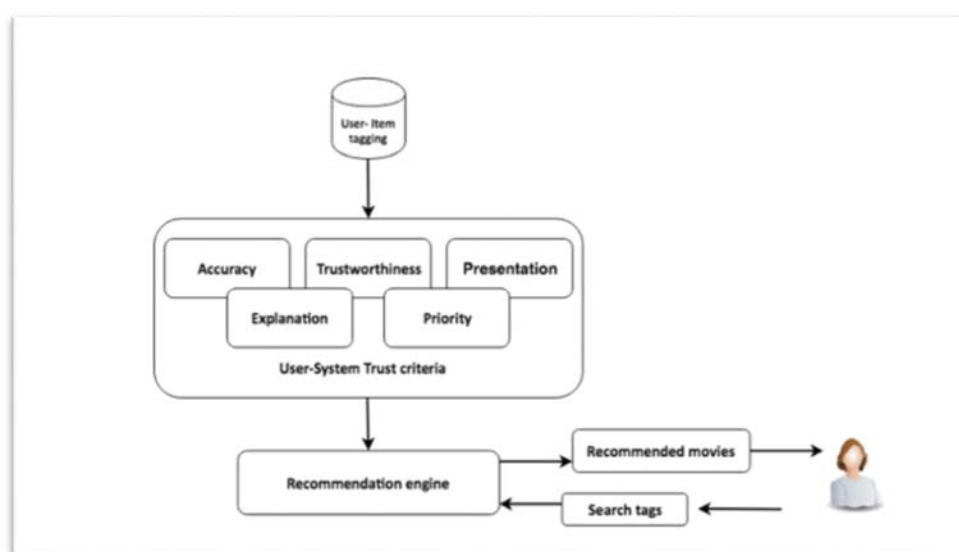


Figure 17. Proposed solution for user-system trust

As the research advocates the recommender engine in Movie website is hardly aid in taking critical decisions like, medicines, doctors, etc. The IT developers were aware of the fact that the users will have little domain expertise about some or the other movies flashing under recommended list. In this case, the RS needs to support decision making but also to keep the users engaged, use more functionality available to aid the decision. Hence, RS is more than just pushing to arrive at a decision. Keeping all this in mind accuracy and trust are of paramount importance for CIST as the main resource of tags are users' themselves. Hence, these criteria are of utmost value to keep the vigour in the users burning.

Clear Way of Distinguishing and Displaying Tags

To address the issue of personalised suggestions and target the users to engage more, the CIST approach needs to consider which tags will appear primarily. So, to avoid confusion a simple method of dividing the ‘film features’ into primary and secondary tags is essential. In Figure 18, the primary tags characterize the main theme of the film. The primary tag is different than the ‘genre’ of a movie. The ‘Genre’ explains the category to which the movie belongs. For example, *The Avengers*, this movie belongs to ‘Science-Fiction’ (referred as ‘Sci-Fi’ in future), but the tags like *Superhero* is its ‘primary tag’. All the other plot keywords or film features describing the storyline or themes of the movie are ‘secondary tags’. Also, to make it simpler, the primary tag can be highlighted font-wise to separate from the secondary tags.

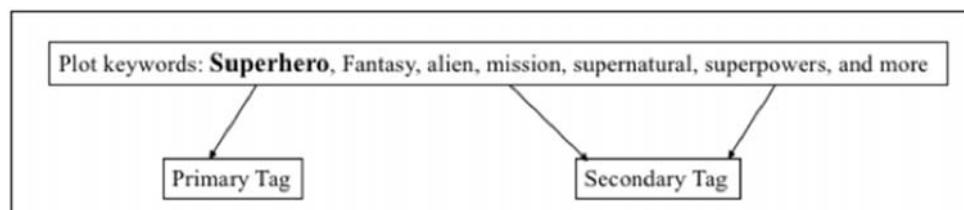


Figure 18. Primary and Secondary tags

During the interviews, one main piece of information that came forward was, to clearly display the more liked and relevant tags. The relevant tags after passing through the Accepted tag model, still needs to be eye-catching, intriguing for users to click on them. Hence, we found out a clear way to make this possible. In Figure 19, *the Avengers*, is a movie which can have ‘n’ number of tags, but not all tags can be eye-catching. To keep it interesting, interactive and relevant, we can have a system, where the users are allowed to click ‘+1’ if they think the tag is relevant or ‘-1’ if they think it’s not relevant. This ‘+1’ and ‘-1’ system will also add to the most liked tags for the item profile and less crowded. The number of tags added to the system should also have a limit, but mostly it can be thrice as much as the current tags. This solution will also alleviate the role of CIST to be more likely the most fitting solution for CBRS.



Figure 19. Displaying ‘most preferred’ tags

CONCLUDING REMARKS

This research paper aims to address the issue of ‘less data categorization’ in a content-based recommendation system by proposing a novel method known as ‘Collective Intelligence Social Tagging’ (CIST). This hybrid solution will increase the current functionality of the content-based approach and make a significant difference to its accuracy. The category selected for researching is the online movie sales platforms. The reason being, to recommend choices based on user’s browsing history than that of his/her neighbours’ search. To test the feasibility of CIST semi-structured interviews were conducted on IT developers and Users. The user group was further divided into lead and novice users to anticipate difference of opinions. The feedback received from both the group, developers and users gave tested the satisfaction level and acceptability of CIST. After careful analysis, following three recommendations were suggested in order to improve CIST to function better.

1. Clustering of tags to avoid confusion
2. Five criteria of user-system trust
3. Clear way of distinguishing and displaying tags

This research throws the light on the broader aspects like crowdsourcing, tags and recommendation system, put together the response collected was positive.

The scope of this research was to understand the acceptance and feasibility of CIST. But there are two main limitations: 1) Smaller sample size of design interviews. 2) Lack of working prototype for this design experiment of CIST. Down the line, it will be insightful and interesting to understand the experience and performance of a larger sample size. Also, to acquire more knowledge on the algorithm to code a working prototype will aid in any changes required.

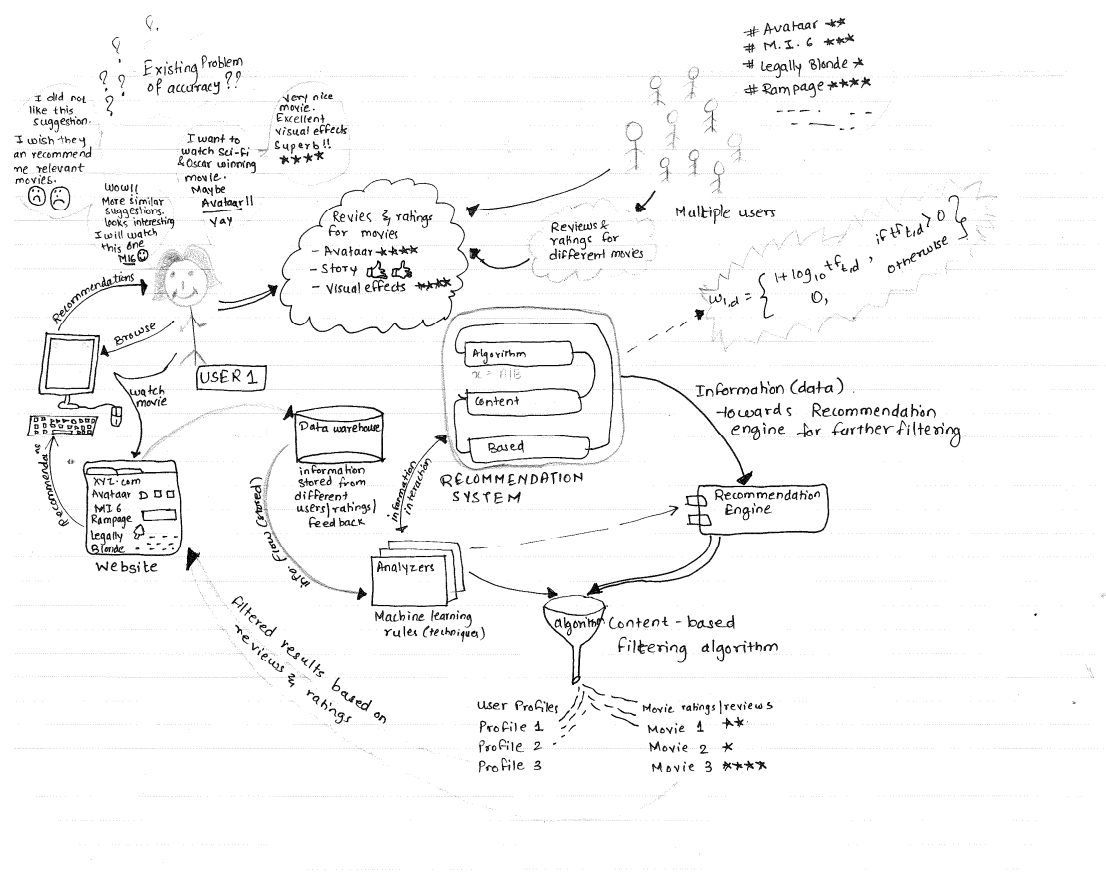
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ANNEX: DESIGN INTERVIEW TEMPLATE

CONDUCTING THE DESIGN INTERVIEW



IT DEVELOPERS

Recommendation System Accuracy

- **Design statement 1.** Content-based recommendation system is more precise than the collaborative filtering approach
1. In your professional experience, do you agree with this statement? If yes, why so?
 2. What about the trustworthiness? Do you think ratings and user profile are credible to increase precision in RS?
 3. Can you elaborate on your experience of using recommended choices when you browse?

Explanation

- **Design statement 2.** Tags will make the RS more personalized and persuasive to the user
- 4. Which of the classification users prefer with persuasive, personalized or IMDb ratings?
- 5. What if movies were suggested with the tags alongside the IMDb ratings? How do you think they would help?
- 6. Tags will enrich the recommender engine to suggest more personalized suggestions. Agree? Content based RS is all about suggestions based on content. Please provide comments.

User-System Trust

- **Design statement 4.** User generated tags increases the confidence of users to review items.
- 7. 'The more tags about a product, the more you know about it' - Agree? Comments
- 8. What motivates users to engage in generating content i.e. tagging?
- 9. What are the implementing challenges in developing user generated based tagging system? (*quality, trustworthy, security, privacy, relevance*)

Presentation

- **Design statement 3.** Current functionality of RS is more precise in appearance of results.
- 10. Displaying tags like that of Tumblr can increase personalized suggestions. Do you agree? Why?
- 11. Generally, RS uses Genre, Human preference and Star rating to display the suggestions. Which method do you prefer and why?

LEAD USERS (PRODUCTION OF TAGS)

Task: Open Netflix and ask them to browse and see how the suggestions have come

Accuracy

- **Design statement 1.** Recommendations systems assist in decision making
- 1. Tell me about how you make your decision to watch a movie?
- 2. Do you think the recommended results influence your decision?
- 3. Tell me about your experience with RS in Amazon or Netflix? Why you prefer this one?
 - User-system trust (Showing Tumblr)
- **Design statement 2.** Contributing to ratings and reviews increases the sense of involvement with after joy
- 4. When do you write feedback or reviews for items/products/services you use?
- 5. User generated content is more trustable than generated by the system. Agree? Please provide some comments
- 6. How about you get to generate tags for a movie? What will motivate you to do so?
 - Explanation
- **Design statement 3.** User generated tagging is an effective way to receive personalize recommendations
- 7. Tags or no tags – which one will help in shortlisting the items you want to buy?
- 8. 'The more tags about a product, the more you know about it'. Agree? Please provide some comments.
- 9. What if movies were suggested with the tags alongside IMDb rating? How do you think they would help?

Presentation

- **Design statement 4.** Tags will be an effective appearance method on the website
- 10. Above picture is about the types of recommended results. Which one do you prefer? Why?
- 11. Recommendation results on search are preferred. Will tags help in narrowing the search to the relevant results?

NOVICE USERS (CONSUMERS FOR TAGS)

User-system trust (Showing Tumblr)

- **Design statement 2.** The preciseness of user generated Tags will motivate to become the part of Tagging community
- 1. Like the Tumblr website you just saw, would you like the same concept of tags in other ecommerce websites like Netflix or Amazon prime?
- 2. User generated content is more trustable than generated by system. Agree? Please provide some comments
- 3. Would you like to contribute to the content by creating tags movies?y

Design of Front-End for Recommendation Systems: Towards a Hybrid Architecture (Full Paper)

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ABSTRACT

To provide personalized online shopping suggestions, recommendation systems play an increasingly important role in “closing a transaction”. Some leading online movie sales platforms, such as Netflix and Rotten Tomatoes, have exploited content-based recommendation approaches. However, the issue of insufficient information about features in item profiles may lead to less accurate recommendations. In this paper, we propose a recommendation method known as Collective Intelligence Social Tagging (CIST), which combines a content-based recommendation approach with a social tagging function based on crowd-sourcing. We used an online movie sales platform as a use-case of how a CIST approach could increase the accuracy of recommended results and the overall user experience. In order to understand the feasibility and satisfaction level for CIST, we conducted fifteen design interviews to first determine user-developer perspectives on CIST, and then collected their overall design input.

Keywords: Online suggestion systems, crowd-sourcing, collective intelligence, social tagging.

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INTRODUCTION

The business value of a recommendation or suggestion is that it helps e-commerce platforms uncover associations among large amounts of transaction information for the purpose of providing personalized shopping suggestions for consumers. Recommendation and Suggestion Systems (RSS) are therefore a source of competitive advantage in the electronic marketplace. Business Insider reports that 80% of Netflix’ business comes from its recommendation system and less than 20% from searches (see <https://www.businessinsider.com.au/netflix-recommendation-engine-worth-1-billion-per-year-2016-6>). Netflix believes it could lose \$1 billion or more every year from subscribers quitting service if it not for its personalised recommendation engine. Google recently introduced an improved design and recommendation system to the Home screen of its YouTube app, in order to attract viewers into longer watch-sessions so as to “create the feeling that YouTube understands you” (see <https://www.businessinsider.com.au/youtube-app-redesign-and-recommendations-2016-4>). Apple’s Watch List will recommend content and accompanying marketing messages across their Apple TV devices via a “universal search and suggestion mechanism” that delivers as fast as possible (see <https://www.businessinsider.com.au/apple-tv-recommendation-app-2016-10>). MightyTV is a meta-RSS which allows consumers to swipe through a list of movies or shows across service-providers such as Netflix, Hulu or HBO, and consequently suggests what new ones they should watch, based on profiles (see <https://www.businessinsider.com.au/mightytv-2-million-investment-2016-8>). In a value-added feature known as “mash-up”, consumers can connect with friends for the RSS algorithm to model what their tastes have in common, from shows to specific actors. However, while high-quality, personalized recommendations benefit users, online businesses may violate laws if they collect too much user data or if they globalize its use. It is therefore timely to consider the design of a state-of-the-art approach that may be adopted in global, electronic markets.

It is taken for granted that online customers buy digital products from a host of platforms such as iTunes, Google Play, Amazon Prime Video, or Netflix on the basis of convenience. In order to enhance user experience and sales, almost all leading e-tailers have built their own recommendation systems. The notion of a recommendation or suggestion can help e-commerce platforms uncover associations among large amounts of transaction information for the purpose of providing personalized shopping suggestions for consumers (Venkateswari & Suresh, 2011). Commonly used recommendation approaches include content-based filtering, collaborative filtering, and hybrid filtering. Websites that depend on the content-based filtering approach may face insufficient item information, an issue that often results in less accurate recommendation results (Najafi & Salam, 2016). In order to close the gap between the actual and desired performance in the absence of an effective method to work around the issue, a new method called Collective Intelligence Social Tagging (CIST) recommendation approach for which depend on content-based recommendation, is proposed.

In the intensely competitive and ever-changing e-commerce world, continuous improvement of recommendation systems is pivotal. For this reason, conducting design research to recognize the effectiveness of CIST will help online sales. Mostly, these depend on content-based recommendations to improve the functionality of their current recommend systems. Resolving insufficiency identified through the research reported in this paper can further improve user experience and satisfaction. Considering that such a hybrid

approach also includes the application of content-based recommendations (Najafi & Salam, 2016), the intended objective of this research is to inform more effective design of e-tailing platforms. The remainder of the paper is organized as follows. We begin with a review of state of the art of recommendation systems and crowd-sourcing based tags in Section 2. This is followed by the research design and ethical considerations in Section 3. We interpret and analyze data collected from our design interviews to come up with our key findings in Section 4, where we also refine our proposed hybrid recommendation approach. In Section 5, we conclude with suggestions for increasing the satisfaction level of users and mitigating the key design drawbacks of CIST.

REVIEW OF CURRENT PRACTICES

2.1 Recommendation Systems

With the growth in the number of products that users can view and purchase online, it is inevitable for users to face an information overload problem as they browse. One solution to this problem is the notion of a recommendation system (Cataltepe, Uluyagmur, & Tayfur, 2016; Schafer, Konstan, & Riedl, 1999). Recommendation systems have evolved into what is known as part of predictive Business Intelligence. It directly or indirectly prescribes to users of a web service to locate content, products or services relevant to their search. The essence of a recommendation service is underpinned by user behaviour. Gathering and analyzing users' data helps in a more accurate recommendations, which will then guide users to purchase products or services that are suggested to them (Park, Kim, Choy, & Kim, 2012). Recommendation systems specially helps e-tailers to “pitch” the right product to the right consumer at the right time to ultimately increase revenue (Foo et al. 2015).

However, such a collaborative approach has two major issues: the sparsity of the user-item matrix and the cold-start problem. The latter occurs if a product is not rated by any users at all, then it cannot be recommended. In such a case, a content-based approach is more suitable for recommending movies (Uluyagmur, Cataltepe, & Tayfur, 2012; Bergamaschi & Po, 2014). Some leading movie sales platforms such as Netflix, Rotten Tomatoes and Internet Movie Database, prefer to utilize the content-based approach (Bergamaschi & Po, 2014). For example, Netflix explains movie recommendations by showing users similar movies they have highly rated before (Vig, Sen, & Riedl, 2009). If a Netflix user has watched many “detective” movies, the system will recommend movies having such tags (Rajaraman & Ullman, 2014).

A content-based approach deals with item profile and user profile (Najafi & Salam, 2016; Uluyagmur, Cataltepe, & Tayfur, 2012; Alsalama, 2015). An item profile is a collection of records representing critical characteristics of the item. The features of a movie, such as actors, years, plot keywords, and genres, which can be linked to a recommendation system, can be an example (Rajaraman & Ullman, 2014). A user profile is built for each user containing their preferences, which are captured by analyzing the similarities between the items that the user has rated. A new item can then be recommended by content-based recommendation system through matching the existing user preference in the user profile with the features of the new item not yet rated by the user (Najafi & Salam, 2016).

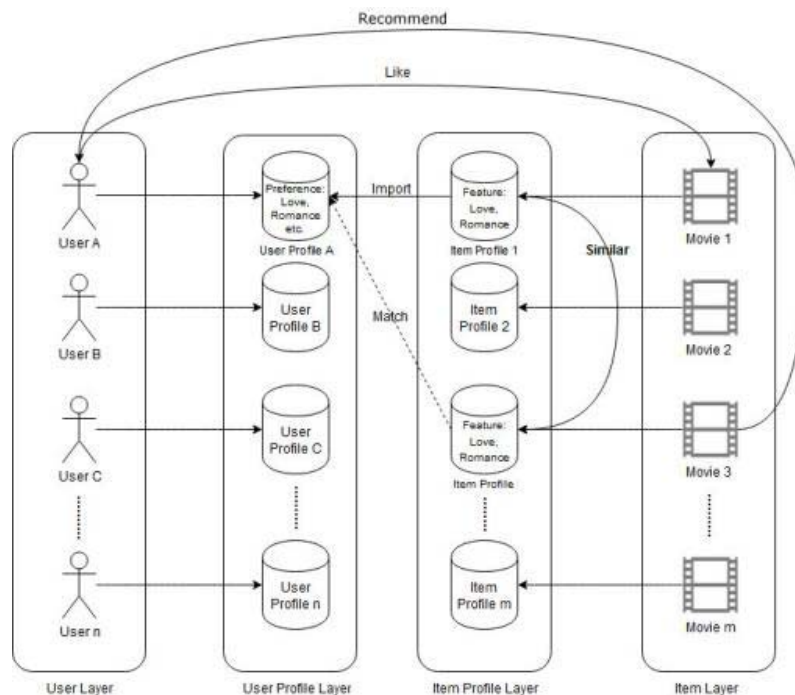


Figure1. Content-based recommendation system schema

Figure 1: Content based recommendation system schema

Some researchers have indicated that tags, which are index terms, can be used to describe item features, so users can obtain information about items through knowing their tags (Rajaraman & Ullman, 2014; Vig, Sen, & Riedl, 2009). Therefore, we review the use of social tagging.

2.2 Social Tagging based on Crowd-Sourcing

In the era of web 2.0 and beyond, users have become sophisticated and in most cases, they are the content generators. Crowd-sourcing is referred to as collective intelligence in the literature. When more than one person contributes towards achieving an objective it creates more value, and collaborative efforts take less time (Sharma, Soe, & Balasubramaniam, 2014). Tags have become more popular with the likes of Flickr, Tumblr, Amazon, Facebook, and Instagram and so on. Users like tags as they are self-explanatory, and their search purpose can be solved within a shorter period of time.

It is worth mentioning that film features, such as genres and plot keywords, can be described by tags (Rajaraman & Ullman, 2014). However, if websites assign tagging tasks to internal staff, it will undoubtedly increase the workload of internal staff. Thus, some authors suggested adopting crowd-sourcing to perform tagging (Nguyen-Dinh, Waldburger, Roggen & Tröster, 2013; Hsueh, Melville, & Sindhvani, 2009). Smaller e-tailers could recruit external annotators through Internet services (e.g., Amazon Mechanical Turk (AMT)) to allow multiple tagging tasks to be done in bulk with fast completion rates and low overall costs (Hsueh, Melville, & Sindhvani, 2009).

It is not necessary for users to be an expert to create tags. Hence, crowd-sourcing can also be a good way to increase user-system trust in recommendation systems and understand users' perspectives on presentation, explanation, and priority online (Berkovsky, Taib, & Conway, 2017; Vig, Sen, & Riedl, 2009).

2.3 Content-Based Recommendation Systems

The main view currently is that recommendation systems can facilitate customers' purchasing processes and make positive impact on the user experience of online purchasing (Venkateswari & Suresh, 2011; Swathi & Reddy, 2014). In the online movie sales industry, unlike the collaborative approach, content-based approach does not have the problem of the sparsity of the user-item matrix and cold-start (Uluyagmur, Cataltepe, & Tayfur, 2012). The content-based approach is more inclined towards user information, like user preference, and item information, like ratings. It recommends items in-sync with the interest demonstrated by users in the past. Even if a movie was not rated by any users before, so long as the movie has sufficient movie information, it can be recommended to users who have similar user preference. The extent of sales diversity is then increased by allowing consumers to access to more new and niche products among seemingly endless alternatives (Fleder & Hosanagar, 2009).

2.4 Social Tagging based on Crowd-Sourcing

Using crowd-sourcing tools (e.g., AMT) to generate tags allows multiple tagging tasks to be done in bulk with fast completion rates (Hsueh, Melville, & Sindhvani, 2009). For start-ups and de-novo firms entering a digital marketplace, it provides several benefits, such as broader access to specialized skills, shorter product development cycles, more flexible and faster-hiring processes as well as relatively low costs (Knop, Durward, & Blohm, 2017). Moreover, the empirical results of Nguyen-Dinh et al. (2013) showed that the final annotation set generated by AMT is of comparable quality of the annotation of experts with high accuracy (76% to 92%). Generating tags using crowd-sourcing can increase the level of active engagement of users, and it allows users to reflect their real views through input of tags to further increase user experience and satisfaction level to some extent (Carletti, Giannachi, Price, McAULEY, & Benford, 2013).

Overall, the more tags an item has, the more features of the item that can be captured and displayed to users. Accordingly, the more user preferences that can be uncovered, expressed and matched correspondingly, the more accurate the recommended results may be expected to be. Thus, in order to generate more tags faster and at lower cost, crowd-sourcing is utilised.

2.5 Shortcomings of Content-Based Recommendation Systems

Insufficient information in item features will lead to less accurate results (Najafi & Salam, 2016). For many movie sales platforms, especially small websites, they do not have enough capacity to generate many tags to cover all features in movies. In most cases, they only create tags for main themes of movies, and many sub-themes will be ignored. For example, in Figure 1, the film genres of Movie 1 are "Love" and "Romance", and Movie 3 contains the same genres. The relevance of the items are then established based on the similarity, and Movie 3 is then recommended to User A. However, case in point is that Movie 1 has traces of "Limerence" which is a form of love, while Movie 3 contains "Cheating" plot, even if their plots in actuality account for only a few minutes of footage. But since both these features are not generated as sub-themes and enlisted there, if User A likes the former more than the later, a recommendation of Movie 3 to User A may not be a successful exercise itself because of insufficient film features related data.

One of the main issues that online recruitment of taggers brings up is that these workers are not specifically trained for tagging, and we cannot control the quality. Therefore, the quality of their output may not be as high as we have expected (Nguyen-Dinh et al., 2013; Hsueh, Melville, & Sindhvani, 2009).

2.6 Research Gap in Architecture

AMT is a useful tool for tagging items based on a crowd-sourcing technique. Nguyen-Dinh et al. (2013) conducted experiments of tagging human activities in videos by using AMT with high accuracy of tags (76% to 92%). It showed the effectiveness and feasibility of generating tags in videos by crowd-sourcing. Thus, it is possible to use crowd-sourcing to tag movies and generate more social tags to enrich movie features (e.g., film genres and plot keywords) to increase the accuracy of recommended results. Hsueh, Melville and Sindhvani (2009) introduced three selection criteria for determining high-quality annotations: 1) the noise level of a group of annotators, 2) the inherent ambiguity of an example's class label, and 3) the informativeness of an example to the current classification model. They found that the quality of tags can be improved through eliminating ambiguous examples and noisy annotators. Nguyen-Dinh et al. (2013) proposed two strategies – 1) individual filtering and 2) collaborative filtering – to detect and remove non-serious taggers to increase the accuracy of activity annotation in videos. However, few articles discussed criteria models for examining and evaluating the quality of those selected tags, which passed the selection step. This is a research gap, and in this paper we develop a criteria model for this purpose.

DESIGN RESEARCH METHOD

The research method adopted in this paper follows the five iterative stages of design thinking to generate solutions for improving the user experience (see Figure 2). Generating solutions and model validation are significant steps in design research (Peppers et al., 2008). It checks if the design artefact is acceptable and useful for addressing the problems being addressed (Macal 2005). In design research, relevance is a key aspect of solution validation (Checkland, 1995). It can be learned through observing and analysing stakeholders' views and actions in the context of a task and system. Such content analysis of discussions can be assumed as a reflection of issues in the real world and the values of stakeholders (Hanafizadeh & Mehrabioun, 2018). By drawing from the guidelines of design research, where experts and novices are sought for their comments and insights, we conducted such design interviews with users and developers in order to iteratively improve our understanding of effective recommendation systems. For the purpose of this research study, online movie platforms were chosen as a convenient yet rich context for the design interviews.

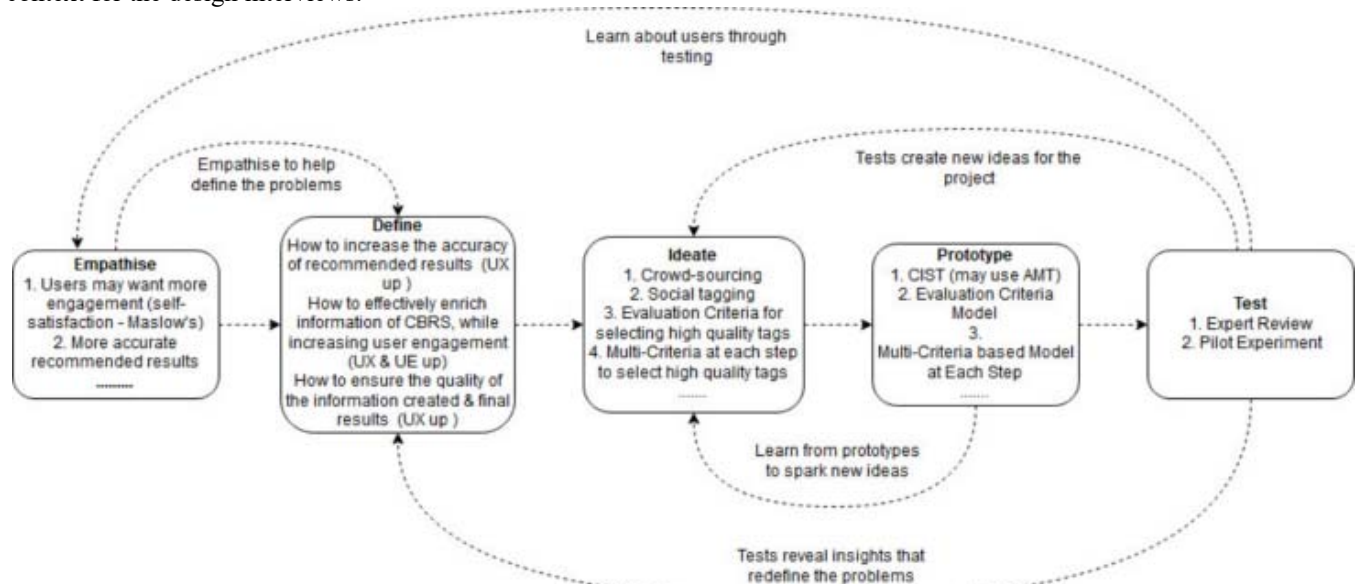


Figure 2: Stages of Design Thinking (Adopted from Dam & Siang, 2017)

3.1 Design Interviews with Developers

In order to obtain design feedback from experts to improve our CIST architecture, we conducted 60-90 minute, individual interviews with five developers having relevant knowledge and experience with in developing applications for 3 years or greater. We applied design thinking to generate a solution for examining and evaluating tags created by the crowd to improve the accuracy of the recommendation. We previously noted that few researchers discuss systematic models for evaluating the quality of tags.

Step 1 was to gain an empathic understanding of the problem that needs to be solved. We adopted a role-playing scenario where we advocated a user-perspective in our design questions. Our context was that of online platforms which depend on content-based movie recommendation systems. From a customer's point of view, we derived sixteen examination and evaluation criteria that will possibly have an influence on the quality of tags based on our experience. Developers who were interviewed helped us validate and improve our criteria, and they are asked to complete a form and tick the criteria that would influence the quality of tags. In addition, they could list any new criteria that they come up with.

Step 2 involved a definition of key vocabulary and this was corroborated with the developers.

The over-arching focus of the design interview was the question "How might we use these criteria to examine and evaluate the quality of tags for online movie sales platforms in order to get accepted tags with high quality and further increase end-users'

experience." The objective of interviews was next (as Step 3) to ideate as many as possible solutions to resolve any human-centered problems based on the comments of respondents (Conrath & Sharma, 1993).

Table 1: Assessment and evaluation criteria

Criteria of Quality for Tags	Criteria of Quality for User Accounts	Quality for Examining Mechanism
1. Relevant: Tags must be relevant to the contents of items.	1. Last Active: Last Login Time.	1. The Frequency of the Examining Mechanism Version Update: Update frequency about the rules/version of Tagging-related knowledge of Examining Mechanism. Version, which contain rules, must keep up with the development of state-of-the-art technology.
2. Searchable: Tags can be recognized by search engines and can be used to search relevant items.	2. Credibility of Accounts: The level of trustworthiness rated by other users about all activities of one account.	2. Quality of Examiners: The knowledge level of tag examiners.
3. Reusable: Tags for one item can be reused for other items.	3. Total Cumulative Posts: The total number of post generated by one account.	3. Quality of Examining Technology: The performance level of back-end examining technology for tags.
4. Valid: Tags must have a sound basis in logic or fact; reasonable or cogent.	4. Rating for Posts: The level of usefulness and helpfulness rated by other users about all review posts generated by one account.	4. Degree of Implementation of Relevant Laws and Rules: Tags must comply with local laws and regulations.
5. Meaningful: Tags must have meanings.	5. Degree of Completion for User Information: The level of completion of the account information filled in by the owner of the account.	
6. Extensible: Tags can be given or added new meanings.		
7. Stable: The meaning of tags must be consistent within a certain period of time.		

3.2 Design Interviews with Users

In order to complete the comprehensive view of recommendation systems, feedback from end-users were also obtained from design interviews. Ten users, including five lead users and five novice users participated in hour-long, individual sessions. Design thinking theorizes that users with different levels of usage experience with recommendation systems and tags may have different views on social tagging and hence we divided users into lead and novice users. We define lead users as those who have experience in using online movie sales platforms in excess of 2 years and novice users as those who do not.

The design interviews proceeded as follows. First, all participants were required to complete a task in one scenario to help them to understand the application of tags in recommendation systems and its benefits to users. Because CIST currently is only a conceptual idea and has not been implemented in any online movie platform, we allowed the participants to use Tumblr and Amazon.com to experience the idea of tagging. On Tumblr, one instance of CIST, almost every picture is tagged, and the website can recommend relevant blogs and searches based on users' history about tags that are frequently searched or viewed. In addition, if a given user follows a particular blog, then other blogs will be recommended based on the similarity of tags and the number of similar tags used among those blogs. Participants were required to browse and search any tags and pictures that they liked. They could then check if Tumblr recommended blogs and searches that they also liked. Amazon.com, as a traditional e-commerce website, does not use tags to recommend items. Participants were required to browse and search items that they liked. They could later check the recommended results provided by Amazon. After the exercise, the interviewed "users" were given time to compare the recommended results provided by two websites, in terms of accuracy, user experience and trustworthiness.

3.3 Design Statements & Interview Questions

The box below is a shortened version of design interview template for developers (4 statements, 9 questions) and users (3 statements, 6 questions) respectively.

<p>Design Statement 1: <i>IT developers think that the current functionality of recommendation systems can improve online shopping.</i></p> <p>Question 1: Someone said that recommended results on online shopping websites can help them to find the products that they like to buy quickly, do you agree with this statement? Please provide some comments.</p> <p>Question 2: Are the products recommended by the recommendation system what you really want to buy most of the time? In other words, how do you think about the accuracy of recommendation systems currently?</p>
<p>Design Statement 2: <i>IT developers think that tags can improve the functionality of recommendation systems and further motivate online purchase.</i></p> <p>Question 3: Since tags can present information for online contents, how do you think about using tags to enrich item profile to further make recommendation results more accurate?</p>
<p>Design Statement 3: <i>IT developers think that it is feasible to allow users to generate tags for items online.</i></p> <p>Question 4: Have you contributed tags as a user? Do you agree with the statement that user-generated contents can lead to accuracy/trust for other users?</p> <p>Question 5: Would you like to contribute tags yourself? If yes, what motivates you to do this? If no, why?</p> <p>Question 6: What are the main advantage and disadvantage of user-generated tags, compared with developer-generated tags? Please list one separately.</p>
<p>Design Statement 4: <i>IT developers think that the functionality of recommendation system can be improved by applying tags generated by users and an Accepted Tag Model, which is to ensure the quality of tags.</i></p> <p>Question 7: Do you agree that more tags generated by more users for a product can help to enrich item profile and discover latent needs of other customers? Please provide some comments.</p> <p>Question 8: Do you think that the quality of tags can be improved by applying an accepted tags model, which will contain criteria listed on Table 1?</p> <p>Question 9: Overall, do you think that the accuracy, user experience and trustworthiness for recommendation system can be improved by adding high-quality tags to describe items?</p>
<p>Design Statement 1: <i>Lead users are more satisfied with the current functionality of recommendation systems, in terms of accuracy, trustworthiness and user experience.</i></p> <p>Question 1: Someone said that recommended results on online shopping websites can help them to find the products that they like to buy quickly, do you agree with this statement? Please provide some comments.</p> <p>Question 2: How does recommendation system change or affect your purchasing process? Please provide some comments in terms of trustworthiness and user experience.</p> <p>Question 3: Do you feel satisfied with the accuracy of recommended results based on your purchase? Please provide reasons.</p>
<p>Design Statement 2: <i>Lead users are more likely to contribute to creating tags for online products, and they are more satisfied with the impact of using more tags for describing items on the improvement of the accuracy of content-based recommended system.</i></p> <p>Question 4: Would you like to add your own tags as feedback for online movie products that you purchased or watched? If yes, what motivates you to do this? If no, please provide reasons.</p> <p>Question 5: "The more tags about a product, the more you know about it" - do you agree with this statement? Please provide some comments.</p>
<p>Design Statement 3: <i>Novice users are more concerned about the use of social tagging based recommendation systems and crowd-sourcing based tags.</i></p> <p>Question 6: Among security, ease of use, accuracy and/or trustworthiness, what is your biggest concern about recommendation systems and /or user-generated contents (e.g. tags)?</p>

ANALYSIS OF DESIGN STATEMENTS

4.1 Consolidation of Feedback

The purpose of the interviews for IT developer group is to help to refine CIST. IT developers, who have relevant knowledge and experience, are more likely to provide reliable and professional feedback. The user group, comprising lead and novice users, is mainly used to measure the satisfaction level of CIST from a user's perspective. Any concerns raised by participants are an important reference for us to improve CIST. Seven key findings synthesized from our design interviews are summarized as follows: 1) The current functionality of recommendation systems can improve online shopping. 2) Tags can improve the functionality of recommendation systems and further motivate online purchase. 3) It is feasible to adopt user-generated tags for describing online products. 3) The current functionality of content-based recommendation system can be improved by adding high-quality tags screened out by an Accepted Tag Model. 4) Lead users are more satisfied with the current functionality of recommendation systems, in terms of accuracy, trustworthiness and user experience. 5) Both lead and novice users think that recommendation systems can positively affect their purchasing process. 6) Both lead and novice users are likely to contribute tags for online products, but lead users are more satisfied with the potential impact of using more tags for describing items on the improvement of the accuracy of content-based recommended system. 7) Lead users are more concerned about the use of social tagging based recommendation systems and crowd-sourcing based tags than novice users. The above findings guide design guidelines for CIST described in the Section 4.2.

4.2 Design Guidelines for Accepted Tag Model and CIST

4.2.1 Accepted Tag Model

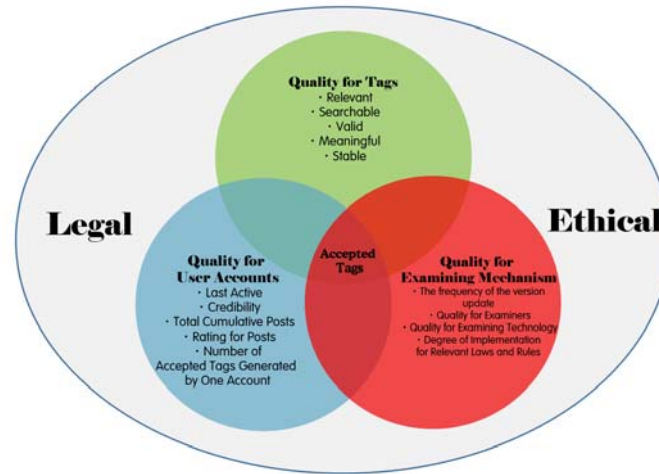


Figure 3. Accepted Tag Model

Figure 3 illustrates the key design concepts associated with Accepted Tag Models. For CIST, user-generated tag is the main source for recommending items. However, from the feedback of our participants, we determined that most are concerned about the quality of user-generated tags. Meanwhile, generating too many tags, especially irrelevant tags, under products will confuse users because of information overload. In order to improve the quality of tags as well as cut down the number of tags, especially the number of low-quality tags, we propose an accepted tag model. Only when tags meet most of the criteria outlined in Table 1 can they be considered as high-quality tags. However, since the capacity of database and software processing may be limited, and we may not accept and process all tags created by all users, we should have criteria in the blue sphere to cut down the number of tags through setting the threshold for user accounts. Therefore, only high-quality tags created by high-quality user accounts will potentially be accepted. In spite of this, whether tags are finally accepted or not depending largely on the quality of examining mechanism. Only when the version of mechanism is up-to-date, it can learn to recognize latest tags. For example, if you tag #8KUHD for a movie before 2015, it may not be accepted, because at that time there is no 8K UHD movie at all. However, if you tag #8KUHD five years later for a real 8K UHD movie, but the version of examining mechanism is not up-to-date, the tag may still not be accepted. This is not the fault of that tag, but the fault of the outdated examining mechanism. In order to make this model effective all the time and not miss any high-quality tags, the version of mechanism should be updated frequently to be up-to-date. Quality of examiners and examining technology decide whether high-quality tags can be finally accepted by websites as well. Knowledgeable examiners and advanced AI examining technology are more likely to capture any potential high-quality tags. Finally, examining mechanism should always ensure compliance with relevant laws and rules to evaluate and examine tags, in order to make sure that all high-quality tags generated by high-quality users are also legal and ethical. Developers said that it is feasible to use current technology to implement such a model for real movie sales websites. Therefore, this approach can be treated as a solution for controlling the quality of tags and avoiding information overload caused by too many tags.

4.2.2 CIST Schema

The Accepted Tag Model can be seen as one part of CIST. The main purpose of the model is to improve the quality of tags to further provide a high-quality source for accurate recommendations. With the benefit of design input obtained in the manner described in Section 3, the modified schema of CIST is shown in Figure 3.

To simplify the use-case, we label item profile to represent a movie and label user A as an example. The issue of insufficient information in item profile now can be resolved by using user-generated high-quality tags to enrich item profiles. Previously, many movie sales platforms, do not have enough capacity to generate many tags to cover all features in movies. In most cases, they only create tags for main themes of movies, and many sub-themes are ignored. In Figure 4, the item profile 1 and 3 have limited numbers of features, for example, only "Love" and "Romance" as main themes are generated there. However, if Movie 1 contains "Limerence", and Movie 3 contains "Cheating", but both features as sub-themes are not generated and listed there, it may not be a good fit to recommend Movie 3 to User A, whose preference does not contain "Cheating", according to his viewing and purchasing history.

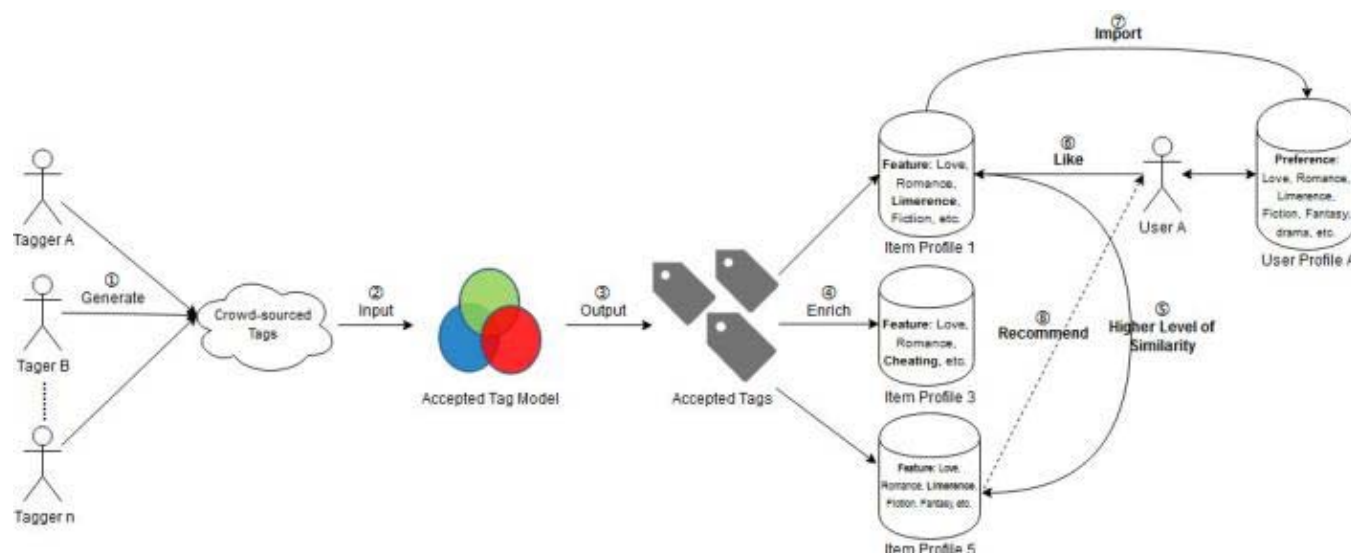


Figure 4. Modified CIST Schema

Since we use user-generated high-quality tags to enrich item profiles, item profiles can include more tags. Even sub-themes, which only account for a few minutes in one movie, can be covered and described by tags. We can then find that actually item profile 1 and 5 have higher levels of similarity, and item profile 5 is closer to User A's preference, which is accumulated from past history. Therefore, recommending Movie 5 to User A will be a better choice, after we have enriched item profiles. The number of tags expected to be generated for each movie may vary from movie to movie, but we expect that the estimated number should be three times of the current number or more.

4.2 Validating the Design Process

In order to validate our design statements, we cross checked the sentiment expressed by developers and users against each design statement. We used IBM Watson's natural language understanding tool (www.ibm.com/watson/services/natural-language-understanding/) to conduct sentiment analysis to understand participants' attitudes towards each of the design statements discussed with them. Note that the sentiment score calculated by IBM Watson only reflects the sentiment level of text (which were transcribed from voice recordings of the design interviews), and it can be positive or negative. The scores for design statements (except Design Statement 3 for users) are shown in Figure 5 for all three groups. Higher scores reflect greater concordance or positivity towards a design statement.

User Type \ Design Statement	D1	D2	D3	D4
IT Developer	1.91	0.7	1.22	3.3
User Type \ Design Statement	D1	D2		
Lead User	1.93	0.68		
Novice User	1.31	0.15		

Figure 5. Output from IBM Watson Natural Language Sentiment Analyzer

On the one hand there was consistency in terms of positive inclination towards machine generated recommendations. Yet there were subtle differences in the perspectives of novice or lead users on the one hand and developers on the other.

PRACTICAL IMPLICATIONS AND CONCLUDING REMARKS

In Section 4, some key findings showed that different stakeholder groups have different attitudes towards recommendation systems or tags. Meanwhile, many concerns about CIST were raised by participants. In this concluding section, we will analyze possible reasons why the attitudes of some users are not as positive as the rest and come up with three main suggestions for increasing lower satisfaction level and mitigating their concerns.

5.1. Accepted Tag Model

As mentioned previously, the two major disadvantages are the lack of control over the quality of tags and information overload due to too many tags. In order to resolve them, we have introduced an Accepted Tag Model in Section 4.4.1. Each of three spheres has its own function. When user-generated tags pass all criteria in the green sphere, we can get high-quality tags. The criteria in the blue sphere limit the number of users who can generate tags and further cut down the number of tags. These two spheres ensure that all high-quality tags are generated by high-quality users. The red sphere contains some limiting factors of examining mechanism, which may or may not further reduce the number of high-quality tags. Although we do not expect any further reduction in the number of high-quality tags, we still need to consider any possible factors, which may lead to this result, for the mechanism. Finally, we can get accepted tags with high quality and not an excessive quantity.

5.1.1 Justifying CIST Results and Tagging Function

From the design research, it was found that the satisfaction level of novice users for recommendation systems is lower than that of other two groups, and we assume that the situation is due to novice user's lack of basic knowledge about how recommendation systems work. In order to allow users to understand how CIST works, we can place a conspicuous question mark icon at the top right of the recommended results area. When users click on that icon, a dialog box, which shows the reasons why these items are recommended, will pop up. A pie chart, which contains tags that users frequently search or are included in the products which users frequently buy, can also be shown in that dialog box. The more frequently a tag interacts with a user, the larger percentage the tag will take in the pie chart. All data in the pie chart are based on big data statistics of users' history. Through showing the explanation for recommended items, users will know how CIST works and understand that all recommendations are based only on their own history and are not interfered by producers of items. In addition, to make tagging function easy to use, a step-by-step instruction is employed to guide users to tag. The instruction will tell users what they should do next when users start to tag.

5.1.2 Concise and Marked Way of Displaying Tags in the Front-end Interface

User-generated tags are not only used to recommend items, but also provide simple descriptions of items. However, if we randomly put many tags on one movie's information page, users might still feel confused about which tags can best describe the movie, and it will make users' attitudes for tags more negative. In order to avoid this problem, we can allow users to "+1" or "-1" tags. When users put their mouse cursors on existing tags, a dialog box, which contains "+1" or "-1", will appear. When users think that some tags can reflect the main theme of the movie, they may "+1" those tags, otherwise, "-1". When a tag receives a certain number of "+1" (for example, 100 "+1"), the font size of that tag will become bigger (Up to three times bigger). Hence, even when users see many tags under one film, they can quickly know what the film is mainly about. Meanwhile, only six tags with the most "+1" will be shown directly in the front-end interface, while the remaining tags can only be shown when users click on "See More" at the end of all six tags (see Figure 6.).

Film Features:

Plot Keywords: **game** | augmented reality | deep learning | artificial intelligence | memory | death | See More »

Genres: **Animation** | Action | Adventure | Fantasy | Sci-Fi | Love | See More »

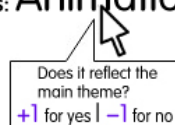


Figure 6. An Example of How to Display Tags

Taking into account information amount limit, the number of tags shown on one web page may be under fifty after users click on "See More", and other tags will be stored in the back-end database for recommendation purpose only.

In this paper, Collective Intelligence Social Tagging (CIST) is proposed as a recommendation approach for online movie sales platforms. In order to test the feasibility and user-acceptance level for CIST, design thinking was used to illicit attitudes on two major parts of CIST: the recommendation and user-generated tagging. Although developers and lead users' overall attitudes towards CIST were positive, there are still some concerns raised by novice users. The design contribution of this research are three suggestions to improve CIST: 1) Adopting Accepted Tag Model; 2) Adding necessary explanation for recommended results and tagging function; 3) Applying concise and marked ways of displaying tags in the front-end interface.

One main open issue we could not effectively resolve was regarding the security and privacy concerns of users about CIST. Although every e-commerce website has clear agreements containing privacy and security terms, it does not completely eliminate user fears of violations. For instance, it is well known that IP addresses may still leak users' private information related to their purchasing and tagging preferences. Hence, finding effective solutions and improvements for CIST to avoid invasions of privacy through IP addresses is a necessary design feature for CIST.

Our future work includes constructing a practical prototype of CIST and using larger groups of developers and users in order to test user experience and system performance. In addition, solutions for resolving security and privacy concerns about CIST may be investigated.

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Detection of Gray Hole Attack in Software Defined Networks

(Full Paper)

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ABSTRACT

Gray Hole Attack is an advanced transformation of black hole attack. Both of them are a common type of attack in Wireless Sensor Network (WSN). Malicious nodes may constantly or randomly drop packets and therefore reduce the efficiency of the networking system. Furthermore Software Define Network (SDN) has been highly developed in recent years. In this type of networks switch/router functionality is separated into the control plane and data plane. Network managers can select control policies and build operating rules according to their own preferences. In addition, network protocols and packet fields are also programmable. Because the switch/router only implements the data transmission and executes the switching/routing decisions based on commands coming from control plane. Compromised switches/routers themselves or malicious control instructions both can result in selectively dropped packets. This makes a gray hole attack possible in the infrastructure of SDN. Therefore, this paper would like to discuss time-base and random-base gray hole attack in SDN, and then propose a useful detection method based on weighted K-Nearest Neighbor (KNN) and Genetic Algorithm (GA). The simulation data collected from switches/routers indicate that our method does demonstrate pretty good performance.

Keywords: Gray hole attack, SDN, weighted KNN, GA, detection method.

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INTRODUCTION

Software Define Network (SDN) decouples the control function from traditional data forwarding devices. The switches/routers become simpler because they separate the control unit and functionality to controller. The controller can easily manage the network resource and traffic by sending the instruction to the switches/routers (data plane). The switches/routers can only focus on the packets transmission. The switches/routers typically ask the controller to obtain flow rules when the data plane receives new packets. The flow rules are stored in the Flow Table. Hence every decision and calculation are made by the controller. The centralized architecture can make it easier for the network manager to collect network information and implement the policies. Due to the fast growth of SDN, nowadays, it faces many types of threats. Mostly the purpose of these attacks may crash the network or reduce the network efficiency. Gray Hole Attack, also named selective forwarding attack, is one of the common attacks identified in the wireless networks, including mobile ad hoc network (MANET), WSN, etc. It is a variation of Black Hole Attack which has some compromised switches/routers swallow all of the received packets (Shanmuganathan & Anand, 2012). Gray Hole Attack is more difficult to detect due to its unpredictable behavior changing between the normal device and the black hole. Many prior research results regarding Gray Hole Attack focused on wireless networks. However, we believe it may also cause huge losses if initiated in SDN.

Machine learning algorithms have been very popularly used in recent years. The application of big data analytics to mitigate security attack problem has become more and more attractive (Cui et al., 2016). Because of the rapid growth of calculation capacity, modern computers or server farm can handle a lot more calculation jobs than ever before. As a consequence, the separation of data plane and control plane becomes more feasible for controller to collect huge data and then implement the switching/routing decision making and execute the machine learning algorithms to detect malicious attack as well.

In this paper, we study the Gray Hole Attack in SDN and then design an intelligent method to detect it. This method including three phases combines the weighted KNN and GA to recognize the abnormal switched/routers. The simulation results support the effectiveness and efficiency of our method.

LITERATURE REVIEW

Review of Software Defined Network

McKeown et al. (2008) had proposed the first concept of Software Define Network, the OpenFlow. OpenFlow switch consists of three parts: (1) Flow Table, (2) Secure Channel, (3) OpenFlow Protocol. The Flow Table is composed of many flow entries to inform the switch how to process the flow. The Secure Channel connects the switch to the controller. It allows transmitting instruction and packets between switch and controller. OpenFlow Protocol provides a standard for controller to communication with switches.

Flow Table plays an important role in OpenFlow switch. It manages the packets transmissions. When the switch receives a packet, it checks the flow table first. If the packet header matches the rule in the table, the switch will do the action as indicated in the rule. If the packet header doesn't match any rules in the tables (called table miss), the switch will check table-miss table. The actions in table-miss table include (1) send the packet to the controller (called packet-in), (2) forward to all interface, (3) drop the packet. After receiving the packet-in packet, the controller checks the network topology and add new rule about the packet

in the switch. Next time the switch receives a packet with the same destination header, it will know how to handle this packet. Actually there are three parts in the Flow Table, i.e. packet header, action, and counter.

Gray Hole Attack

The gray hole attack is an extension of black hole attack in which a malicious node's behavior is exceptionally unpredictable (Jhaveri et al., 2012). It typically can be categorized into three types (Jhaveri et al., 2010). The first one is that a node may behave like black hole in a short time, but later on it acts like a normal node in the network. We call this type 'Gray hole attack'. It changes its status based on some situation and the drops the receiving packets accordingly. The time-based gray hole is that a node changes its status in regular period. For example, acts like a normal node in the first five seconds, and acts like a black hole node in the next five seconds and so on. The random-based gray hole is that it changes its status for no reason, usually by probability. For condition-based gray hole, it changes its status if some specific conditions happen. For example, the network speed reaches a specified value and then the switching node starts to drop packets. In the second type, a malicious node may drop packets in fixed percentage or drop packets of a specified data flow and forward all other packets. We call it selective forwarding attack (Bysani & Turuk, 2011). For this type, we classify them by defining how they drop packets, i.e. they drop 70% of all the received packets or 50% of flow 2 in queue. The third type is the hybrid of the previous two types and we can also name it as the selective forwarding gray hole. In this way, a malicious switch/router may drop packets randomly in the gray hole period.

We may consider that the gray hole is a kind of passive attack in general. It does not completely interrupt the normal operation of the network (Wazid et al., 2011). However, the black hole could be an active attack. The black hole attracts the flow by modifying the routing table. Although the gray hole attack is an extension of the black hole attack and it only drops packets without attracting the data flow, the gray hole attack is more difficult to detect than the black hole attack. That is because the malicious black hole switch /router drops the received packets with certainty (Hongmei et al., 2002).

Gray Hole Attack in SDN

Dhawan et al. (2015) proposed SPHINX: Detecting Security Attacks in Software-Define Networks. They presented a detect system to defend several attacks in Software Define Network. One of these attacks is that there may be a black hole switch in the data plane. A malicious switch in the flow may drop or siphon off packets. They implemented it by the 'action' attribute of the OpenFlow. The 'action' of drop can make the switch drops specified packets. When it drops all packets from the in-port, a black hole switch occurs. Since the black hole switch may exist in the Software Define Network, the gray hole switch also may exist in the Software Define Network because a gray hole is the variation of black hole.

PROPOSED DESIGN

Our method is inspired by those results published by Sen et al. (2007). They proposed an operating architecture to detect the gray hole attack and the cooperative black hole attack in the Wireless Sensor Network. The detection approach is divided into three phases, i.e. anomaly detection phase, gray hole attack test and confirmation phase, and warming phase. The traffic monitor of SDN collects the traffic data and flow parameters of each switch/router constantly. After collecting these data and parameters, the controller uses the weighted KNN with GA to classify whether each switch/router is abnormal or not and then builds the suspicious list for the further test and confirmation in the next phase. In order to achieve the higher accuracy of detection, we should retest all the switches/routers in the suspicious list until we believe that their statuses are confirmed as clear or guilty. In this architecture, we may send test packets to go through some switches/routers in the suspicious list non-periodically. If the evidence is strong enough, the system will alert the manager and controller that which one should be a gray hole switch/router in the network.

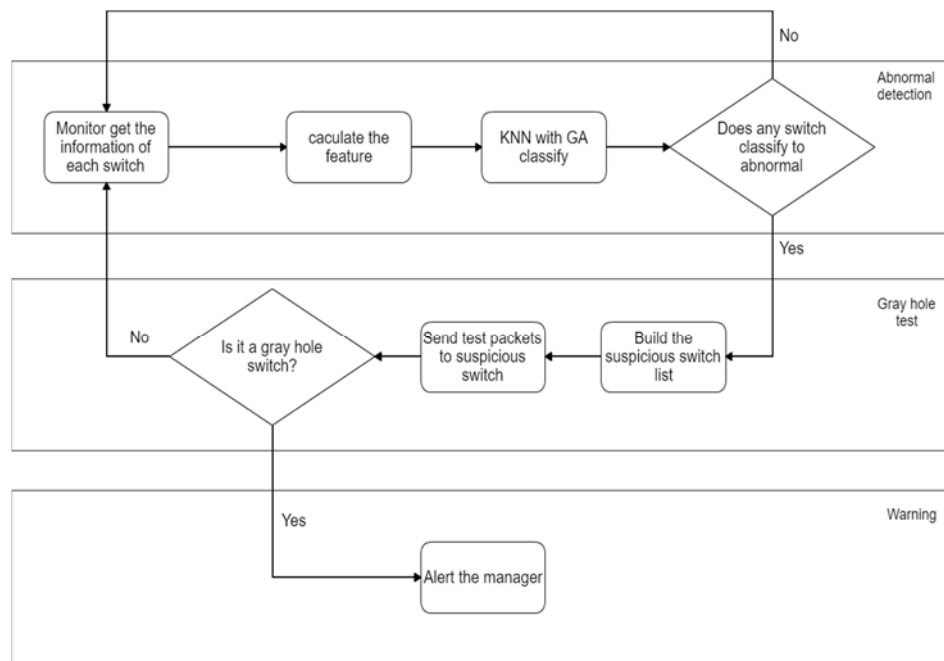


Fig. 1. Three phases of gray hole detection

In the abnormal detection stage, the monitor evaluates each switch/router using weighted KNN with GA in which the weights of features of KNN are calculated according to GA since it is very difficult to decide which attribute is more important than the other in various situations and what number should be assigned as weight. Fig. 2 demonstrates the flow char of Genetic Algorithm that generates the weight set.

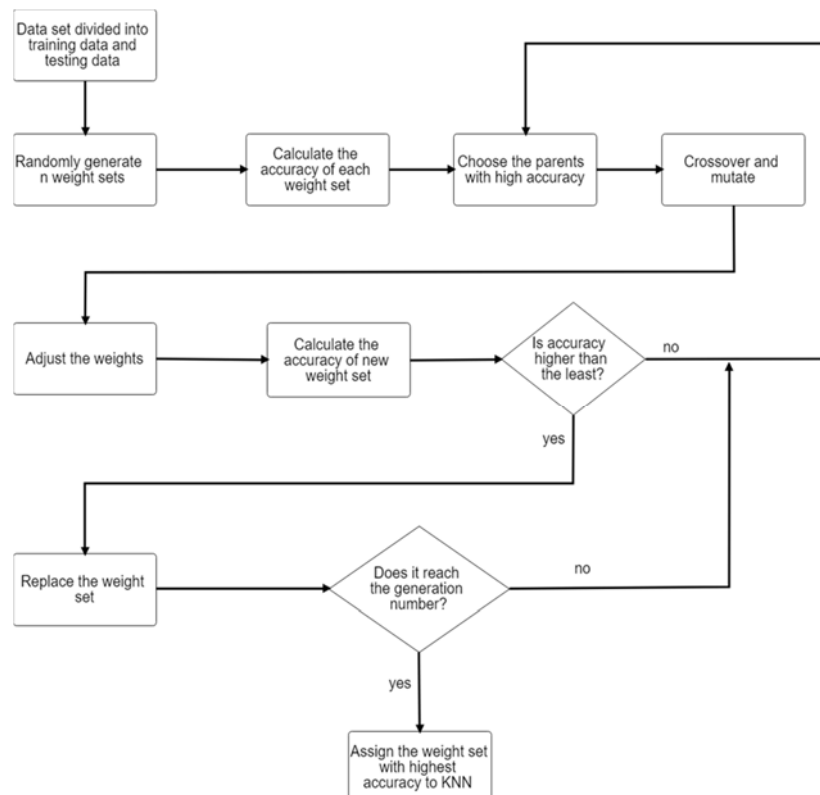


Fig. 2. Flow chart of Genetic Algorithm to generate the weight set

Anomaly Detection Phase

A gray hole drops the packet, and therefore decreases the networking efficiency (Tseng et al., 2011). In the anomaly detection phase, the SDN network monitor collects the detailed network information continuously. The monitor calculates the features of each switch/router, and these data will be used by the weighted K-Nearest Neighbor algorithm to classify them. If any switch/router is classified as the gray hole, the monitor should add it into the suspicious list for the next phase to implement the further test. The features we use in weighted KNN are listed in Table 1.

Table 1. Features in weighted KNN

Features	Description
<i>pkt_rx</i>	The number of packet received in the period
<i>pkt_tx</i>	The number of packet transferred in the period
<i>speed</i>	Bits transferred per second
<i>change of speed</i>	The difference of speeds
<i>packet dropped</i>	The number of packet dropped in the period

We choose weighted KNN features based on the transmission behavior of switch/router. The *pkt_rx* and *pkt_tx* are collected from the monitor module. The *speed* is calculated from *tx_byte* which is also collected from the monitor. The *change of speed* is calculated from the *speed* parameters. When the gray hole switch drops the packets, the *speed* of gray hole switch must drop to a low level. This should make the *change of speed* higher than a normal value. The *packet dropped* shows the number of packets dropped in some period. When there is a gray hole switch within the network, the *packet dropped* must be higher than a normal one. In the K-nearest neighbor algorithm, it usually calculates the distance and classifies items by using brute force concept. When the number of data and items we want to classify grows, it must do lots of calculation. Furthermore, the dimension of the features also affects the time complexity. Since the time complexity of K-nearest neighbor classification is $O(D*n)$, where D is the dimension of feature and n is the number of data in data set, it is very hard to classify all the switches in a short period. To solve this problem, we use the ball tree data structure (Liu et al., 2006). The ball tree is a binary search tree. Every node defines a D -dimensional hypersphere. The concept is to encode the aggregate distance of the sample to reduce number of the calculation. The time complexity of ball tree in K-nearest neighbor is $O(D*\log n)$. Constructing the ball tree costs most of resource in CPU, but it is quite efficient to classify the dataset. With this data structure, we can construct the ball tree in the initial phase and the classification work can be done in time.

Gray Hole Attack Test and Confirmation Phase and Warming Phase

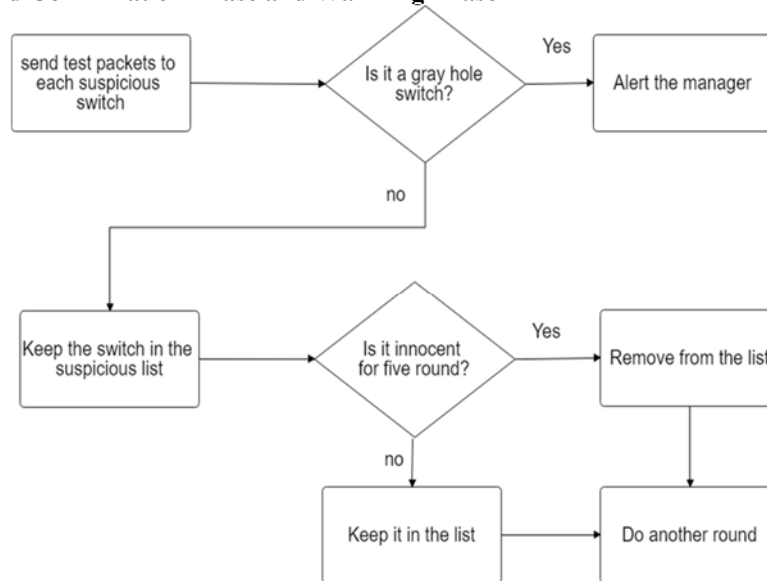


Fig. 3. Flow chart of test and confirmation phase and warming phase

In the test and confirmation phase as shown in Fig. 3, the controller non-periodically sends test packets to go through suspicious switches/routers recorded in the suspicious list. These packets are filled with specific header. When one destination receives the packet, it sends back to controller immediately. If the controller doesn't receive the packet, then that switch/router may be gray hole with high probability. One switch/router will be identified as a gray hole after n consecutive losses of packets. If the controller receives all of n testing packets, then that switch/router should be released from the suspicious list. If not both, the monitor keeps the switches/routers in the suspicious list and waits for the results of next round test. Once a gray hole switch/router is detected, the controller alerts all the network by flooding this warming message as indicated in Fig. 3.

SIMULATION RESULTS AND DISCUSSION

Simulation Tools

● Mininet

Mininet (Oliveira et al., 2014; Mininet, 2018) is a network simulator. It runs hosts, switches, routers and links in Linux kernel. All the machines in Mininet are just like the machines in the real world, i.e. using ssh in it and running the programs. Sending packets in Mininet is also very much like sending in the real Ethernet interface. The user can write a program to input the speed and delay. The packets will get processed in the steps which are run in real Ethernet switches. All the virtual hosts, switches, links and controller are like the real things but created by software rather than hardware. Most importantly, its behavior is similar

to hardware element in Ethernet. The user can create the necessary topologies, customized packet forwarding rules and the network application. Moreover, Mininet is widely used for simulating the Software Define Networks. Based on the above observation, we decide to use Mininet to create the network topology and simulate our proposed approach.

● Ryu controller

Ryu (Ryu controller, 2018) is one of the controllers used in the Software Define Network. The source code is available on the GitHub and is maintained by the open Ryu community in Japan. Ryu is a component-based SDN framework. It provides well-defined API for developers to create and manage the network easily. We decide to use Ryu controller in our simulation because it is written in Python, and we use scikit learn which is a famous machine learning library for Python, too.

● Scikit learn

Scikit learn (Scikit-learn, 2018) is a free software machine learning library for Python language. It contains many machine learning algorithms categorized as classification, regression, and clustering algorithms. It is designed to cooperate with the Python numerical and scientific libraries Numpy and Scipy. Every algorithm is designed in high efficiency, the time cost and memory cost are quite low. Since our monitor has to classify every switch/router in short period, it must finish the calculation of algorithms in time. That's why we use the KNN in scikit learn rather than create new one.

● D-ITG

D-ITG (Distributed internet traffic generator) is a traffic generator in internet (Botta et al., 2012; D-ITG, 2018). It supports many protocols, including TCP, UDP, ICMP, etc. It also supports both IPv4 and IPv6 traffic generation and it is capable to generate traffic on the network, transport, and application layers. Furthermore, the packet size and the distribution of generating traffic could be defined by the user. It makes the simulation environment closer to the real world situation. The distributions include uniform distribution, exponential distribution, normal distribution, Poisson distribution, and Pareto distribution. We use D-ITG to generate IPv4 traffic with UDP in our experiment.

Simulation Setup

● Topology

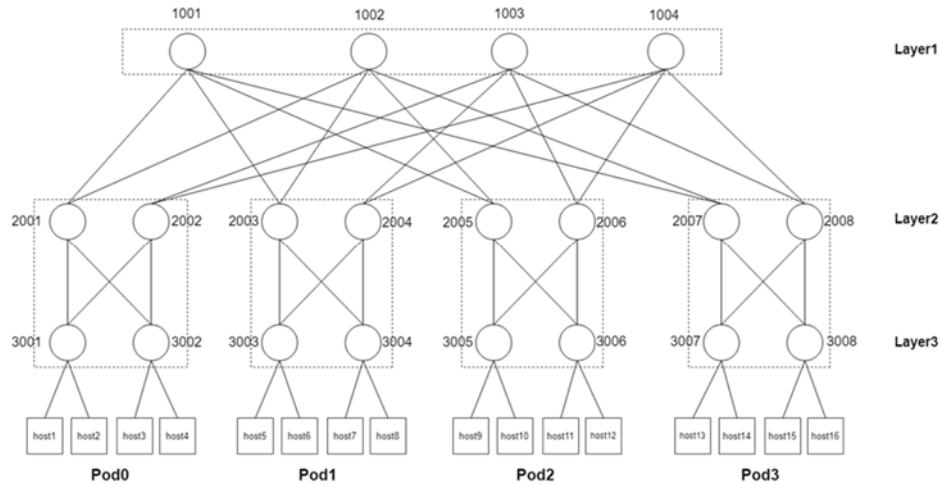


Fig. 4. Fat-tree topology

The fat-tree topology is a famous topology in Software Define Network. We choose this topology in our experiment because many studies use this topology to simulate their environments, too. Fat-tree topology is shown in Fig. 4. There are 20 switches and 16 hosts in the fat-tree topology. The 1001~1004 switches are the core switches based on definition and 2001~3008 are aggregation switches. Four switches compose a 'Pod', i.e. switch 2001, 2002, 3001 and 3002 compose Pod 0 as shown in Fig. 4. We define No. 1001~1004 switches as layer 1, No. 2001~2008 switches as layer 2 and No. 3001~3008 switches as layer 3. Each switch in layer 3 connects two hosts. We will discuss the detection rate and accuracy rate for gray hole switch in each layer.

● Traffic model

The concept of traffic model we used is commonly used in many experiments for Software Define Networks. Each host sends UDP packets to two hosts in every other Pods except its own Pod. The receiver is chosen randomly. Let's take the example in Fig. 4, host 1 may send six data flows to other six hosts, two in Pod 1, the other two in Pod 2, and the remaining two in Pod 3. Every host sends the data flow until the end of the experiment. D-ITG can generate packets based on many stochastic distributions. We use D-ITG to send UDP packets in normal distribution.

● Gray hole switch implementation

We use the attribute 'hard-timeout' in Flow Table to implement the gray hole switch in Software Define Network. The meaning of hard-timeout is that the flow rule will be eliminated after n seconds when this rule is created. We let the controller sends gray hole rule every m seconds and the hard-timeout of the rule is n . In this way, the gray hole switch drops packets for n seconds within every m period.

● The data set for KNN

We simulate the gray hole switch and then collect the data because there is no real data set available on Internet. In the simulation, we choose one switch as gray hole and run for 3 minutes. The monitor collects the features we need from each type of switch.

The simulation is run 60 times and each switch has been selected as the gray hole at least 2 times. We totally collect more than 150,000 sets of data for normal switches and gray hole switches. In the beginning of the experiment, we randomly choose 10000 data sets of normal switches and 10000 data sets of gray hole switches as the training data set for K-nearest neighbor.

● The K value

The K value for K-nearest neighbor is decided based on the accuracy rate of testing data. The initial data set contains 20000 data sets for each type of switches. The accuracy rate is the percentage of total testing data which are the same as the original ones. Each value are run 10 times and then we calculate the average accuracy rate. Finally we select K value with the highest accuracy rate. As shown in Fig. 5, 31 is the best K value for our experiment because the accuracy rate is nearly 75%.

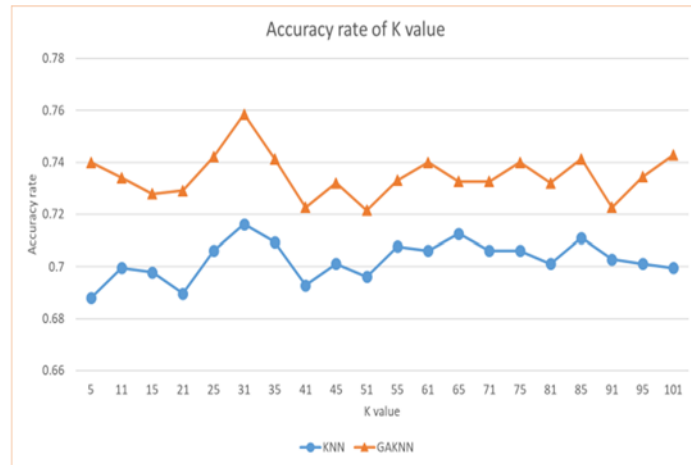


Fig. 5. Accuracy rate of K

Table 2. Experiment parameter

Emulation Parameter	Value
K value	31
Numbers of genes	20
Mutation rate	0.01
Generation number	30
Get topology period	20 sec
Initial time	90 sec
Detection time	180 sec
Total Emulation time	270 sec
Repeat times	Each layer for 100 times

Results of Time-based Gray Hole Attack

● Monitor period: 3 seconds

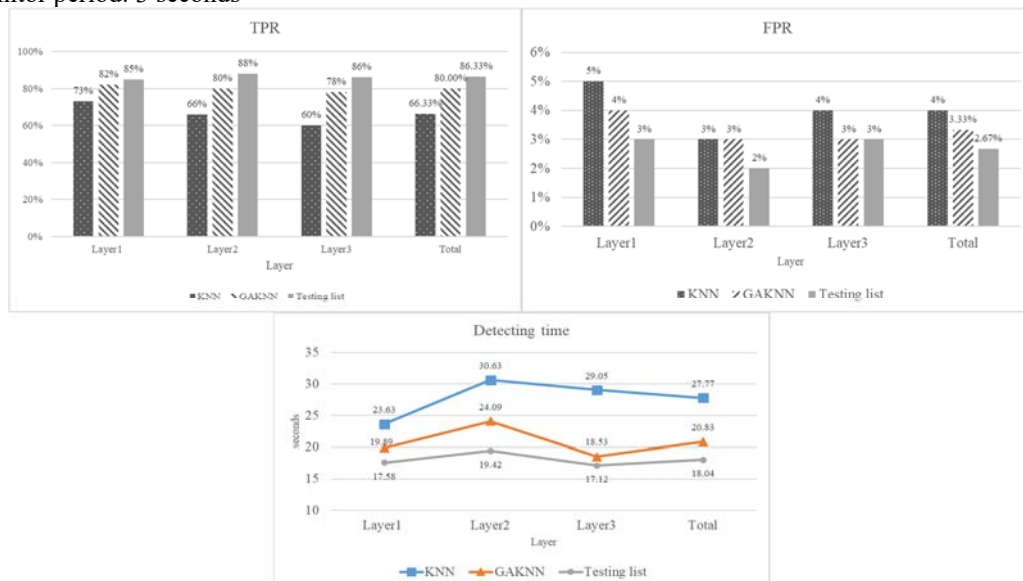


Fig. 6. Performance comparison for detection of time-based gray hole attack with shorter monitoring period

We can observe that our GAKNN (KNN with GA) outperforms the traditional KNN while detecting time-based gray hole attack with shorter monitoring period.

● Monitor period: 8 seconds

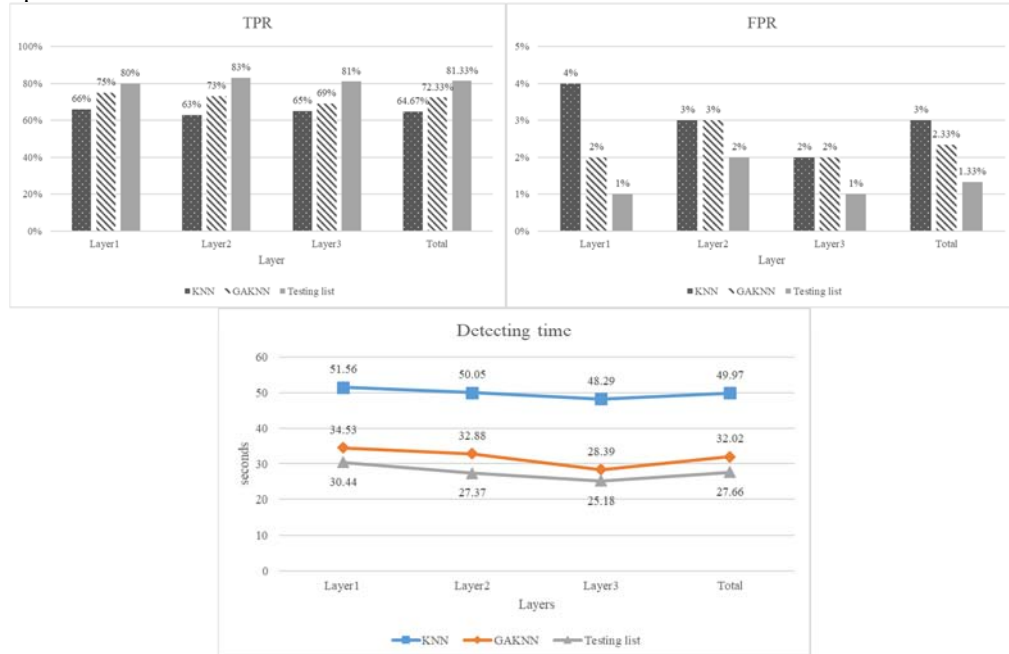


Fig. 7. Performance comparison for detection of time-based gray hole attack with longer monitoring period

We can observe that our GAKNN (KNN with GA) outperforms the traditional KNN while detecting time-based gray hole attack with longer monitoring period.

Results of Random-based Gray Hole Attack

● Monitor period: 3 seconds

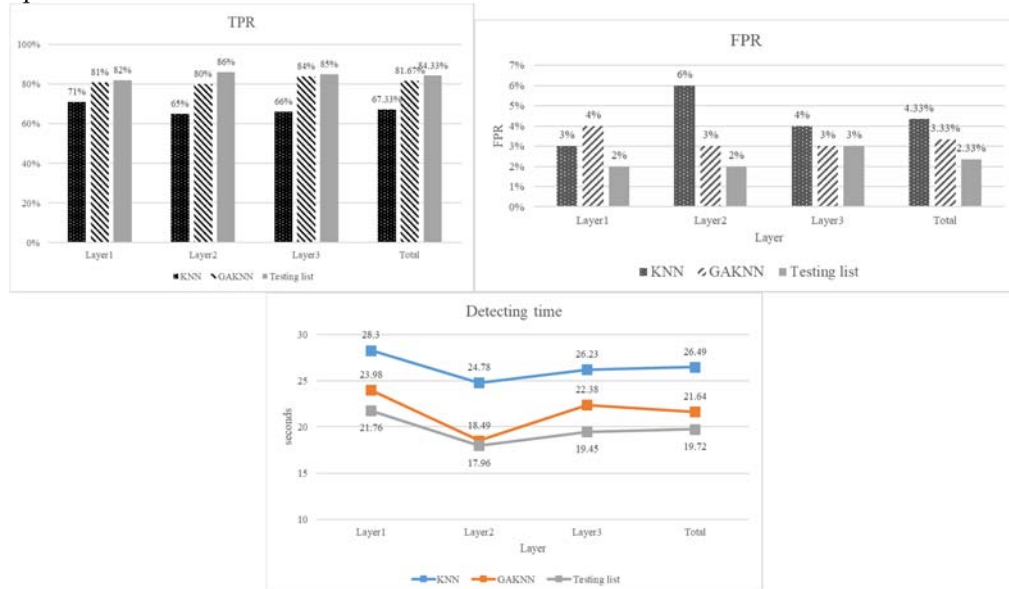


Fig. 8. Performance comparison for detection of random-based gray hole attack with shorter monitoring period

We can observe that our GAKNN (KNN with GA) outperforms the traditional KNN while detecting random-based gray hole attack with shorter monitoring period.

● Monitor period: 8 seconds

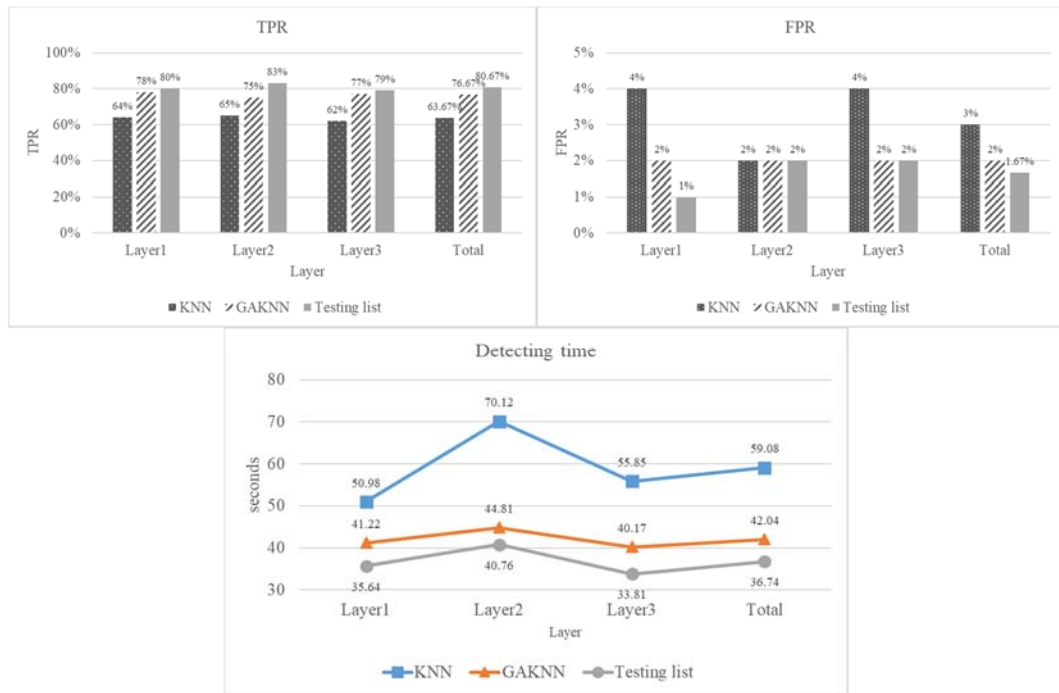


Fig. 9. Performance comparison for detection of random-based gray hole attack with longer monitoring period

We can observe that our GAKNN (KNN with GA) outperforms the traditional KNN while detecting random-based gray hole attack with longer monitoring period.

CONCLUSIONS

In this paper, we extend the gray hole attack study in Wireless Sensor Network to Software Define Network. Since the gray hole switch/router drops packets and reduces the efficiency of the Software Define Network, we propose a detection method and the corresponding architecture. The abnormal detecting phase is the key core to find the gray hole attack and GAKNN is suggested in this paper. The GAKNN classifies the switches/routers in a higher accuracy rate than the original KNN. Using GAKNN, the accuracy rate increases 10%~15%. The false positive rate reduces 1%~2%. The necessary detecting period reduces 2~4 rounds. In the future, we may study the complex type of gray hole attack. Furthermore, we should consider to simulate in a bigger topology to test the performance of our proposal. For the detection part, we can try other machine learning algorithms or statistic methods in the abnormal detection phase.

ACKNOWLEDGEMENT

This work is partially supported by Minster of Science and Technology in Taiwan, ROC under the project MOST 106-2410-H-009-025-MY3.

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Developing the Ideal Profile of OCAs and IT Usage in the Foodservice Chain

(Full Paper)

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Abstract

In recent years, the number of the branches of the foodservice chain rapidly increases, and every branch wants to be successful. Thus, how to use information technology to support Organizational Critical Activities (OCAs) has become an important issue. This research found out ten Organizational Critical Activities (OCAs) of the foodservice chain and three types of information technology usage, Defender Type, Follower Type, and Innovator Type. Furthermore, after the revision of two experts, the ten Organizational Critical Activities (OCAs) are divided into three categories, Internal Management, External Management, and Product Service. The analytical result found out that Defender Type matches Internal Management, External Management matches Innovator Type, and Product Service matches Follower Type. Finally, this study hopes that companies in the foodservice chain can develop appropriate IT strategies according to this research result to enhance their core competitiveness.

Keywords: Organizational critical activities, foodservice chain, information technology usage, ideal profile and grounded theory.

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INTRODUCTION

As the number of branches of the foodservice chain increases rapidly in recent years, enterprises of the foodservice chain one by one implement the uniform set of information technology (IT) to support the daily operation and management of the head office and branches. In this situation, these branches must use the uniform set of information technology (IT) to support the different strategies and operating activities when facing different environments. Therefore, "how to use the uniform set of information technology (IT) to support different daily operating activities in different branches" has become a critical issue.

The past literature about foodservice and information technology mostly emphasizes the head office and rarely discusses the branches. Oronsky and Chathoth (2007) indicated that the branches must adjust their use ways to meet actual demand when using new information technology. Thus, they suggested that future research should be conducted from the perspective of branches to have a better understanding of enterprises' actual information technology usage. This research will combine Organizational Critical Activities (OCAs) proposed by Hung (2006) and Hung, McQueen, Ku, and Chang (2012) to discuss how these branches use the uniform set of information technology to support OCAs in order to achieve the success.

Organizational Critical Activities (OCAs), proposed by Hung (2006) and Hung et al. (2012), are crucial to an organization's success, and they help the organizations achieve expected success through organizations to invest a large number of resources in them, as well as through monitoring, guidance, and continuous practice. The contents of OCAs are different in different organizational environments and strategies. In the situation of the foodservice chain, because branches are spread all over the country, OCAs adopted by each branch will be necessarily different due to the effect of the geographical location, customer characteristics, and other relevant factors. Thus, during the process of making marketing strategies, commodity combinations, promotion activities, and service types should be distinct according to the relevant features of different business circles.

The information technology usage has always been regarded as a very important factor in the field of information management (Delone & Mclean, 1992). Tajima (2007) thought that the type of information technology usage has an effect on the benefits of information technology. Relevant research also indicates that information technology has an inconsistent effect on enterprises, and this may be related to the type of information technology usage in an organization (Sanders, 2008). These inconsistent research findings have also reflected the complexity of issues of the information technology usage and the importance of in-depth research among organizations.

Under the tide of informatization, this research found very few studies on the combination of the foodservice chain and information technology in the past. On the growth of the foodservice market, relevant information is quite limited. Moreover, past literature never discussed issues on an organization's use way of the uniform set of information technology. Therefore, this research hopes to explore how branches use the uniform set of information technology in combination with OCAs to bring benefits and success to their organization and to clarify the different types of IT usage during the process of applying information technology as well as reasons from the perspective of the branches of the foodservice chain.

According to the above discussion, this research concludes research questions as follows.

1. What are OCAs of foodservice chain and the types of IT usage?
2. How and why do the branches of the foodservice chain use IT to support OCAs?
3. What is the ideal profile of OCAs and IT usage?

Through above questions, this research has the following three purposes. The first purpose is to understand OCAs of branches from the perspective of branches and to understand how branches use the uniform set of IT to support OCAs. The second purpose is to develop different types of IT usage and to classify OCAs obtained in this research. The third and most important purpose is to develop the ideal profile of OCAs and IT usage. In the end, except that this research can be a reference in the future academic research, this research mainly hopes that the research result can help the foodservice chain adjust the type of IT usage and operational strategies.

LITERATURE REVIEW

2.1 OCAs (Organizational Critical Activities)

Organizational Critical Activities (OCAs), proposed by Hung (2006), refer to "some special types of organizational activities", and such activities have strategic importance as to whether organizations can achieve success. On the part of research of OCAs, Hung (2006) explained the hierarchical relationship among process, task, activity, and OCAs. The process is a set of hierarchical interaction activities, this set of activities is imbedded into a set of rules and resources and able to force and endow society. The task contains the activity (aimed at achieving a procedural goal) and resource (which is used or modified by the task). An activity is the necessary core to execute the procedure or task. OCAs are the activities crucial to an organization's success. Therefore, the scope of the activity is smaller than that of the procedure and task. Besides, the resource, power, and rule during the activity are not contained in the activity.

Hung (2006) explored OCAs in his research and defined them as "the top-priority activities in a series of organizational activities as well as the activities which are indispensable for an organization's short-term, medium-term, and long-term success and must be executed. In OCAs, a large number of resources are invested continuously and the senior manager's frequent monitoring and guidance are provided", and he also indicated that OCAs should support the organizational strategy. Based on the above-mentioned discussion, OCAs in this research are activities that are preferentially executed and regarded as organizational activities indispensable for an organization's short-term, medium-term, and long-term success. Besides, OCAs are continuously monitored and guided by senior managers. Moreover, a large number of resources are invested in OCAs to help organizations achieve success.

For the correlation between OCAs and strategy, Mintzberg (1978) defined the strategy as a series of decisions and actions, while Croteau and Bergeron (2001) defined organizational strategy as a series of organizational activities. It can be clearly understood from the above-mentioned literature that there exists a correlation between organizational strategy and organizational activity. For the correlation between OCAs and environment, their relationship is indirect and environmental change will first cause the strategy change and then affect OCAs through that strategy change. However, the developmental and making process of organizational strategy consumes lots of time (Edwards, Ward, & Bytheway, 1995). Therefore, some organizations will change their OCAs before the development of the strategy to gain competitive advantages, in order to adapt to the environmental change in a timely manner.

Shortell and Zajacym (1990) believed that the method of organizational self-evaluation can effectively find out the organizational strategy. According to past relevant research, it is found that the self-evaluation method is classified into an interview and questionnaire survey. Based on these 2 considerations - the self-evaluation method and providing or not providing possible OCAs, 4 different methods of seeking OCAs are gained. Hung (2006) sorted out 4 different methods of seeking OCAs: (I) providing possible OCAs in the questionnaire; (II) not providing possible OCAs in the questionnaire; (III) providing possible OCAs in the interview; (IV) not providing possible OCAs in the interview.

This research therefore intends to find out the list of OCAs in the foodservice chain according to the above-mentioned methodology. In addition to conducting the research, the result can also be provided to organizations as the basis of execution of strategy and operation. Besides, implementing OCAs can bring success to organizations.

2.2. Foodservice chain

Kotler (1991) defined a chain store as a retail store possessing or controlling 2 or more retail outlets and the same product line is sold in these retail stores with unified purchase and sales. Muller (1999) thought that a restaurant is the place where foods or beverages exchange remuneration. Ninnemeier (2010) pointed out that the foodservice industry is mainly divided into Independent Operation, Chain Restaurants, and Franchises. (1) Independent Operation refers to one restaurant owned by 1 or several owners; these owners usually own one or several restaurants having no chain relationship, and the menu, purchased food materials, and operation procedure in each restaurant are different. (2) Chain Restaurants are composed of multiple foodservice business outlets that usually share the same menu, jointly purchase the food materials and equipment, and follow the same standardized operational procedure. (3) Franchises, a special type for chain operation, mean that the franchisees pay fees to the franchiser to gain the right to use the tradename, building design, and operational and managerial method from the franchiser.

As defined by Block, Scribner, and DeSalvo (2004), a fast food chain restaurant refers to a restaurant characterized by rapid supply of meals, takeout service, limited working personnel, and the consumption rule of paying the bill first. After referencing the past literature on the chain industry and foodservice industry, this research defines the foodservice chain as “a standardized, simplified, and specialized foodservice store which has 2 or more branches with a unified operating model, where each branch supplies tangible meals and beverages and intangible service and atmosphere”.

2.3. Information technology of the foodservice chain

Agrawal and Smith (2013) indicated that the demand items of each branch will be obviously different under the same chain system due to the differences in economic status, culture, and population in various regions as well as the different branch forms. Muller (1999) stated that information technology is an important fundamental type of investment in the foodservice chain and information technology usage not only reduces operational costs and improves management ability and production efficiency, but also accelerates the enterprise's market reaction. The analysis result of a large amount of branch data can also expand an enterprise's most important knowledge base system to bring success to the enterprise.

Information technology plays an important role in the foodservice industry, and it is also one of the important factors affecting an organization's financial success (Kimes, 2008). Nevertheless, with the expansion of the foodservice chain, when each branch adopts unified information technology to coordinate with branch operation in various regions, its disadvantages also appear gradually. According to Huber, Hancer, and George (2010), there is no commonly used information system applied to all situations in organizations. As chain restaurants become prevalent, enterprises will import information technology to assist with branch operation. The import of information strategy not only strengthens the connection between an enterprise's internal departments and branches, but also brings competitive advantages like higher efficiency, more rapid supply of service, and supply of analysis. However, it is unknown in the past literature how branches use information technology uniformly implemented by the head office to support the operational activities in organizations to bring success, which is the gap that needs to be filled.

The information technology usage emphasizes the direct use of experience (Mao & Palvia, 2008). As defined by Mishra and Agarwal (2010), the information technology usage refers to its applications in the operational procedure to complete the task. This research defines the information technology usage as “the dynamic process and actual application model where organizations use the information technology to support organizational activities and operational procedure during the dynamic process of adapting to a specific environment”.

Kearns and Lederer (2004) indicated that when an enterprise's strategy is related to the information technology usage, competitive advantages can be gained. Trkman (2010) thought that the performance brought by information technology is measured by activity/procedure dimensions - namely, they discussed it from the perspective of the form of information technology usage. However, the method to use information technology is a complex concept, and different forms of information technology usage will bring different values, further bringing different types of benefits (Sanders, 2008).

2.4. Ideal profile

“Ideal type” refers to the complex structure and operational rule gradually formed in an organization to achieve a specific purpose and management effectiveness (Meyer, Tsui, & Hinings, 1993). Subsequently, Miles and Snow (1994) followed it and changed it to “ideal profile”. Using the business strategic type as the standard, Miles and Snow (1994) classified the organizational characteristics into product and market strategy, R&D direction, production, organizational structure, and planning process. Under the business strategy of Defender, Prospector, and Analyzer, the attributes and traits in different characteristics are respectively described, and contrast and comparison are conducted, as shown in Table 1.

Table 1: Ideal Profile of Miles and Snow.

	Prospector	Analyzer	Defender
Product and market strategy	Wider and changeable	Stable and changeable	Limited and stable product line

	product line The first to enter the new market	product line Follow Prospector to enter the market	
R&D direction	Product design and market survey	Adaptation of procedure and product	Process reengineering and product improvement
Production	Flexibility and adaptive equipment and procedure	Transferred into project development with low-cost production	Mass and low-cost specialized process
Organizational structure	Regional	Mixed	Functional
Planning process	Action -> evaluation -> planning	Evaluation -> action -> planning	Planning -> action -> evaluation

Source: Miles and Snow (1994); Grimmer et al. (2017).

Sabherwal and Chan (2001) constructed an ideal profile through literature review, indicated that Defender, Prospector, and Analyzer are respectively highly connected to Information System Efficiency, Information System Flexibility, and Information System Comprehensiveness (Information System Strategy), and thought that alignment between business strategy and information system strategy will bring success to an enterprise. The ideal profile is shown in Table 2.

Table 2: Ideal Profile of Business Strategy and Information System Strategy.

	Defender	Prospector	Analyzer
Information System Efficiency	High	Low	Low
Information System Flexibility	Low	High	Low
Information System Comprehensiveness	Low	Low	High

Source: Sabherwal and Chan (2001); Street et al. (2018).

In combination with past research literature, this research defines an ideal profile as “a method used to construct alignment between 2 different aspects to combine and analyze the 2 different aspects by means of inferential and ideal opinions and to establish a set of profile focusing on organizations that can help organizations find out the best combination to achieve a specific purpose and efficient management”.

An ideal profile is widely applied to research of strategy and organizational characteristics, and many previous scholars also used information technology as one aspect to align with enterprise strategy, organizational characteristics, or enterprise process to establish an ideal profile (Tallon, 2007). Through an ideal profile, a suitable pairing method between 2 aspects can be found out to enhance their degree of coordination and be used as a reference for practical application.

It can be found from the discussion above that past studies are mostly based on enterprise-level opinions to discuss but have little discussion on branches. How branches use the same set of information technology to support OCAs has become an issue that must be valued. Therefore, this research combines OCAs and information technology usage to establish an ideal profile to fill the gap in the past research.

RESEARCH METHOD AND DESIGN

The purpose of this research is to find out how branches in the foodservice chain use the uniform set of IT to support OCAs and to understand the process and reasons from it to build an ideal profile. Therefore, the events of the discussion mainly focus on contemporaneous events. In the past, there was not much literature exploring the application situation of information technology in branches. Therefore, the type of the qualitative research is in line with the type of this research. This research adopted case study to understand the situation that each branch uses information technology to support its OCAs and conducted comparison and analysis according to the situation of each branch. This research applied the multi-case analysis and concluded one phenomenon by comparing the interview contents of each analysis unit (branch of foodservice chain). On research data collection, this research adopted the “in-depth interview method” to collect the data and combined the secondary data collection to have a multi-aspect understanding of the company and branch status as well as the relevant phenomena in the research from the company website,

annual report, news, newspapers and magazines, and relevant public materials. On the choice of interview type, this research adopted the semi-structured method to conduct in-depth interviews, as it can help the interview be conducted in an organized way and provide respondents with the space to answer the questions. Thus, relevant research data can be collected effectively without losing flexibility.

Over the past 10 years, the grounded theory has been widely applied to research related to information systems (McLaren et al., 2011; Sarker et al., 2012). McLaren et al. (2011) suggested that enterprises can find out their internal ideal profile through case interviews which combine with grounded theory to further analyze their internal difference and the reasons of their internal difference. This research adopted the multi-case study which combined with collection of relevant secondary data, as few studies in the past have discussed branches in the chain industry, causing a lack of theoretical basis. In order to establish more stable research results, this research adopted the grounded theory of Chicago School of Sociology (Robrecht, 1995) to analyze a large number of data obtained. On data analysis, open coding, axial coding, and selective coding in the grounded theory were adopted. After transforming the interview content into verbatim transcription, this research deleted related background information and paragraphed verbatim transcription to conduct open coding, and then the analytical manuscript was formed. After open coding was finished, axial coding was used to get 10 items of OCAs and 3 activity types of OCAs; besides, this research also used axial coding to get types of information technology usage and unified information technology items. Finally, selective coding was used to group the same kind of OCAs into the same activity type and develop the ideal profile of OCAs and IT usage in the foodservice chain.

This research took one of Taiwanese famous enterprises of the foodservice chain as the research object and adopted the semi-structured method to conduct the case interview. The grounded theory was used to analyze the data, and the research results and relevant findings were put forward. On the choice of branches, in order to increase the diversity of research results and findings to carry out the comparison, this research took branches in Taiwanese northern, central, and southern regions as research objects. As the research field involved OCAs, the respondents were mainly the store managers, assistant store managers, junior managers, and supervisors of each branch store and were secondarily management personnel who acted as duty manager in each branch store.

It was expected that at least 9 branches in the foodservice chain would be interviewed. Hung (2006) thought that supervisors usually have different opinions on OCAs. Therefore, this research interviewed 2-3 people, who are mainly middle and senior supervisors, in each branch and applied cross-comparison against the interview contents to improve reliability and validity of interview contents. In terms of the choice of case quantity, this case adopted the snowball sampling method, whereby the respondents introduced other respondents to gain more samples. On the interview outline, the interview outline proposed by Hung (2006) was used as a reference, and the interview outline was drawn up after past relevant literature was referenced; then the outline was submitted to experts for review and modification and interviews were conducted formally in the end. The total number of participants in the formal interview is 18. On supplementary data, a second interview was conducted, where communication software or a telephone was used for voice recording to make up for insufficient data. After the end of the interview, the interview contents were transformed into verbatim transcription to facilitate subsequent analysis.

RESEARCH RESULT AND DISCUSSION

After interviewing 9 branches, this research found that the foodservice chain's OCAs contained 10 items: managing human resources, developing and maintaining customer relationship, communicating, monitoring and ensuring the product and service quality, carrying out advertising promotion, providing the customer service, developing new services, doing market research, establishing the branch culture, and enhancing brand image. After the 18 respondents were interviewed in the 9 cases, this research found that each branch's information technology usage differs in "intention to use". The types of information technology usage are classified into Defender Type, Follower Type, and Innovator Type according to "intention to use".

(1) Defender Type:

In addition to the proximity among the import times of information technology in the 9 branches, the respondents also said that the company provides unified information technology items, and the information technologies uniformly allocated by the company include computer, notebook computer, point of sale (POS), mobile ordering machine, and WiFi; the computer configuration includes Enterprise Information Portal (EIP), enterprise integration system, training trace, scheduling system, E-mail, and office software.

(2) Innovator Type:

In order to adapt to the competitive environment, each case branch also uses information technologies different from those stipulated by the company, and the difference in computer use is the greatest. The data inquiry function of the original system is used, and then the office software is used for data integration to further reach the function of rapidly reporting back on the degree of goal achievement and analyzing data. Due to customers' high variability, some case branches use the computers for data management and comparison analysis to improve service diversity. Other cases are different in information technology usage in order to provide differentiated service to customers. Based on the above contents, it can be found that the competitive

environments in different business circles will cause the change in an enterprise's operational pattern, which further causes difference in each branch's information technology usage.

(3) Follower Type:

In innovative use, case branches' intention to use can be classified into goal orientation and innovation orientation. Innovation orientation mainly refers to attempting the method of new information technology usage to keep its leading position in turnover. The goal orientation mainly refers to taking other branches' successful experience as the goal to learn their successful innovative experiences, expecting to bring success to themselves. Therefore, through intention to use, this research classified it into Follower Type and Innovator Type. Thereinto, Follower Type belongs to the goal orientation, and Innovator Type belongs to the innovation orientation.

It can be found from the interviews that Defender is partial to the enhancement of Internal Management efficiency and cost control, helping internal information technology usage achieve high consistency through standardization - namely, the delicacy of the old model and controlling and managing product quality and service efficiency through the procedure of high controllability, so as to improve efficiency and reduce cost. As for Follower, the cost on adopting personal communication equipment is not high. Therefore, they all actively adopted it to improve internal communication efficiency and action. Follower lies between Defender and Innovator, and it follows Innovator and keeps the balance of positioning between operating efficiency and difference to try to bring benefits to the branches. Besides, those branches which belong to Innovator will actively experiment with new models and improve the variability in the method of information technology usage to try to improve the difference through developing the new method of information technology usage to bring benefits to themselves.

By referencing OCAs proposed by Hung (2006), this research concluded 3 activity types through 2 industrial experts and grounded theory and classified the 10 OCAs obtained in the interviews into these 3 activity types (Internal Management, External Management, and Product Service) in order to facilitate subsequent construction of ideal profile. Thereinto, Internal Management includes managing human resources, communicating, and establishing the branch culture; External Management includes developing and maintaining customer relationship, carrying out advertising promotion, doing market research, and enhancing brand image; Product Service includes monitoring and ensuring the product and service quality, providing the customer service, and developing new services. Besides, Internal Management, External Management, and Product Service are combined with information technology usage (Defender Type, Follower Type, and Innovator Type) to establish an ideal profile. The results find that Internal Management is suitable for Defender Type and the branches will have better management efficiency; when External Management is combined with Innovator Type, turnover will increase stably; when Product Service is combined with Follower Type, customers will increase continuously. The ideal profile of OCAs and IT Usage is shown in Table 3.

Table 3: Ideal Profile of OCAs and IT Usage.

	Defender Type	Follower Type	Innovator Type
Internal Management	Internal Management efficiency is high (match) Internal Management attaches importance to internal efficiency and stability to make the performance objective conform to the company's stipulations. Thus, Defender Type can stabilize Internal Management system to increase Internal Management efficiency and decrease management cost at the same time.	The change in Internal Management causes management efficiency to decrease (mismatch) Internal Management aims to make the performance indicator conform to the company's requirement and attaches importance to internal efficiency and stability. Therefore, when Follower Type is used, it will cause the interior to change irregularly to result in decrease of Internal Management efficiency.	Continuous change in Internal Management causes management costs to increase (mismatch) Internal Management needs internal efficiency and stability and aims to make the performance objective conform to the company's requirement. Therefore, when Innovator Type is used, it will cause Internal Management to change continuously and the benefits produced by information technology usage are relatively weak to cause the Internal Management cost to increase.
Product Service	Product Service is fixed, and differentiated services cannot	Product Service difference is	The continuous change in Product Service causes worse

	<p>be provided to the customers (mismatch)</p> <p>In terms of Product Service, it is necessary to keep product quality and service difference. Defender Type can keep fixed service efficiency and product quality, but it cannot provide differentiated service according to different customers. Thus, the turnover performance is worse.</p>	<p>improved (match)</p> <p>Product quality and service difference must be considered at the same time in Product Service. Therefore, coordination with Follower Type can stabilize product quality and improve the difference at the same time in Product Service to result in better turnover performance.</p>	<p>product quality (mismatch)</p> <p>In terms of Product Service, it is necessary to manage and control product quality and provide differentiated service. Therefore, Innovator Type can make the product and service change continuously and improve service diversity, but product quality is worse than that of other types.</p>
External Management	<p>External Management is fixed, but the market demand cannot be reflected timely (mismatch)</p> <p>External Management needs to face a rapidly changing diverse market. Therefore, Defender Type can reduce External Management cost, but it cannot cope with the diversity of the external market, and so market demand cannot be reflected timely.</p>	<p>External Management is more stable, but market change cannot completely be handled (mismatch)</p> <p>External Management faces a rapidly changing market. Therefore, Follower Type can increase marketing stability, but it cannot completely cope with a rapidly changing market to result in worse performance in new market development.</p>	<p>It supports marketing innovation (match)</p> <p>External Management often faces a diverse and rapidly changing market. When Innovator Type is combined, it can assist with marketing innovation, cope with a rapidly changing market context, and create new market opportunities.</p>

In the following, this research will discuss match and mismatch between different types of information technology usage and different types of OCAs and reasons about match and mismatch.

(1) Internal Management:

- (a) Defender focuses on Internal Management - match: The branches adopting Defender Type attach importance to Internal Management efficiency and the establishment of the long-term system in the organization, have more fixed information technology usage, and exhibit no significant change. Therefore, this can improve Internal Management efficiency and reduce management cost at the same time. Therefore, Internal Management matches Defender Type.
- (b) Follower focuses on Internal Management - mismatch: This research finds that the branches adopting Follower Type are characterized as following a goal orientation, but they also tend to use innovative information technology to reduce Internal Management cost. However, this will cause the Internal Management system to change irregularly, thus internal personnel will not adapt to the irregular change of management system, and then Internal Management efficiency will decrease. Therefore, Internal Management doesn't match Follower Type.
- (c) Innovator focuses on Internal Management - mismatch: The branches adopting Innovator Type attach importance to e-business. In order to keep their competitive position, they try various methods of information technology usage different from those stipulated by the company to assist with their own Internal Management. However, when they try various use forms of new technologies, they may increase the resource losses and consumption of Internal Management at the same time. Innovator Type will also involve problems concerning the time and skill possessed by personnel, so that the personnel's workload will increase at any time to cause Internal Management to continuously change. In this case, the benefits produced by information technology usage are relatively weak to cause Internal Management cost to increase. Therefore, Internal Management doesn't match Innovator Type.

(2) Product Service:

- (a) Defender focuses on Product Service - mismatch: The branches adopting Defender Type in Product Service pay attention to cost management and control and enhance product quality and service efficiency through the use method stipulated by the company. However, Defender Type cannot provide customized service to satisfy the demand of external customers, excessively consistent services may result in loss of customers, and thus turnover performance will be worse than that of Follower Type. Therefore, Product Service doesn't match Defender Type.
- (b) Follower focuses on Product Service - match: The branches adopting Follower Type are relatively conservative in developing new services, but they modify their service contents to increase diversity once they encounter more successful

services launched by their competitors, and thus product quality and service diversity must be considered simultaneously in Product Service. When Product Service cooperates with Follower Type, the branches simultaneously attach importance to product quality, service efficiency, and service quality in Product Service and choose innovative services developed by Innovator in their own competence scope to make their turnover performance better. Therefore, Product Service matches Follower Type.

- (c) Innovator focuses on Product Service - mismatch: The branches adopting Innovator Type in Product Service are featured with active innovation, which makes them be partial to customer service orientation in Product Service. In order to meet the demand of regional customers, Product Service combines Innovator Type to provide extra services. However, they may place more emphasis on customer demand when trying Innovator Type to cause product quality to be affected. Although they are devoted to the development of new customers, existing customers become fewer and fewer simultaneously. Therefore, Product Service doesn't match Innovator Type.
- (3) External Management:
 - (a) Defender focuses on External Management - mismatch: The branches adopting Defender Type in External Management attach great importance to cost control and management, but their performance in maintaining customer relations is usually insignificant, and their market type are more single and centered in the urban area. External Management needs to face the rapidly changing diversified market, and so Defender Type can reduce External Management cost, but it cannot cope with diversity of the external market to result in failure to timely reflect market demand. Therefore, External Management doesn't match Defender Type.
 - (b) Follower focuses on External Management - mismatch: The branches adopting Follower Type in External Management increase their marketing innovativeness through learning Innovator Type. However, Follower Type can increase stability in external marketing and customer relations, but it cannot completely cope with the rapidly changing market to result in worse performance in new market development. Although stability in external marketing and customer relation is higher when Follower Type is adopted, new customers cannot be developed at any time to result in loss of customers gradually to further affect sales status. Therefore, External Management doesn't match Follower Type.
 - (c) Innovator focuses on External Management - match: The branches adopting Innovator Type in External Management attach importance to the marketing method and service innovation. Therefore, they apply information technology to gaining highly real-time market information and to rapidly understanding the market context. Besides, they develop customer relations, carry out advertising promotions, do market research, and improve brand image through Innovator Type. External Management often faces a diverse and rapidly changing market. The combination of External Management and Innovator Type can assist with the continuous innovation of marketing, cope with the rapidly changing market context, and create new market opportunities. Therefore, External Management matches Innovator Type.

Based on the above analysis, it can be found that Internal Management attaches importance to management efficiency and stability, and it matches Defender Type. Product Service needs to attach importance to product quality and service diversity at the same time, and so it is suitable to adopt Follower Type. External Management is suitable for Innovator Type to cope with a rapidly changing market.

CONCLUSION

This research divided 10 OCAs obtained in this study into 3 types of OCAs (Internal Management, External Management, and Produce Service) and classified types of information technology usage into Defender Type, Follower Type, and Innovator Type to jointly establish the ideal profile of OCAs and information technology usage. The pairing reasons are explained as follows.

- (1) Concentrating on IT usage in Internal Management is best fit with Defender: This research finds that the head office invests most of its resources in Internal Management, and that established information technology and system are the most perfect; the head office synchronously integrates the information in various branches and attaches importance to the efficiency and stability of Internal Management. Therefore, information technology usage provided by the company meets the needs for cost control and management and the enhancement of internal operational efficiency, so as to reduce internal resource expenditure on trying other use methods. In comparison, the branches adopting Innovator Type pay attention to e-business. To maintain competitive status, they will try other kinds of IT usage different from that of the company to assist with Internal Management, which causes internal continuous change at the same time, and the benefit that IT usage produces is relatively weak to result in the increase of internal management cost; although Follower can reach the objective stipulated by the company, it still cause Internal Management to change irregularly to result in the decrease of degree of satisfaction of employees to further influence efficiency of Internal Management.
- (2) Concentrating on IT usage in Product Service is best fit with Follower: Follower follows Innovator to increase Product Service diversity, and the innovation risk undertaken is smaller; at the same time, it attaches importance to product quality and service diversity. Therefore, diversified information technology usage can be combined with Product Service to reach a service advantage while the advantage of product quality is kept. In comparison, Defender may cause loss of customers because it provides excessively consistent service to customers to result in worse turnover performance than that of Follower; Innovator

makes products and service change continuously, increase diversity of service, but cannot take product quality into account. Therefore, Follower is more suitable than Defender and Innovator in Product Service.

- (3) Concentrating on IT usage in External Management is best fit with Innovator: External Management attaches importance to service innovation. The branches in the foodservice chain have no power to develop new products. Therefore, the branches adopt Innovator Type to provide customized and innovative marketing service to customers to maintain and develop customer relations to further rapidly gain market direction, improve external service efficiency, pursue a leadership advantage in marketing innovation, cope with the rapidly changing market context, and create new market opportunities, so as to achieve the competitive advantage of External Management. In comparison, Defender pays less attention to external development and only adopts IT usage provided by the company to maintain customer relationship. Although it can reduce the cost of External Management, it cannot cope with diversity of external market, and so market demand cannot be satisfied in time; the branches adopting Follower Type is similar to those adopting Innovator Type in marketing methods, but they carry out maintenance of customer relationship at most time. Although Follower Type can increase stability in external marketing and customer relationship but cannot develop new customers at any time to result in loss of customers to further influence sales status. Therefore, Innovator Type matches External Management.

In conclusion, it is found that stable Internal Management can improve the efficiency of Internal Management, so Internal Management matches Defender Type; Produce Service must take good product quality and differentiated service into account at the same time, so Produce Service matches Follower Type; External Management in combination with Innovator Type is the most ideal, coping with a rapidly changing market through innovative marketing.

In terms of the contribution of this research in the industrial circle, the foodservice chain's import degree of information technology cannot be underestimated to provide more rapid service. This research hopes to develop the ideal profile of OCAs and IT usage for the foodservice chain, understand how the specific type of OCAs should use information technology, and provide one practical reference framework with the foodservice chain. Besides, OCAs proposed by Hung (2006) are indispensable activities for enterprises' success. Therefore, the ideal profile not only can be used as the basis to employ information technology in combination with OCAs, but can be used to understand the effect of different types of information technology usage on OCAs. Hence, the proper coordination between information technology usage and OCAs can bring success to enterprises.

In terms of academia, this research mainly discusses OCAs, information technology usage, and the ideal profile of OCAs and IT usage. Discussions in the past literature are conducted under the context that information technology is investible and changeable. Therefore, the main purpose of this ideal profile is to make up for the deficiency in past academic discussions in the situation that related literature in the past was lacking about branch chain stores using IT and is to help understand the differences between academic theory and practical application, so as to help with the adjustment of future relevant research.

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Do Customers Perceive Reviews as Manipulated? A Warranting Theory Perspective

(Full Paper)

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ABSTRACT

Online customer reviews proved to have an influence on customer's purchase. However, most online reviews don't always prove effective in guiding the purchase process, because of fake reviews. While e-commerce platforms do tend to incorporate ways to counter review manipulation, customer perception on review quality is more important. In this study we aim to understand the impression mechanism of online reviews. Using warranting theory, as theoretical lens we found that textual and review characteristics play a crucial role in forming an impression amongst the customers. Further, research suggest that higher contamination of reviews influence customers to perceive reviews less authentic.

Keywords: online reviews, perceived manipulation, warranting theory, e-commerce platforms, fake reviews.

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INTRODUCTION

Dear Customer,

Thank you for your purchase! Hope you like the new case! Could you please give 5-star positive review? That'll be helpful to other customers. Much appreciated!!

This is the personalized hand-written note received by a customer who purchased MacBook Air 11-inch hard case from Amazon. With the prevalence of online reviews, these days sellers are incorporating various manipulating techniques such as positive reinforcement (which includes offering money, gifts, praise, and personalized messages) to fetch positive reviews from the customers. Such luring appeals often influence customers leave a review of higher rating than they actually intend to (Aral, 2014). Apart from manipulating customers, sellers are asking their friends and family to leave high product ratings and reviews. Furthermore, they themselves are making purchases from their own business so as to get a *certified (or verified) buyer* badge, thereby rating and reviewing their own product. In 2017, the news website Quartz highlighted that nearly two-thirds of the customers experienced a significant variation in product review and product, which is making them distrust the reviews present on the website. All these techniques adopted by sellers to generate reviews can be viewed under umbrella term- *review manipulation*.

Review manipulation basically involves injection of either fake positive reviews for themselves or fake negative reviews for their competitors (Hu *et al.*, 2012). Zhang *et al.* (2016) define fake reviews as *deceptive reviews provided with an intention to mislead customers in their purchase decision making, often by reviewers with little or no actual experience with the products or services being reviewed. Fake reviews can be either unwarranted positive reviews aiming to promote a product or unjustified false negative comments on competing products in order to damage their reputation* (p.457). Enormous volume and anonymity make it easy for sellers to manipulate/corrupt the information flow through online reviews by adding biased contents. Many anecdotal evidences in the recent past provides evidence for review manipulation. For instance, Samsung was alleged to have hired students to post negative comments about mobile phones made by HTC (Zhang *et al.*, 2016); professional marketers were hired to promote and post positive reviews for new albums (Mayzlin, 2006); booksellers and publishers were discovered to write reviews for their own book on Amazon (Hu *et al.*, 2012). In 2013, nineteen companies based in New York were charged hefty penalties for writing fake online reviews in United States. These companies were found to have bombarded a number of customer review sites such as Yelp.com and CitySearch.com (Zhang *et al.*, 2016). Although research has been conducted on the impact of such strategic manipulation (e.g., posting praising reviews, hiring influencers) on information quality and firms' payoff (Dellarocas, 2006), literature remains silent on how customers perceive such manipulation.

Studies in Information Systems (IS) (e.g., Hu *et al.*, 2012; Luca & Zervas, 2016) have established a systematic relationship between the review manipulation probability and financial variables – predominantly 'sales'. Luca and Zervas (2016) found that a one-star increase in rating leads to more than a 5% increase in sales for independent businesses. With the review manipulation prevalent, research has also examined the characteristics of fake reviews. For instance, Ong, Mannino, and Gregg (2014) explored linguistic characteristics of fake reviews by comparing shill reviews with genuine reviews; where shill reviews were generated by hiring people from Amazon Mechanical Turk and the reviews available on the internet were treated as genuine reviews. On comparison, both the reviews differed in terms of informativeness, product usage experience, and readability. Although, a number of studies have

examined the characteristics of fake reviews (see Jindal & Liu, 2008; Kumar *et al.*, 2018; Mukherjee, Liu, & Glance, 2012) which is well documented at the review or reviewer's level, no consensus has been arrived if characteristics of manipulated reviews listed by the literature are identified as manipulated by customers as well. Customer's perception of a review ultimately shapes perception about their behavior intention well as about the trustworthiness of a platform (Zhang *et al.*, 2016).

From a customer's perspective there are four possibilities of review classification. However, all these four possibilities influence his/her impression towards reviews as well as behavioral intention towards platform differently (see Table 1). If a review in actual is genuine and customer also perceives it as genuine (Category I), then in this case reputation for the platform as well as sellers increases, or the trust remains intact. In category II, if a review is perceived fake, whereas in actual it is genuine it would affect both the platform as well as sellers in terms of their popularity and sales respectively. Even a single review perceived fake has potential to damage the platform's reputation, making them bear high costs. Similarly, category III depicts the condition when customer perceives fake review as genuine. In this case there are two sub-conditions:

1. *When seller fakes positive reviews:* Extreme positive review will make customers chose the product, but the main issue arises when the product is delivered to the customer. The probable variation between the actual product delivered and reviews makes customer suffer by making them put more effort in filing complaint and tracking package. Further, platforms incur higher cost in terms of delivery and packaging of the return products.
2. *When seller's competitor fakes negative reviews:* Here, the ultimate damage is done to the seller as customers might not opt for the product yielding lesser sales. However, this is not going to the customer altogether.

Next is category IV where customer presumes fake review as a fake. This will affect a customer's trust towards the platform and further leading to the customer migration from one platform to another. In general, a study by Jin Ma and Lee (2014) found that consumer's trust towards reviews decreases when made aware about sellers' involvement in review content manipulation.

Table 1: Customer's perception map and its consequences to platforms and sellers.

Perceived Actual	Genuine	Fake
Genuine	True Positive (Category I) <i>Increases reputation of both platforms and sellers</i>	False Negative (Category II) <i>Affects platform and sellers in terms of popularity and sales</i>
Fake	False Positive (Category III) <i>When sellers fake positive review: Platforms incur higher cost in terms of delivery and packaging and customer follow-up</i>	True Negative (Category IV) <i>Decreases trust towards the platform and leading to customer migration and loss of market share</i>

In summary, as platforms are the face for the customers any action taken by sellers will ultimately affect platforms who have to bear the cost. Hence, looking at the damages perceived review manipulation by customers have on platforms this study poses two fundamental questions:

RQ1: Do customers perceive reviews as manipulated?

RQ2: What factors form the customer's impression of a review? And through what mechanism these factors shape customer's impression of reviews?

We examine these questions from the lens of warranting theory according to which greater the perceived manipulation in the content by the customers, lesser would be its perceived authenticity (Walther *et al.*, 2009). This suggests that higher the manipulation done by the firms more likely its reputation and brand image is at stake. From the business perspective answer to the above questions are important for understanding their customers and ultimately findings of the study can be implemented for developing an automated system for filtering out perceived fake reviews.

These research questions remain largely unexplored. Research on online reviews till date has focused on understanding the impact of review characteristics (numerical rating, review length) and sentiment of review on perceived helpfulness of reviews (Ho, Wu, & Tan, 2017). Review characteristics might determine why some reviews get higher up-votes over other reviews, but with the prevalence of review manipulation across the globe intensifies the consumer's concern regarding authenticity of online reviews. Since, customer's knowledge on manipulation influences their purchase intention (Jin Ma & Lee, 2014). Hence, in this study we try to understand how individual reviews are evaluated by the customer. We argue that it is the characteristics of a review that shapes the consumer's perception towards the ethical norms and values of the platform.

Theoretical development and empirical testing in this area are still scant. Thus, on the theoretical front we make four key contributions to the literature. First, we extend the line of research proposed by Ho, Wu, and Tan (2017) by examining an important issue of customer perception in understanding review manipulation. Second, we develop and test the research model to predict the performance of online reviews. Although previous studies have measured the review performance through perceived helpfulness, we argue that latter might not be a good predictor of review performance. Third, we contribute to the online ethics and business literature by identifying the information cues that shapes an impression of a reviews. On practice front we contribute by informing platforms regarding the areas they should address to avoid such perception of manipulation among customers.

The rest of the paper is organized as follows. In the next section, we examine the literature on review manipulation as well as discuss the theoretical lens to examine review manipulation. In the third section, we present our research model and related hypothesis. In the fourth section, we present our data collection procedure to test these hypotheses. In the fifth section, we present the analysis of our data. In the sixth section, we discuss our research findings and present the implications of our research to theory and practice. Finally, we conclude with the limitations of our study.

LITERATURE REVIEW AND THEORETICAL BACKGROUND

Research on Online Reviews

Online customer reviews can be defined as *peer-generated product evaluations posted on a company or third-party website* (Mudambi & Schuff, 2010). Let us first understand the review generation mechanism and the role of different stakeholders in review generation. Reviewers are the ones who evaluate the product with an intention to share their opinion after its usage. Apart from providing textual review of the product, they also provide a numerical rating (usually varying from 1 to 5, where 1 means lowest and 5 means highest) about the product. These star ratings numerically depict individuals' experience with the product. In other words, textual review and star-ratings are the two review-components provided by the reviewers. Figure 1 depicts a typical review.



Figure 1. Sample of customer review from Flipkart.com (Source :<https://www.flipkart.com>)

The product (or service) for which a reviewer posts a review is known as the bystander (Luca & Zervas, 2016). On the review platforms, such as Trip Advisor, Amazon and Zomato, people leave reviews for the product or the sellers. Upon receiving the review, these platforms now add further components to these reviews namely – review date, badge and reviewer name. Some platforms also rank reviewers and/or provide badges (such as top 500 reviewer, certified buyer, generic reviewer name in case not mentioned by the reviewer) to increase the perceived authenticity of the review. Other potential customers who visit these platforms to understand more about the product (apart from the information provided in the product description) through other's experience can vote a review by giving a thumbs-up or thumbs-down. For example, Amazon asks people: "Was this review helpful? Yes or No" or as in Figure 1 – the likes and dislikes. This helpful vote count reflects other potential customers' view towards a review.

Thus, different stakeholders are involved with a single review– (a) reviewer who writes a review, (b) bystander who are the subjects of a review being written, (c) platforms who posts the reviews on their website, (d) customers (or readers) who reacts towards a review by participation in voting, (e) other customers whose read reviews to make a purchase decision.

Studies on online reviews have primarily focused on two units of analysis, namely, reviewers and readers. Studies using reviewers as unit of analysis focus on understanding the motivation behind people writing reviews. Previous studies (e.g. Wang, 2010; Zhang *et al.*, 2015) have used the construct *online review authorship* to understand the factors which motivate people to write. A number of studies (e.g. Zhang *et al.*, 2015) found social factors as having significant influence on authorship of online reviews. Wang (2010) observed that people tend to write a greater number of reviews and prefer giving less extreme star ratings in order to establish a social image. This implies that there is an audience effect which shapes user's writing behavior. Moreover, people naturally tend to prefer giving ratings from 3 to 4 stars. Basically, content shared/ created by people has a social exchange value of generating reciprocity (Fehr, Kirchsteiger, & Riedl, 1998). That means, if I like your content, you will like mine. Most of the platforms, such as Zomato and Amazon, enable establishment of follower-following relationship. Goes, Lin, and Au Yeng (2014) examined such relationships and demonstrated that people on attaining substantial number of followers begin to review product more objectively, induce less focus on negativity and valence variance. Further studies have also identified content's affective characteristics (Berger & Milkman,

2012) as well as individual traits (Mowen, Park, & Zablah, 2007) as antecedents motivating people to contribute to the content creation.

While studies using readers as unit of analysis seek to find the drivers that motivate people to read (or consume) online reviews: (a) information acquisition mainly in case of pre- or post- purchase decisions (Goldsmith & Horowitz, 2006) (b) risk reduction (Kim, Mattila, & Baloglu, 2011) (c) seek social assurance (Bailey, 2005) (d) enact negativity bias (O'Reilly & Marx, 2011). Drawing on similar lines, previous studies have also explored the context using different perspective, such as examining the factors that influence people to judge the informational value of the reviews (Weiss, Lurie, & MacInnis, 2008), information quality (Kane & Ransbotham, 2016), and helpfulness (Mudambi & Schuff, 2010). The question of what makes a review helpful has received much scholarly attention in e-commerce and information systems literature. Mudambi and Schuff (2010) found that star-rating and number of words present in a review are strong predictors of helpfulness of a review for the readers. Liu and Karahanna (2017) also found that review characteristics of online reviews shape customers' perception about their helpfulness.

In summary, the textual characteristics and review characteristics of an online review shape the readers (or consumers) perception of helpfulness. We define textual characteristics of a review as the semantic and stylistic features of the review (Cao, Duan, & Gan, 2011) which are related to a reviewer's writing style. Review characteristics, on the other hand, are defined as the basic characteristics of a review (such as star rating, review posting time, total up-votes) which can be observed easily (Cao, Duan, & Gan, 2011). Research on review manipulation (e.g. Hu *et al.*, 2012; Mayzlin, Dover, & Chevalier, 2014) have found evidence of manipulation of reviews by different stakeholders. Mowen, Park, and Zablah (2007) found that review quality and quantity frames people's purchase intention. However, with review manipulation, bystanders, sellers, and paid reviewers try to manipulate customer's intention by injecting fake positive for themselves as well as fake negative review for their competitors. Additionally, a study by Wan and Nakayama (2014) found that review helpfulness count for the reviews on the platforms are inflated. This suggests that the results of studies that have examined the relationship between various review characteristics and their perceived helpfulness could be biased. Most of these studies have also assumed that a higher utility perception of a review affects consumer trust and product sales (Mudambi & Schuff, 2010). However, as per Wan and Nakayama (2014) manipulation might backfire this assumption of increase in product sales. Thus, building on the study by Wan and Nakayama (2014), we try to understand how consumers perceive reviews with possible review manipulation (Hu *et al.*, 2012) on online business platforms. We use warranting theory as the theoretical lens to examine the phenomenon of review manipulation as discussed below.

Warranting Theory

Walther and Parks (2002) proposed warranting theory to theorize the phenomenon of impression management. Using the context of social networking sites (e.g. Facebook) they tried to understand the phenomenon of why experiences vary when people meet offline for the first time, after they have already met online. They suggested that this variation is a function of potential for anonymity which leads to the discrepancy in the outcome of experience. Researchers have applied warranting theory to understand how people assess an information and how does this assessment shape impressions in various context, such as social networking sites (Fox, Warber, & Makstaller, 2013), online dating sites (Ellison, Heino, & Gibbs, 2006) and online rating systems (Flanagin & Metzger, 2013). Most of these studies have found source of information to be an important predictor of information control.

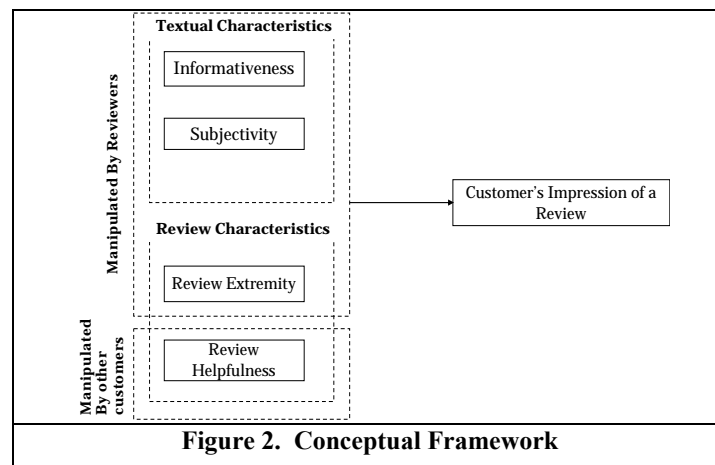
The term *warrant* in the warranting theory refers "to any cue that authenticates and legitimizes an online-presentation" (DeAndrea, 2014, p.187) and *warranting* refers to the process of validation. For e.g. Willemsen, Neijens, and Bronner (2012) claims that people labelled as experts are considered people with greater expertise over self-claimed experts in an online-community because, "...their status as experts is warranted by others" (p.23). As per DeAndrea's (2014), warranting theory proposes a psychological construct that reflects "perceptions about the extent to which information is immune to manipulation by the source it describes" (p.187). In other words, people attach credence to the information, if it is perceived to be unaltered by the target body to whom the information refers (DeAndrea, 2014). Warrants that are extremely difficult to manipulate by the user are considered high on warranting value, whereas those warrants that are easily manipulatable have a low warranting value. Warrants with low warranting value are considered questionable and perceived to be less authentic. Perceptions of the information controllability and the way it influences the perception is the core tenet of warranting theory. In summary, the warranting principle theorizes that *the lesser an information is perceived to be controllable by the person to whom it refers, the greater will be the weight it will carry in shaping impressions* (DeAndrea, 2014, p.188)

Applying this argument to the context of online reviews, the components of reviews (such as review text, review star rating, up-vote, downvote, reviewer name, and the reviewer badge) have higher probability of being subjected to manipulation. Out of these components, review text and star-rating are easily subjected to manipulation by reviewers. If a reviewer is paid, or is writing to seek social acceptance from others, then in both these cases the likelihood of information being subjected to manipulation is high. However, in the former case of the review being paid, the information controllability is also very high. Paid reviews and socially accepted (aka most helpful reviews) reviews are most likely to be extremely high rated reviews if meant to enhance the brand perception and visibility. While if the reviews are paid to tarnish the image of competitors, they are more likely to be extremely negatively rated (1 star). In summary, reviewers can manipulate the textual characteristics of the review, namely informativeness and writing style by

incorporating more stylistic characteristics. Moreover, reviewers can also manipulate review characteristics, such as review extremity (i.e. star rating).

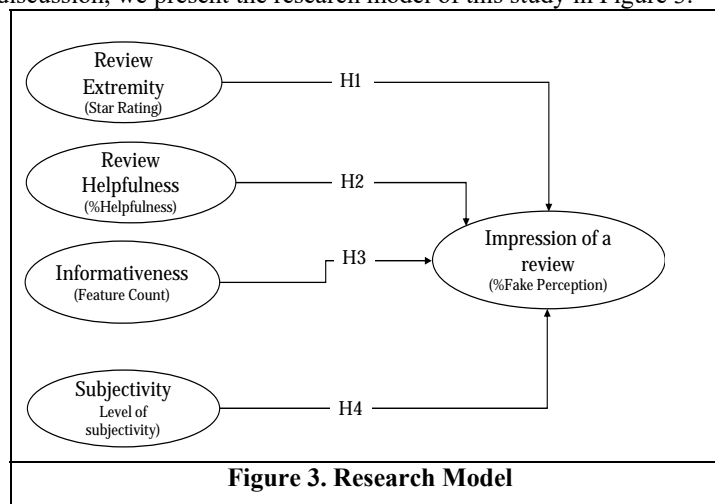
The information on up-votes and down-votes received by a review is provided by other customers who are neither involved in writing a review nor are related to the target body or bystander. Following warranting theory, information which is provided by the third-party about a target is perceived as more authentic, as it is difficult to control what others post or vote online (Walther *et al.*, 2009). As the number of likes and dislikes received by a review cannot be controlled by the target body, their authenticity is high because peer generated cues are more authentic than self-claims (Willemssen, Neijens, & Bronner, 2012). However, these can also be manipulated, when a large number of customers randomly provide up-votes to a product because of the herding effect leading to inflated reviews (Wan & Nakayama, 2014). Based on the discussion and extant literature, it is evident that review characteristics and textual characteristics can be manipulated by the target body as well as other customers.

E-commerce platforms initially created a section called *Customer Reviews* so as to allow customers co-create value with them (Prahalad & Ramaswamy, 2003). This section helped other customers create an impression of a product leading to a wiser purchase decision. However, with adulteration of reviews (both in terms of quality and quantity) due to manipulation, the impression of a review formed in a consumer's mind is hazy. As per the theory of selective attention, people selectively process the information as per their processing capability (Treisman, 1969). When a person receives cluttered information, human mind selectively chooses lesser information to process. Likewise, in the case of online reviews, customers selectively look at few reviews by applying sort and filters such as "Most positive", "Critical ones", "Top rating", "Most helpful" etc. These processing style varies from customer to customer. On these selected reviews customers then look for warrants (or cues) which help shape the perception of warranting value and ultimately the impression of a review. Figure 2 depicts the conceptual framework for this study.



HYPOTHESIS DEVELOPMENT

Based on the aforementioned discussion, we present the research model of this study in Figure 3.



Review Characteristics

According to the theory of selective attention, people read reviews selectively as reading all the reviews for a product is time consuming and a tedious job. On selection of reviews, consumers look for informational cues (or warrants) (DeAndrea, 2014) that help them authenticate the review. Star rating along with the review helpfulness is the first warrant people look for while selecting the review. Focusing on star ratings, e-commerce sites, such as Amazon and Flipkart, have a filter to view only specific star rating reviews or the most helpful reviews first. Further Amazon classifies the reviews as favorable (includes 5-star reviews) and critical (includes 1-star reviews) based on the star rating. Literature defines star-rating as review extremity which is the extent to which review is positive or negative (Mudambi & Schuff, 2010). Review extremity usually varies on a continuum from 1 to 5, where 1 means extremely negative and 5 means extremely positive rating for the review.

Prior research has suggested that many bystanders try to manipulate reviews by posting fake positives for themselves and fake negatives for their competitors (Luca & Zervas, 2016; Mayzlin, Dover, & Chevalier, 2014). Further, Aral (2014) in his article mentioned a study by Hu, Zhang, and Pavlou (2009) who compared the rating behavior of students with that on Amazon. They found that students rating pattern followed a normal-distribution with a crest in middle over J-shaped distribution of Amazon. Students rated products moderately as 2, 3 or 4 stars over Amazon reviewers whose frequency for 5-star reviews doubled that of 1, 2, 3, or 4-star reviews. Social influence can be one of the reasons for higher extreme ratings. Aral (2014) mentions that *"I had thought the place deserved a three...Her review moved me. And I gave the place a four"* (p.47). On the contrary, Wang (2010) observed that people tend to write more reviews in (higher volume) and prefer giving lesser extreme ratings in order to establish a social image on the review platforms. From, these inconsistent results it can be inferred that reviewer controls star-rating irrespective of what incites it. The higher controlling power of review extremity makes its perceived warranting value low, leaving customers suspicious of its authenticity. Further, it is well known that platforms such as Amazon offer their products to the reviewers for getting it reviewed, and in return platform offers them hampers and gift vouchers. In such condition, it is less likely to remain unbiased and provide an honest review for the product. Hence, we hypothesize:

H1: Reviews with extreme star ratings are perceived less impressive than reviews with moderate ratings.

Next, warrant that people look at is review helpfulness. According to the warranting theory, content has a high warranting value, if it is less likely to be controlled or manipulated by the target body (Walther *et al.*, 2009). Review helpfulness is given by other potential customers, who up-vote/down-vote (or like/dislike) a review depending upon whether they perceive the review as helpful or otherwise in making their purchase decision. Moreover, the research suggests that as any content given by a third-party has no role in influencing the content it is perceived to be more authentic (Walther & Parks, 2002). For instance, claims made by friends on social-networking sites have been argued to create more impression than the self-made claims (Walther *et al.*, 2009). Therefore, we argue that if a review is perceived to be highly helpful by the large number of people, it is more likely that it will be perceived as authentic by the customers as well. Hence, we hypothesize:

H2: Higher review helpfulness count for a review is likely to impress customers more.

Textual Characteristics

Bond and DePaulo (2006) have found that people are able to detect deception in visible lies in comparison with audible lies. Due to lack of social cues in an e-commerce platform detection of fake content or paid reviews becomes difficult. But as per warranting theory claims made by people have an impact on warranting value of the information (Walther *et al.*, 2009). Self-generated claims are difficult to evaluate as even the sincere disclosers can be easily faked and disguised as unbiased reviewers. In an e-commerce platform, all the reviews are the self-generated claims made by reviewers making them susceptible to higher perceived manipulation. As per Walther and Park (2002) an information present on one's personal webpage has low warranting value as compared to the information about the same person present on a website operated by a third-party. Similarly, a photograph posted by an individual on their social media account has lesser warranting value than an online photograph clicked by a third person or a newspaper journalist. Photograph posted directly by an individual might be the results of the application of various camera filters. Similarly, the reviews are the results of the linguistic characteristics chosen by the reviewers.

In this study we focus on two basic linguistic characteristics namely – informativeness and subjectivity that have been considered by most of the literature in distinguishing genuine reviews from shill reviews. Linguistic characteristics are in the hands of reviewers who write reviews. Linguistic characteristics depicts the self-claims made by a reviewer, hence making it vulnerable to perceived manipulation. As discussed earlier, informativeness of a review refers to the amount of product-related information present in a review (Ong, Mannino, & Gregg, 2014). Prior research divides product information into two categories: official and unofficial. Ong, Mannino, and Gregg (2014) found that fake reviews discuss a greater number of product features than genuine reviews. Taking this as the basis, it can be argued that paid reviews, which are often lengthier, cover product features in a review more elaborately and thus are high on informativeness. While a genuine review often discusses only few features. This is also because a review is usually written by a reviewer within a week or two of the purchase and to mention all features elaborately is a daunting task. Most users focus on few features in their evaluation due to their cognitive inability to process all the features. On the other hand, many fake

reviews are also injected to increase the number of high rating reviews. Such reviews usually consist of a single word or a single phrase such as “Good phone”, “Awesome”, “Excellent” and are low on informativeness. They usually do not contain much information about product features and are written with an intention to increase the number of ratings and in turn product ratings. Thus, reviews that are very low or very high on informativeness are likely to have high warranting value and are likely to be perceived as suspicious by customers.

H3: Reviews with moderate informativeness will be perceived more impressive over the reviews embedded with no or extreme informativeness.

Subjectivity is another measure to judge customer's product usage experience (Ong, Mannino, & Gregg, 2014). Researchers have used subjectivity as a parameter to judge reviews' perceived helpfulness and readership intention. Ong, Mannino, and Gregg (2014) found that in case of skill reviews percentage of usage of subjective sentences are lesser than in normal reviews. Using subjective sentences, customers describe unique experience with a product usage. With objective sentences customers list product description. The reviews loaded with objective sentences doesn't give any crucial information which can influence customer's purchase decision. Instead these reviews are injected as fake positive reviews so as to increase the visibility of the product on the platform. Most of these reviews rate different features of a product on a scale of ten. Ong, Mannino, and Gregg (2014) argue that reviews generated for the injection are mostly written by the customers who have never really used the product. In this case the reviews will have higher percentage of objective sentences over subjective sentences. This is because writing subjective sentences require writers to actually own and use the product for at least a few days, making such reviews less susceptible to suspicion, leading to the lower perceived warranting value.

H4: Reviews with higher level of subjectivity are perceived to be more impressive over reviews with lower level of subjectivity.

RESEARCH METHODOLOGY

Data Collection

We used mixed method approach in our study to collect the data. The unit of analysis in our study is a review. The data for main dependent variable (Impression of a review) was collected using an online survey developed using Qualtrics.com, an online survey site. The survey link was shared with the respondents using e-mail. Before sending the survey mail, we constructed the e-mail list of the respondents. We initially started with the post-graduate students of premium management institute of Central India. The institute on daily basis maintains a log of students who have received parcels from e-commerce sites. The log contains student's name, order receive date, order source, receiving date, student's enrolment number, and student's e-mail address. Later, the authors shared survey link on their Facebook account and requested their friends who shop online to respond and shared survey with avid shoppers. Facebook platform was chosen to cover heterogeneous customers. The respondents represent a mix of people from all over the country and also represent the sample for online shoppers.

The data for other variables was collected as objective data from Flipkart – a leading e-commerce platform in India – for all the mobile phones launched in India in 2017. The reason for selecting Flipkart and mobile phones was because almost 80% of the business of Flipkart comes from mobile phones and most of the big mobile giants (such as One Plus, Redmi, and Motorola) initially launched their phones exclusively on Flipkart. Further, the year 2017 in India witnessed rapid evolution in mobile technology. Before heading towards collection of reviews, we collected the product details (total ratings given to the product by the purchasers, total reviews received from the purchasers, product rating given by the Flipkart, and price of the product) of all the mobile phones available in Electronics Section on Flipkart. Later, we mapped their launch dates from Digits Magazine – a leading electronics magazine in the country.

On mapping the launch dates of all the mobile phones available on Flipkart at the time of data collection, we got 550 mobile phones that were launched in India in 2017. We further selected only those mobile phones which received more than 200 customer reviews. We were then left with 110 mobile phones. For each of these 110 mobile phones, we collected customer reviews from Flipkart. To build the customer reviews dataset, we wrote a R script to collect the data for each mobile phone. Flipkart has four filters on its customer reviews page namely- Most Helpful, Most Recent, Positive First, and Negative First. For each product, we collected reviews by applying each of these four filters so as to get an exhaustive set of customer reviews. We then removed duplicates, if any from the reviews dataset. The complete dataset thus consisted of 34,389 reviews. For each review we collected: (a) numerical star rating given by the reviewer to the product on the scale of 1 to 5 where 5 stands for highest rating, (b) review text, (c) title assigned to the review by the reviewer, (d) reviewer name (Flipkart tags anonymous reviews as Flipkart Customer), (e) buyer type (certified Buyer /Noncertified Buyer), (f) review date, (g) number of up-votes received by the review from other customers, and (h) number of down-votes received by the review from other customers.

Questionnaire Design

Before the survey construction for the main study, we conducted an exploratory study. Initially, we interviewed around 20 online shoppers and asked their opinion on customer reviews available on the e-commerce platforms and their understanding on its

manipulation. We stopped at 20 respondents because of the theoretical saturation in their reply. These interviewees were representative of the population who shop online. Interviews gave us an insight that most people are aware of presence of fake reviews on e-commerce platform. So as to not fall into the trap of these fake reviews customers take some preventive measures. For instance, one of the interviewees say *“For electronic products I first prefer to do a thorough search even visit brick and mortar stores and check product reviews. Often I visit critical reviews first so as to check where exactly the problem lies.”* Another one states *“In case of apparels I can easily distinguish fake reviews. Most of the times reviews include alternate names to describe the cloth type mentioned in product information. After being deceived 2-3 times, I now pay enough attention to the review details especially the product details. I have also stopped purchasing products from the site which had disappointment earlier.”* Some customers look for the helpfulness count as an indicator to distinguish between reviews and mentions *“...say for example if one or two reviews have 100+ likes and others have just 2 or 3 that considerable difference helps me identify how the review is.”* In summary, most of the customers are aware of the review manipulation prevailing on e-commerce platforms and take necessary precautions in analyzing them. With this exploratory study, it was evident that review manipulation has a huge impact on customer's purchase decision and influences trust towards an e-commerce site. Further, review characteristics play as deciders in predicting the quality of reviews.

Later, as per warranting principle information controllability is a crucial factor in accessing the warranting value. Thus, we then surveyed individuals on to catch the impression of a review. Alternatively, we also verified our qualitative findings using a quantitative survey. The instrument captures an individual's understanding on review manipulation by asking them to rate their understanding on a scale of 1 to 7 from *Strongly Disagree* to *Strongly Agree*. We found that 65.34% customers believed that sellers of Flipkart have an ability to control the reviews that appear on the e-commerce platform. 81% further, marked in agreement that they think reviews are manipulated by the sellers. Only 35% people felt confident that reviews are actually written by the actual users of mobile phone. Thus, to further comprehend how reviews frame an impression on customers, we tested our research model as presented in Figure 3.

The main survey instrument for this study aims to capture the dependent variable – impression of an online review (fake/genuine). Each review was presented to the respondents requesting them to categorize 30 set of reviews into either fake or genuine. After collecting reviews, we created a survey instrument to capture customer's impression of reviews by asking them to categorize reviews as fake or genuine. For survey instrument, we randomly selected 120 reviews from the review corpus of 34,389 reviews. We then divided these 120 reviews into 4 blocks containing 30 reviews each. Each block was evenly randomly presented to the survey participants such that each participant receives a block i.e. 30 reviews. Decision to keep a block of 30 reviews was made after interviewing few customers, who asserted that most of them read reviews up to 3 pages (each page contains 10 reviews on Flipkart and Amazon). One IS Professor and three IS scholars (also active online shoppers and mobile enthusiasts) reviewed the survey instrument. They were asked to share their feedback about the length of the instrument, content, and question ambiguity. Subsequently, the survey was presented online. Appendix A presents the snapshot of the survey instrument. Each review block was presented to an average of 50 respondents. Thus, combining responses for four blocks, we obtained a total of 246 responses. Table 2 presents the respondent characteristics. After removing the partial/incomplete responses, we were left with 202 usable responses.

Table 2. Descriptive Statistics of the Respondent's Characteristics

Variable	Categories	Frequency (%)
Gender	Male	129 (63.8%)
	Female	73 (36%)
Age	Under 18	0 (0%)
	18-24	68 (33.6%)
	25-34	115 (56.9%)
	35-44	15 (7.4%)
	45-54	4 (1.9%)
	Above 55	0 (0%)
Education	Below high school	0 (0%)
	Graduate	58 (28.7%)
	Post-Graduate	108 (53.5%)
	PhD	16 (7.9%)
	Other Professional degree	20 (9.9%)
Online Shopping Frequency	Once a week	20(9.9%)
	Once a fortnight	28(14%)
	Once a month	105 (51.98%)
	Once a six month	49 (24.26%)
Last Purchase made using Online Reviews	This week	32 (15.84%)

	Last week	36 (17.82%)
	Last month	107 (52.97%)
	Don't consider online reviews	27 (13.36%)
<i>Total</i>		202 (100%)

Operationalization of Variables

We operationalized the explanatory variables included in the model using the reviews dataset collected from the Flipkart. We have review extremity, helpfulness, informativeness, subjectivity, and objectivity as the explanatory variables. First variable – review extremity (on a scale of 1 to 5) – was measured as the numerical star rating given by the reviewer (Mudambi & Schuff, 2010). Review extremity varies from 1 to 5, where 1 depicts low rating and 5 depicts highest rating. Helpfulness was measured as the percentage of people who found the review helpful (Mudambi & Schuff, 2010). The percentage helpfulness was calculated by dividing the total number of up-votes received by a review to the sum of total up-votes and total down-votes for a review.

For measuring informativeness, we examined each review for the number of product features of the mobile phone discussed in the review. Although, it was subject to author(s) judgment, it was quite objective as it was quite easy to decipher number of features about the mobile phone discussed in the review. The last explanatory variable, subjectivity level (Tan *et al.*, 2018) was dummy coded as low, medium, and high.

The dependent variable – Impression of an online review – was operationalized using the data collected through the survey instrument and was defined as the percentage of people who found the review fake. This was derived by dividing the number of people who voted a review as fake to the total number of people who voted for a particular review (both fake and genuine). Dependent variable varies between 0.0 and 1.0. Numerically, we operationalized an impression of a review in terms of percentage of people who find it fake. Higher is the fake perception percentage, less likely is the review going to form an impression amongst the customers. Table 3 describes the variables used in our study. The descriptive statistics of the variable are presented in Table 4.

Table 3. Variables and their operationalization

Construct	Variable	Operationalization
Impression of a review	Fake Perception %	Percentage of people who found the review i as fake
Review Extremity	Star Rating	Numerical star rating assigned with a review i
Review Helpfulness	Review Helpfulness %	Percentage of people who found the review i helpful
Informativeness	Feature Count	Number of product features mentioned in a review i
Subjectivity	Subjectivity level	Dummy coded as low, medium, and high

Table 4. Descriptive Statistics for the Sample

Variable	Mean	SD	Min, Max, Med.	N
Impression of a review	0.38	0.0167	0.03, 0.8, 0.39	120
Review Extremity	3.61	1.58	1, 5, 4	120
Review Helpfulness	0.602	0.311	0, 1, 0.71	120
Informativeness	2.425	3.663	0, 18, 1	120
Subjectivity				High (31), Low (60), Medium (29); Total 120

DATA ANALYSIS AND RESULTS

We used fractional logit model to analyze our research model due to the nature of the dependent variable (Papke & Wooldridge, 1996). The bounded nature of the dependent variable (impression of a review) makes this technique suitable. The variable in our case is bounded within 0 and 1. The main issue with using OLS, when the dependent variable is ratio, is that the predicted values can never be guaranteed to lie within unit interval (Papke & Wooldridge, 1996). Fractional logit model does not consider any structural assumption for prediction of the dependent variable. The main advantage of this statistical method is that it can also address the possibility of non-normal errors, heteroscedasticity, and non-linear errors, if any. Another reason which makes the model suitable for our data is that the predicted value of the dependent variable can also include 0 and 1, 0 when the review is considered entirely genuine by the customers and 1 when everyone who encounters the review regards it as fake.

In H1, we hypothesized that review extremity shapes impression of a review. We expect that reviews with extreme star ratings should be perceived as less authentic over reviews obtaining moderate ratings. Thus, we expect a non-linear relationship between review extremity and impression of a review and hence modelled the same by incorporating both linear (star rating) and quadratic term (star rating²). Further, we expect linear term to be negative and quadratic term to be positive, that is a U-shaped relation, implying that reviews with extreme star ratings would be perceived more fake (or less authenticity) than reviews which received moderate ratings. To test hypothesis H2, we include percentage of helpfulness. In H2, we expect that increase in review helpfulness decreases

perception of fakeness towards a review. For H3, we included number of product features mentioned in a particular review. Similar to review extremity, we expect informativeness to follow non-linear relationship with review impression, hence, we included both linear (feature count) and quadratic term (feature count²). We expect a U-shaped relationship with linear term to be positive and quadratic term to be negative implying, fake perception of a review decreases at a threshold point and then again increases with each additional product feature mentioned in a review. To test H4, we used dummy of subjectivity level. We expect that highly subjective reviews to decrease perception of a review being fake making it useful in product evaluation. Based on the explanation, the resulting non-linear model is

$$\text{Fake Perception\%} = G(\beta_1 + \beta_2 (\text{Star rating}) + \beta_3 (\text{Star rating})^2 + \beta_4 (\text{Helpfulness Percent}) + \beta_5 (\text{Feature Count}) + \beta_6 (\text{Feature Count})^2 + \beta_7 (\text{Subjectivity Medium}) + \beta_8 (\text{Subjectivity High})) \quad (1)$$

Where $G(\cdot)$ function satisfies $0 < G(z) < 1$ for all z belongs to real number. $G(z)$ function guarantees that the predicted values lie within 0 and 1. $G(z)$ can be any cumulative distribution function (Papke & Wooldridge, 1996), and we have used logistic functional model (Ramalho *et al.*, 2011). The results of estimating equation 1 are presented in Table 5. The statistical modeling was done using 'R' – an open source software for multiple statistical purposes.

Table 5. Fractional Logit Model Output

Fractional logit model Output DV: Fake Perception%				
Variable	Coefficient	Standard Error	t-value	Sig
Constant	1.266	0.279	4.538	0.000***
Star Rating	-1.512	0.228	-6.632	0.000***
(Star Rating) ²	0.263	0.0362	7.263	0.000***
Helpfulness %	-0.507	0.175	-2.891	0.004 ***
Feature Count	-0.0596	0.041	-1.429	0.153
(Feature Count) ²	0.008	0.002	3.360	0.001 ***
Subjectivity Medium	-0.055	0.143	-0.387	0.699
Subjectivity High	-0.345	0.146	-2.356	0.018 **
Observations	120			
R-squared	0.484			
RESET	0.288 (0.592)			

Value in parentheses in the RESET statistics are p-value; these are obtained from a chi-square distribution with two degrees-of-freedom. Note: p-value < '***' 0.001; '**' 0.01; '*' 0.05; '.' 0.1; ' ' 1

All the variables are highly significant except the linear term of feature count and medium subjectivity level. The higher p-value of RESET statistics suggest that equation 1 has no misspecification (Papke & Wooldridge, 1996). This suggest that there is a non-linear relationship between both star rating (review extremity) & feature count (informativeness), and fake perception (review impression). The linear negative and quadratic terms being positive indicates our hypothesized U-shaped relationship of view extremity, and informativeness with the dependent variable. In case of non-linear econometric models, it is difficult to interpret the coefficients. However, the results in Table 4 inform the direction and statistical significance of the relationship between independent and dependent variables. Thus, from Table 4 it can be interpreted that increase in review and textual characteristics shapes negative impression of reviews in a consumer's mind.

For interpreting the magnitude, literature suggests computation of average partial effects (APE) (Gallani, Krishnan, & Woolridge, 2015). APE's coefficients are interpreted similar to linear regression coefficients. As per Gallani, Krishnan, and Woolridge (2015) "calculation of APE involves computation of marginal effect at every observation, and then averaging the marginal effects across the range of the predictors" (p.18). Further, Gallani, Krishnan, and Woolridge (2015) states that "by calculating and interpreting APE's, the researcher obtains useful information about the average magnitude of the causal relation, without compromising the non-linearity of the model and its enhanced fit characteristics compared to the linear ones" (p.18). Table 6 presents the APE results.

Table 6. Average Partial Effects

Average Partial Effects DV: Fake Perception%				
Variable	Coefficient	Standard Error	t-value	Sig
Star Rating	-0.3378	0.0486	-6.952	0.000***

(Star Rating) ²	0.0587	0.0077	7.671	0.000***
Helpfulness %	-0.1134	0.0392	-2.895	0.004 ***
Feature Count	-0.0133	0.0093	-1.433	0.152
(Feature Count) ²	0.0018	0.0005	3.402	0.001 ***
Subjectivity Medium	-0.0124	0.0320	-0.387	0.698
Subjectivity High	-0.0770	0.0326	-2.363	0.018 **

Table 6 shows negative sign in linear term and positive sign in quadratic term of star rating. These terms suggest a U-shaped relationship, implying that reviews with extreme star rating are quite likely to be less impressive than moderate reviews. In other words, with an increase in star rating, the fake perception and star rating graph decreases till a certain point and then increases thereafter, thus supporting hypothesis H1. It has to be noted that dependent variable -impression of a review measures fake perception percentage, which means the percentage of people who find a particular review to be fake. Higher value of fake perception implies lesser impressive (or authentic) review. In other words, review with extremely high ratings (5 star) and extreme low ratings (1star) are likely to be perceived less authentic than reviews with moderate ratings (2, 3 and 4 star). Results show that one percent increase in the count of review helpfulness decreases the fake perception percentage by 11.34%. Thus, reviews with higher review helpfulness percentage are perceived to be more impressive, supporting hypothesis H2. On examining the coefficients of informativeness, linear term feature count is insignificant, but the quadratic term of feature count appears as significant in the model. The negative and positive signs of linear and quadratic terms respectively suggest that a non-linear relationship exist between informativeness and fake perception percentage. This make reviews with moderate feature count more impressive, thus supporting hypothesis H3. Next, for subjectivity level, we have considered low subjectivity level as the base category. Thus, the coefficients on the two dummy variables measures a proportionate difference in impression relative to low subjectivity level. Variable subjectivity medium turned out to be insignificant, but subjectivity high comes significant. The coefficient of subjectivity medium suggests that highly subjective reviews decreases fake perception by 7.7% with respect to lower subjectivity level reviews. In other words, more people find lower subjective level reviews to be fake as compared to highly subjective reviews. In terms of impression, highly subjective reviews have 7.7% more likelihood to impress people over lower subjective reviews. This supports hypothesis H4. However, nothing can be inferred for reviews having mediocre subjectivity level.

DISCUSSIONS AND IMPLICATIONS

Discussion for Findings

The objective of this study was to examine the factors that led people to evaluate a review, something that all customers engage on a day-to-day basis on online platforms. Using warranting theory, we found that characteristics of a review and textual characteristics of a review play a role in shaping impression towards a review. All of our hypotheses are supported. The study is first of its kind that examines the antecedents of review impression in terms of review quality. Prior scholarship has confined their research on review valence in understanding customers' response towards review manipulation (Jin Ma & Lee, 2014). They found that, when informed of review manipulation customer's trust towards a review influences their purchase intention. Two insights were generated from this study. First, that customers understand review manipulation and heuristics shape an impression of a review. Second, we found that online review information and social cues shapes customer's perception in terms of its being fake. Further, using exploratory study we found that unnecessary manipulation of reviews makes review unattractive, and thereafter affects platforms in terms of website stickiness.

Our findings can also be explained by an alternative theory, i.e. elaboration-likelihood model (ELM) (Petty & Cacioppo, 1986). This theory is apt for understanding why some informational content is more persuasive over other. Theory suggests two distinctive routes to persuasion namely: central and peripheral. Under central route, persuasion occurs when a person thoughtfully ponders over the merits of the information presented in front in support of advocacy. Whereas, under peripheral route, persuasion results from simple cues, primarily due to the familiarity or association with them. It is the people's motivation and ability that influences route selection. Considering informativeness, and subjectivity level as central cues, and star rating and review helpfulness as peripheral cues. Depending on customer's motivation and their ability to comprehend people will chose either of the cues to make their decision. Our results show a consistent negative relation between both central and peripheral cues towards impression formation.

Implications for Theory and Practice

This study presents interesting implications for both theory and practice. Theoretically, we contribute in three ways. First, much of the literature pertaining to review manipulation has focused on its detection and later its impact on product sales (Hu *et al.*, 2012). Previous studies in both computer science and Information Systems have established that review manipulation is wide-spread amongst the sellers and is evident in the online platforms (Hu *et al.*, 2012; Luca & Zervas, 2016; Mayzlin, Dover, & Chevalier, 2014). Even the studies in computer science have focused on identification of review manipulation and built algorithms to identify fake reviews. While those studies which have focused on identification of fake reviews have considered reviewer characteristics, review characteristics, as well as product characteristics. However, none of the studies have incorporated customer's perception while studying review manipulation and its ultimate impact on review impression. Consumer perception of a review is more

important in influencing sales than the perception of the platform. The results of this study suggest that costumers' do understand the review manipulation and review characteristics (such as helpfulness, review extremity) and textual characteristics (such as informativeness and subjectivity) shape customer's impression towards a review. Secondly, we contribute to the literature by presenting review performance parameters. Earlier research has used review helpfulness as an ultimate measure of review performance (Mudambi & Schuff, 2010). However, Wan and Nakayama (2014) proposed the manipulation of review helpfulness count, suggesting inflated and biased results towards the most explored research question "what makes a review helpful?" Thus, we used review helpfulness as an antecedent in forming impression of a review. Thirdly, we contribute to the literature by identifying the cues which affect customer's perception to the increased review manipulation. We found that customers' use textual and review characteristics as signals to deal with review manipulation. We further contribute by establishing the relationship between these cues and customer's perception using warranting theory, thus furthering the frontiers of research on online manipulation.

This study also has interesting implication for practice. From the survey data it was evident that considerable number of customers regard review as fake, the fake perception- the dependent variable ranged from 0% to 80%. This suggests that about 80% people perceived a review as fake. This perception has a huge impact on platforms stickiness. Exploratory study pointed out that people have boycotted a platform, if they encountered mismatch between product description and product received. Additionally, Table 1 also mapped the consequences of customer's perception on attitude towards an e-commerce platform and sellers. We suggest e-commerce platforms to keep an eye on the online reviews posted on their platform. Apart from that, e-commerce platform can deal with fake reviews by introducing a *disputed flag* to highlight the authenticity of the review. This flag will alert the customers of the review's authenticity while they are reading the reviews. Also, they can highlight the paid reviews by introducing a badge, this will help customers decipher information appropriately.

CONCLUSION, LIMITATIONS, AND FUTURE RESEARCH

The objective of this study was to examine whether and how customer perceive online reviews as manipulated. To date, review manipulation has been studied from the firm's perspective and has not incorporated customer's perspective while studying review manipulation. Accordingly, we used mixed method approach to examine customer's impression towards an online review using interviews and survey. Overall, this paper contributes to the literature by conceptualizing customer's impression a review. The results of this study also present interesting insights into customer perception of online reviews as manipulated. Customers do perceive online reviews as manipulated as such perception is primarily driven by review extremity (star-rating) and informativeness (feature count), review helpfulness, and subjectivity. The results of this study reveal that even a slight manipulation of informational and social cues of a review drastically lowers the review impression.

The results of our study should be interpreted in the light of its limitations. First, we have confined the study only to a single product category (mobile phones). Thus, there is a risk with our findings in terms of generalizability. Future studies could confirm the results by using a sample of diverse product. Secondly, we have taken only 120 reviews out of 34, 389 reviews collected, and classified them as fake/genuine by the online shoppers. Although this number is small, and its representativeness may be questioned, we took measures so that this sample remains representative of the entire population. We used random sampling procedure for selecting these 120 reviews. Nonetheless, future studies may build a prediction model by classifying a larger sample as fake/ genuine using customer's perception and then using it as a training sample for classifying the rest of the population of reviews. This would give much better insight into what makes a review impressive. Third, there could be a moderating effect of product type (such as search goods, and experience goods) on shaping customer's perception, which can be considered in future studies along with other control variables (such as customer experience and profession). Fourth, qualitative research opens up further avenues to verify and bring stability to our results.

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APPENDIX A: Screenshot of Survey Instrument

This survey aims to understand customer's perception of online reviews. In this survey, we request you to classify following set of mobile reviews from Flipkart into **FAKE and GENUINE reviews**. By the term fake reviews, we mean

- A. The reviews that are written by an individual with little or almost no experience of the product usage;
- B. Paid reviews
- C. Reviews that are written with an intention to increase product's visibility or damage image.

The survey's responses will be used only for research purposes.

Thanks in advance for sparing your time and efforts

Please classify the following review as per your perception as FAKE or GENUINE

5 Star : Terrific

To order this phone in flash sale -> use a laptop/ pc with a high speed internet connection (strongly recommend) -> be at the site at 11:50 and log in your ID and save your address :- when the clock turns to 11:56 .. reload the page continuously untill you get the buy now option :- now not wasting time place order very fast or else it will be sold out :- choose COD (recommend because other options take much time) Note :- i myself has ordered two redmi note 4 (a gray and a black) Thank you for reading this

Likes Received : 330 | Dislikes Received : 196

MohdAmair Sohail | Certified Buyer | 08-Mar-17

- ☐ FAKE
- ☐ GENUINE

Empirical Study About the Motivations for Using Multifunctional Social Media: Based upon the Uses and Gratifications Theory

(Full Paper)

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ABSTRACT

Social media is a kind of online platform which used by people to share contents and contact each other via virtual communities and networks. With the development of information technology, it becomes neoteric and multifunctional. In order to examine what factors affecting individuals' usage intentions for the various functions of social media, we proposed a model based on the uses and gratifications theory, this theory indicates there are three types of motivations, named as social motivation, utilitarian motivation and hedonic motivation, then six factors derived from the three motivations are presented. We collected 404 samples from the QQ users from 77 cities in China, with statistical analysis, the result shows that four of them can significantly affect individuals' usage intentions of QQ' various functions beyond as an instant messenger. This study extends current understanding about the usage motivations of social media and it can be a reference for future research in this field.

Keywords: Social media, uses and gratifications theory, motivation, user adoption

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INTRODUCTION

Different from traditional contact ways such as letter and telegram, social interaction based on computer networks brings us a convenient and fast way to communicate with others. With the gradually evolution and development, social media came out, more than communicate with our acquaintances, this technology acts on helping us to build social networks or social relations with other people who share similar personal or career interests, activities, backgrounds or real-life connections (Obar & Wildman, 2015).

In the beginning, social media's main function was Instant messaging (IM), it generally deemed as a text-based tool whose sending and receiving short messages almost synchronously via the internet (Shiu & Lenhart, 2004). Later, as it said in Boyd and Ellison's (2010) article, social media possesses a variety of new technical features, and they allow individuals to construct a public/semi-public environment, articulate a list of other users that they share a connection with, and view their lists of connections in the system. In addition, with the high-speed development of information technology, many new functions about social media appeared, meanwhile it frequently consorts with other fields and brings trans-disciplinary functions, such as electronic game, books, music, video. Nowadays, social media are always comprehensive and multifunctional. At present, there are many social media in the world, billions of people use them every day. The largest social media platform in this world is Facebook with approximately 1.79 billion monthly active users worldwide, the second is QQ, it has 887 million monthly active users (Facebook, 2016; Tencent, 2016). In addition, other social media platforms, such as Twitter, LinkedIn, MySpace and WeChat also have numerous users in the world, and each of them has various kinds of functions.

Since there are millions of people use it, social media has a huge influence on our daily life, the significance of studying it becomes prominent. What is the future direction of social media, and which aspects of it should improve? These questions are worthy of concern. In order to explore these issues, we adopt uses and gratifications theory (UGT), this theory stands in the users' position and focuses on why and how they use a specific media to satisfy their needs.

What we want to investigate is about the motivations for people using social media, a number of similar studies have been conducted in this research field. However, as we mentioned in preceding text, social media is continually evolving and more and more new functions appearing, these functions can not only assist us in communication area, but also applied in various aspects of our life, this issue was rarely mentioned in previous literature. In order to fill in the research gap, our research concluded the new functions of social media in three aspects, respectively, they are social motivation, convenience of living and working and amusement. Aiming at these three aspects, we want to know what factors can motivate people using a multifunctional social media, the results can tell us which kinds of social media functions are influential, so we can arouse more attention to them and put forward practical suggestions to social media industry.

In this research, we collected data from the users of QQ, mainly because it is the largest social media platform in China. In the beginning, QQ was a simple instant messaging chat software, later it developed rapidly and extended its functions. As Ma Huateng, the Chairman and CEO of Tencent said "we have sought to enrich the lives of our users through technology, prompting

us to expand from communications to social networking, digital media, digital entertainment, and a world-leading technology and payments infrastructure."(Tencent, 2016) Now QQ has become a compound social media platform covering diversified aspects, so it can be an appropriate example for our research about the usage intentions of multifunctional social media platforms.

The paper proceeds as follows. In next section, we review previous research in the social media area and introduce UGT as the theoretical background of this study. In Section 3, we propose our research model and hypotheses; In Section 4, we expound the research methodology includes the processes of development the measurement instruments, collected and analyzed data, and tested the hypotheses, After that; in Section 5, we analyze the results from the previous section; Finally, we discuss the findings, implications and limitations of our study in Section 6.

LITERATURE REVIEW AND THEORETICAL BACKGROUND

Social media

Social media is defined as an online platform, used by people to build social networks or social relations with others who has similar interests, activities, backgrounds or real-life connections (Obar & Wildman, 2015). In some works the term "social network service" was also put forward, it has similar definition with social media, and some literatures mentioned social media as social networks (Boyd & Ellison, 2010) . For preciseness, in this paper, we may pay more attention to the contents belong to the scope of "social media", but the relevant contents of "social network service" could also be well references.

According to Obar and Wildman's research(2015), recently, social media have 4 common features, respectively are:

- 1) Social media are based on the concept of "Web 2.0". Put forward in 1999, Web 2.0 emphasizes the usability and interoperability for users, under this circumstance, we can create, communicate, collaborate and share diversified content (Dinucci, 1999). Therefore, social media is always interactive,
- 2) Social media's content is user-generated. Users of modern social media always owe their profile pages, they can upload their text, photo and video, chat with friends and watch other people's content, most actions happened in a first-person perspective.
- 3) Users need send service-specific profiles to the social media platforms, these profiles are mostly personal identifying information, with which we can find and communicate with each other, furthermore, many network functions, such as sharing, voting, liking and comparing the score of games need the user profiles, profiles are the backbone of social media.
- 4) Social media build online social networks by connecting a person's profile with the profiles belong to others. Users always create a social network by setting a list of people which they want to contact with, they can see the information of the members and manage their interactions through this list, at the same time, they are in others' lists. In addition, many social media allow users to set up a group in which the members have same interest, purpose or real-life communication.

Our research focuses on individuals' motivations for using the various kinds of functions of social media. Previous research has observed related issues, in respect of Facebook, scientists found that computer-mediated communication motivation can be a mediator variable between personality traits and attitude toward Facebook (Yan & Chua, 2017), but motivation is not this research's main objective, it just put forward generally as a mediator variable and lack of further detailed analysis. Dhir (2017) aims at psychosocial attributes of well-being and stand in a personal perspective, investigating a number of personal factors that drive adolescents' intensive using of Facebook. The result showed online sociability and bridging of social capital were the significant predictors of adolescents' intensive using of Facebook, it confirms the importance of social factors, but we think more aspects should take into consideration not only psychological factors, and the scope of users can be wider.

Besides, there are a number of researches about other social media, Salehan (2017) use a motivation-participation-performance framework to investigate the factors affect individuals participating in social media activities. The respondents are from a few social media platforms, such as Cyworld (a Korean social media), Twitter and Facebook. In this article, motivations are divided into four categories, they are vertical social motivation, horizontal social motivation, hedonic motivation, and utilitarian motivation, they respectively have effects on the participation in various degree. This research can be an applicable reference to us in respect to the definition and classification of motivations, but this research only focuses on using social media' sharing and collaboration functions.

The above-mentioned studies have made significant contributions in the research are of social media, but there are still some issues that beyond their consideration. As mentioned above, with the development of information technologies, social media are getting constant improvement, our research aims at exploring the antecedent factors of usage of comprehensive functions of social media, we hope our study could fill the vacancy to some extent in this research field.

Uses and gratifications theory

Originated in 1940s, uses and gratifications theory (UGT) was developed from a number of prior theories about the socio-psychological communication tradition, this theory utilizes an audience-centered approach, which helps us understanding mass communication, explains why people choose one media over alternatives to fulfil their various needs (Severin & Tankard, 2001). Observing from a new perspective, UGT focuses on "what do people do with media?" instead of "what does media do to

people?"(Katz, 1959).

UGT has been widely used to the researches about traditional media, such as newspaper (Berelson, 1949) and TV (Mcquail, Blumler, & Brown, 1972). At a very early age around 1944, researchers began a work on investigating the reasons what influence people to choose specific types of media, they interviewed a number of soap opera fans and investigated why people listened to soap operas, according to this study, gratifications of audiences can be identified to three types, they are emotional, wishful thinking, and learning (West, Turner, & Zhao, 2010). Besides, McQuail, Blumler, and Brown (1972) had a research on the 1964 election in American by investigating people's motivations for watching certain political programs on TV. They suggested that the uses of different types of media could be classified into 4 categories: diversion, personal relationships, personal identity and surveillance.

Stepping into the information age, with the appearance and development of internet, scholars applied UGT to identify motivations for using Internet. For example, UGT is used to research people's usage motivations in mobile network (Leung & Wei, 2000), online game (Wu, Wang, & Tsai, 2010) and social media platforms. For instance, researchers found that the main motivations for people using social media sites in MySpace and Facebook are finding old friends, making new friends, learning about events, creating social functions, and feeling connected (Raacke & Bondsraacke, 2008). Besides, in a research about Facebook users' gratifications related to their civic participation offline (Park, Kee, & Valenzuela, 2009), authors interviewed a lot of college students about their level of agreement with specific reasons for using Facebook groups, the results showed that there were four needs for using Facebook groups, respectively are socializing, entertainment, self-status seeking, and information. In addition, a recent study used UGT to investigate the motivations for participating in social media interactions, it indicates that there are three categories of motivations which can satisfy people's needs: utilitarian motivation, social motivation and hedonic motivation (Salehan, Kim, & Kim, 2017). Utilitarian motivation is goal-oriented with practical purpose, social motivation is a motivation about social relationship and hedonic motivation is related to the fulfillment of hedonic expectations.

Based on the prior researches, we assume that people's usage intentions of the various functions of social media are stimulated by various motivations. We apply the UGT to our study and generate the hypothesis, and the three major types of motivations, namely social motivation, utilitarian motivation, and hedonic motivation are used to build our model, in the next section, the research model will be put forward and later we will have empirical analysis on it.

RESEARCH MODEL AND HYPOTHESES

Based on the UGT, in this study, three major types of motivations for people's usage intentions of various functions of the social media are identified, they are social motivation (Relationship benefit, Subjective norm and Social connection), utilitarian motivation (Perceived usefulness and Image enhancing), and hedonic motivation (Enjoyment). Figure 1 depicts our research model.

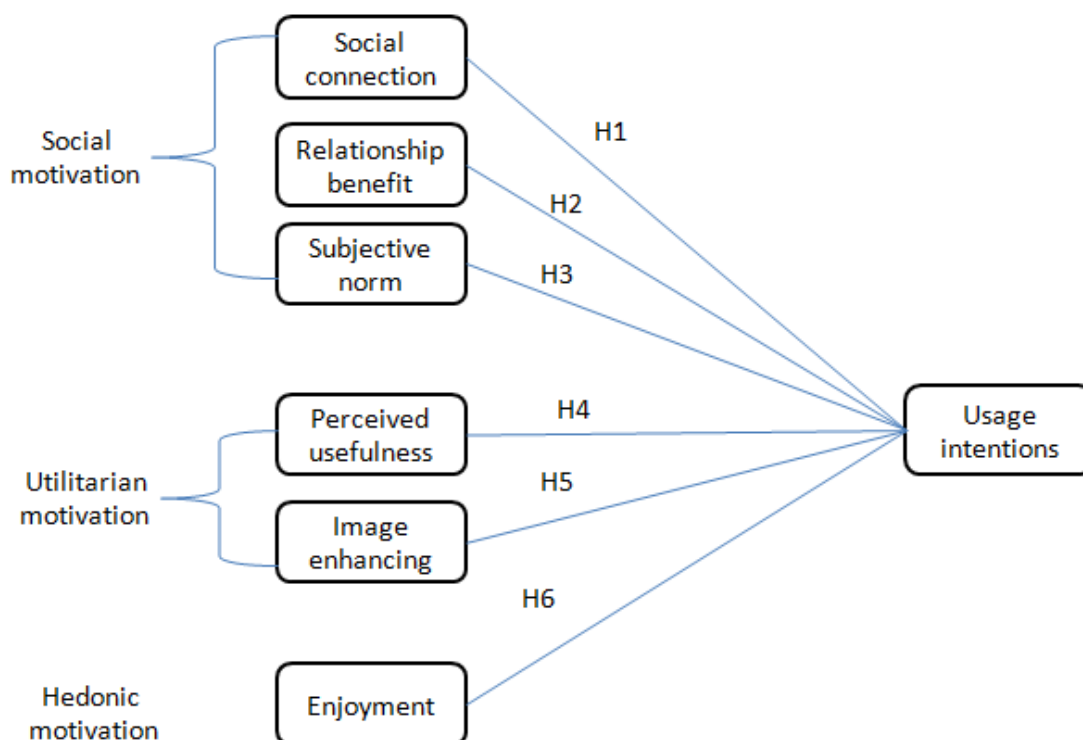


Figure.1: Research model.

Social motivation

Social motivation is defined as a motivation for maintaining social relationship. People can use media to satisfy interpersonal needs, and use interpersonal communication to satisfy their psychological needs, the social media, in particular, can be an instrument for interpersonal communication (Flanagin & Metzger, 2010).

Previous literatures indicated that social or interpersonal interactions can be the reasons for people using social media (Ebersole, 2000), we use two factors, social connection and relationship benefit to describe the interpersonal interactions.

Social connection, also named as social relations or social interaction, is any relational ties between two or more individuals. In this study, high social connection means people are willing to spend plenty of time for keeping in touch with their current friends. They can interact with others by chatting in QQ, posting messages in QQ space (something like blog) or in other ways (e.g., play QQ game and video chat), by this way, people can maintain and strengthen the relationship with others.

When using social media, people would get relationship benefit, it emphasis on establishing relationship with new friends , we consider that people use social media, not only for keeping connections with their current friends and acquaintances, but also want to extend their social circle. With the help of social media, users can find people with similar interest and purpose online, or get in touch with unfamiliar persons in an organization or a specific place in real world.

As mentioned above, social connections and relationship benefits are important purposes for using social media, the social media can help user strengthen social relationship with current friends, they also can make new friends with others, so we predict:

H1. Social connection can positively affect people's usage intention of the various functions of social media.

H2. Relationship benefit can positively affect people's usage intention of the various functions of social media.

Meanwhile, we consider the subjective norm may also significantly affect peoples' usage intention of the various functions of social media. Subject norm is a kind of social influences, which conceptualized as the pressure that people perceive from important others to perform, or not to perform a behavior ; Schepers and Wetzels (2007) regarded subjective norm as a factor influence people accepting a technology. As we point out before, enormous people use social media, most of us cannot avoid being affected by the people around us, so we take subjective norm into our model because people may feel the pressure that from others. In a situation of high social norm, the sense of pressure will compel users using social media in order to adapt to their group, so we predict that subject norm will promote the usage intention of the various functions of social media, then the hypothesis are put forward:

H3. Subjective norm can positively affect people's usage intention of the various functions of social media.

Utilitarian motivation

Utilitarian motivation deals with the use of social media for goal-oriented, mission-critical, rational, and decision-effective user tasks. It has been widely validated and applied in research about utilitarian-oriented information system, such as workplace and student settings (Venkatesh & Brown, 2001). In our study, we assume that users care about the benefits which they can get from using social media platforms, in this process, users may get convenience in work and daily life, they feel the quality of their life are improved, and their gratification for this effect brings their utilitarian motivations. In this study, utilitarian motivation is composed of two factors, Perceived usefulness and Image enhancing.

Davis (1989) developed a Technology Acceptance Model, a significant construct named "perceived usefulness." It was defined as " The degree to which an individual believes that using a particular system would enhance his or her job performance", this construct is widely used in the researches about the motivations for using an information technology. In our study, people not only believes that using social media system would enhance his or her job but also affect their daily life, so we extend "perceived usefulness" to describe the degree to which people think using social media can be conducive to their communication with others in daily life and job. If people think social media are conducive to them, namely they think social media is in high perceived usefulness, they will be glad to use them and get benefits, so it is reasonable to estimate that perceived usefulness can positively affect people's usage intention of the various functions of social media.

Rogers (2003) defined image enhancing as "the degree to which use of an innovation is perceived to enhance one's image or status in one's social system". In his Diffusion of Innovations Theory, he explained that "undoubtedly one of the most important motivations for almost any individual to adopt an innovation is the desire to gain social status". Besides, as discussed by Tornatzky and Klein (1982), researchers have found that the effect of Image is different from relative advantage, it should be considered as a separate factor. In our research, this factor means people think they can get recognition, image and fame from others by using social media platforms. High image enhancing brings people sense of social identity, they will feel the impressions in front of others are improved, so we propose that image enhancing can positively affect people's usage intention of the various functions of social media. Then we hypothesize:

H4. Perceived usefulness can positively affect people's usage intention of the various functions of social media.

H5. Image enhancing can positively affect people's usage intention of the various functions of social media.

Hedonic motivation

Hedonic motivation is related to the fulfillment of hedonic expectations, it refers to using social media for happiness, fantasy, awakening and sensuality, we concluded it as enjoyment. In the field of information system, enjoyment is identified as a dominant motivator or a prominent intrinsic motivation driving an individual's use of a hedonic IS platforms (Ryan & Deci, 2000). The benefit of hedonic motivation is emotional fulfillment and the reasons why hedonic social media users using social media is because they enjoy experiential and emotional pleasure derived from doing so (Heijden, 2004).

In prior literatures, enjoyment has been proven to be a dominant and strong determinant of the intention to use a hedonic IS systems, such as playing games (Wu, Wang, & Tsai, 2010) and social network sites (Xu et al., 2012). Current social media has various functions that can entertain people, such as interesting news, e-books, chatting with friends, videos and games, a great number of people are willing to use these social media functions for getting enjoyment. We believe that it can be a significant factor of motivations for using social media. Hence, a hypothesis is posited:

H6. *Enjoyment can positively affect people's usage intention of the various functions of social media.*

METHODOLOGY

Data collection

We utilized online questionnaire to test the research model. The variables include six independent variable, social connection (SCCN), relationship benefit (RELA), Subjective norm (SBNR), perceived usefulness (USF), image enhancing (IMG) and Enjoyment (ENJ) and one dependent variable. All the items were adapted from prior research to ensure the content validity. They were measured with a seven-point Likert scale, ranging from strongly disagree (1) to strongly agree (7).

Sample demographics

After dropped the invalid respondents who chose the same scores for all questions or spent less than 3 minutes in this questionnaire, a total of 404 respondents completed the questionnaires. Table 1 shows the demographic statistics of the samples. The subjects are from 77 cities of 23 provinces in China, their occupations include student, clerk, worker, manager, and others.

Table 1: Sample demographics.

Measure	Item	Frequency	Percentage(%)
Participants	In total	404	100
Gender	Male	196	48.5
	Female	208	51.5
Age	<=20	33	8.2
	21--25	216	53.5
	26--30	42	10.4
	31--35	33	8.2
	36--40	18	4.5
	40+	62	15.2
The period in using QQ	Less than 1 year	5	1.2
	1-3 years	29	7.2
	4-6 years	103	25.5
	7-9	111	27.5
	Above 9	156	38.6
Frequency of using QQ(per day)	Less than 1	78	19.3
	1-3	134	33.2
	4-6	55	13.6
	7-9	27	6.7
	Above 9	110	27.2
Average time of using QQ(per day)	Less than 20min	133	32.9
	20min-1h	105	26.0
	1h-2h	50	12.4
	2h-3h	39	9.6
	More than 3h	77	19.1

RESULTS

Measurement model analyses

In this study, confirmatory factor analysis (CFA) was adopted to test the measurement model, and we used convergent validity and discriminant validity to test the constructs of the research model. Convergent validity is used to measure whether each

measurement item is related to its corresponding theoretical construct. It can be assessed by examining item reliability, composite reliability, Cronbach's Alpha and average variance extracted (AVE) of each construct (Fornell & Larcker, 1981).

As shown in Table 2, we can see the Cronbach's Alpha is above 0.7, the composite reliability of all of the constructs is above 0.7, and the AVE is above 0.5, all of them are beyond their respective thresholds, so ensuring a good reliability. Table 3 shows that the factor loading of all items are above 0.7, it demonstrates that the item reliability is acceptable. All in all, these results confirmed our data has a high convergent validity.

Table 2: Descriptive results and internal consistency of model constructs.

Construct items	No. of items	Cronbach's alpha	AVE	Composite reliability
Social connection (SCCN)	3	0.913	0.852	0.945
Relationship benefit (RELA)	3	0.907	0.843	0.942
Subjective norm (SBNR)	3	0.908	0.845	0.942
perceived usefulness (USF)	3	0.937	0.888	0.960
image enhancing (IMG)	3	0.947	0.905	0.966
Enjoyment (ENJ)	4	0.948	0.865	0.963
Usage intentions (INT)	4	0.940	0.848	0.957

Table 3: Factor loadings and cross-loadings for all constructs

	SCCN	RELA	SBNR	USF	IMG	ENJ	INT
SCCN1	0.911						
SCCN2	0.919						
SCCN3	0.938						
RELA1		0.889					
RELA2		0.937					
RELA3		0.928					
SBNR1			0.931				
SBNR2			0.935				
SBNR3			0.891				
USF1				0.932			
USF2				0.947			
USF3				0.948			
IMG1					0.949		
IMG2					0.951		
IMG3					0.955		
ENJ1						0.928	
ENJ2						0.932	
ENJ3						0.931	
ENJ4						0.930	

INT1							0.930
INT2							0.942
INT3							0.924
INT4							0.886

Discriminant validity is the extent to which the items in a construct are distinct from those of other constructs; it can be verified by the square root of each construct's AVE is greater than its correlations with other variables. In Table 4, all constructs' square roots of the AVE are larger than other cross-correlations, that confirmed the discriminant validity of the constructs is acceptable.

Table 4: Square root of AVE and cross-correlations

	SCCN	RELA	SBNR	USF	IMG	ENJ	INT
SCCN	0.923						
RELA	0.656	0.918					
SBNR	0.666	0.602	0.919				
USF	0.554	0.667	0.594	0.942			
IMG	0.660	0.653	0.617	0.524	0.951		
ENJ	0.743	0.663	0.671	0.546	0.659	0.930	
INT	0.770	0.663	0.657	0.628	0.585	0.815	0.921

Structural model analyses

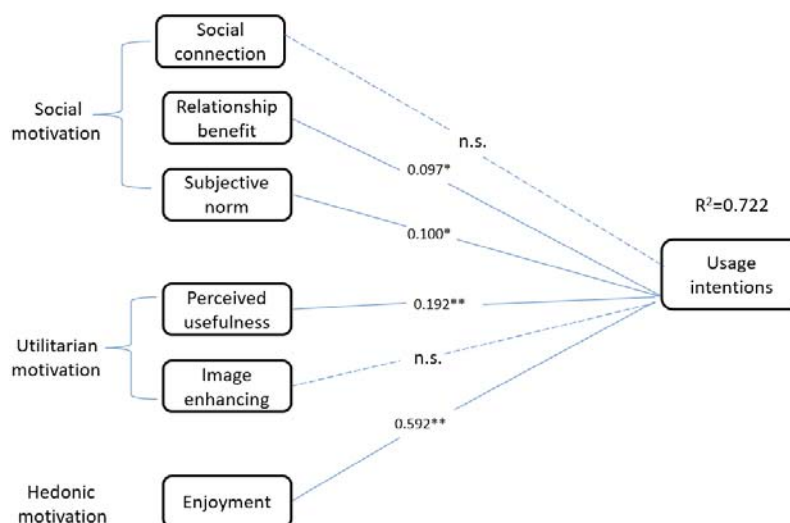
We utilized Smart PLS 2.0 to analyze the structural model (Ringle, Wende, & Will, 2005). As shown in Table 5, the full model is significant, with $R^2 = 72.2\%$. We find there are four constructs can affect the people's usage intentions for QQ, they are relationship benefit (RELA), subjective norm (SBNR), perceived usefulness (USF) and enjoyment (ENJ). With the condition of $P < 0.01$, USF's significant positive coefficient is 0.192 and the value of ENJ is 0.592, so H4 and H6 are supported, in addition, the RELA's path coefficients = 0.097 at $p < 0.05$ level supports H2; the SBNR's path coefficients = 0.100 at $p < 0.05$ level supports H3; However, social connection (SCCN) and image enhancing (IMG) cannot significantly affect the dependent variable, so H1 and H5 are not supported.

Table 5: Main effects test

Model	path coefficients	T	Result
SCCN	0.023	0.403	Insignificant
RELA	0.097	1.829	Significant
SBNR	0.100	1.993	Significant
USF	0.192	5.034	Significant
IMG	-0.046	0.945	Insignificant
ENJ	0.592	12.638	Significant

$R^2=0.722$, Dependent Variable: Usage intention (INT).

The analyses result for all variables are shown in Fig.2.



Note: * $p < 0.05$, ** $p < 0.01$; n.s.: insignificant.

Fig. 2: The Results of the Research Model.

DISCUSSION

Discussion of results

Based on the uses and gratifications theory, this study intends to investigate how the three types of motivations (social, utilitarian and hedonic) affect people's usage intentions on QQ. We test six independent variables' effect on the dependent variable. The results show, the full model explained 72.2% of the reason for the usage intentions.

We find that there are four independent factors are significant in the research model, whereas other two are insignificant, they contradict with our hypotheses. For the four significant factors, the analyses results show that the hedonic motivation (enjoyment) has a very strong effect, its path coefficient is 0.592, it is the most important reason to affect people's usage intention. Besides, perceived usefulness, subjective norm and relationship benefit also have significant effects, but the path coefficient is relatively lower than enjoyment.

We consider that QQ's initial function is instant messaging, and many users have used it for long years, so people glad to spend their time on QQ in order to keep close connections with their friends, and social connection would significantly affect people's usage intentions, but the results showed it has no significant effects. It indicates that social connection is not the crucial factor that affects people's usage intentions. Besides, we also consider that image enhancing should be an important antecedent for individuals' usage intention. Whereas it has no significant effect, it means that no matter the social media (QQ) can improve their social status or not, it cannot affect users' attitude. We consider the insignificance may be due to the dominant effect of enjoyment. Many QQ users now may more incline to treat it as an entertainment tool, instead of a simple instant messenger. Thus, the influences of social connection and image enhancing are attenuated.

Implications for research and practical implication

The findings of this study have made several significant implications for both academics and practitioners. From the theoretical perspective. First, this study aimed at investigating the factors affect people's usage intentions on the various functions of QQ, instead of just treating it as a communication tool. Thus, we enlarge the scope of the dependent variable. This is fit for current social media's development trend, almost all of them have been evolved to be multifunctional platforms. Second, we utilized UGT as the theoretical foundation in our research, to test the influences of social motivation, utilitarian motivation as well as hedonic motivation. The statistical results confirm all of the three kinds of motivations have significant roles. It confirms the applicability of this theory in our research context. Furthermore, we find that hedonic motivation takes the most crucial role in QQ. Third, we find some kinds of social motivation (social connection) and utilitarian motivation (image enhancing) are insignificant; this finding indicates that different kinds of social motivation and utilitarian motivation may take different roles in different research context. People may incline to use different cues to determine their usage intention.

From the practical perspective, we suggest the practitioners can improve the design of QQ according to our findings. As enjoyment takes a very crucial role to affect individuals' usage intention, we suggest the QQ need to improve its entertainment functions. Such as, design more amusement plug-ins in the QQ friend circle and QQ space; and include more popular games into 'QQ game.' Besides, perceived usefulness is also an important factor to affect users. Thus, QQ may also design more functions that can make life and work convenient, such as improve the payment function. Third, the QQ designers may also need to design some plug-ins to help users find new friends in QQ more conveniently, since the findings indicate relationship benefit is also a significant factor in the research model. Finally, as subjective norm can affect QQ users' usage intention, thus, we suggest that QQ may encourage its users to invite their friends to use various kinds of functions, especially the new functions they have experienced. By this way, it can attract more users to use its new functions embedded in QQ.

Limitations and future research

We acknowledged that this study has some limitations. First, we only collect data from QQ, although it is one of the most popular social media. We understand that different social media have different features. Thus, our findings may not be applicable to other social media. We encourage future research to conduct more research in different social media; this will help us understand the crucial factors of social media usage intention more comprehensively. Second, as an initial study exploring the usage intention of the various functions of social media. We only include 6 factors into our research model, we suggest that future research incorporate more factors, to test their influences on individuals' usage intention.

ACKNOWLEDGEMENT

This work is supported by the Fundamental Research Funds for the Central Universities (Grant No. JBK1802012, JBK120505), the Fund from Collaborative Innovation Center for the Innovation and Regulation of Internet-based-Finance (Grant No. JBK150407), and Fund from Laboratory for Financial Intelligence and Financial Engineering, Southwestern University of Finance and Economics.

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APPENDIX A. Measurement Items

Social connection (SCCN)

SCCN1: I'm keeping close relationship with many friends in QQ.

SCCN2: I spend a lot of time for communicating with my friends in QQ.

SCCN3: I frequently communicate with lots of friends in QQ.

Relationship benefit (RELA):

RELA1: Using QQ' various functions can help me enhance the connection with new friends.

RELA2: Using QQ' various functions can help me make many new friends

RELA3: Using QQ' various functions can enlarge the circle of my friends.

Subjective Norm (SBNR):

SBNR1: People who have an impact on me think I should use QQ.

SBNR2: People around me think I should use QQ.

SBNR3: The environment I was in prompted me to use QQ.

Perceived usefulness (USF):

USF1: Using QQ' various functions greatly facilitate my communication with others.

USF2: Using QQ' various functions can increase the efficiency of communicating with others.

USF3: Using QQ' various functions make it easier to communicate with others.

Image enhancing (IMG):

IMG1: Using QQ can improve my image within the circle of friends.

IMG2: Using of QQ can help me get approval from my friends.

IMG3: Using QQ can help me get a high reputation in the circle of friends

Enjoyment (ENJ)

ENJ1: I like using the various functions of QQ.

ENJ2: Using the various functions of QQ makes me happy.

ENJ3: I feel satisfied with the various functions of QQ.

ENJ4: I feel pleasant when using the various functions of QQ.

Usage Intention (INT):

INT1: I intend to continue using the various functions of QQ.

INT2: For a long time, I will continue to use the various functions of QQ.

INT3: I will often use the various functions of QQ in the future

INT4: I will continue to use the various functions of QQ when I need it

Empirical Study of the Effects of Information Description on Crowdfunding Success — The Perspective of Information Communication

(Full Paper)

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ABSTRACT

From the perspective of information communication, we identify four dimensions of information description, including information quantity (word number, picture number and video number), information attitude, information quality (as measured by readability) and information update. We then empirically examine their effects on crowdfunding success using binary logistic regression. And data is collected from Kickstarter, a popular crowdfunding platform. The results reveal that word number, picture number, video number and update are positively associated with crowdfunding success. And readability is negatively associated with crowdfunding success. In addition, attitude positively moderates the relationship between picture number and crowdfunding success. These findings show the significance of information description on crowdfunding, providing theoretical and practical guidance for project creators.

Keywords: crowdfunding success, information description, information communication.

*Corresponding author

INTRODUCTION

With the rapid development of Internet, crowdfunding has become increasingly popular in recent years. Crowdfunding is a group behavior in which the public communicates through the Internet and pools funds to support activities initiated by other organizations and individuals, and it is a new financing model for microfinance through internet platform (Ordanini *et al.*, 2011). There are mainly four categories of crowdfunding. The first one is patronage-based, where supporters expect no direct return from their contributions or donations. The second one is lending-based, where the supporters expect some rate of return on their capital invested. The third one is reward-based, where supporters receive a reward for backing a project. The reward can simply be a mention/credit in a movie or a prototype (earlier version) of a product. The last one is equity-based, where the supporters are treated as investors and are given certain shares of future profit of the project (Mollick, 2014).

Today, there are approximately 1250 active crowdfunding platforms across the world (Massolution, 2015). According to Massolution, the global crowdfunding industry reached \$34.4 billion in 2015, up from \$6.1 billion in 2013; the compound annual growth rate is expected to be 26.87% for the period of 2016–2020 (Crowd Fund Beat Data Center, 2016). In a recent research report, Clifford (2016) found that the failure rate ranges from 69% (Kickstarter.com) to 87% (Indiegogo.com) among the five largest platforms (Clifford, 2016). This shows that the actual completion rate of financing is not high, the financing efficiency is low, and the financing success rate needs to be improved. Therefore, it is crucial to identify general antecedents of funding success or performance, because it can provide insights to project creators to improve the rate of crowdfunding success. From the perspective of information communication, this article explores the effects of information description on crowdfunding success, and increases the possibility of project financing to improve the financing efficiency of the crowdfunding industry and promote the healthy development of the industry.

LITERATURE REVIEW

Antecedents of crowdfunding success

Crowdfunding has attracted enormous attention from scholars. And many scholars have studied the antecedents of crowdfunding success, including project information (duration, goal, industry category, reward category, investable amount, word, picture and video), creator information (creator's experience, education, government support and social relationship), support information (backers number, shares number, comments number, initial amount) and risk information (geographic distance, risk description).

Many researchers had demonstrated the vital factors during crowdfunding. Mollick (2014) offered underlying dynamics of success and failure of crowdfunding which include personal networks (Facebook friends of founders), underlying project quality (video, spelling errors, updates) and geography. The study showed that Facebook friends of founders, video and updates are all positively related to funding success, while spelling errors reduced the chance of funding success. And geography was associated with both the type of projects and successful fundraising (Mollick, 2014). Wang *et al.* (2017) paid attention to the interaction between

creators and backers. They examined effects of comment (quantity, sentiment and length) and reply (ratio, length and speed) on crowdfunding success (Wang *et al.*, 2017). Huang *et al.* (2015) analyzed the factors influencing the success of crowdfunding projects from the perspective of customer value, including product value, people value, service value, image value and monetary cost. Their study suggested that service value and image value have a significant influence on funding success, product value and people value influence it in a certain extent, while monetary cost influences it insignificantly (Huang *et al.*, 2015). What's more, Huang *et al.* (2017) examined the factors of influencing crowdfunding using Trust Theory, including project information, initiator features and uncertainty, and created neural network model to predict success or failure (Huang *et al.*, 2017). Based on previous literature, the antecedents of crowdfunding success consist of project characteristics, information description, creator characteristics, baker characteristics and risk information. Our study focuses on the aspect of information description.

Information description and crowdfunding success

Previous literature had examined the influence of information description on crowdfunding success from diverse perspectives. Moy *et al.* (2018) examined the effects of information quantity (word count) on crowdfunding performance and found that excess information quantity negatively affect funding outcome and number of backers (Moy *et al.*, 2018). Zhou *et al.* (2016) identified five exemplary antecedents (length, readability, tone, past experience and past expertise) from project descriptions to study the influence of project descriptions on funding success. Length, readability, and tone are related to the content of project descriptions; past experience and past expertise are related to the owner of project descriptions (Zhou *et al.*, 2016). Our study focuses on the perspective of information communication.

MODEL AND HYPOTHESES

Theoretical model

Our research model is shown in Figure 1. We consider four dimensions of information description, including information quantity, information attitude, information quality and information update, and three dimensions of information quantity, including word number, picture number and video number. And information quality includes readability. Since projects characteristics (funding goal, duration, comment) and creator characteristics (experience as creator, experience as backer) have been identified as antecedents of crowdfunding success in previous researches (Kuppuswamy and Bayus, 2014; Mollick, 2014), we treat them as control variables.

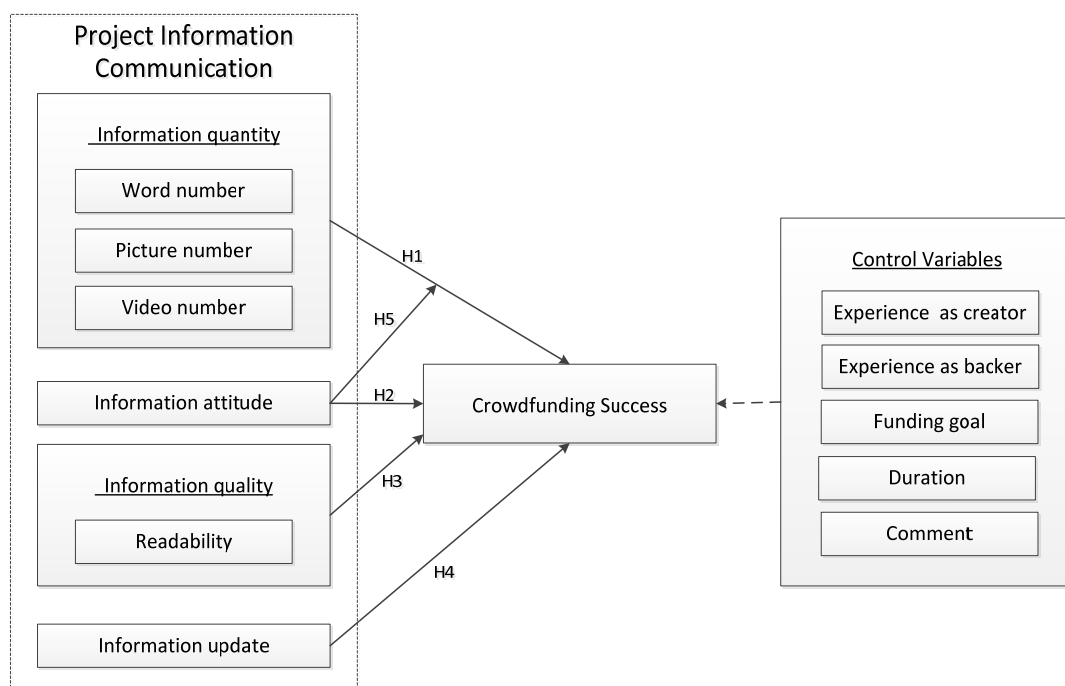


Figure 1: Theoretical model.

Hypotheses

Based on the theoretical model, we make the following assumptions including four dimensions of information description. They are information quantity, information attitude, information quality and information update.

Information quantity

Moy *et al.* (2018) revealed that the amount of word has a positive effect on the crowdfunding success. Increasing the word number within the range of optimal number of word is beneficial to crowdfunding. And Zhou *et al.* (2016) also proved that the amount of information measured by the number of words is positively associated with funding success. Thus, the more word number within optimal quantity will describe the project in more detail, which can make bakers more understand the project information. We propose:

- Hypothesis 1a (The Word number Hypothesis): The word number of project description is positively associated with crowdfunding success.

Huang *et al.* (2015) analyzed the factors of crowdfunding success using Customer Value Theory, whose study showed that image number in project introduction influence the crowdfunding success positively (Huang *et al.*, 2015). Many empirical studies also have found that the picture in description is associated with crowdfunding success (Frydrych *et al.*, 2014; Beier and Wagner, 2015). Thus, we propose:

- Hypothesis 1b (The Picture number Hypothesis): The picture number of project description is positively associated with crowdfunding success.

Mollick (2014) revealed that video in the project description is related to crowdfunding success. And video has positive effects on success (Mollick, 2014). And there are many empirical studies that revealed the use of video in description is associated with crowdfunding success (Frydrych *et al.*, 2014; Beier and Wagner, 2015; Mollick, 2014). Thus, we propose:

- Hypothesis 1c (The Video number Hypothesis): The video number of project description is positively associated with crowdfunding success.

Information attitude

In this study, attitude is the meaning of risks. The risky content in project description may increase perceived risk of bakers. And previous literature have proved that perceived risk has negative effects on intention to purchase (Pelaez *et al.*, 2019; Park *et al.*, 2005). Based on these, we make the hypothesis 2.

- Hypothesis 2 (The Information attitude Hypothesis): The information attitude of project description is negatively associated with crowdfunding success.

Information quality

Readability variable has been used in previous studies. Readability means that the understanding of text is easy, which is measured by the Gunning Fog Index (Li, 2008; Zhou *et al.*, 2016). Thus, with the ease of understanding information, backers will have a greater possibility to support the project. Therefore, we make the hypothesis 3.

- Hypothesis 3 (The Readability Hypothesis): The readability of project description is positively associated with crowdfunding success.

Information update

Mollick (2014) demonstrated that frequent update during funding has positive influence on success. Kuppaswamy and Bayus (2013) also revealed that update is positively and significantly related to crowdfunding success (Kuppaswamy & Bayus, 2013). Frequent update can present the development of project timely, which can make bakers support it. Following these, we propose:

- Hypothesis 4 (The Information update Hypothesis): The update number of project description is positively associated with crowdfunding success.

Information quantity \times Information attitude

- Hypothesis 5a (The Word number and Attitude Hypothesis): The information attitude positively moderates the relationship between the word number and crowdfunding success.

- Hypothesis 5b (The Picture number and Attitude Hypothesis): The information attitude positively moderates the relationship between the picture number and crowdfunding success.
- Hypothesis 5c (The Video number and Attitude Hypothesis): The information attitude positively moderates the relationship between the video number and crowdfunding success.

Mathematical model

To test if the hypotheses are true, we use the following mathematical model:

$$\begin{aligned} \text{Crowdfunding Success} = & \beta_0 + \beta_1 * \text{word_num} + \beta_2 * \text{picture_num} + \beta_3 * \text{video_num} + \beta_4 * \text{attitude} + \beta_5 * \text{readability} \\ & + \beta_6 * \text{update} + \beta_7 * \text{experience_creator} + \beta_8 * \text{experience_backer} + \beta_9 * \text{goal} \\ & + \beta_{10} * \text{duration} + \beta_{11} * \text{comment} + \varepsilon \end{aligned} \quad (1)$$

MEASURE

In the mathematical model, crowdfunding success is dependent variable which takes a value of either 1 or 0. If the project is funded successfully, the value of success is 1, otherwise it is 0. And we measure word_num, picture_num and video_num using the number of total word, total picture and total video in project description respectively. Attitude represents creator's awareness for risks and challenges of project. So we measure attitude using the ratio of risky and challenging words in the total number of words. Information attitude is calculated as follows:

$$\text{Attitude} = \frac{\text{risky and challenging words}}{\text{total words}} \quad (2)$$

We measure information quality by using the ease of understanding (readability). Following the previous literature, we use the Gunning Fog Index to measure the readability of information description (Li, 2008; Zhou, 2016). The Gunning Fog Index was developed by Robert Gunning in 1952 and the Gunning Fog Index is calculated with the following algorithm (Gunning fog index, 2015):

$$\text{The Gunning Fog Index} = 0.4 \left[\left(\frac{\text{words}}{\text{sentences}} \right) + 100 \left(\frac{\text{complex words}}{\text{words}} \right) \right] \quad (3)$$

The higher the fog index, the lower the readability. So readability uses the reciprocal of Fog Index.

$$\text{Readability} = \frac{1}{0.4 \left[\left(\frac{\text{words}}{\text{sentences}} \right) + 100 \left(\frac{\text{complex words}}{\text{words}} \right) \right]} \quad (4)$$

Since the update is not related to funding after ended time, we measure information update using the number of update between the launched time and ended time of project. Furthermore, we measure the comment variable using the number of comment about project. All variables and their measures are shown in Table 1.

DATA COLLECTION

The data of this study were collected from Kickstarter using Python, and part of data were collected manually. Kickstarter is one of most popular and largest crowdfunding websites in the world. It was launched in 2009 and it has more than fifteen million backers, and about five million of them are repeat backers. At present, more than 148, 000 projects have been successfully funded, and more than four billion dollars have been raised (Kickstarter, 2018). What's more, the majority of research on crowdfunding use Kickstarter data. Therefore, we also choose data from Kickstarter website. This can make comparison between our results and previous researches, and make our results more reliable and meaningful.

We collected the latest projects data spanning from January 2018 to August 2018. We excluded projects that were ongoing at the date of the data collection. And we removed canceled projects and suspended projects from them. What's more, we also removed projects with goal less than 100 dollars or more than 1, 000, 000 dollars to reduce the error of analysis. The resulting dataset contains 922 projects across all fifteen funding categories, of which 633 projects were funded successfully (achieving 100% or more of the goal), whereas 289 projects were funded unsuccessfully (achieving less than 100% of the goal).

Table 1: Variables and their Measures

Variables	Measures
Dependent Variable	
Crowdfunding Success	The value of successful funding is 1, otherwise it is 0
Independent Variables	
word_num	Number of word in project description before the project starts
picture_num	Number of picture in project description before the project starts
video_num	Number of video in project description before the project starts
attitude	Ratio of risky and challenging words in project description
readability	The reciprocal of Gunning Fog Index
update	Number of update between launched time and ended time of project crowdfunding
Control Variables	
experience_creator	Number of projects initiated by the creator
experience_backer	Number of projects backed by the creator
goal	Target amount of funding
duration	Number of days during fundraising
comment	Number of comments about project

RESULTS

Descriptive statistical analysis

The results of descriptive statistical analysis are showed in Table 2, listing the minima, maxima, means, standard deviations and variances.

Table 2: Descriptive statistical analysis results

Variables	Min	Max	Mean	SD	Variance
Success	0	1	0.69	0.464	0.215
duration	0	60	31.93	12.316	151.690
goal	100	400000	10162.10	27205.164	740120968.328
word_num	12	4172	716.29	589.310	347285.748
picture_num	0	155	7.88	13.052	170.365
video_num	1	7	1.13	.528	0.279
attitude	0	0.9483568080	0.192657795661	0.1330136250789	0.018
commnet	0	838	13.37	64.654	4180.193
readability	0.0183940870	0.0946818610	0.054420552671	0.0096900481215	0.000
update	0	50	3.45	4.920	24.206
experience_creator	1	49	2.34	3.808	14.501
experience_backer	0	334	9.11	28.358	804.168

Multicollinearity analysis

To reduce kurtosis and skewness, we used the logarithm values of goal and word_num. Table 3 shows the correlated relationships among variables. The correlation coefficients are all between -0.395 and 0.501. The correlated relationship is not high. In addition, Table 4 shows that the value of VIF for each independent variable is smaller than 2 and far less than 10. So there is no multicollinearity problem between variables.

Table 3: Correlation analysis results

Correlation												
Variable	Success	duration	goal	word_num	picture_num	video_num	attitude	comm-net	readability	update	experience_creator	experience_backer
Success	1	-.103**	-.060	.201**	.186**	.048	-.173**	.136**	-.071*	.310**	.172**	.176**
duration		1	.070*	-.001	-.030	.012	.027	-.012	-.031	.024	-.167**	-.102**

goal	1	.156**	.129**	.055	-.069*	.301**	.024	.162**	-.010	.007
word_num		1	.501**	.191**	-.395**	.213**	-.084*	.398**	.198**	.236**
picture_num			1	.194**	-.193**	.324**	.022	.400**	.211**	.207**
video_num				1	-.068*	.062	.002	.211**	-.008	.067*
attitude					1	-.052	.021	-.139**	-.117**	-.125**
commnet						1	-.005	.302**	.115**	.263**
readability							1	.004	.108**	.028
update								1	.133**	.225**
experience_creator									1	.286**
experience_backer										1

** Significantly related at 0.01 level (both sides).

* Significantly related at 0.05 level (both sides).

Table 4: Multicollinearity analysis results

Variable	Multicollinearity statistic	
	Tolerance	VIF
duration	0.941	1.063
goal (log)	0.784	1.275
word_num (log)	0.523	1.913
picture_num	0.693	1.442
video_num	0.950	1.052
attitude	0.762	1.313
commnet	0.797	1.255
readability	0.943	1.061
update	0.752	1.330
experience_creator	0.842	1.187
experience_backer	0.826	1.210
Dependent: Success		

Binary logistic regression analysis

Since the dependent variable (Crowdfunding Success) is dichotomous variable which takes a value of either 1 or 0, we test the hypotheses using the binary logistic regression. We establish three models. Model A consists of the control variables and the dependent variable. We add the independent variables to Model B. Furthermore, we add moderator to Model C including all variables. The analysis results are presented in Table 5.

Table 5: Binary logistic regression analysis results

Variables	Success		
	Model A	Model B	Model C
intercept	1.836** (.001)	1.829 (.108)	.576 (.712)
<i>Controls</i>			
goal (log)	-.496** (.001)	-.844** (.000)	-.880** (.000)
duration	-.008* (.028)	-.008 (.217)	-.007 (.291)
experience_creator	.186** (.006)	.194** (.007)	.188** (.009)
experience_backer	.032* (.032)	.011 (.011)	.011 (.011)

	(. 023)	(. 369)	(. 391)
comment	. 364**	. 279**	. 257**
	(. 000)	(. 000)	(. 000)
<i>Main effects</i>			
word num (log)		. 944**	1. 522**
		(. 004)	(. 005)
picture num		. 021*	. 055**
		(. 043)	(. 003)
video num		. 112*	. 073*
		(. 046)	(. 036)
attitude		-1. 511*	5. 861
		(. 030)	(. 265)
readability		-18. 455*	-19. 568*
		(. 036)	(. 028)
update		. 188**	. 199**
		(. 000)	(. 000)
<i>Moderating effects</i>			
word num (log)*attitude			-2. 935
			(. 119)
picture num*attitude			. 252*
			(. 034)
video num*attitude			-0. 702
			(. 783)
<i>Model summary</i>			
-2 Log likelihood	920. 178	850. 603	841. 43
Cox & Snell R2	0. 216	0. 273	0. 281
Nagelkerke R2	0. 303	0. 384	0. 394
**p<. 01			
*p<. 05			

As shown in Model A, the goal (-0. 496, p=0. 001), the duration (-0. 008, p=0. 028), the experience as creator (0. 186, p=0. 006), the experience as backer (0. 032, p=0. 023) and the comment (0. 364, p=0. 000) are significantly associated with crowdfunding success. In Model B, we add word number, picture number, video number, attitude, readability and update to investigate the effects of information description on crowdfunding success. The results shows that these variables are also significantly associated with crowdfunding success.

In Model C, we add the moderator to test all of the hypotheses. As shown in Table 5, the word number (1. 522, p=0. 005), the picture number (0. 055, p=0. 003), the video number (0. 073, p=0. 036) and update (0. 199, p=0. 000) are all positively related to crowdfunding success, supporting the Hypothesis 1a, Hypothesis 1b, Hypothesis 1c and Hypothesis 4, respectively. But attitude (5. 861, p=0. 265) is not related to crowdfunding success, so the Hypothesis 2 is not supported. What's more, we find that readability (-19. 568, p=0. 028) is negatively related to crowdfunding success. This is confusing because we expect a positive relation. Since the information description of project is more readable, it is easier for backers to understand. Being easy to understand means the information description of project mainly consists of informal or easy words with low Fog Index. Using the formal words (with high Fog Index) to write information description may represent the professionalism of project creator (Chen *et al.*, 2009). So backers have positive perception for the project and it increases the possibility of crowdfunding success. Therefore, the Hypothesis 3 is not supported.

The moderator in Model C indicates that attitude (0. 252, p=-0. 034) positively moderates the relationship between picture number and crowdfunding success, supporting the Hypothesis 5b. This means that attitude of information description enhance the effect of picture number on crowdfunding success. However, attitude (-2. 935, p=0. 119) has no effect on the relationship between word number and crowdfunding success, and attitude (-0. 702, 0. 783) also has no effect on the relationship between video number and crowdfunding success. Therefore, the Hypothesis 5a and Hypothesis 5c are not supported. The results of all hypotheses testing are summarized in Table 6.

Table 6: Hypotheses testing results

Hypotheses		Results
H1a	The word number of project description is positively associated with crowdfunding success.	Support
H1b	The picture number of project description is positively associated with crowdfunding success.	Support
H1c	The video number of project description is positively associated with crowdfunding success.	Support
H2	The information attitude of project description is negatively associated with crowdfunding success.	Not Support
H3	The readability of project description is positively associated with crowdfunding success.	Not Support negatively
H4	The update number of project description is positively associated with crowdfunding success.	Support
H5a	The information attitude positively moderates the relationship between the word number and crowdfunding success.	Not Support
H5b	The information attitude positively moderates the relationship between the picture number and crowdfunding success.	Support
H5c	The information attitude positively moderates the relationship between the video number and crowdfunding success.	Not Support

CONCLUSION AND DISCUSSION

To assess the impacts of information description on crowdfunding success, we consider four aspects of information description including information quantity, information attitude, information quality and information update based on the perspective of information communication. We measure information quantity as the word number, picture number and video number. And we measure information quality as the readability. Using these variables, we are able to make hypotheses between information description and crowdfunding success. And we collect data from Kickstarter website to test the hypotheses. Our results indicate that the number of word, picture and video in project description are all positively associated with crowdfunding success. Moreover, the number of update is positively associated with crowdfunding success. However, the readability is negatively associated with crowdfunding success. Because low readability means the professionalism of the creator. And information attitude have no effects on crowdfunding success. What's more, we also find that information attitude positively moderates the relationship between the picture number and crowdfunding success. But it doesn't moderate the relationship between the word number or the video number and crowdfunding success.

This research makes two contributions to the crowdfunding research. On one hand, this study systematically investigates the influence of information description on crowdfunding. Previous studies only tested influence of the number of word in description. On the other hand, the results of this study emphasize the importance of information description and make project creators understand the effects of antecedents to increase the possibility of crowdfunding success.

Nevertheless, our research has also some limitations and it can provide opportunities for future research. Firstly, our data were collected from only one crowdfunding platform (Kickstarter). But there are other crowdfunding platforms, such as Gofundme and IndieGoGo. This limits the universality of our research results. Secondly, our study focuses on the information description of project before the project starts. The information description during updating has also effects on crowdfunding success. Thirdly, we can't control the personal characteristics of backers, such as age, sex or category interests, which may also affect their decisions. In the future, the research can be extended from the above aspects.

ACKNOWLEDGMENT

This work is supported by grant 17YJA630050 of the Humanities and Social Science of Ministry of Education Planning Fund, China.

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Exploring Consumer Value Path of Cross-Border E-Commerce: A Perspective of Means-End Theory

(Full Paper)

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ABSTRACT

Despite the explosive growth of CBEC, research into the phenomenon has not increased proportionally. Prior studies mainly discuss the opportunities, challenges and critical elements in CBEC on the organizational level. Little research has explored the individual consumer's psychological processes of joining and the benefits derived from purchasing on CBEC. Filling the research gap identified above, the objective of this study is to construct the hierarchical value map (HVM) of CBEC illustrating how consumers pursue their end through the decision making process consisting the linkage from perceived attributes to desired benefits and the eventual customer value when using CBEC. For this purpose, a qualitative rather than a quantitative approach ought to substantiate prior findings by uncovering the key defining components of CBEC context. The HVM presents 4 important benefits obtaining paths marked as boldfaced, referred as economic oriented path, efficacy oriented obtaining path, choice optimization path, and shipping progress oriented path.

Keywords: Cross-border e-commerce, means-end-chain theory, hierarchical value path

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INTRODUCTION

Cross-border e-commerce (CBEC) retailing is experiencing the enormous growth and significant impacts on electronic commerce marketplaces. A survey of global online shoppers by Ipsos and PayPal found that China was the No. 1 cross-border e-commerce (CBOS) destination in 2017. eMarketer (2017b) indicates that cross-border retail ecommerce sales in China has climbed 29.1% in 2017 to total \$110.68 billion. Actually, One-quarter of digital buyers in China made a cross-border purchase in the past 12 months in 2016 (eMarketer 2017a). While purchasing via the CBEC channels, individual customers purchase the products from different countries and regions, conducting international payment and cross-border logistics for goods delivery (Li *et al.* 2016). According to the survey report of Alibaba Academy (2016) and China Internet Network Information Center (CNNIC 2016), there are mainly three channels for individual consumers to conduct CBEC, domestic platform, international platform and agents. In other words, customers can use domestic online shopping platform specialized in cross-border transaction, such as KAOLA in China which occupies 30% of the overall market (reference) and Taobao (its international channel); go to international online shopping platform, such as Amazon and eBay, and purchase through the CBEC trade agents.

However, despite the explosive growth of CBEC, research into the phenomenon has not increased proportionally. Prior studies mainly discuss the opportunities, challenges and critical elements in CBEC on the organizational level, such as the cultural adaptation of online messages to local culture Sinkovics *et al.* (2007)., and the challenge for a corporation to create a global online dispute resolution system to develop cross-border e-commerce. Little research has explored the individual consumer's psychological processes of joining and the benefits derived from purchasing on CBEC. However, successful marketing strategies are based on understanding consumers and the characteristics and benefits they pursue in the products and they buy, and the channels or platforms they choose to purchase on; as well as the values derived from their own personality and the society that they project through these products and purchasing channels (Barrena *et al.*, 2017). Therefore, in order to explore the consumer's decision process, it is important to focus on the structured value chain exploring the linkages of consumer values, benefits of consumption, and the perceived attributes. Previously, a number of studies have explored the factors determining consumptions, utilizing various techniques, such as interviewing, questionnaires, observing users, analyzing documents, and others. But little studies have concerned with how users perceive the benefits produced by the system attributes (features), and what personal values the benefits reinforce (Chiu, 2005), especially in the context of CBEC.

Filling the research gap identified above, the objective of this study is to construct the hierarchical value map (HVM) of CBEC illustrating how consumers pursue their end through the decision making process consisting the linkage from perceived attributes to desired benefits and the eventual customer value when using CBEC. For this purpose, a qualitative rather than a quantitative approach ought to substantiate prior findings (Coursaris & Kim, 2011) by uncovering the key defining components of CBEC context. Therefore, the following research questions are proposed:

- RQ1. What are the means-end elements (e.g. attributes, consequences, and values) in CBEC?*
RQ2. How do these elements interweave and construct the hierarchical value map?
RQ3. What are the dominant paths (including attribute and consequence) leading to consumer value?

Accordingly, this study takes a means-end approach (Gutman, 1982) and laddering interview methodology to examine user perceptions of the attributes, consequences, and values associated with the consumption through CBEC. ‘Means’ are objects that facilitate actions and activities in which people engage. ‘Ends’ are valued states of being, such as pragmatism and self-esteem (Pai & Arnott, 2013). MEC theory, has been suggested as a suitable theoretical lens for differentiating lower-level attributes, consequences, and higher-level values (Botschen *et al.*, 1999). The organization of this paper is as follows: the next section provides theoretical background regarding customer value and means-end chain theory. In this section, we also illustrate how the means-end chain can be applied to study customer value. In section three, we describe the research methodology, including research process and sampling method, and present the results of the data analyses in section 3 and 4 respectively. Following, we discuss the research findings, the theoretical contributions, the implications of our findings. Eventually, we discuss the limitations of the study and future research.

THEORETICAL BACKGROUND

Cross-border E-commerce

A survey of global online shoppers by Ipsos and PayPal found that China was the No. 1 cross-border e-commerce (CBEC) destination in 2017 (eMarketer 2017a). There are mainly three CBEC channels, the domestic platforms specialized in CBEC retailing business, such as Kaola in China, and the international channels managed by Taobao and Jingdong; E-commerce websites in foreign countries, including international EC platform in different countries and a local EC platform in a certain country; and CBEC agents helps customers to purchase products abroad (offline and online) and deliver the product to the customer, these agents can be occupational or occasional (e.g. airline hostess or the people who often travels to other countries). However, there are some barriers of cross-border transactions creating more risks and difficulties for CBEC customers, and each channel has its disadvantages in the overall shopping process.

Although it would be interesting to study how consumer values potentially influence consumer behaviors, only few studies have investigated cross-border online operations. Freund & Weinhold (2000) examined how the increase of online trade is likely to have an impact on offline trade patterns. Hortaçsu *et al.* (2009) compared the features of online trade within US from eBay and cross-border trade from Mercadolibre. The findings showed that distance is an important factor in determining the volume of trade. Lendl *et al.* (2012) again collected the data from eBay on cross-border transactions between 62 countries over the period 2004-2007. They found that almost all explanatory factors related to trade growth such as distance, transport cost, legal regime, etc generated less costs on eBay than in offline trade. Gomez-Herrera *et al.* (2013) constructed a unique matrix of online B2C domestic and cross-border trade in goods between the 27 EU Member States, showing a significant role of institutional variables such as online payments facilities and cost-efficiency of parcel delivery systems in cross-border trade. Overall, most of the research has focused on testing the direct link between CBEC performance and various external factors (e.g. geographic managerial, social or technological features). However, little is known on its interaction with other behavior enhancing determinants such as customer value.

Customer Value

Consumer value plays an important role in marketing and consumer research (Overby *et al.*, 2004; Reynolds and Gutman, 1988; Vinson *et al.*, 1977). While marketing and consumer research provides several conceptualizations of consumer value, consensus exists among several aspects of these definitions. In general, consumer value is:

- Perceived by consumers subjectively (Gale, 1994; Sinha and DeSarbo, 1998);
- Related to products, services and contexts (Holbrook, 1999);
- A trade-off between benefits and costs (Holbrook, 1999; Zeithaml, 1988); and
- A preference that lies in the heart of the consumption experience (Holbrook, 1999).

Individuals often perform some goal-oriented shopping behaviors in order to achieve their values (Lai, 1995; Sheth *et al.*, 1999). Past studies have recognized that a shopping behavior may be motivated by utilitarian and hedonic values of a consumer (Babin *et al.*, 1994; Baumgartner and Steenkamp, 1996). Utilitarian value indicates that consumers tend to efficiently achieve their goals with minimal investments, whereas hedonic value denotes that consumers emphasize more on joyful aspects, which they experience from the shopping process (Hirschman and Holbrook, 1982). These aspects of consumer value are also important in the context of MCS (Dholakia *et al.*, 2010; Kwon and Jain, 2009). On one hand, MCS allows consumers to obtain product information, seek product assortment, and compare product prices (Noble *et al.*, 2005), which can achieve utilitarian and economic goals. On the other hand, Verhoef *et al.* (2007) suggest that consumers tend to believe that searching in one channel facilitates them to make

smart purchase decisions on another channel. Consumers may perceive desirable feelings of being smart shoppers in MCS. Moreover, MCS can be treated as a variety-seeking behavior, which is driven by the hedonic aspect of MCS experience (Kwon and Jain, 2009).

In addition to the dichotomy of utilitarian and hedonic values, other scholars also regard shopping safety and freedom as two important consumer values in the context of MCS (Alba *et al.*, 1997; Schoenbachler and Gordon, 2002; Wolfenbarger and Gilly, 2001). Although the internet is considered convenient for information seeking, it is also considered risky to purchase online due to its inability to touch, feel and experience the product. High shopping risks may attenuate consumers' willingness to shop online. They are likely to perform online-offline channel integration to ensure their safety regarding their purchases. Furthermore, multi-channel marketing is a consumer-centric approach to satisfying new consumers who want to shop whatever, wherever, and whenever on their own terms (Loewe and Bonchek, 1999). MCS is able to provide such location and time flexibilities compared to single-channel shopping, leading to the fulfillment of consumers' need for freedom.

Understanding the various consumer goals is essential but not sufficient for practitioners as CBEC businesses can only serve their customers well if they know not only what customers want but also how to offer what they want and why they want what they want, i.e., the paths leading to the ultimate goals. This type of research is even scarce in e-commerce contexts, though a large number of studies have provided motivations of consumer online shopping behavior (Bagdiniene & Zemblyte; Chang *et al.* 2010). These motivation studies considered online shopping motives in isolation, with no relationship being identified among each other. This deeper level of understanding is fundamental to our understanding of the drivers of CBEC adoption. By employing a user-oriented goal hierarchy approach, our study adds additional insights into this phenomenon by not only identifying diverse consumer goals for this new e-commerce model adoption but also illustrating the goal fulfillment paths. Such insights into consumer behavior and consumer needs would give businesses huge advantages in providing customer-centric service, the key to attract new and retain existing customers

Means-end Chain Theory

The means-end chain is the cognitive structure that links the consumer's knowledge of products to his personal knowledge of certain consequences and values, as demonstrated in a series of studies of different markets. It was Gutman (1982) who first applied it in the field of marketing and consumer research; Ter Hofstede *et al.*, 1998; Zanolli and Naspetti, 2002; De Boer and McCarthy, 2003; Fotopoulos *et al.*, 2003; Leppard *et al.*, 2004; Russell *et al.*, 2004 are also worth highlighting. The main premise of MEC analysis is that consumers learn to select the products that possess the attributes that allow them to achieve their desired ends (Reynolds and Gutman, 1984; Ter Hofstede *et al.*, 1998; Grunert and Valli, 2001; Olson and Reynolds 2001; Fotopoulos *et al.*, 2003; Costa *et al.*, 2004).

It differentiates three hierarchical levels: product or service attributes (A), consequences of product usage and service consumption (C), and values as the desired end-states of consumers (V). The meansend perspective is analogous to the expectancy-value theory (Rosenberg, 1956), which delineates consumers' inclination to refer experienced consequences to attributes of past decision behavior in product encounters. Consequently, consumers learn to choose attributes that are instrumental to their desired consequences (Reynolds & Gutman, 1988), such as the selection of the most supportive channel to ensure a good product choice. Consequences are antecedents to desired "end"-values such as self-actualization (Xiao, Guo, D'Ambra, & Fu, 2014).

According to Gutman (1982), consumers learn to think about products or services in terms of attributes – physical or concrete. Attributes (means) are instrumental to achieving the desired consequences and values (ends). Consequences can be positive or negative. Positive feelings result from the benefits from consuming the product; therefore, benefits can be considered substitutes for desired consequences. The central aspect of the MEC model is that consumers choose actions that produce desired outcomes and minimize undesired outcomes (Gutman, 1982). Consumers learn which outcomes they desire and which to avoid. Once they learn which acts produce the desired consequences (benefits) and values, their choice behaviour is guided accordingly (Gutman, 1982). Consumer behaviour is generally goal oriented and can be regarded as a consumer's movement through a goal hierarchy. An MEC is a hierarchy of goals in which higher-level goals represent a deeper layer of consumer motivation. In such a hierarchy, values can be considered as the final goals that motivate consumers to engage in shopping behaviour, and benefits are the subgoals that are subordinate to values. MEC theory, indeed, has been suggested as a suitable theoretical lens for differentiating lower-level (benefits) and higher-level (values) goals (Botschen *et al.*, 1999).

Olson and Reynolds modified Gutman's model by distinguishing finer gradation of attributes, consequences, and values according to the levels of abstraction in terms of its relationships to personal values, as shown in Fig. 1. Concrete attributes are defined as being physical and concrete characteristics of a product/service that can be directly measured, such as the location of a store or color of a product. Abstract attributes are more subjective in nature, usually existing only in the minds of those who perceive the product/service, such as information quality of the website or service quality. Functional consequences refer to the practical benefits and performance outputs accrued directly to the consumers from consuming the products/service (e.g., save money), while psychosocial consequences refer to psychological feelings or social considerations (e.g., perceived risk, satisfaction) derived from

functional consequences. Instrumental values are defined as preferred modes of behavior or ways of behaving (e.g., be loyal, be polite), while terminal values are defined as preferred end states of being (e.g., self-esteem, sense of fulfillment). Thus, the MEC model is also viewed as representing the relationship between self and products, in which the means represent aspects of product/service knowledge and the ends represent aspects of consumer self-knowledge. Olson and Reynolds emphasize that not all of these links are present in every situation as consumers may not be able to always possess the abstract meanings of the products/services they use because of inactivation of self-relevant knowledge in the working memory during that decision situation.

Scholars emphasized the usefulness of the means-end approach in IS research (Chiu, 2005; Lin & Wang, 2008; Pai & Arnott, 2013), for example to shed light on resistance factors to adopt complex products such as online payment (Kuisma *et al.*, 2007). In the course of resistance research, the means-end relation might however cause confusion, since it captures the antagonists of certain goals, contrary to means in its original sense. Means are therefore referred to as antagonists in this article. Studies in consumer research have used the means-end approach to examine consumer perceptions of price and service quality (Voss, Gruber, & Szmigin, 2007; Zeithaml, 1998). Recent research has used means-end analysis to investigate users' behavior when adopting online applications, such as web-based document management systems (Chiu, 2005), online shopping (Lin & Wang, 2008), and e-learning systems (Sun, Cheng, & Finger, 2009). In particular, scholars have begun using the means-end approach to investigate user goals in social virtual worlds such as Second Life (Jung & Kang, 2010). Because these online contexts are similar in nature to SNSs in terms of satisfying users' social, functional, and hedonic needs, means-end analysis is applicable for understanding users' perceptions of and motivations for adopting SNSs.

RESEARCH METHOD

Laddering Interviews

Personal consumption choices are often driven by their personal values. People attend to classifies merchandise to reduce complexity of the selection, and give meaning to goods or services; those meanings are related to personal values. Theory of basic human values indicates that values influence purchase action when they are relevant in the context and important to the actor and also guides attitudes and behaviors (Schwartz, 1996). More in depth, expectancy value theory argues that people orient themselves to the world according to their expectations and evaluations. Behavior, behavioral intentions, or attitudes are as a function of expectancy that an object possesses a particular attribute or that a behavior will have a particular consequence (Palmgreen, 1984). Those theoretical conceptions views consumer as value-oriented decision makers who choose product attributes with that will most likely lead to desired outcomes.

The purpose of means end theory there is to explore the relevance of product or service attributes and consumer's personal values. Where "means" refers to the individual's perceptions and views of attributes of goods or services, "end" refers to the end status of results or the final value of the results provided by these attributes. Grunert and Grunert propose motivational view and cognitive structure view to explain the consumer's shopping behaviors with means-end theory. Motivational view concerns with obtaining insight into consumers' buying motives. Cognitive structure view is a model of consumers' consumption-relevant cognitive structure, where it is assumed that behavioral motivation is derived by linking cognitive categories corresponding to concrete objects, like products, with cognitive categories at a high degree of abstraction, like values. Therefore cognitive categories of different levels of abstraction are interlinked in chains and networks (Grunert & Grunert, 1995). Means-end chains technique is often been adopted to advertising or marketing of products or services, market positioning, new product development, and segmentation of consumer markets. (Bagozzi & Dabholkar 1994). And, some of researchers have used to study the consumer behaviors (Zeithaml, 1998) and online shopping (Lin & Wang, 2008).

Laddering technology could transforms attributes of a product into meaningful links, which is the most commonly used methodology for the purpose of structure the hierarchy of means-end chains (Gutman, 1982; Gutman & Miaoulis, 2003). Due to the difficulty in directly eliciting consumers' personal values at the highest level of means-end chains hierarchy, the top down approach is hard to do. Thus, laddering technology adopt bottom up process to draw out the consumers' personal value, start with collecting factors, which are attributes of products or services, at the lowest level of means-end chains hierarchy, and end in summarizing the factors, which refer to consumers' personal values, at the highest level of means-end chains hierarchy. It can be divided into soft laddering and hard laddering. The soft laddering technology refers to collect information with in-depth interviews (Gutman, 1982; Gutman & Miaoulis, 2003; Overby *et al.*, 2004). During the interview, respondents' responses were not subject to any restrictions or guidance. Interviewers must have the concept of "treating respondents as experts" to reduce the subjective bias of the interviewer and affect the interviewee's answer, so that you can really understand the products or services in the eyes of consumers. The hard laddering is applicable to popular subjects (Grunert & Grunert 1995), which collect information with a paper and pencil laddering task, or through mailing questionnaires (Walker & Olson, 1991; ter Hofstede *et al.*, 1998). Compare to the soft laddering, it is able to collect large numbers of samples and save manpower, but respondents are easily interfered with by the question items. Consequently, it is difficult to obtain personal subjective ideas of consumers. Furthermore, the process of laddering is also difficult to draw to a higher level (Phillips & Reynolds 2009).

In the early stage of exploratory research in cross border online shopping, we allow respondents to define their personal attributes and values in their own terms and contexts. Thus, this study used soft laddering, which is more flexibility and more easily to depth—in the contexts, to interview research respondents and collect research data. The procedure of analyzing laddering data involves five steps including, (1) elicit and select key distinctions to ladder means-end chains, (2) construct an implication matrix, (3) construct a hierarchical value map, (4) determine dominant perceptual orientations, and (5) make interpretation.

Interview procedure

The interview time ranged from about 30 to 45 minutes. All the interviewees were asked for the approval to record. The major topics in the interview include: “What are the cross-border online shopping platforms you often use?”, “What is the difference between cross-border online shopping and domestic online shopping?”, “What benefits do you get from cross-border online shopping?”, And “What values of yours are in line with those benefits?”etc. During the interview, the questions were flexibly adjusted based on the respondents’ answer, in order to collect more diverse information.

More in detail, in the pre-interview stage, this study illustrates the purpose of the study and introduces the interview process through chatting, in order to make the interviewee feel comfortable. In the meantime, respondents, while recalling the past experience of cross-border online shopping, create a relaxed and suitable atmosphere for sharing. And then, ask interviewee to answer questions about personal information, such as gender, age, education Level and consumption habits etc. After the completion of the basic information questionnaire, this study formally entered the laddering interview process.

At the beginning of laddering interview, start with question “What is the opportunity to start using cross-border online shopping?”, let the interviewee to share their experience about recent or impressive cross-border online shopping by the way storytelling. In addition to enabling respondents to recall their initial motivation and quickly enter to the interviewed situation, this initial approach can also collect a lot of additional useful information. Technologies used to elicit the attributes that are important to interviewees while shopping online across the border, this study adopt three guideline proposed by Reynolds and Gutman, (1) Triadic sorting, (2) Preference-consumption differences, (3) Difference by occasion.

At second part of the laddering interview, based on the collected attributes, ask the interviewee in depth, keep asking "Why the specific attribute is important to you?", "What can you get from that specific attribute?" and other similar questions to understand why interviewee think these attributes are important. And then, collect those answers as consequences of those attributes, and values as final achieve of those attributes. In addition, this study refer to the six interview techniques proposed by Reynolds and Gutman to facilitate the interview until interviewee can no longer continue to provide any more information or information is sufficient. Those are (1) Memories of past situations, for example: What was the last time shopping at a foreign website? (2) Assuming the consequences of a lack of certain attributes, for example: What do you think if the shopping platform does not have free shipping promotion as well as full amount of specific amount. (3) Negative laddering, for example: Why do you not like the platform checkout process? (4) Compared with the past, for example: What are the different between cross-border online shopping and online shopping experience in the past? (5) The third-person method, for example: Do you think why other people want to choose this shopping website? (6) Silence or answer confirmation. If respondents refuse to think, it could keep silence to let respondents adjust their tempo and continue to think about the answers. If the respondents' answers are difficult to understand, it could repeat the answer, so that interviewee could re-organize their thoughts and then use more precise terms to answer.

After that, switch to next ladder (attribute) at previous part. And repeat it all over again, until each attribute - consequences -value ladder is completed. The figure 1 shows the MEC interview procedure chart.

Sampling/Participants/Choice of respondents

The cross border online shopping adoption, and consumers motivation have recently received great attention from researchers, but most of the research has used data from the developed country. Thus, little is known about the factors that influence cross border online shopping consumers motivation in societies that are economically and culturally distinct from the developed countries, such as China or Taiwan. The same consumers’ personal values may bring out different behaviors in another country, or behavior probably driven by the same motivation but through a different path. To study this phenomenon, interviews were conducted in Chain and Taiwan as this gives possibilities for cross-validation within a culturally fairly homogeneous part of Chinese. Two groups were held in two countries to explore the range of values held and to contrast the results between countries and between earlier and later adopters.

In this study, the population of interviewees is consumers with cross-border online shopping experience; thus a purposive sampling strategy was used to ensure the validity of the sample data. Furthermore, because of the in-depth interview process takes long time to do and also has restriction of interview venue, it’s very difficult to sampling. Therefore, we further adopt convenience sampling and snowball sampling, in order to reach valid samples, and find next sample through the previous one.

Sample relevant is more critical than sample size, in the qualitative research (Denzin & Lincoln 1994). Previous studies using soft laddering show that the number of interviewees is from a single digit to double digit (Manyiwa & Crawford 2002 ; Overby *et al.* 2004 ; Zeithaml 1988). Reynolds and Gutman suggest the appropriate number of interviewee is between 30 to 50, and Reynolds and Olson (2001) also indicate the number of interviewee should more than 20 at least. In the other hand, if there is no further attribute mentioned by a new interview, it could stop the sampling procedure (Denzin & Lincoln 1994).

In current study, a total number of 30 Taiwan interviewees were interviewed, it meet the sample size requirement suggested by past studies. More in detail, there is no longer update the attributes during the interview up to 22. Moreover, for the accuracy of the result, this study interview 8 more interviewees, a total of 30 interviewees, the final result is the same as the result elicited from 22 interviewees.

The demographics profile can be seen in Table 1. It reveals an equal split between genders, the area of residence is mainly 76.7% of the northern part of Taiwan, and the distribution of age is 60% of the population aged 19 - 25 and 30% of the population aged 26-30. The graduate education level is dominated with the largest proportion (66.67%), followed by 30% of the college; the occupational classification is dominated by 66.7% of the students, and the average monthly disposable income below \$700 accounting for 63.33%. In this study, it adopts purposive sampling, plus convenience sampling and snowball sampling to identify more of the 19 to 30 years-old internet generation interviewees. As a result, respondents were mostly students and average monthly disposable income was lower, and less than \$700 accounting. Among the Taiwan interviewees in this study, there are 14 respondents are the most commonly used cross-border online shopping platform is Taobao (<http://www.taobao.com/>), followed by Amazon (<https://www.amazon.com/>), 6 respondents. There are 53.33% of the respondents, their cross-border online shopping experience is between 2 to 3 years, followed by less than 1 year (30%), and between 4 to 5 years (10% of buyers). The number of cross-border online shopping respondents who purchased twice or thrice every year accounted for the largest proportion of respondents (36.67%), followed by purchased more than 5 times every year (30%), 4 or 5 every year (23.33%), and only one time every year (6.67%). The average spending on a single shopping was mainly in the range of \$10-\$70 (66.67%), followed by \$70-\$150 (26.67%), and above \$150 (6.67%), the most frequently purchased merchandises are clothing (50%), and followed by 3C products (16.7%).

In Mainland China, a total number of 30 interviewees were interviewed also, it is same sample size compare to previous sampling in Taiwan in this study. The demographics profile shows in Table 1. It reveals that 63.33 % respondents were female, residential areas in East China accounted for the largest share of 23.33%, and the distribution of age is 80% of the population aged 19 - 25 and followed by the population aged 26 - 30. The largest proportion of education level is 66.67% having graduate degree; the occupational classification is dominated by 63.33% of the students, and the average monthly disposable income is below \$700 accounting for 60%, and followed by between \$700 to \$1,400 (20%). Due to the purposive sampling, plus convenience sampling and snowball sampling to identify the internet generation interviewees, respondents were mostly students and average monthly disposable income was lower, and less than \$700 accounting. Among the Mainland China interviewees in this study, there are 10 respondents are the most commonly used open platform such as Tmall (<http://www.tmall.com/>) or Jingdong Buy International (<http://www.jd.hk/>), followed by using self-operation shopping website such as NetEase kaola (<http://www.kaola.com/>), Xiaohongshu (<http://www.xiaohongshu.com/>) etc. There are 50% of the respondents, their cross-border online shopping experience is between 2 to 3 years, followed by less than 1 year (23.33% of buyers), and therefore most of them are represent experienced cross-border online shopping consumers. The number of cross-border online shopping respondents who purchased 2 to 3 times every year accounted for the largest proportion of respondents (36.67%). The average spending on a single shopping was mainly in the range of \$10-\$70 (63.33%), the most frequently purchased merchandises are cosmetics and personal care products (53.33%), and followed by clothing, shoes and bags (25.67%).

Table 1: Demographic

	China (n=30)	Taiwan (n=30)
Gender		
Male	36.67%	50.00%
Female	63.33%	50.00%
Age		
<18 years	0.00%	3.33%
19 ~ 25 years	80.00%	60.00%
26 ~ 30 years	10.00%	30.00%
31 ~ 35 years	6.67%	3.33%

36 ~ 40 years	0.00%	3.33%
>40 years	3.33%	0.00%
Education		
High School	3.33%	3.33%
College	30.00%	30.00%
Graduate School	66.67%	66.67%
Occupation		
Student	63.33%	66.67%
Manufacture	20.00%	13.33%
Service	10.00%	13.33%
Others	6.67%	6.70%
Years of use of cross-border online shopping		
< 1 year	20.00%	30.00%
2 ~ 3 years	50.00%	53.33%
4 ~ 5 years	23.33%	10.00%
> 5 years	6.67%	6.67%
Average number of purchases (annually)		
1 times	33.33%	6.67%
2 ~ 3 times	36.67%	36.67%
4 ~ 5 times	20.00%	23.33%
> 5 times	10.00%	30.00%
Average disposable income (monthly)		
<\$700	60.00%	63.33%
\$700~\$1400	20.00%	26.67%
\$1400~\$2100	10.00%	10.00%
>\$2100	10.00%	0.00%
Average spending on a single shopping		
<\$10	3.33%	0.00%
\$10~\$70	63.33%	66.67%
\$70~\$150	20.00%	26.67%
> \$150	13.34%	6.67%

DATA ANALYSIS

Refer to Reynolds and Gutman's data analysis method, the first step of content analysis is coding. Merge and give the similar elements an appropriate name, for example, merge "foreign goods are better" and "you can buy more durable things" into "quality of goods". The method of determining levels of each element can refer to the situation of source (from) and extended (to). The element that only has source must be attribute level; the one that has both source and extended must be consequence level and the one that only has extended must be value level. Categories results of elements are presented in table form. In order to minimize subjective factors. Coding by three coders (Grunert & Grunert 1995) that familiar with means-end chain theory, laddering and cross-border online shopping. Without interference in each other and then discussion for the divergent parts. After completion of coding all the elements, give each element a number and create a table for subsequent analysis steps. The second step is creating implication matrix, depiction the number of direct link and indirect link between elements. According to definition of link between elements, direct link is the link that between two adjacent elements, indirect link is that there are one or more elements between these two elements. The higher the number represents stronger relation between these two elements. Implication matrix displays the number of times each element leads to each element. Example is shown in table 2.

Table 2 : Example of implication matrix

	(C5)	(C6)	(C7)	(C8)	(C9)	(V10)	(V11)	(V12)
(A1)	1:00		5:11		0:04			0:04
(A2)	4:00		0:04	0:02	0:03		0:08	
(A3)	6:00		3:04	1:02	1:07	1:08	0:05	0:05
(A4)		8:00	0:01		2:00		0:01	
(C5)		3:00	5:01	4:03	9:01	3:02	0:06	0:05
(C6)				7:00			1:03	0:04
(C7)						8:00	0:06	1:04
(C8)					9:00		4:02	5:04
(C9)							10:00	8:00

The third step is constructing the hierarchical value map (HVM), in order to avoid a too large and complex HVM, it must be set the cut-off level to remove the relatively weak relations. Reynolds and Gutman recommend that if the number of samples is 50 to 60, the appropriate cut-off level is 3 to 5, Grunert, and Grunert (1995) believes that there is no absolute standard-setting of cut-off level. This study set the cut-off level 3. Means researcher only put those relations that direct link number more than three times into HVM. And This study also refer to Reynolds and Gutman's five kinds of link relations to make the relationship between the elements clearer. The example of HVM is shown in figure 1.

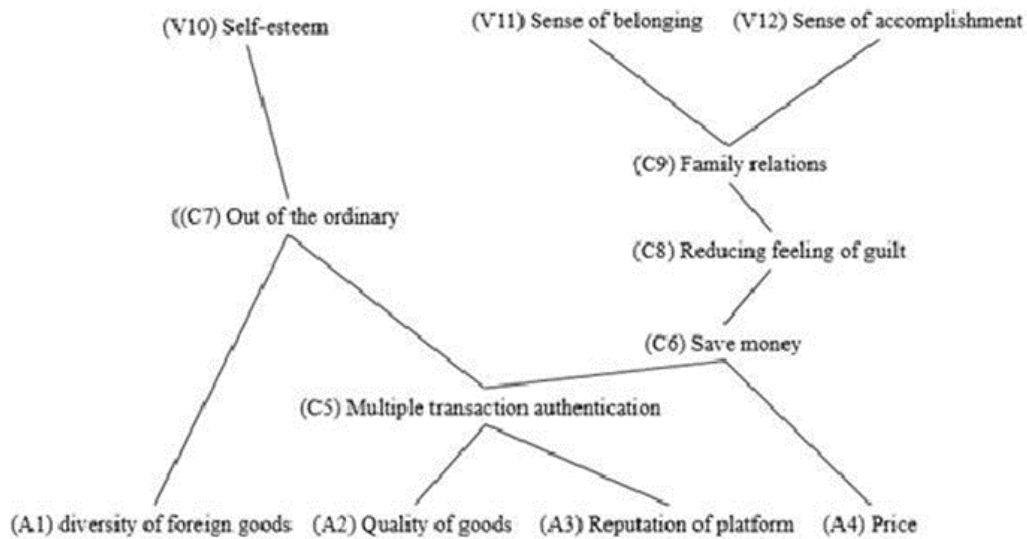


Figure 1 : Schematic diagram of HVM

After finishing HVM, it can show a complete user cognitive architecture of cross-border online. Put the value level's elements into Maslow's hierarchy of needs, then researcher can sort these elements to find the value hierarchy. Researcher can also find the important attributes and consequences by their link relations with the values. For example, put (10) self-esteem, (11) sense of belonging and (12) sense of accomplishment into needs hierarchy, and it can be seen that (12) sense of accomplishment is in the highest level, next is (10) self-esteem and (11) sense of belonging is relatively low. According to Maslow's hierarchy definition (Maslow 1954), low-level needs must first be satisfied, before they can pursue the higher level needs. Showing that (11) sense of belonging must first be satisfied. And in order to satisfy (11) sense of belonging, the related attribute (4) price has the highest influence, next are (2) quality of goods and (3) reputation of platform (1) diversity of foreign goods has no influence to (11) sense

of belonging. This shows that cross-border online shopping service provider must pursue competitive prices, good quality and the credibility of its own platform first not the diversity of foreign goods.

RESEARCH RESULTS

Hierarchical Value Map in CBEC Consumers

This study uses Means-End Chain's "attribute-consequence-value" analysis to understand how Taiwanese consumers use cross-border online shopping service to match their personal values. First, create the HVM to understand the consumers' cognitive architecture of cross-border online shopping service. Next, apply these values in HVM to Maslow's hierarchy of needs to find the level positions of each value, then refer to the association relations of elements in HVM, find the important attributes in cross-border online shopping service.

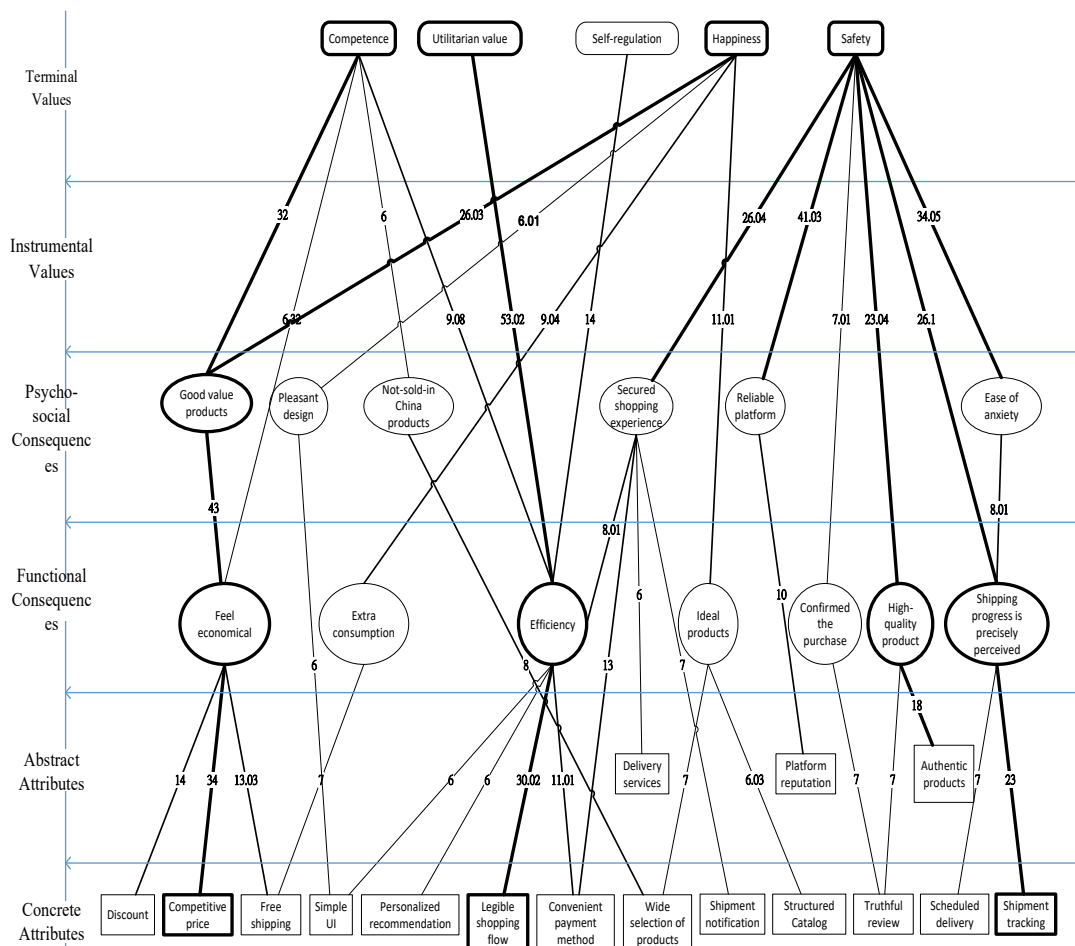


Figure 2 : Hierarchical value map and value paths

The HVM presents 4 important benefits obtaining paths marked as boldfaced, referred as economic oriented path, efficacy oriented obtaining path, choice optimization path, and shipping progress oriented path, those are shown in figure 2. Economic-oriented benefits are the one of the main important value obtaining path for CBEC consumers. It was evident that attributes such as "competitive price", "free shipment", and "discount" are the critical attributes perceived in economic driven path. Especially, the linkage of competitive price and feel economic are mentioned 34 times, and the linkage of good price value and feel economic are mentioned 34 times. The ultimate values are competence and happiness, referred as "consumers feel themselves to be capable to buy product with good price" and "consumers feel happy when they buy a product with low price".

Efficacy-oriented chain suggests another important value obtaining path in CBEC consumers. It was evident that attributes such as "legible shipping flow", "convenient payment method", "simple UI" and "personalized recommendation" are the critical attributes perceived in efficacy driven path. Especially, the linkage of legible shipping flow and efficacy are mentioned 30.2 times. The ultimate values is utilitarian, suggesting that the important value underpin of purchasing on CBEC is the utility of the shopping process.

Choice optimization-oriented chain suggest another important value obtaining path in CBEC consumers. It was evident that attributes of “authentic products”. Especially, the linkage of authentic products and choice optimization are mentioned 18 times. The ultimate value is safety, suggesting that consumers value the safety of the products and shopping process while purchasing via CBEC channels.

Shipping progress perception-oriented chain suggest a last important value obtaining path in CBEC consumers. It was evident that attributes of “shipment tracking”. The linkage of shipping progress perceived precisely and shipment tracking are mentioned 23 times. The ultimate values is safety, suggesting that consumers value the safety of shipment process while purchasing via CBEC channels.

IMPLICATIONS

Contribution to academic research: most of previous researches focus on domestic online shopping service. Fewer researches for cross-border online shopping service. In recent years, cross-border online shopping is on a vigorous development trend. This study takes the lead from perspective of consumers' personal value, combine with relevant theory basis, it will be more substantive and in-depth understanding of obstacles and opportunities that brought by the booming cross-border online shopping. The research results can be the future researches' reference.

Contribution to Practical application: online shopping websites are facing the difficulties of price and low-quality competition; cross-online shopping can be a good development direction. This study hopes to capture the deep inner thoughts and feelings of consumers, in order to deduce the behavior patterns of consumers, it can be reference of product development and marketing. Allowing manufacturers and brands can be output to the international market.

ACKNOWLEDGMENT

This work is partially supported by grant ORD-106052 of the Personal Project Fund from the Da-Yeh University, Taiwan.

This work is partially supported by grant 2016M602838 of the Post-doctoral foundation from Ministry of Education, PRC

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Ampong, G.O.A., Mensah, A., Boakye, K., Simpson, G., Ofori, K.S., & Addae, J.A. (2018). Exploring mobile SNS continuance intention from the perspective of network externalities and mobile value. In *Proceedings of The 18th International Conference on Electronic Business* (pp. 295-303). ICEB, Guilin, China, December 2-6.

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Exploring Mobile Social Networking Sites Continuance Intention from the Perspective of Network Externalities and Mobile Value

(Full Paper)

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ABSTRACT

Key shifts in the nature and characteristics of technology have led to evolutions in social media usage. For the first time in history, the internet is being accessed from more mobile devices than desktop computers. This revolution is especially felt among social networking sites, many of whom have presciently developed and released mobile applications of their platforms. Drawing from the Perceived Value Theory, Network Externalities and the Expectation Confirmation Theory of IS Continuance, we tested a model that sought to explain the effect of Network Externalities on Perceived Value and in turn Continuance Intention. Data was collected from 452 students from a university in Ghana and analyzed using the Partial Least Square approach to Structural Equation Modeling. Results from the current study showed that Referent Network Size and Perceived Complementarity had significant effects on both Utilitarian and Hedonic Value as well as Satisfaction. Hedonic Value, Utilitarian Value and Satisfaction in turn were found to be significant predictors of Continuance Intention. In all, the model accounted for 58.0% of the variance in continuance intention. The implications and limitations of the current study are discussed, and directions for future research proposed.

Keywords: network externalities, hedonic value, utilitarian value, continuance intention, social networking sites.

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INTRODUCTION

Over the past few years, social media as a technological phenomenon has overwhelmed the world. Usage statistics establish that billions of people are actively engaged in sharing and consuming the information available on social media platforms (Correa, Hinsley, & de Zúñiga, 2010). This sharing and consumption of information generate billions in revenue for technology companies that have succeeded in capturing consumer's hearts and attention. Marketers have also successfully exploited the new platforms to access target audiences for advertising (Trusov, Bucklin, & Pauwels, 2009). Scholars, in their turn, have paid particular attention to antecedents of social media usage (Bolton et al., 2013; Hughes, Rowe, Batey & Lee, 2012), how exactly relationships are built and maintained on these platforms, and even the effect of social media usage on real-life relationships, jobs, emotions, and society as a whole (Gil de Zúñiga, Jung, & Valenzuela, 2012; Kaplan & Haenlein, 2010).

Key shifts in the nature and characteristics of technology have led to evolutions in social media usage that require deeper study. The first issue is that of the mobile revolution, Etherington (2016) reported in 2016 that for the first time in history, the internet was accessed from more mobile devices than desktop computers. By 2017, almost half of all web page views were from mobile devices rather than fixed computers. This revolution was especially felt among social networking sites, many of whom had presciently developed and released mobile applications of their platforms. Subsequently, major SNS platforms like Facebook and Twitter reported an increase in the number of people accessing their services using mobile devices. The increase in access has led scholars to examine whether there are major differences in user behavior and attitude on mobile SNSs as against traditional computer-based SNSs. The research remains largely inconclusive (Zhou, Li, & Liu, 2010).

Again, a second concern that has emerged has been that of continued usage. The survival of social networking sites depends on the persistent usage of subscribers who base their connections with one another on the platform and its added services (Lin & Bhattacharjee, 2008). Without this bond of networks, the site becomes an irrelevant relic and soon ceases to be profitable to stakeholders. Scholars and practitioners are therefore interested in identifying what factors can influence and predict continuance (Kim, 2011). These realities as discussed have presented gaps in the literature on social networking sites that remain to be filled by relevant empirical research from as many different contexts as possible.

Notably, academics have identified the fact that the networks built and maintained on social networking sites – a form of social media -- have characteristics that in themselves affect the perceived usefulness and enjoyment of the site to the users. These network effects influence the value that a consumer attaches to the site, and may, in turn, affect his/her satisfaction with the site, and his/her intention to continue usage of the site. These relationships have been put forth in the literature (e.g. Lin & Bhattacharjee, 2008), but remain in dire need of testing across various geographical locations. For instance, a majority of the research questioning the impact of network effects on SNS usage and continuance intention have come from Eastern nations like China. Few have been situated within the African context, where social networks are a strongly influential part of daily life, business, politics, and relationships (Meagher, 2005). Indeed, although some scholars have posited that user behavior online is not location-dependent, other researchers support the possibility that the offline setting of an online user could have an impact on their behavior online (Benevenuto, Rodrigues, Cha, & Almeida, 2009; McHugh, 2014; Yee, Bailenson, Urbanek, Chang, & Merget, 2007). The current study, therefore, sought to examine the interplay between network externalities, mobile SNS user's hedonic and utilitarian value, satisfaction and continuance intention

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Network Externalities

An important perspective in understanding the workings of social networking sites is dependent on the considerations of network externalities. Katz & Shapiro (1986) made seminal headway on the issue by establishing that network effects can stimulate both direct and indirect value for the participants of a network. An insightful study by Lin & Lu (2011) found that the number of peers and the perceived complementarity of the social networking site under study served as an even greater motivation for people to adopt the SNS than their perceived value of the site for usefulness and enjoyment. Moreover, when it came to continuance intention, it was found that women considered the network size of the SNS although men did not. Additionally, Zhao and Lu (2012) found that network externalities also positively influenced users' perceived interactivity of the site, which led to their greater satisfaction and also continuance intention.

Network Externalities and Value

The importance of perceived value in instigating the adoption and continued usage of a particular technological system has been studied severally in the literature (Curran & Meuter, 2005; Jurison, 2000; Kim, Chan, & Gupta, 2007; Turel, Serenko, & Bontis, 2007). However, the predictors of customer value are still yet to be well-established with empirical studies. It is the contention of the current study that network-related factors like the number of participants, and perceived complementarity can affect the value which the user ascribes to the social networking site.

Network size and value

The size of a network has been found to be an important element in discussions about network effects because users determine the value of any social networking site, and the more of a consumer's acquaintances, friends, colleagues, and family that use the site, the more the consumer can get a lot done when they participate on the SNS (Lin & Lu, 2011). There are instances where a large network size can rather result in a reduction of overall value to the user in question (Lin & Bhattacharjee, 2008). For instance, the more users who are connected to an internet network at a time, the slower the network is for each user. In such a case, a large network size has a negative effect. On social networking sites, however, large networks are more often than not a benefit to users because they enhance the experience of using the site.

It is interesting to note that some researchers specify that referent network size, or peer network externality, should be distinguished from the general network size (e.g. Zhou & Lu, 2011; Gao & Bai, 2014), explaining that a consumer's utility is only increased by a large network size on the SNS if those within their sphere of influence can also be found there. Thus, while it may be well and good for the SNS to have a billion network participants, if the consumer in question cannot find many of his/her personal or referent social network there, s/he will not derive any value from the network size. Indeed, research has substantiated that a majority of people who engage and are active on social networking sites do so because they are, in a sense, recreating their offline networks in a digital setting (Dunbar, Arnaboldi, Conti, & Passarella, 2015; Subrahmanyam, Reich, Waechter, & Espinoza, 2008).

As to what kind of value is gained from a large network size, empirical evidence exists to suggest that both hedonic and utilitarian value can be obtained from a large network size. Hedonic value is increased for consumers who gain entertainment, joy, and fulfillment from experiencing the lives of those within their referent network. In fact, (Sledgianowski & Kulviwat, 2009) assert that one of the greatest reasons individuals adopt SNS usage is for the perceived playfulness of the site. Additionally, Okazaki, Rubio, and Campo (2013) observed that online gossipers perform most effectively among a large network, and are then able to provide information, entertainment, and friendship value on the SNS. Xu, Ryan, Prybutok, and Victor (2012) also explain that many people use SNS platforms for more than fun: many business connections and professional communications and linkages are carried out on social networking sites. These are supported by research from the likes of Ernst, Pfeiffer, and Rothlauf (2013), whose study focuses on how both hedonic and utilitarian value can be derived from social networking sites. Based on the evidence presented above, the following hypotheses will hold in mobile SNSs:

H1: Network size significantly predicts hedonic value

H2: Network size significantly predicts utilitarian value

Network perceived complementarity and value

It has been explained that an example of network effects within such systems is that as the network gains participants and credence, a significant number of compatible systems, platforms, goods, and services are also enabled, all contributing to increased overall value for the user. Within the social network context, (Lin & Lu, 2011) illuminate that social applications both on the website and on the general world wide web can be enjoyed based on membership of the more popular SNSs. Moreover, other social media tools and capabilities can be taken advantage of, such as messaging, sharing photos and videos, connecting with celebrities or businesses, etc. All these extra services add value to the usage of the site and make it more attractive to users.

From the above, it can be understood that perceived complementarity of the social networking site can lead to hedonic value, as it provides an opportunity for the user to engage in fun, de-stressing, and enjoyable experiences which are indirect effects of belonging to the network for which s/he has subscribed. Zhang, Li, Wu, and Li (2017), for example, observe in their study on the Chinese SNS WeChat, that greater perceived complementarity enhances the user's sense of enjoyment on the platform and their subsequent continuance intentions. Moreover, as well, when the SNS can provide many complementary services, the users also benefit from utilitarian value. For instance, many web services now allow users to log in to external sites using their SNS identities and details, thus proving to be more convenient and less time- and energy-consuming for the consumer. Again, the provision of capabilities like messaging, sharing of multimedia content, and connecting with business colleagues and partners allow users to fulfill some functional obligations while on the SNS, apart from enjoying the hedonic value of the site. Still again, Kang and Namkung (2016) found that perceived complementarity was an important predictor of the perceived usefulness of the site, and this, in turn, made users more likely to share information about restaurants to their social network. Thus, we posit that:

H3: Perceived complementarity significantly predicts hedonic value

H4: Perceived complementarity significantly predicts utilitarian value

Network Externalities and Satisfaction

A second key relationship observed in practice, and the literature is that of the influence of network externalities on the satisfaction of users. It is well understood that satisfaction is one of the most important things a business or brand can aim for because it is the foundation for almost all desirable consumer behaviors (Cronin, Brady, & Hult, 2000). In the most elementary understanding of it, satisfaction consists of the consumer's perception of how the product or service that has been provided either falls below, is equal to or exceeds their expectations of how it would be. Within the social networking site literature, user satisfaction has been studied to be dependent on a variety of factors. For instance, Ogara, Koh, and Prybutok (2014) posit that user satisfaction with mobile services is predicted by the user's experience, social influence, and the perceived medium richness of the platform. Zhao and Lu (2012) also identify that the perceived interactivity of the platform determines satisfaction with a micro-blogging SNS. According to them, perceived interactivity consists of users' perceptions of control, playfulness, connectedness, and responsiveness. Interestingly, again, although Lien, Cao, and Zhou (2017) find that user satisfaction with WeChat is reliant on environmental quality and outcome quality, they did not establish a significant relationship between interaction quality and satisfaction. These all indicate that the antecedents of satisfaction in an SNS can be varied and come from a multiplicity of sources. The literature is, however, less developed on the role of network externalities in predicting satisfaction.

There is, however, sufficient grounds to believe that network size and perceived complementarity of the SNS can yield greater satisfaction for a consumer. It is evident that as more and more people are added to the network, especially those who are known to the consumer, the user experiences greater satisfaction in interacting with them and being a part of their lives. Moreover, perceived complementarity and the flexibility that it ensures users in using the site and other web resources also enhances user satisfaction with the SNS and with their experience. We, therefore, proffer that:

H5: Network size significantly predicts satisfaction

H6: Perceived complementarity significantly predicts satisfaction

Value and Satisfaction

The role of value in yielding satisfaction is not a new topic to the literature. Perceived value has been acknowledged as one of the more common antecedents of satisfaction (e.g. Kuo et al., 2009) since satisfaction as a concept in itself is dependent on consumer perceptions of value. Among South Korean audiences, Kim (2011) found that perceived usefulness and perceived enjoyment were significant predictors of customer satisfaction. Research is however ambiguous on whether hedonic or utilitarian value provides greater motivation towards user satisfaction. Illustratively, Eroglu, Machleit, & Barr (2005) found that hedonic value is a stronger predictor of satisfaction than utilitarian value. Thus, the current study puts forth that:

H7: Hedonic value significantly predicts satisfaction

H8: Utilitarian value significantly predicts satisfaction

Value and Continuance Intention

Again, both types of perceived value can lead to continuance intention on the side of the consumer. Chiu, Wang, Fang, & Huang (2014) posited that hedonic value is a significant indicator of consumer continuance intention, establishing that when the consumer perceives that whenever they log on to the platform, they can experience an enjoyable time and be joyfully fulfilled, they will keep wanting to come back. Moreover, utilitarian value can also motivate continuance intention. Ryu et al. (2010) especially found this to be true within the restaurant sector, but there exists space in the literature to examine the impact of perceived value on continuance intention in mobile SNSs. We, therefore, propose that:

H9: Hedonic value significantly predicts continuance intention

H10: Utilitarian value significantly predicts continuance intention

Satisfaction and Continuance Intention

It is the contention of the current study that it is when the consumer is satisfied with the services of the mobile SNS platform that they can make this decision. Our stance is substantiated by research in the literature which provides the same conclusions within some different contexts. For one, Zhao & Lu (2012) found that when microbloggers were satisfied with the site, their intention to continue usage of the site was greater. In the same way, this has been found true within the restaurant industry (Kang & Namkung, 2016; Namkung & Jang, 2007; Ryu et al., 2010). Lien et al. (2017) found this to be applicable within social networking sites as well, explaining that the relationship between satisfaction and usage intentions is also mediated by the stickiness, or addictiveness, of the site. Kim (2011), whose study focused on Cyworld, another Asian-originated social networking site, also found satisfaction to be a strong predictor of continuance intention. Thus, there is sufficient basis to believe that within the context:

H11: Satisfaction significantly predicts continuance intention

METHODOLOGY

The items for the latent variables used in this study were drawn from previous studies, and the questions were reworded to fit the mobile social networking sites' context. Items for referent network size and perceived complementarity were derived from Gao and Bai (2014) while those for hedonic value and utilitarian value were derived from Lin and Lu (2015). Satisfaction and continuance intention, on the other hand, were derived from Bhattacharjee (2001). The measurement instrument had 24 items in all and items were presented in English. Items were measured using a 5-point Likert scale anchored between 1 (Strongly Disagree) and 5 (Strongly Agree). To test the hypothesized research model, the researchers adopted a survey research methodology to collect data. Data were collected from students in three private universities in Ghana. Students in these universities were sampled based on convenience and handed a paper-based questionnaire. Research assistants were each sent with 250 questionnaires to collect data from three private universities in the Greater Accra Region of Ghana. The data were collected over a period of five days. In all, 523 questionnaires were returned, out of which 71 had to be discarded because significant portions of the questionnaires were not filled out. A total of 452 were therefore used for the analysis. From the valid responses, 209 were male, and 243 were females.

RESULTS AND ANALYSIS

Measurement Model Assessment

Reliability of the constructs was assessed using Cronbach's alpha and composite reliability. For the items to be seen to reliably measure the constructs, Henseler, Hubona, and Ray (2016) recommends that reliability statistic must be greater than 0.7. From Table 1 it can be seen that the reliability statistics for all constructs are compellingly higher than the threshold recommended by Henseler et al. (2016).

Table 1 Results of reliability and convergent validity testing

	INT	HV	RNS	PCC	SAT	UV	CA	CR	AVE
INT1	0.902	0.582	0.671	0.641	0.548	0.616	0.922	0.924	0.81
INT2	0.927	0.515	0.713	0.675	0.552	0.610			
INT3	0.905	0.425	0.695	0.642	0.544	0.553			
INT4	0.865	0.425	0.682	0.659	0.506	0.509			
HV1	0.459	0.874	0.417	0.388	0.256	0.494	0.913	0.939	0.793
HV2	0.471	0.886	0.411	0.412	0.280	0.477			
HV3	0.531	0.913	0.433	0.440	0.306	0.501			
HV4	0.477	0.889	0.389	0.382	0.287	0.465			
RNS1	0.733	0.437	0.950	0.650	0.475	0.497	0.892	0.949	0.902
RNS2	0.723	0.443	0.950	0.657	0.448	0.522			
PCC1	0.684	0.387	0.663	0.888	0.484	0.456	0.916	0.941	0.799

PCC2	0.634	0.417	0.630	0.902	0.420	0.423			
PCC3	0.626	0.417	0.590	0.905	0.477	0.453			
PCC4	0.653	0.411	0.577	0.882	0.451	0.469			
SAT1	0.446	0.251	0.361	0.420	0.855	0.299			
SAT2	0.518	0.326	0.416	0.378	0.854	0.390			
SAT3	0.529	0.246	0.438	0.463	0.877	0.353	0.922	939	0.72
SAT4	0.521	0.255	0.421	0.413	0.826	0.331			
SAT5	0.496	0.238	0.387	0.455	0.838	0.343			
SAT6	0.525	0.298	0.442	0.478	0.840	0.360			
UV1	0.563	0.455	0.443	0.462	0.359	0.892			
UV2	0.569	0.488	0.497	0.436	0.367	0.916	0.929	0.95	0.825
UV3	0.584	0.506	0.505	0.452	0.362	0.918			
UV4	0.601	0.526	0.500	0.482	0.398	0.906			

Note: INT- Continuance Intention, HV-Hedonic Motivation, RNS-Referent Network Size, PCC-Perceived Complementarity, SAT-Satisfaction, UV- Utilitarian Value, CA-Cronbach's alpha, CR-Composite Reliability, AVE- Average Variance Extracted

The assessment of convergent validity was also done using the average variance extracted AVE. For the measurement model to exhibit sufficient convergent validity, Henseler et al. (2009) recommend that the AVE of all constructs in the model must be above 0.5. Evidence for convergent validity is provided in Table 1 as AVE for all constructs are above 0.5.

Finally, discriminant was assessed using the following rules: (1) The Fornell-Larker criterion; which states that the average variance extracted (AVE) of each latent construct should be greater than the highest squared correlations between any other construct (Fornell and Larcker, 1981), (2) the loadings of each indicator should be greater than all its cross-loadings (Chin, 1998; Gotz et al., 2010; Henseler et al., 2009) and (3) the heterotrait-monotrait ratio of correlations (HTMT) values must be less than 0.85 (Henseler, Ringle, & Sarstedt, 2015). Table 1. reveals that all indicators load their highest on their respective construct. Again, from Table 2 it is evident that the square root of the AVEs for each construct is greater than the cross-correlation with other constructs. Table 3 also reveals that the HTMT criterion has been met since all HTMT values are less than 0.85. Based on these results we conclude that the psychometric properties of the measures used in the study are adequate.

Table 2. Test of discriminant validity using Fornell-Larcker Criterion.

	INT	HV	RNS	PCC	SAT	UV
INT	0.900					
HV	0.545	0.891				
RNS	0.767	0.463	0.950			
PCC	0.726	0.456	0.688	0.894		
SAT	0.598	0.318	0.486	0.513	0.848	
UV	0.638	0.544	0.536	0.504	0.409	0.908

Note: Square roots of average variance extracted (AVEs) shown on diagonal while off-diagonals are inter-construct correlations.

Table 3 Test of discriminant validity using the heterotrait-monotrait ratio of correlations (HTMT) ratios.

	INT	HV	RNS	PCC	SAT	UV
INT						
HV	0.588					
RNS	0.846	0.513				
PCC	0.791	0.498	0.761			
SAT	0.646	0.345	0.534	0.556		
UV	0.686	0.590	0.588	0.546	0.440	

6.2 Structural model assessment

In support of H1 and H3, Referent Network Size was found to be a significant predictor of Hedonic Value ($\beta = 0.284$, $p = 0.001$) and Utilitarian Value ($\beta = 0.359$, $p = 0.000$) respectively. Referent Network Size was also found to be a significant predictor of Satisfaction. Perceived Complementarity was found to have significant effect on Hedonic Value ($\beta = 0.261$, $p = 0.003$) and Utilitarian Value ($\beta = 0.258$, $p = 0.004$) respectively. Perceived Complementarity was also found to significantly affect Satisfaction ($\beta = 0.299$, $p = 0.000$).

Table 4

Hypotheses	Path	Path Coefficient	T Statistics	P Values	Results
H1	RNS \rightarrow HV	0.284	3.435	0.001	Supported
H2	RNS \rightarrow SAT	0.197	2.498	0.013	Supported
H3	RNS \rightarrow UV	0.359	4.449	0.000	Supported
H4	PCC \rightarrow HV	0.261	3.002	0.003	Supported
H5	PCC \rightarrow SAT	0.299	4.236	0.000	Supported
H6	PCC \rightarrow UV	0.258	2.889	0.004	Supported
H7	HV \rightarrow SAT	0.010	0.179	0.858	Not Supported
H8	HV \rightarrow INT	0.230	3.884	0.000	Supported
H9	UV \rightarrow SAT	0.148	2.369	0.018	Supported
H10	UV \rightarrow INT	0.358	5.943	0.000	Supported
H11	SAT \rightarrow INT	0.378	8.641	0.000	Supported
Model Fit					
SRMR		0.039			

Contrary to expectations, Hedonic Value was found not to significantly predict Satisfaction ($\beta = 0.010$, $p = 0.179$). It was however found to be a significant predictor of continuance intention ($\beta = 0.230$, $p = 0.000$). Utilitarian Value was found to have a significant effect on both Satisfaction ($\beta = 0.148$, $p = 0.018$) and Continuance Intention ($\beta = 0.358$, $p = 0.000$). Finally, in support of H11, Satisfaction was found to have the strongest effect on Continuance Intention ($\beta = 0.378$, $p = 0.000$). In all, the validated model accounts for 58% of the variance in Continuance Intention. The overall fitness of the model was assessed using the SRMR composite factor model. The composite model SRMR value for the model was 0.039, below the 0.08 threshold recommended by Hu and Bentler (1999). The results indicate that the proposed model presents a good model fit.

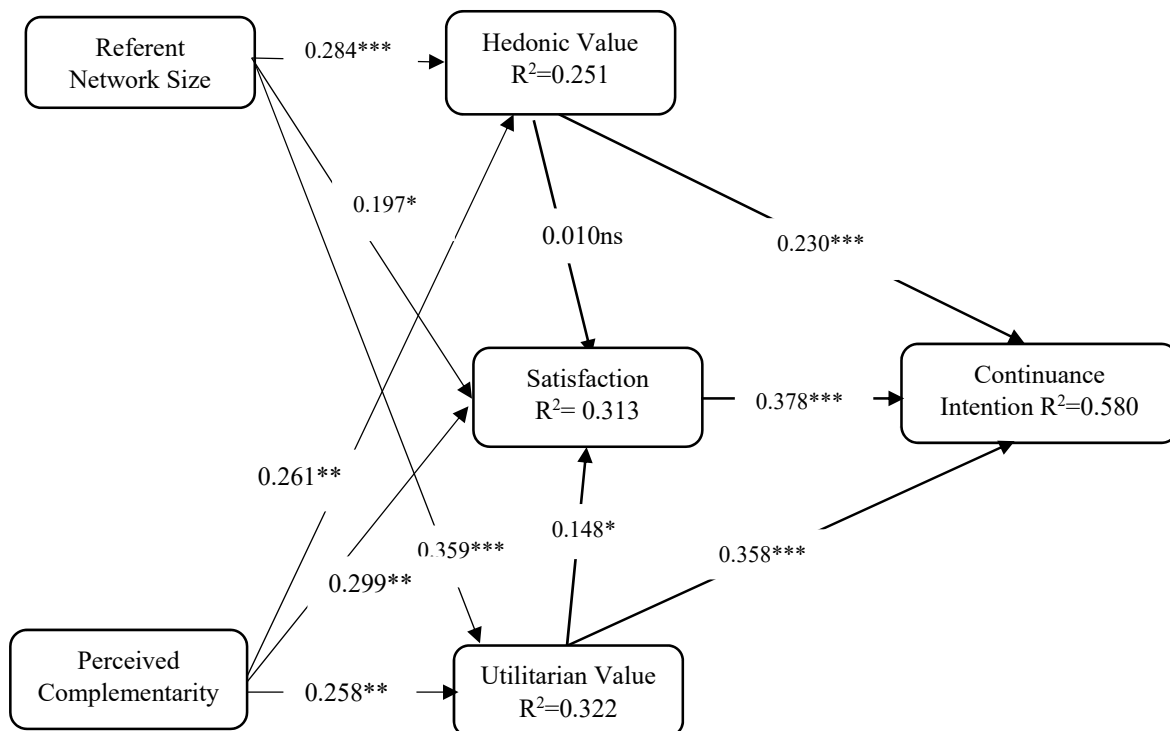


Figure 1: Structural model

DISCUSSIONS AND IMPLICATIONS

As evidenced by the results of the study presented above, almost all of the hypotheses of the study were found to be significant, except the relationship between hedonic value and satisfaction. The results of the current study serve as a support for many of the previous studies in the literature and also contributes useful insights from the context.

First of all, the relationship between the two-pronged network externalities and consumer value was investigated. Extant research has set the foundations for a positive relationship between the constructs, with scholars like Lin & Bhattacharjee (2008) finding a strong correlation. In the current study, also, both referent network size and perceived complementarity were found to influence both utilitarian and hedonic value. Of the four interrelationships, the link between referent network size and utilitarian value was found to be the largest and most significant. This result is interesting as previous literature has generally placed greater emphasis on the role of large network size on hedonic value more than utilitarian value (Ernst et al., 2013; Sledgianowski & Kulviwat, 2009). However, it is aligned with literature that explains how a large referent network size can enhance the functional usage of the site for consumers (Xu et al., 2012).

Again, the study considered the effects of network externalities on the satisfaction of the consumer with the mobile SNS. Luo & Lee (2015) identified earlier that such a relationship existed, and that perceived complementarity was a greater predictor of satisfaction than network size; however, their study was situated in the mobile instant messaging context. The results of our study supported these findings within the mobile SNS context as well, demonstrating that a large network size and perceived complementarity enhance user satisfaction as it provides them with an opportunity to interact with their acquaintances without fear of being isolated from other technological platforms and apps (Lin & Lu, 2015; Zhao & Lu, 2012; Zhou & Lu, 2011).

Moreover, both hedonic and utilitarian value were tested for their relationship to satisfaction and subsequent continuance intention. Utilitarian value was found to be a predictor of satisfaction, as has been the case in some previous studies (Kim, 2011; Kuo et al., 2009). Within the context, however, hedonic value was not found to be significant in predicting satisfaction, which is in contrast with some studies that found the opposite (Eroglu et al., 2005).

Finally, the relationship between satisfaction and continuance intention was tested. The results of our study concurred with prior research which establishes that satisfaction with a mobile network engenders continuance intention which, like Kim, Chan, & Gupta (2007) and Venkatesh & Davis (2000) explain, is a proxy for continuance behavior. (Lien et al., 2017) and (Ryu et al., 2010) are only examples of scholars' position on the issue.

Implications

The focus of the study has been to identify the effects of network externalities on consumer perceived value, satisfaction, and subsequent continuance intention specifically on mobile social networking sites.

The study contributes to contemporary discussions on some interesting issues. First, it deliberates on the network effects occurring in social networking sites (Lin & Bhattacharjee, 2008), providing empirical evidence to support scholarly thoughts on the effects of network size and perceived complementarity on customer attitudes like satisfaction and continuance intention. Additionally, it supports research which discusses the effects of perceived value on satisfaction and continuance intention (Jin et al., 2010; Kim, 2011; Kim et al., 2007; McDougall & Levesque, 2000), distinguishing between hedonic and utilitarian value as precursors of these constructs.

By playing these roles, the study has contributed to studies of network effects, perceived value, and continuance intention specifically within the mobile SNS literature. Particularly, it has substantiated the role of perceived value as a predictor of satisfaction and continuance intention (Chiu et al., 2014; Kuo et al., 2009; Ryu, Han, & Jang, 2010), while also introducing the network externalities theory as a valid explanation for the network effects identified on social networking sites.

Among some of the specific lessons, practitioners can learn from the findings of the study are the following. Firstly, as perceived value plays such an important role in the generation of satisfaction and continuance intention, practitioners must strive to find avenues of providing both hedonic and utilitarian value to their users on the site. Second, although the results of the study did not indicate that hedonic value affects satisfaction directly within the context, practitioners must make sure that they do their best to fulfill the enjoyment needs of consumers on the platforms, as it still influences their continuance intentions.

Limitations and Future Research Directions

Even though the current study presents empirical findings to further our understanding of continuance intention from the perspective of network externalities and perceived mobile value, a few limitations must be considered when interpreting and generalizing results. First, our result is limited by the fact that data were collected from students in only three private universities in Ghana. While this sample characterizes a fairly typical band of SNS users, it is still not representative of all SNS users. Second, our study employed a cross-sectional design; it would be interesting to consider a longitudinal design in future studies. Although Hedonic Value was found not to be a significant predictor of Satisfaction in this study, the results may be different for another cultural context. It would, therefore, be interesting to replicate the study in other cultural contexts.

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Exploring the Influential Factors of Consumers' Willingness to Purchase Fresh Agricultural Products Online: A Meta-Analysis

(Full Paper)

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ABSTRACT

What are the key influential factors of consumers' willingness to purchase fresh agricultural products online? A large number of existing studies indicate that even the same factor has significant inconsistency or even opposite conclusion. Based on this contradiction, this study uses meta-analysis and uniform effect values to analyze the existing researches, and find a more unified conclusion. The results show the degree of self-health concern, the quality, safety and price, online shopping evaluation, the consumers' perceived usefulness, perceived ease of use, and perceived risk in online shopping for fresh agricultural products all have a significant impact on consumers' online shopping willingness.

Keywords: Online shopping willingness, fresh agricultural products, meta-analysis.

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INTRODUCTION

Fresh agricultural products also named fresh vegetables, fresh fruits, fresh aquatic products, livestock, poultry, meat, egg and milk, which differed from other consumer products in that its perishables put forward timeliness requirements; safety requirements; and consumers' tastes of variety diversity. Due to its obvious experience-based product for consumption, traditional agricultural product trade volume online relatively small (He, Han, & Li, 2014). Online sales volume of fresh agricultural products increased dramatically along with the emergence of E-commerce (Alibaba's Agricultural E-Commerce White Paper (2016), 2018 Fresh Food Consumption Report by Jingdong). At the same time, China's precision poverty alleviation projects and rural revitalization plans facilitate more and more fresh agricultural products selling online.

Exploring the factors that affect consumers' willingness to purchase online for fresh agricultural products becomes necessary. Lots of existing research studied the influencing factors of consumers' online purchase intention of fresh agricultural products. Qi and Lin (2018) employ the construal level theory to reveal the influence of social distance on purchase intention through consumer behavior experiment. He, Han, and Li (2014) carried out empirical analysis to explore the model of influencing factors of Chinese consumers' purchase intention of fresh agricultural products based on models of consumer behavior. However, the relationship between various factors and online shopping intentions has been inconsistent in different studies, and there are also differences in the strength and weakness of the influence.

Zou (2011) propose that the convenience of purchase and family dining habits have no significant impact on consumers' willingness, Liu (2017) believes that consumers' eat, cooking frequency, Internet convenience have a significant positive impact on consumers' willingness of purchase of fresh agricultural products. Lin (2017) believes that attributes of fresh agricultural products, quality of logistics service, website service quality positively affect consumers' willingness to purchase. Liu (2017) believes expected freshness of products, expected quality and safety of products, quality of service of e-commerce websites, and consumers' perceptions of online shopping risks has not significantly affected consumers' online shopping willingness of fresh agricultural products. Zhang *et al.* (2015) state that there is a negative relationship between perceived risk and purchase intention. Liu (2017) believes that consumers' perceptions of online shopping risks has no significant impact on consumers' online shopping for fresh agricultural products. Yi and Yi (2015) propose perceived ease of use positively affect consumers' willingness to purchase, but its impact is not significant. Bai (2017) propose that perceived ease of use significantly affects the willingness of online shopping for fresh fruits.

Meta-analysis is a valid method for quantitative statistical analysis to solve inconsistencies. Specifically, it comprehensively analyzes various studies on the same subject, to achieve general conclusions from individual conclusions, even the relationship between research variables has strong or weak differences in different studies, or even direction differences. Furthermore, it can reveal the reasons for the inconsistency of many research conclusions (Bai, 2017). This study uses meta-analysis method to review

researches on the existing online shopping intentions of fresh agricultural products; and then use meta-analysis to unify the effect values to solve the different emphasis, the same factors have different influences on online shopping intentions, even inconsistencies in direction. Through meta-analysis, scattered researches can be connected to scientifically summarize existing researches, reveal the universal factors affecting consumers' online shopping for fresh agricultural products, and further provide theoretical support for agricultural sales activities of e-commerce platform.

RESEARCH METHODS, THEORIES AND HYPOTHESES

Meta-analysis, also known as integrated analysis, is a scientific quantitative comprehensive analysis method that systematically evaluates and quantifies multiple research results with the same purpose and independent of each other. This method has been widely used in psychology and clinical medicine (He, Yang, & Chen, 2009), and now it's now widely applied to the field of social sciences. With the combined research data from different studies, the sample size increased, which helps to avoid bias, and get more universal influential factors.

The theory of reasoned action (TRA) consider human behavior is determined by behavior intention that is influenced by attitude and subjective norms, which affect behavior intention and ultimately determine whether an individual takes action. Behavior intention refers to the tendency of the individual to prepare for a particular behavior; the behavioral attitude refers to the individual's evaluation of the good or bad of a certain thing; the subjective norms refer to the opinions of individuals who believe that most people and actions that are important to them are important to their actions. According to TRA, we can conclude that consumers' own feelings and evaluations, the evaluations of others around them have a direct impact on the willingness to act. Huang *et al.* (2010) explored the driving factor system of enterprise employees' knowledge sharing behavior based on TRA. TRA assumes that people are either completely rational or completely irrational. Actually, this isn't existent almost, and for individuals to completely control their behaviors without external factors is impossible. Azjen added perceived behavior and proposed theory of planned behavior (TPB). Perceived behavior refers to an individual's assessment of how easy it is to complete a behavior, which will affect purchase intention (Huang, 2017).

Based on the above both theories, Technology acceptance model (TAM) introduces perceived usefulness and perceived ease of use into theory, which was originally explain the acceptance determinants of computer. Perceived usefulness reflects the extent that someone thinking a system is used to improve performance, while perceived ease of use reflects the extent to which one considers it easy to use a particular system.

Based on the above theories and related research, this paper uses the following variables as the influencing factors of online shopping willingness.

Consumers' Personal Characteristics

Consumers' personal characteristics includes online shopping experience, the degree of self-health concern and perception of fresh agricultural products. Specifically, former includes the net age of consumers and the convenience of online shopping; the degree of self-health concern includes the form of consumers often eat and the degree of willingness to cook for themselves; perception of fresh agricultural products is knowledge and experience in the selection of fresh agricultural products.

Characteristics of Fresh Products

Characteristics of fresh products mainly includes products quality, safety and price (i.e. discount). Specifically, product quality and safety include freshness and safety certification; products price include consumer expectations for price and price discounts.

Characteristics of the Online Shopping Platform

This refers to quality of information, packaging and logistics service quality, and online shopping evaluation displayed by the platform. Specifically, the information quality includes the richness of information, the information's professionalism and quality; packaging and the quality of logistics services mainly refer to the special nature of fresh agricultural products, which requires more elaborate packaging and faster delivery; online shopping evaluation includes consumer evaluation, trust and platform reputation.

Consumers Perception of Online Purchase

Consumer perception of online purchase for fresh agricultural products mainly refer to perceived ease of use, perceived usefulness, and perceived risks. Specifically, former includes perceived costs and innovation of individual; the second one includes perceived benefits and functional value; perceived risk includes perceived uncertainty.

Consumers who consider online shopping as a positive, appropriate, trend-oriented shopping method are more inclined to accept online shopping for fresh agricultural products, while consumers who oppose online shopping and think online shopping is a passive shopping method tend to refuse to adopt online purchase methods (Zou, 2011). Hence, we propose hypothesis H1.

H1. Consumers' online shopping experience has a positive impact on online shopping willingness.

Considering the situation of consumers eating out and the frequency of cooking themselves, people pay more attention to their own health, then prefer to cook by themselves and buy fresh products online (Liu, 2017). Hence proposing hypothesis H2.

H2. Consumers' own concern for health has a positive impact on online shopping willingness.

The more consumer master information of agricultural products, the more they tend to purchase online (Wang & Dai, 2017). Hence, we propose hypothesis H3.

H3. Consumers' own perception of fresh agricultural products has a positive impact on online shopping willingness.

The freshness of fresh agricultural products and safety certification mark reduce consumers' perception of risk and uncertainty in online shopping. If the quality and safety of agricultural products are high, consumers are willing to purchase fresh agricultural products online. Hence proposing hypothesis H4.

H4. The quality and safety of fresh agricultural products have a positive impact on online shopping intention.

Price (i.e. discount) affect the online shopping demand for commodities. The price of product will directly affect consumers' demand and purchase intention. The higher the price discount of fresh agricultural products, the higher the consumer's willingness to purchase (He, Han, & Li, 2014). Hence proposing hypothesis H5.

H5. The price (i.e. discount) of fresh products has a positive impact on shopping willingness.

Most fresh agricultural products belong to non-standardized products. Lack of information and information asymmetry will hinder consumer purchase fresh agricultural goods online. E-commerce sites provide professional, high quality and rich information that will help consumers making decisions. Consumers' perception of the richness of information provided by the website may be an important factor in consumers' willingness to purchase (He, Han, & Li, 2014). Hence proposing hypothesis H6.

H6. Quality of information displayed by online platform has a positive impact on willingness of online shopping.

Packaging and logistics services is import to fresh agricultural products. Good packaging will ensure fresh agricultural products be properly protected, reducing damage, loss and possible quality degradation during transport. At the same time, timely and rapid logistics services are also an important guarantee to meet the needs of consumers and ensure the quality of agricultural products. Most fresh products are difficult to preserve and transport. Consumers often require sellers to deliver goods as quickly as possible (He, Han, & Li, 2014). Hence, we propose hypothesis H7.

H7. The quality level of packa ging and logistics services provided by th e online shopping platform has a positive impact on the online shopping willingness.

Online consumer review reveals consumers' evaluation on the reputation of the platform and seller, has a certain impact on the potential consumer's purchase behavior (Huang, 2017). Consumers tend to shopping online when saw positive reviews. Hence, we propose hypothesis H8.

H8. Evaluation of products has a positive impact on consumer online shopping willingness.

If the desired product is easy to find on the fresh e-commerce platform, the online shopping process is easy to master. And if it is simple of return, then will promote consumers online shopping behavior (Liu, 2017). Hence proposing hypothesis H9.

H9. Perceived ease of use about online shopping has a positive impact on online shopping willingness;

If e-commerce platform enables to aid consumers make better choices and online payment is convenient, these will also have an impact on consumers' online shopping willingness (Liu, 2017). Hence, we propose hypothesis H10.

H10. Consumers' own perception of the usefulness of o nline shopping for fresh agric ultural products has a positive impact on online shopping willingness.

Online purchases may cause economic losses. Consumers may receive damaged packages, and may need to be returned, which will affect willingness (Liu, 2017). Hence, we propose hypothesis H11.

H11. Consumers' own risk perception of online purchase for fresh agricultural products has a negative impact on online shopping willingness.

According to all hypotheses above, we proposed the framework of factors affecting the willingness to purchase fresh agricultural products as shown in Figure 1.

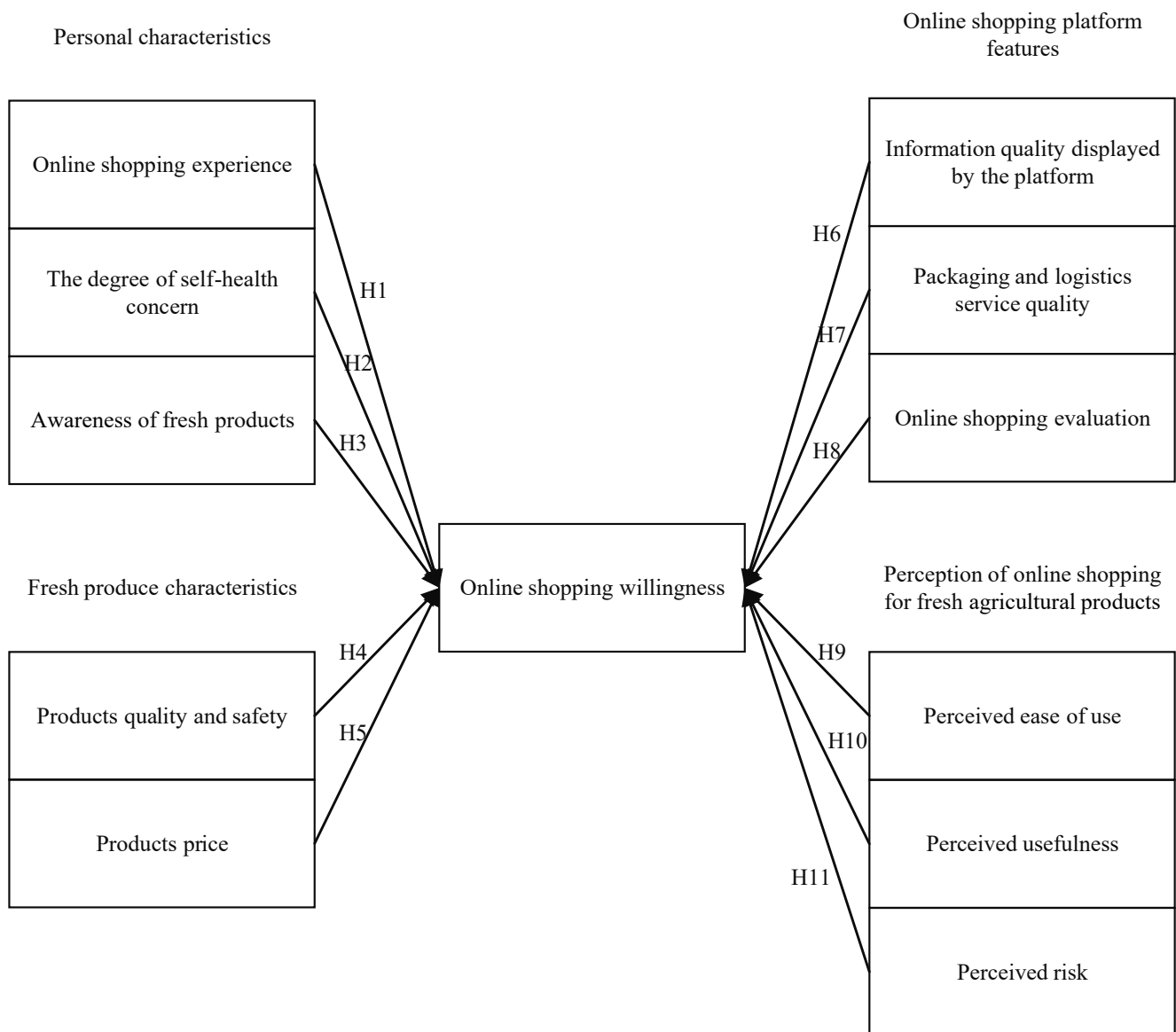


Figure 1: The Framework of Factors Affecting the Willingness to Purchase Fresh Agricultural Products.

THE DATA SOURCE

Words: “fresh products, fresh agricultural products” and “purchase, purchase intention, online shopping, online shopping willingness” were used to search related articles in the fields of title, keyword, abstract or subject words from CNKI, CQVIP, WANFAN DATA, Google Scholar Search, EBSCO, Elsevier Science Direct, PROQUEST, Web of Science. 132 relevant articles were collected.

All these articles were screened according to three standards for further investigation. (1) It must be an empirical study, and one of above paths at least is included. (2) Sample size needs to be reported. (3) It is necessary to provide either a correlation coefficient,

or a significant t value of the path, or a standard regression coefficient, or the chi-square values. The detailed screen process is shown in Figure 2:

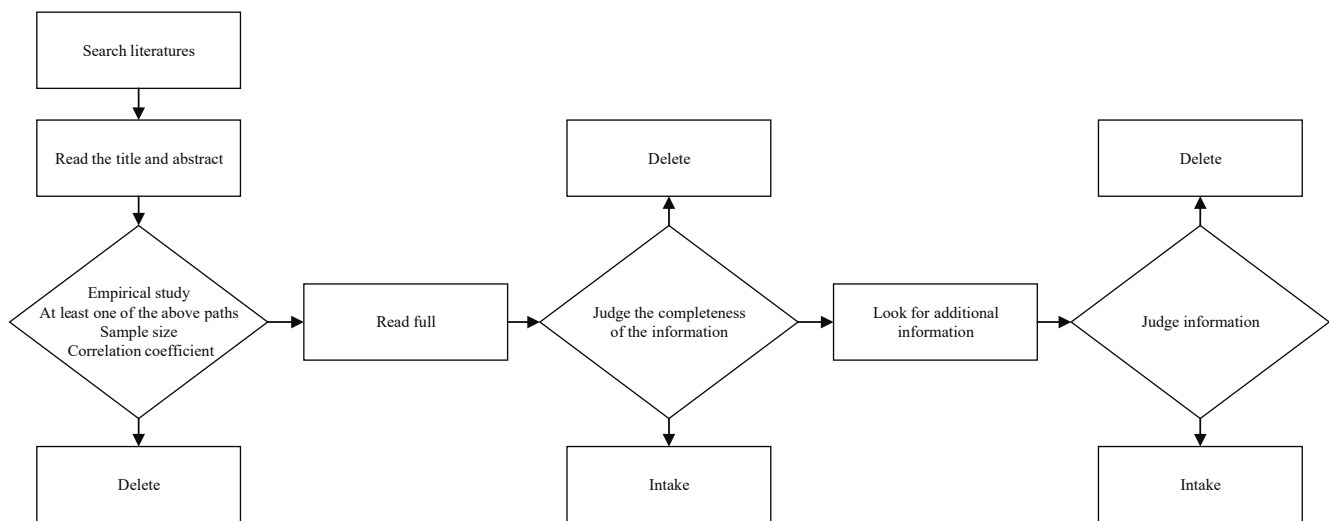


Figure 2: Screen Process.

After the screen process, 86 empirical researches were collected, of which only 37 articles were full all the three standards and finally selected for Meta-analysis. 21 articles were in Chinese while 16 articles were in English. 14 of Chinese articles were dissertations and 7 were journal articles. The empirical part of all the articles meet the statistical criteria for inclusion in the meta-analysis.

Among all the Chinese studies selected above, two studies published in 2011 and 2013, two studies published in 2014, the remaining 17 studies were published during 2015-2017. Among data surveys, 11 were reported for people with online shopping experience, 4 were for educated people, and the rest pointed out to include white-collar workers or randomly sampled samples. The minimum sample size was 155, the maximum sample size is 631, the remaining sample size is 5 in the 200-300 interval, 9 in the 301-400 interval, and 2 in the 401-500 interval. About questionnaire survey method, 7 studies use online and offline combination methods, 6 studies only use online questionnaire survey methods, 5 studies adopt field survey methods. 16 articles using a Likert scale of 5 points, the others using 7 points. Only 16 English articles were included for analysis due to more are research pay attention on organic agricultural products and green agricultural products. There are few empirical studies about online shopping intentions, so online are not emphasized, and inclusion criteria are based on purchase intention.

Article type, author, publication time, data survey objects, sample size, data source, and scale feature of each included literature are list in Table 1:

Table 1: Basic Information of Research Literature.

No.	Type	Author	Data survey object	Sample size	Data sources	Scale feature
1	Dissertation	Lin	Consumers with online shopping experience.	357	Offline and online	Likert Level 5 Scale
2	Journal	Zhang <i>et al.</i> (2015)	A group with a certain level of literacy and participation in work.	631	Offline and online	Likert Level 5 Scale
3	Journal	Zou (2011)	Younger groups with a higher level of education and a certain understanding of online shopping.	288	Offline and online	Likert Level 5 Scale
4	Journal	He <i>et al.</i>	-	413	Offline and online	Likert Level 7 Scale
5	Dissertation	Liu	20- 40 years old online shopper.	294	Questionnaire	Likert Level 7 Scale
6	Dissertation	Bai (2017)	Consumers who have experience in online shopping.	318	Questionnaire	Likert Level 5 Scale

7	Journal	Yi and Yi (2015)	WeChat use group and fresh e-commerce purchase group.	189	Offline and online	Likert Level 5 Scale
8	Journal	Wang and Dai (2017)	-	289	—	Likert Level 5 Scale
9	Dissertation	Xiao	Chengdu consumers.	313	Field research	Likert Level 5 Scale
10	Dissertation	Xie (2016)	-	212	Field research	Likert Level 5 Scale
11	Journal	Wu	-	396	Questionnaire	Likert Level 5 Scale
12	Journal	Zhu <i>et al.</i>	Consumers with online shopping experience.	329	Questionnaire	Likert Level 7 Scale
13	Dissertation	Yang	Young and middle-aged groups with a higher level of education and a deeper understanding of online shopping.	582	Field distribution	Likert Level 5 Scale
14	Dissertation	Huang (2017)	Consumers who have experience in online shopping for fresh products.	155	Field distribution	Likert Level 5 Scale
15	Dissertation	Yang	Urban white collar.	370	Questionnaire	Likert Level 5 Scale
16	Dissertation	Han	College students and professional white-collar workers between the ages of 20 to 40.	387	Questionnaire	Likert Level 5 Scale
17	Dissertation	Zhu	Consumer groups with different levels.	288	Field distribution	-
18	Dissertation	Dan	Adults with independent spending power and able to express subjective feelings and behavior intention.	488	Offline and online	Likert Level 5 Scale
19	Dissertation	Ge	Consumers who have experienced the failure of online shopping for fresh products.	186	Offline and online	Likert Level 5 Scale
20	Dissertation	Xiao	Consumers who have experienced online shopping for fresh products on the Taobao.	374	Questionnaire	Likert Level 7 Scale
21	Dissertation	Li	Fresh Platform High income white collar and college students who are about to step into society.	370	Questionnaire	Likert Level 5 Scale
22	Journal	Sabbe <i>et al.</i>	Participants during the Agriculture and Food Expo in Ghent, Belgium.	290	Questionnaire	Likert Level 7 Scale
23	Journal	Sabbe <i>et al.</i>	Groups during the Agriculture and Food Expo in Ghent, Belgium.	281	Questionnaire	Likert Level 7 Scale
24	Journal	Verbeke and Viaene	Fresh meat consumers.	303	Questionnaire	-
25	Journal	Boccaletti and Nardella	-	336	Questionnaire	-
26	Journal	Verbeke <i>et al.</i>	Belgian meat consumer families.	291	Questionnaire	-
27	Journal	Acebron <i>et al.</i>	Determining the family buying group.	180	Questionnaire	Likert Level 5 Scale
28	Journal	Fu <i>et al.</i>	Married woman.	377	Interview	Likert Level 7 Scale
29	Journal	Rezai <i>et al.</i> (2012)	People who consume in the supermarket.	1355	Questionnaire	Likert Level 7 Scale
30	Journal	Salleh <i>et al.</i> (2010)	Personnel at Teknologi Mara University, Northern Malaysia.	265	-	-
31	Journal	Guido <i>et al.</i> (2010)	Normal consumers.	207	Questionnaire	Likert Level 7

32	Journal	Gracia and Magistris	Family main food buyer.	200	Interview	Scale Likert Level 5 Scale
33	Journal	Ahmad (2010)	Three regional supermarket consumers.	177	Questionnaire	Likert Level 5 Scale
34	Journal	Xu <i>et al.</i> (2012)	14 supermarket consumers.	386	Questionnaire	Likert Level 7 Scale
35	Journal	Magnusson <i>et al.</i> (2001)	Randomly sampled respondents between the ages of 18 and 65.	1154	Questionnaire	Likert Level 5 Scale
36	Journal	Tarkiainen and Sundqvist	Supermarket consumers.	200	Questionnaire	Likert Level 5 Scale
37	Journal	Teng and Wang (2015)	Customers of large supermarkets and three health food stores.	693	Questionnaire	-

DESCRIPTIVE ANALYSIS

Each document reports a different way of relevance, so it requires a unified transformation. If the correlation matrix or correlation coefficient is reported, the effect value is the correlation coefficient value; standard regression coefficient can be regarded as effect value for literatures using regression method; if the literature gives the significant t value of the path, effect value can base on following formula to calculate.

$$r = \sqrt{\frac{t^2}{t^2 + df}} \quad (1)$$

t is the significance t value of path, and df is degree of freedom that is obtained by using structural equation model's data points number subtracting free parameters number (Wu et al., 2017). Each path's descriptive statistics are shown in Table 2:

Table 2: Descriptive Statistics.

Path	Number of paths	Min correlation coefficient	Max	Significant	Not significant	Significant rate	Min sample	Max	Total	Average
Online shopping experience → online shopping willingness	4	0.113	0.441	4	0	1	155	294	1026	257
Degree of self-health concern →online shopping willingness	15	0.005	0.854	13	2	0.867	281	396	4696	313
Perception of fresh products →online shopping willingness	7	-0.215	0.675	4	3	0.571	180	396	2175	311
Products quality and safety →online shopping willingness	25	0.002	0.854	21	4	0.84	212	413	7738	310
Products price (i.e. discount) →online shopping willingness	8	0.081	0.731	5	3	0.625	155	413	2351	294
Information quality →online shopping willingness	9	0.053	0.357	5	4	0.556	186	413	2739	304
Packaging and logistics quality →online shopping willingness	9	0.004	0.498	3	6	0.333	155	413	2731	303
Online shopping evaluation →online shopping willingness	16	0.077	0.819	13	3	0.813	155	396	4143	259
Perceived ease of use →online shopping willingness	14	0.056	0.739	12	2	0.857	186	582	4968	355
Perceived usefulness →online shopping willingness	16	0.145	0.816	14	2	0.875	189	631	5926	370
Perceived risk →online shopping willingness	13	-0.057	-0.531	9	4	0.692	180	631	4715	363

As show in Table 2, products quality and safety in most of researches have impact on online shopping willingness, a total of 25 paths, 21 of which are significant probably 84%. Overall 16 paths of online shopping evaluation, and 13 are significant, and the

significant rate is reached 81.3%. There are 16 paths of perceived usefulness, 14 of which are significant, with a significant rate of 87.5%. There are 15 paths of the degree of self-health concern, and 13 of them are significant, with a significant rate of 86.7%. The impact of perceived ease of use has 14 paths, with a significant number of 12 and the significant rate is 85.7%. There are 13 paths of perceived risk to online shopping willingness, with a significant number of 9, a significant rate 69.2%. All paths of online shopping experience are significant; in the seven studies on the perception of fresh agricultural products, significant rate is almost equal to insignificant rate; in the nine studies of information quality displayed by the platform, insignificant rate is almost equal to significant rate. About price (i.e. discount) and perceived risk, significant rate is higher than 60%; however, significant rate of packaging and logistics quality is only 33.3% on online shopping willingness.

RELIABILITY ANALYSIS

Reliability analysis refers to consistency and stability of measurement results. It is an effective analysis method to measure comprehensive evaluation system whether has certain stability and reliability. Usually the Cronbach's Alpha coefficient is analyzed in the empirical study (Lin, 2017). Reliability measurement of each variable is shown in Table 3:

Table 3: Reliability Analysis.

Variable	Average reliability	Minimum value	Maximum value	Variance	Number of studies
Online shopping experience	0.795	0.712	0.882	0.005	6
Degree of self-health concern	0.880	0.828	0.931	0.005	2
Perception of fresh products	0.788	0.749	0.815	0.001	3
Products quality and safety	0.818	0.703	0.896	0.007	7
Products price (i.e. discount)	0.778	0.701	0.865	0.007	3
Information quality	0.779	0.656	0.865	0.005	7
Packaging and logistics Service quality	0.801	0.718	0.874	0.006	4
Online shopping evaluation	0.822	0.724	0.948	0.004	13
Perceived ease of use	0.823	0.636	0.918	0.006	12
Perceived usefulness	0.806	0.738	0.868	0.002	13
Perceived risk	0.769	0.56	0.866	0.013	7
Purchase intention	0.848	0.697	0.97	0.005	17

From table 3, reliability values about the experience of online shopping, degree of self-concern, perception of fresh products, products quality and safety, products price, information quality of platform display, packaging and logistics quality, online shopping evaluation, perceived ease of use, perceived usefulness, perceived risk, and purchase intention were 0.795, 0.880, 0.788, 0.818, 0.778, 0.779, 0.801, 0.822, 0.823, 0.806, 0.769, and 0.848, all of these are higher than 0.7. The minimum is 0.769 and the maximum is 0.880. According to the reliability coefficient comparison, it can be judged that the reliability of these variables is good and reliable, and has been widely used in the research of online shopping willingness.

CORRELATION ANALYSIS

Correlation analysis mainly contains five sections. It contains simple mean, adjusted mean, Fisher r to z conversion mean, FSN and 95% confidence interval upper and lower limits.

Specifically, simple mean is the average of effect values; the adjusted mean is the weighted average by the sample size, and the formula is:

$$r_+ = \frac{\sum N_i r_i}{\sum N_i} \quad (2)$$

r_i refers to the value of the i th correlation coefficient, and i refers to corresponding sample size.

Usually converts statistical test values such as r values, t values, F values or chi-square values into correlation coefficient r values. When using each correlation coefficient as the effect value statistic, Fisher's conversion (Fisher's z) is required. Correlation coefficient is converted, and the transformed correlation coefficient r_z is analyzed as an effect value. The discussion below is based on r_z (Xu, Guan, & Lin, 2018).

The Fisher r to z conversion takes three steps:

(1) Converted the r value to Fisher's z value, thereby converting the distribution of correlation coefficients into a progressive positive distribution (Su *et al.*, 2017).

$$z = 0.5 * \ln\left(\frac{1+r}{1-r}\right) \quad (3)$$

(2) According to sample size to determine weighted values for z (Su *et al.*, 2017):

$$z_+ = \frac{\sum N_i z_i}{\sum N_i} \quad (4)$$

(3) The conversion yields accurate and reliable effect values:

$$r_z = \frac{e^{2z_+} - 1}{e^{2z_+} + 1} \quad (5)$$

Kreamer and Andrews pointed out that when authors publish articles, they tend to report better results and some apparently established research hypotheses, if results were not supported significantly, it will be avoided by the authors and not reported in their articles (Deng, Zhang, & Zhang, 2012). This will cause deviations between published research results and other unpublished or unfinished research results, called publication bias (Deng, Zhang, & Zhang, 2012). Fail-Safe coefficient N was used to assess publication bias, and reported how many unpublished studies of invalid results needed to reduce the cumulative effect of the study to a non-significant level (Rosenthal, 1978), other studies in meta-analysis may completely change the results of the analysis. Results of meta-analysis are more stable and less likely to be overturned when the value is higher. If it is negative, the results are unstable. The publication bias is large (Zhang & Hu, 2013). Formula is as follows.

$$N_{fs.05} = \left(\frac{\sum z}{1.645}\right)^2 - N \quad (6)$$

Correlation analysis of each paths, as shown in Table 4:

Table 4: Correlation Analysis.

Path	Adjust mean	Simple mean	Fisher r to z	S.D.	95% confidence interval		FSN
					Lower limit	Upper limit	
Online shopping experience →Online shopping willingness	0.196	0.225	0.200	0.135	-0.014	0.414	-3.675
Degree of self-health concern →Online shopping willingness	0.320	0.335	0.385	0.310	0.213	0.557	0.168
Perception of fresh products →Online shopping willingness	0.123	0.125	0.141	0.104	0.046	0.237	-6.617
Products quality and safety →Online shopping willingness	0.416	0.422	0.476	0.311	0.348	0.604	39.455
Products price →Online shopping willingness	0.271	0.264	0.294	0.201	0.125	0.462	-5.965
Information quality →Online shopping willingness	0.167	0.164	0.170	0.108	0.087	0.253	-8.152
Packaging and logistics service quality →online shopping willingness	0.177	0.184	0.185	0.170	0.054	0.315	-7.864
Online shopping evaluation →Online shopping willingness	0.364	0.363	0.311	0.210	0.199	0.423	-0.142
Perceived ease of use →Online shopping willingness	0.448	0.428	0.474	0.227	0.343	0.605	3.587
Perceived usefulness	0.424	0.407	0.446	0.201	0.339	0.554	4.335

→Online shopping willingness							
Perceived risk	-0.197	-0.189	-0.203	0.134	-0.284	-0.122	-10.586
→Online shopping willingness							

Effect size makes the sample of each study has same measure unit. Meta-analysis combines the collected effect values into a single effect value, reflecting the combined effects of multiple independent studies with a combined effect value. It represents a standardized measurement that indicates the strength and direction of the relationship between variables. This study uses the measurement of Cohen to interpret the average effect value from the weighted mean, classifying the effect values of the eleven groups into high, medium, and low and discussing them (Han, 2017). According to Cohen, when the effect value is close to 0.1, indicating the effect is small; when the effect value is around 0.3, the effect value is centered; if it reaches 0.5, indicating the effect is larger. In table 4, the results show that the three groups have medium effect values: degree of self-health concern → online shopping willingness, products price → online shopping willingness, online shopping evaluation → online shopping willingness. The effect value of the three groups of relations is high: products quality and safety → Online shopping willingness, perceived ease of use → online shopping willingness and perceived usefulness → online shopping willingness.

The correlation coefficient r_z between products quality and safety and online shopping is 0.476. Effect value is the largest in this study. According to this, it can be judged that this group of variables is the strongest group, indicating that products quality and safety is a high positive correlation with online shopping intentions. This finding is consistent with the research results of Zhao and Gao (2016) based on the reference effect that the agricultural products quality and safety awareness will affect consumers' online shopping willingness, the higher the quality and safety level is, the more obvious the impact is on shopping willingness.

The correlation coefficient r_z between perceived ease of use and online shopping willingness is 0.474, which is a higher effect value. This conclusion verifies the applicability of the technology acceptance model. At the same time, it also verifies the hypothesis in the theory of planned behavior, that is, consumers' evaluation of the difficulty of online shopping and the difficulty of obtaining information during online shopping will affect consumers' willingness to purchase. The correlation coefficient r_z between perceived usefulness and online shopping willingness is 0.446, indicating that consumers' perceived usefulness is highly correlated with online shopping intentions, which is consistent with Liu (2017), that is, consumer perceived usefulness has a significant positive impact on consumers' willingness to purchase, and also with Yi and Yi (2015), that is, the perceived usefulness is directly proportional to the consumer's willingness to purchase fresh agricultural products online, which theoretically confirms the hypothesis of the technology acceptance model.

The correlation coefficient r_z between degree of self-health concern and online shopping intention is 0.385, indicating that there is a moderate positive correlation between the degree of concern about health and the willingness to purchase online. The degree of concern here specifically refers to the eating habits of consumers and the frequency of cooking themselves; the correlation coefficient r_z between online shopping evaluation and online shopping willingness is 0.311, which indicates that there is a moderate positive correlation between online shopping evaluation and online shopping willingness. This is related to the analysis of Zou (2011), that is, consumer online shopping perception and evaluation factors have a significant positive impact on the willingness of online shopping fresh agricultural products, and also validate the hypothesis in rational behavior theory, that is, the evaluation of the behavior of online shopping for fresh agricultural products by people around the consumer has a certain impact on consumers' willingness to purchase. If other people have higher evaluation of online shopping fresh agricultural products, then consumers' willingness to purchase will increase, and vice versa will reduce the enthusiasm of consumers to purchase fresh agricultural products online.

The correlation coefficient r_z between products price and online shopping willingness is 0.294, explain that there is a moderate positive correlation between price (i.e. discount) and intention. This point is consistent with the research results of Wang and Dai (2017), they analysis of the influencing factors of online shopping intention of green fresh produce based on Logit model, that is, price (i.e. discount) has a significant negative impact on the willingness, and it also confirms the analysis of the willingness and influencing factors of online shopping for fresh agricultural products from the perspective of consumers from Xie (2016), the lower the price of fresh agricultural products, the stronger the consumers' willingness to purchase fresh agricultural products online.

The confidence interval of the online shopping experience variable on the online shopping will is on both sides, so it is not passed by test; the FSN value of the degree of health concern, products quality and safety, perceived ease of use and perceived usefulness is greater than zero, and the online shopping evaluation is close to zero, indicating that these variables have a greater impact on online shopping willingness. The rest of the variables did not pass the FSN test, indicating that there is a large publication bias, and

the descriptive statistics table of the combined path, found that there are only 13 literatures on the perceived risk, and the impact of perceived risk on online shopping will be significant, probably because the FSN is not passed because of too few inclusion studies, so the impact of perceived risk on online shopping will be considered significant. According to analysis, the factors affecting the online shopping intention of consumers' fresh agricultural products are obtained, as shown in Table 5:

Table 5: Factors Affecting the Willingness to Purchase Fresh Agricultural Products.

Hypothesis	Path	Support
H1	Online shopping experience → online shopping willingness	Not Support
H2	Degree of self-health concern → online shopping willingness	Support
H3	Perception of fresh products → online shopping willingness	Not Support
H4	Products quality and safety → online shopping willingness	Support
H5	Products price → online shopping willingness	Support
H6	Information quality → online shopping willingness	Not Support
H7	Packaging and logistics service quality → online shopping willingness	Not Support
H8	Online shopping evaluation → online shopping willingness	Support
H9	Perceived ease of use → online shopping willingness	Support
H10	Perceived usefulness → online shopping willingness	Support
H11	Perceived risk → online shopping willingness	Support

RESULTS AND DISCUSSION

This paper uses the meta-analysis method to explore factors affecting consumers' willingness to purchase fresh agricultural products online. Specifically, health concern, product quality and safety, product price, online shopping evaluation, perceived ease of use, perceived usefulness, and perceived risk impact are verified. Among them, product quality and safety significantly affect consumers' willingness to purchase fresh produce online.

There are several findings were found according to the above research.

Firstly, consumers' willingness to adopt new technologies and new methods is still greatly influenced by their own feelings, that is, perceived usefulness and perceived ease of use are still useful to measure consumer behavior, so when designing a fresh agricultural products online shopping platform, you should pay attention to whether it can bring real benefits to consumers and whether it is easy to use.

Secondly, online shopping evaluation has a significant effect on consumers' online shopping intentions, that is, other consumers' experience and evaluation of online shopping fresh agricultural products will significantly affect consumers' personal online shopping willingness, that is, when consumers make behavioral decisions, the evaluation of other consumers will significantly affect their willingness. Therefore, online shopping malls of fresh agricultural products should pay attention to the display of evaluation information when they are selling, and strive to obtain positive evaluations to positively influence the consumers' willingness to purchase.

Thirdly, quality, safety and price (i.e. discount) in the characteristics of fresh agricultural products will significantly affect consumers' online shopping intentions. The quality and safety of fresh agricultural products sold online must be guaranteed. Only in this way will there be willingness to purchase, and consumers who take online shopping will think that e-commerce does not have a physical storefront, and psychologically think that the price of online shopping for fresh agricultural products should be more favorable than offline purchase, this is also one of the expectations of consumer online shopping. if the online fresh-selling agricultural products and the offline purchase price are the same as or even higher than the offline purchase, it will negatively affect the consumer's willingness to purchase, that is, the consumer has a price discount expectation on the fresh-selling agricultural products purchased online, the higher price (i.e. discount) is, the stronger online shopping willingness is.

Finally, the consumer's own concern to health significantly positively affects the willingness to purchase fresh agricultural products. Pursuit about healthy lifestyle, physical health and higher quality of life will affect consumers' healthier, green and low-purity fresh agricultural products are purchased. When displaying product information, merchants should seize the needs of this part of consumers and ensure that the product information required by this segment of the customer group is displayed.

CONCLUSION

In this paper, the current researches on the willingness of consumers to purchase fresh agricultural products online is quantitatively reviewed by meta-analysis. Specifically, the theory of reasoned action, the theory of planned behavior and the technology acceptance model are used to develop hypotheses. By collecting relevant literatures and screening according to criteria, the effect

value analysis is carried out for the included studies, and finally the comprehensive results are analyzed and summarized according to the existing standards.

The degree of self-health in the personal characteristics of consumers, the quality and safety and price (i.e. discount) in the characteristics of fresh agricultural products, online shopping evaluation in the characteristics of online shopping platform, and consumers' perceived usefulness, perceived ease of use, and perceived risk have a significant impact on online shopping.

However, there are some limitations also. Most included studies were in Chinese, few English studies involved, the research conclusion may be limited. In future, more English research can incorporate to make the conclusion more universal. Only 37 articles were included because of the rigorous screening of the research content. These constraints reduced the number of relevant studies that can be included. In the future, a variety of methods can be used to convert effect values to increase the number of studies that can be included and lead to more scientific conclusions.

ACKNOWLEDGMENT

This work is partially supported by grant Qian Jiao he KY [2017] 034 of Major Research Project of Innovative Group from Guizhou Provincial Education Department and 2016ZR0048 of Soft Science Project from Science & Technology Department of Sichuan Province.

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Factors Impacting Consumers' Sharing Behavior under Sharing Economy: A UTAUT-Based Model

(Full Paper)

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ABSTRACT

Sharing economy is emerging gradually in China, which is a field worth studying, especially the use behavior of participants in e-commerce background. Based on the UTAUT model, this research considers the characteristics of sharing economy and establishes the basic framework of influencing factors of sharing behaviors. It takes P2P sharing riding as an example to do some empirical analysis through Smart PLS and SPSS PROCESS. It explores the influencing factors of participation behavior, the mediation effect of sharing intention. The study finds that performance expectancy, effort expectancy, social influence have significant positive influence on the sharing intention. The facility condition, social entertainment motivation and sustainable motivation have significant positive influence on the sharing behavior through the mediation of sharing intention.

Keywords: Sharing economy, sharing behavior, UTAUT model, e-business.

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INTRODUCTION

In February 2018, the "China's Sharing Economy Development Annual Report (2018)" published by the National Information Center showed that the total value of China's shared economic market in the previous year was 492.05 billion yuan, a growth rate of 47.2%. The term "sharing economy" was originally proposed by Felson, which is "the act of consuming an economic product or service by one or more people in a joint activity with others" (Felson, 1978). It is deeply reshaping China's economic structure and transforming traditional industries with its revolutionary and subversive forces. In China, the application of the sharing economy is very broad. There are "OFO" and "Didi" in the field of transportation, Airbnb and "Xiaozhu" for short-term rent of houses. There are also shared charging and shared umbrellas in our daily life. Due to late emergence of the sharing economy in China, the development process is not completed, and the sharing concept is not yet mature. It affects the public's willingness to participate in the sharing economy. In addition, the sharing economy relies on the Internet platform. Compared with the traditional economic model, the characteristics of online trading in the sharing economy cause its anonymity, difficulty in control, and opportunism, which brings uncertainty and certain risks. For example, Airbnb is too much involved in user privacy, "Didi" has a bad reputation of the passenger mechanism which shows the information that is not related to the passengers. These factors make the current user's willingness to use is still insufficient. While the sharing economy advocates everyone's participation and leaves the "human" element, the development prospects of the sharing economy will be threatened. How to motivate consumers to participate and expand the foundation of shared groups is a key issue that needs to be solved urgently.

Scholars have pointed out the related factors of user sharing behavior from different perspectives and identified the motivation of users to participate in sharing economy. Some scholars have verified the sharing behavior factors model through empirical methods. The motivations for participation proposed in the existing research are mainly as following. The study of scholars proposed environmental motivation (Hamari, Sjöklint, & Ukkonen, 2016) and social motivation. Many empirical research based on sharing behavior has also emerged. Bucher (2016) validates the significant impact of economic efficiency as an antecedent on participation behavior, and Hellwig et al. (2015) also derives positive from the perspective of utility. In addition, Buhe et al. concluded that there are three main motives for consumers to actively participate in sharing behaviors: instrumental motivation, normative motivation, and social entertainment motivation. Benoit suggested that users' motivation to participate in sharing economic behavior includes more aspects, in addition to the widely studied economic motivation, social motivation and hedonic value, innovative consideration of risk avoidance and motivation for both responsibility and environmental benefits. There are also some users whose motivation is more complicated than the above-mentioned "basic motivation". For example, Benoit's entrepreneurial freedom means that participants can feel the joy of starting a business in the process of freely selling idle items. In the verification of the model of sharing behavior influencing factors, the theories adopted by scholars are: rational behavior theory, planned behavior theory, technology acceptance model, integrated technology acceptance model and trust theory. For example, Schaefers (2013) based on the methodological chain of ideas and the economic activities of American consumers participating in car sharing, identifying the motivations for participation in value search, convenience, lifestyle and environmental motivation. Liu et al. (2014) took expectation theory as the research basis, compared the costs, benefits and risks of "car possession" and "car use", and drew the conclusion that expected performance and cost affect consumer behavior.

There are also scholars in China who conduct experimental surveys on the car sharing behavior of consumers in first-tier cities. For example, Shaheen (2010) and Zhang Yujie (2015) are all based on Beijing users, but the research perspective is different. The high-educated young people in the car have a high degree of participation in car sharing, who believes that interest is the most critical factor affecting the willingness to use. Based on the consumer selection model, there were scholars analyzed the difference in utility between car purchase and car sharing services. He gave weight to each influencing factor, of which price factor is the most important. In addition, some of the current literatures are based on trust theory. They study the formation of trust mechanisms in shared scenarios and the impact of trust on users' shared behavior. For example, Xie Xuemei (2016) and other scholars build the basic formation mechanism of trust under the shared economic model by sharing the personal characteristics of the subject. Other scholars concluded that by studying the trust and reputation of the sharing economy, in the shared accommodation mode, product characteristics and landlord characteristics determine the user experience. It means that the user shows the characteristics from the landlord. Determine the degree of trust, which in turn affects the user experience. In summary, the existing research in this field has the following shortcomings: Existing research focuses on the direct impact of certain types of influencing factors on sharing intention or sharing behavior, and rarely pays attention to the mediation role of sharing intention.

Based on this, this paper takes the use of P2P shared car as an example and based on the UTAUT model and motivation theory. We construct an expansion UTAUT model of consumer participation motivation in the shared context. In addition to verifying the direct effect of the influencing factors of participatory behavior under the sharing economy in the expansion model, this study also verifies the mediating effect of the sharing intention. The incremental contributions of this paper include the following points: (1) In theory, this study helps to strengthen the application depth of the UTAUT model and motivation theory in the shared economy. On the other hand, it helps consumers form a deeper and clearer cognition; (2) in practice, the conclusions of this study will provide strategic inspiration for the sharing of economic platforms to encourage consumers to participate in sharing and expand the group foundation, and help the benign development of the sharing platform.

BACKGROUND AND RESEARCH MODEL

UTAUT model

The Integrated Technology Receiving and Using Model (UTAUT) was proposed by Venkatesh & Davis (2003), who combined eight theories from different fields as following, the theory of planned behavior, the model of technical adaptation, the theory of innovation diffusion, the theory of rational behavior and social cognitive theory et al. The UTAUT model comprehensively uses the independent variables of the eight theories. It finally selects and summarizes four variables: Performance Expectancy, Effort Expectancy, Social Effect, and Facility Condition. The influence of the former three variables to the intention is more significant, while the facility condition has a greater impact on the use behavior. The UTAUT model appeared later, so the current application range is not as wide as the technology acceptance model. However, UTAUT has obtained multiple empirical verifications since it was proposed. In the research field of user intention (behavior), its interpretation ability is as high as 70% and has gradually attracted the attention of scholars at home and abroad. The UTAUT model has been widely accepted by many scholars and implemented in testing. In the fields of e-commerce, economic management, and information systems, scholars have studied UTAUT as a model.

Research model

In the basic structure of the UTAUT model, the facility conditions have an important influence on the usage behavior. At the same time, there are other domestic and foreign literatures showing that the facility conditions also have an influence on the intention to use. Based on the integration of UTAUT model and motivation theory in shared context, this paper constructs performance expectancy, effort expectancy, social influence, facility condition, social entertainment motivation and sustainable motivation as independent variables, and sharing intention as mediator. In the end of the model, sharing behavior is the outcome variable (Figure 1 Shown).

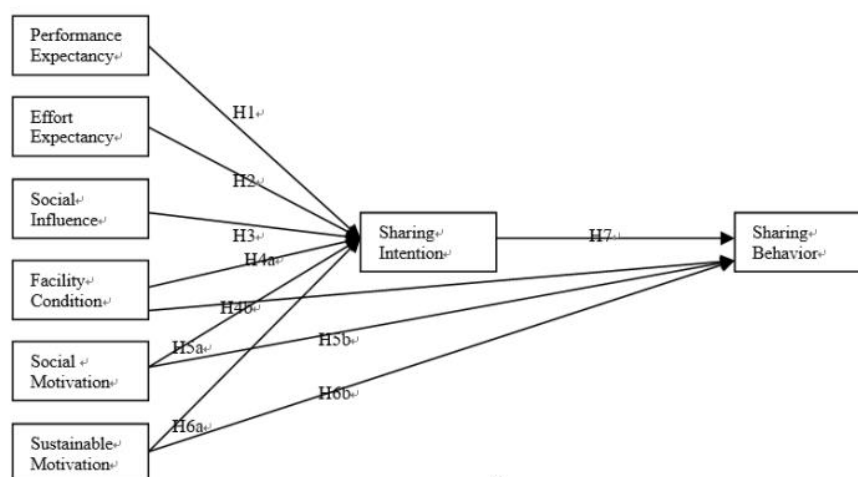


Figure 1: Research Model.

HYPOTHESIS

The impact of performance expectancy on sharing intention

Performance expectancy is defined as the degree to which a user believes in improving the performance of a job when applying a system or technology. The UTAUT model is based on the development of the TAM model. The performance expectancy of the former is similar to the perceived usefulness of the latter. It means whether the user can feel "useful". In the context of this article, participants can initiate sharing behaviors anytime and anywhere to meet their needs and provide great convenience for participants. This study understands performance expectancy from an individual perspective and defines them as participants who believe that sharing economic behavior can improve the efficiency of their access to services and thus benefit themselves. In addition, Anderson & Schwager found that performance expectancy has a significant impact on users' intention to use a kind of technology (Anderson & Schwager, 2004). Based on this, the study proposes the following hypothesis:

H1: Performance expectation positively affects sharing intention.

The impact of effort expectancy on sharing intention

Effort expectancy refers to the degree of difficulty perceived by participants when they use information technology. That is, the degree of effort users use to use the technology or service. The operation of the sharing economic model generally involves many factors. For example, the use of the car-sharing includes the use of the mobile terminal APP, the communication between the two parties, the payment problem, the evaluation mechanism, etc. When the participants feel a complicated process and high learning cost, they will resist the use of this technical service. On the contrary, they are willing to use. In the related field of research, Knutsen (2002) researched the mobile service business and verified that the impact of efforts on the willingness to use is significant. Based on this, this study proposes the hypothesis:

H2: Efforts expectancy positively affects sharing intention.

The impact of social influence on sharing intention

Venkatesh proposed in his study that social influence refers to the degree to which users perceive the perception of a technology or product by people around them (Venkatesh, 2003). The various forms of the sharing economy are a relatively new type of technology generated under the "Internet +" environment. They are still in the development stage. It is possible that some people do not fully understand it. The propaganda and introduction of various media will affect the individual's choice. In addition, as a part of society, users are vulnerable to environmental influences, such as friends, family, colleagues, etc. When their group tends to recommend sharing economic behavior, the individual's acceptance of it will be strengthened. Based on this, this study proposes the hypothesis:

H3: Social influence positively affects sharing intention.

The impact of facility condition on sharing intention and sharing behavior

In the empirical study of Venkatesh, the facility condition refers to the individual's perception of the extent to which existing organizations and equipment support the use of information technology (Venkatesh, 2003). It has been proven that the facility conditions affect the use of information technology. For example, the rider only needs to make a reservation on the mobile phone terminal to ensure the travel time and route. Obviously, it is more convenient than the traditional travel mode. At the same time, referring to the research of Venkatesh, the facility conditions require the convenience of objective conditions and the consistency of cognition. It affects the willingness of participants to use and directly promotes the use of behavior. Based on this, this paper proposes the hypothesis:

H4a: Facility condition positively affects sharing intention.

H4b: Facility condition positively affects sharing behavior.

The impact of social entertainment motivation on sharing intention and sharing behavior

The motivation for social entertainment comes from the user's desire to establish social connections in shared economic activities, and to get a sense of belonging and fun (Shaheen, 2010). The ability to establish social relationships during the sharing process will also positively promote existing social relationships (John, 2013). Karlsson pointed out that users in the sharing desire to get in touch with new friends (Karlsson & Dolnicar, 2016). There is a tendency to share their personal thoughts with others. Based on this, this study proposes the hypothesis:

H5a: Social entertainment motivation positively affects sharing intention.

H5b: Social entertainment motivation positively affects sharing behavior.

The impact of sustainable motivation on sharing intention and sharing behavior

Sustainable motivation describes a psychological process inherent in the user. Users expect resource consumption to be minimal. So they choose sharing behavior. Those who have environmental consciousness always have stronger sustainable motivations. They are more willing to participate in environmentally friendly activities (Gleim & Lawson, 2014). The sharing economy is to realize wealth of idle resources and reuse them. It is environmentally friendly. Therefore, the sustainable

motivation of consumers is an important factor affecting their participation in sharing economic intentions. Based on this, the study proposes the following hypothesis:

H6a: Sustainable motivation positively affects sharing intention.

H6b: Sustainable motivation positively affects sharing behavior

Mediating role of sharing intention

In the theory of rational behavior, it suggested that the behavioral intentions of individuals directly affect their behavior for a certain individual behavior. This article defines the using intention as a willing to start or continue to use the ride. The behavior is the specific usage behavior that the user has developed for the technology and service of the ride. Based on this, this paper proposes the hypothesis:

H7: Sharing intention have a mediating effect between (H7a: Facility condition; H7b: Social entertainment motivation; H7c: Sustainable motivation) and sharing behavior.

RESEARCH METHODOLOGY AND DATA ANALYSIS

Research sample and data collection

There are 8 variables involved in this research model. In order to ensure the reliability and validity of the scale, all the measurement items refer to the mature existing scale. They are modified according to the settings in the sharing context of this paper. The questionnaire uses the Likert five-level scale. The score indicates the accuracy of the description of the item for the respondent. From 1 to 5, it means "Strongly inaccurate", "not very accurate", "general", "accurate" and "Very accurate".

Firstly, In order to make the study more scientific, 53 questionnaires were distributed and collected in a small group randomly for pre-study. According to the results, the initial scale was revised. In the formal research process, users who have used car-sharing service are randomly selected as the survey objects, through WeChat, QQ, BBS and other channels. In the end, a total of 272 questionnaires were collected. After eliminating the invalid questionnaires which are with too short response time and too many repeated answers, 260 valid questionnaires were obtained. It exceeds the theoretical effective sample size with the effective rate of 95.59%. The sample characteristics were as follows: Among those who use P2P car-sharing services, there were 147 men, accounting for 45 percent while 143 were women, accounting for 55%. The age of users is mostly between 21 and 30, accounting for 80.06%. In terms of academic degree, the majority of students are undergraduates and master's students, accounting for 68.67% and 21.52% respectively. The frequency of using car-sharing service was mostly concentrated in 1-2 times per month, accounting for 53.11%.

Reliability and validity

Firstly, through the sample basis test, it can be seen that this model can be factor analysis. So the Smart PLS is used to perform confirmatory factor analysis on the variables. The model basis of this paper is the existing theoretical model. But in order to make the data have both good reliability and internal consistency, we test the reliability and validity of the sample. The Cronbach's α coefficient and the combined reliability CR of all variables in this study were all above 0.7. It proves the scale had good internal consistency. It can be seen from Table 1 and Table 2. And the factor loadings of the item are more than 0.7. All the AVE are larger than 0.6. The scale of this research has high convergence validity. And the correlation coefficient between variables is less than 0.9. The square root of the AVE value of all variables is greater than the correlation coefficient of the variable with other variables. So the scale has a good discriminant validity.

Table 1: The Results of Reliability and validity

Variable	Loading		CR	Cronbach's α	Resource	Variable	Loading		CR	Cronbach's α	Resource
Performance expectancy	PE1	0.845	0.845	0.786	Venkatesh et al.	Social entertainment motivation	SEM1	0.873	0.918	0.867	Bucher; Mohlmann et al.
	PE2	0.791					SEM2	0.908			
	PE3	0.872					SEM3	0.884			
Effort expectancy	EE1	0.921	0.972	0.965	Venkatesh et al.	Sustainable motivation	SUS1	0.877	0.924	0.876	Hamari et al. Barnes et al.
	EE2	0.918					SUS2	0.938			
	EE3	0.976					SUS3	0.871			
	EE4	0.973									
Social influence	SE1	0.757	0.868	0.798	Venkatesh et al.	Sharing intention	SP1	0.878	0.916	0.862	Venkatesh et al.
	SE2	0.813					SP2	0.886			
	SE3	0.782					SP3	0.892			

	SE4	0.804									
Facility condition	FC1	0.870	0.878	0.814	Venkatesh et al.	Sharing behavior	SB1	0.850	0.888	0.811	Kankanhalli
	FC2	0.826					SB2	0.824			
	FC3	0.737					SB3	0.882			
	FC4	0.771									

Table 2: The Correlation Coefficient

Variable	AVE	1	2	3	4	5	6	7	8
1.Performance expectancy	0.700	0.837							
2.Effort expectancy	0.898	0.015	0.948						
3.Social influence	0.623	0.627	-0.017	0.789					
4.Facility condition	0.644	0.676	0.033	0.716	0.802				
5.Social entertainment motivation	0.790	0.472	0.059	0.468	0.600	0.889			
6.Sustainable motivation	0.802	0.558	0.019	0.548	0.646	0.690	0.896		
7.Sharing intention	0.784	0.744	0.062	0.725	0.790	0.658	0.720	0.885	
8.Sharing behavior	0.726	0.635	0.054	0.703	0.793	0.635	0.711	0.850	0.852

Direct effect

This study used Bootstrap to test the hypothesis of the model. Model 1 shows performance expectancy ($\beta = 0.135$, $p < 0.01$), effort expectancy ($\beta = 0.020$, $p < 0.05$), social influence ($\beta = 0.210$, $p < 0.001$), facility condition ($\beta = 0.386$, $p < 0.001$), social entertainment motivation ($\beta = 0.122$, $p < 0.01$) and sustainable motivation ($\beta = 0.216$, $p < 0.001$) are positively correlated with sharing intentions. So hypothesis 1, 2, 3, 4a, 5a and 6a are supported. Model 2 shows that facility condition ($\beta = 0.508$, $p < 0.001$), social entertainment motivation ($\beta = 0.277$, $p < 0.01$), and sustainable motivation ($\beta = 0.146$, $p < 0.001$) are positively correlated with sharing behavior. So hypothesis 4b, 5b and 6b are supported.

Table 3: The Results of Direct effect

variable	Sharing intention	Sharing behavior
	Model 1 ($R^2=0.773$)	Model 2 ($R^2=0.699$)
constant	-0.354	0.309
Performance expectancy	0.135**	
Effort expectancy	0.020*	
Social influence	0.210***	
Facility condition	0.386***	0.508***
Social entertainment motivation	0.133**	0.277**
Sustainable motivation	0.216***	0.146***

Mediation effect

Referring to Zhao Xin's research, the procedure for testing the mediating effect is verified by the Bootstrapping analysis method and SPSS PROCESS(Zhao et al., 2010). We select PROCESS model 4, the independent variables are facility conditions, social entertainment motivation and sustainable motivation, while dependent variable is sharing behavior and mediator is sharing intention. So model 3, 4 and 5 are formed respectively according to different independent variables. Model

3 shows that the confidence interval of the mediating effect of sharing intention does not contain 0 (LLCI=0.277, LCI=0.423). It indicates that the mediating effect of sharing intention is significant between facility condition and sharing behavior, and the mediating effect is 0.345. Moreover, after controlling the influence of sharing intention, the facility condition has a significant influence on the sharing behavior ($\beta=0.163$, $p<0.001$). It indicates that sharing intention is not the only mediator variable between the facility condition and sharing behavior. It means sharing intention plays a partial mediator role. Hypothesis 7a is supported. The results of Model 4 show that the mediating effect is significant between the social entertainment motivation and the sharing behavior (LLCI=0.030, LCI=0.130). After controlling the influence of sharing intention, the influence of the independent social entertainment motivation on the sharing behavior is not significant. And the interval(LLCI=-0.047, ULCI=0.099) contains 0. It can be seen that sharing intention plays a mediating role in the influence of social entertainment motivation on the choice of sharing behavior. Moreover, it is the only mediator variable. So hypothesis 7b is supported. According to the results of Model 5, the mediating effect of sharing intention does not contain 0 (LLCI=0.100, LCI=0.229), indicating that the mediating effect of sharing intention is significant between sustainable motivation and the sharing behavior. The mediating effect is 0.160. After controlling the influence of sharing intention, the sustainable motivation has a significant impact on the sharing intention ($\beta = 0.116$, $p < 0.01$), indicating that sharing intention is not the only mediator between sustainable motivation and sharing behavior. So hypothesis 7c is supported.

Table 4: The Results of mediation effect

Variable		Sharing intention			Sharing behavior		
		coefficient	LLCI	ULCI	coefficient	LLCI	ULCI
Constant		0.032	-0.234	0.299	0.290	0.078	0.502
Sharing intention->Sharing behavior					0.592***	0.4939	0.6900
Model 3	Facility condition	0.584***	0.4956	0.6714	0.163***	0.0723	0.2531
	Mediation effect	coefficient	LLCI	ULCI			
		0.345	0.277	0.423			
Model 4	Social entertainment motivation	0.136**	0.047	0.226	0.037	-0.047	0.099
	Mediation effect	coefficient	LLCI	ULCI			
		0.081	0.030	0.130			
Model 5	Sustainable motivation	0.271***	0.171	0.371	0.116**	0.032	0.201
	Mediation effect	coefficient	LLCI	ULCI			
		0.160	0.100	0.229			

CONCLUSION AND DIRECTIONS FOR FUTURE RESEARCH

Conclusion

Based on UTAUT, this study explores the impact of users' performance expectancy, effort expectancy, and social influence on sharing intention in a sharing economy context. This paper extends the research on the mediating effect of sharing intention between facility condition, social entertainment motivation, and sustainable motivation and sharing behavior. The hypothesis are proven.

First, the study found that performance expectancy, effort expectancy, and social influence have a significant positive impact on sharing intention. This is consistent with previous studies by Lan Jing and Huang Guoqing (Lan, 2016; Huang, 2017). Among the independent variables of the UTAUT model, performance expectancy has an impact on sharing intention. It indicates that users pay attention to the utility of sharing products and services. The more utility, the more users are willing to participate in the sharing economic. Second, if it doesn't need complicated processes to participate in an economic activity, users will also have a sharing tendency. Third, social influence has a positive impact on sharing intention. Social influence of sharing economic behavior has increased. More users are willing to start participating in the sharing economy.

Second, facility condition, social entertainment motivations and sustainable motivation have a significant positive impact on shared intention and sharing behavior. In the traditional UTAUT model, scholars only verified the impact of facility conditions on behavior. From the analysis results of this study, it can be seen that in the sharing economic context, they will not only directly choose to participate, but also increase their intention to participate if it is convenient to participate in the sharing economy. That is the path of "facility conditions → sharing behavior" in the original UTAUT model. But we prove that the intention plays a mediator role. That is, "facility conditions → sharing intention → sharing behavior".

Third, sharing intention plays a partial mediator role between facility condition, sustainable motivation and sharing behavior. This study found that facility condition and sustainable motivation have a direct impact on sharing behavior. Acceptance from intention is also a key factor as linkage. In addition, this study also found that sharing intention is not the only path to link

facility condition(sustainable motivation) and sharing behavior. There may be other mediating paths. So the further research is needed.

Fourth, social entertainment motivation completely affects sharing behavior through sharing intention. It means sharing intention plays a mediator role between these two variables. For domestic users, the social motivation and the entertainment feeling it brings from sharing economy model will not directly lead to the sharing behavior. It has to be through sharing intention. This may be because the domestic development of sharing economy is not fully mature. The users will not be directly involved in a sharing economic activity because of social motivation.

Management practice significance

Based on the analysis of the above research conclusions, this study can provide the following suggestions for suppliers and platform managers of the sharing economy to promote the efficient operation.

First, improve the efficiency of the sharing economy. The platform needs to start from the user's performance expectancy, effort expectancy, facility conditions, etc., to improve operational efficiency. It allows users to feel profitable, saving time and saving effort. So that they can easily and quickly participate in sharing economic activities.

Second, expand the social influence of the sharing economy. Social influence is one of the most important factors for users to accept and use the sharing economy. According to the conclusion of this study, social influence can positively affect sharing intention. When consumers face a new economic model, they often judge whether they want to use it according to the usage of people around them. Therefore, word-of-mouth proliferation plays a vital role in the promotion of the sharing economy. Suppliers or platforms can attract customers' attention through online and offline and the method of targeted multi-channel marketing. So that there will be more participation of potential users, further spreading this influence among many groups and integrating the sharing economy mode into people's lives.

Third, properly control the user's perception of the sharing economy. In real life, most users are generating the first cognition of emerging things to participate in the sharing economy. Therefore, the promoter of the sharing economy such as platform should grasp the characteristics of users and the psychology of consumption. If the appropriate information is given to the consumer to adjust the user's intention to use, for the new market entry mode, the user can generate sharing behavior with great probability after generating sharing intention.

Limitations and prospects

This paper is based on UTAUT model, adding a path of facility condition to sharing intention. In addition, there also add two more variables, social entertainment motivation and sustainable motivation. Finally the model of this study is formed. However, the research in this field shows that there are many factors influencing users' acceptance and participation in the sharing economy. Based on the characteristics of the sharing economy and the mature UTAUT model, this paper verifies the limited influencing factors. Therefore, if we want to explore the factors influencing the participation behavior of the sharing economy more comprehensively, more theories should be involved and other important factors should be considered.

The research of influencing factors of sharing behavior under the sharing context has practical significance. It can guide corporate strategy. This paper mainly figured out the factors that may affect the behavior of users from the perspective of users. However, many studies have shown that the sustainable development of the sharing economy needs to aggregate supply parties and platforms, such as the security of platforms, preference degree and so on. At the same time, how platforms and users can use these factors to promote the more harmonious development of the sharing economy is also a subject worth further research.

ACKNOWLEDGMENT

This work is supported by grant 17YJA630050 of the Humanities and Social Sciences of Ministry of Education Planning Fund.

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Fair or Not: Effects of Gamification Elements on Crowdsourcing Participation

(Full Paper)

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ABSTRACT

Fairness perceptions have been found to be a critical driving factor for solvers' engagement in crowdsourcing. However, the literature still lacks on how to design crowdsourcing platform to enhance solvers' fairness perceptions. By integrating organizational justice theory with the gamification literature, we conceptualize solvers' perceptions of two typical gamification elements: the point-rewarding perception and the feedback-giving perception. We develop model to explain the effects of gamification perceptions on both distributive and interpersonal justice perceptions, which are conducive to solvers' participation. Based on a survey of 295 solvers, we apply the partial least squares-structural equation modeling (PLS-SEM) approach to test the research model. Results show that both point-rewarding perception and feedback-giving perception can enhance the distributive and interpersonal justice perceptions which, in turn, foster solvers' crowdsourcing participation. Theoretical contributions and practical implications are discussed.

Keywords: Gamification, crowdsourcing, organizational justice theory, distributive justice, interpersonal justice, point-rewarding perception, feedback-giving perception.

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INTRODUCTION

Crowdsourcing platforms are popular online organizations that organize work by sourcing tasks to their members (Ye *et al.*, 2017). According to the World Bank, the crowdsourcing initiatives generated \$2 billion revenue globally in 2013 and the number is expected to reach between \$15 billion and \$25 billion by 2020. Crowdsourcing platforms allow firms to solve problems at a lower cost and retrieve market feedback about new products or services (Boons *et al.*, 2015). However, the ratio of active participation in the crowdsourcing platforms remains extremely low. For instance, only about 6,000 members have visible active profiles in the InnoCentive, suggesting that 98.4% of the registered members are inactive in this platform. A significant reason for the low active participation in the crowdsourcing platform is the lack of sufficient fairness or justice perceived by the solvers, as evidenced in the crowdsourcing contests of Moleskine and Henkel (Faullant *et al.*, 2017). The Moleskine Facebook page ended up with hundreds of negative comments from designers, fans and customers who are disappointed with the Moleskine incentive scheme, which awarded only the winner with a cash prize. In the case of Henkel, participants disagreed with the jury decision and the selected winners of the contest felt overruled.

Anecdotal evidences suggested that in addition to monetary incentives, crowdsourcing solvers also care about fairness; and conflicts may arise due to perceived unfair treatment (Faullant *et al.*, 2017). It has been reported that perceived unfairness in crowdsourcing contests may result from unfair prize allocations, nontransparent jury decisions, unfriendly climate and intolerable communication behavior (Franke *et al.*, 2013; Gebauer *et al.*, 2013). However, crowdsourcing literature reveals little about how to design the crowdsourcing platform to effectively alleviate the perceived unfairness in the crowdsourcing contests.

Gamification elements, such as points, badges, and leaderboard, have been regarded as an effective non-monetary design mechanism in the context of organizational work (Mollick & Rothbard, 2014; Sarangi & Shah, 2015). It has been argued that gamification elements can act as non-monetary rewards that influence people's perceptions of justice, which further alter their behaviors (Abdullah & Wan, 2013). Extrapolating to the context of gamified crowdsourcing, several gamification elements, such as points, badges, and leaderboard, effectively work as non-monetary incentives (Mekler *et al.*, 2017), which might affect solvers' justice perceptions and promote their participation. However, little research has explored the effects of gamification elements on crowdsourcing participation from the justice perspective. Without a nuanced understanding on how the gamification elements influence solvers' justice perceptions and their behaviors, it may be challenging for crowdsourcing platforms to design effective

gamification elements that arouse solvers' justice perceptions and foster their participation. Thus, this study aims to fill this gap by answering the research questions: *How do gamification elements affect solvers' justice perceptions and hence their participation in crowdsourcing?* By integrating the organizational justice theory with the gamification literature, we develop a research model to explain the impacts of gamification elements perceptions on solvers' crowdsourcing participation. We argue that two gamification elements perceptions, i.e., point-rewarding perception and feedback-giving perception will positively affect both distributive and interpersonal justice perceptions, which in turn affect solvers' crowdsourcing participation. In general, this study will contribute to the crowdsourcing literature by empirically examining the impacts of gamification on solvers' justice perceptions, which affect their participation. It will also extend the gamification literature by integrating organizational justice theory with the gamification literature and exploring the impacts of gamification elements on justice perceptions.

The reminder of this paper is organized as follows. We first introduce the theoretical foundation of this paper, i.e., the gamification literature and the organizational justice theory. Based on the theoretical foundation, we develop our research model and hypotheses correspondingly. Next, we introduce the methodology as well as data analysis results. Finally, we discuss our findings and draw some implications for research and practice.

THEORETICAL BACKGROUND

Organizational Justice Theory

According to the organizational justice theory, justice denotes perceptions of fairness and assessments regarding the appropriateness of performance outcomes or processes (Cropanzano & Greenberg, 1997). Recent theoretical development on organizational justice theory has centered on identifying and distinguishing different dimensions of justice such as distributive justice, procedural justice, interpersonal justice, and informational justice (Greenberg, 1993). Distributive justice focuses on evaluations of the fairness of economic and socio-emotional outcomes that an individual receives, while procedural justice refers to perception of fairness with regard to process and procedure used to make decisions concerning the outcome. The interactional aspect of procedural justice was extracted and conceptualized as interactional justice. Later, Greenberg (1993) further separated the interactional justice into two subcategories: interpersonal justice and informational justice. Interpersonal justice refers to the degree to which individuals are treated by others with politeness, dignity, friendliness, and respect, whereas informational justice reflects the adequacy of explanation behind the process and outcome (Greenberg, 2001).

The organizational justice theory (OJT) primarily posits that users with high justice perceptions will develop trust and satisfaction in uncertain organizational circumstance, which enhance users' reciprocity and loyalty towards the organizations. The OJT has been widely adopted by information systems researchers to analyze the justice perceptions of individuals when adopting the information systems. Some research has been done to investigate online crowdsourcing participation from the perspective of justice. These studies have mainly looked at the effects of perceived justice on solvers' behaviors and outcomes, such as creativity (Franke & Klausberger, 2009; Zou *et al.*, 2015), product interest and perceived product innovativeness (Faullant *et al.*, 2017), and the efforts expended by the solvers (Franke *et al.*, 2013). For example, Zuo *et al.* (2015) suggested that solvers' perceptions of distributive, procedural, and interactional justice positively affect their creative performance, which are mediated by idea cooperation and idea generation. For another instance, Faullant *et al.* (2017) discovered that fairness perceptions of solvers can enhance their product interest, perceived innovativeness, and loyalty intentions. However, relatively little research has stepped further to explore the antecedents for the solvers' justice perceptions. For instance, Fieseler *et al.* (2017) conducted a qualitative survey on 203 active workers in the Amazon Mechanical Turk and proposed some suggestions for increasing their fairness perceptions. They found that minimum remuneration and professionalization can enhance distributive fairness; increased transparency and dispute settlement, and workers' representation both increase procedural justice; while humanization can promote interactional fairness. For another example, Franke *et al.* (2013) based on two experimental simulations to argue that terms and conditions of the crowdsourcing systems and the ex-ante level of identification with the organizing firm affect solvers' perceptions of distributive fairness and procedural fairness which, in turn, influence their willingness to contribute and ex-post identification with the organizing firm. Apart from these few studies, several research has hinted that gamification design elements might impact the fairness perception as well (Callan *et al.*, 2015; Mollick & Rothbard, 2014). In this study, we follow this line of research and explore the driving factors of solvers' fairness perception from the gamification design perspective. We posit that gamification elements might play an effective role in strengthening the justice perceptions of solvers.

Effects of Gamification Elements on Solver Participation

Gamification, referred to the use of game elements in non-game contexts (Deterding *et al.*, 2011), is first introduced to the educational settings as a mechanism to enhance student learning. The notion of gamification is not until recently adopted and developed by information systems scholars to the design of incentive mechanisms for information systems use (Hamari *et al.*, 2016). Gamification in information systems is defined as the adoption of gamified design elements (e.g., points, badge, leaderboard) in information systems in an attempt to, change or improve individual's attitudes and usage behaviors towards the systems (Liu *et al.*, 2017).

Gamification has also been applied to the context of online crowdsourcing, with the aim of enhancing solvers' psychological and behavioral outcomes (Morschheuser *et al.*, 2017). Past research has repeatedly noted that gamification elements foster solvers' engagement and participation by affording their motivations. On one hand, a number of studies have found that gamification elements enhance solvers' participation through their intrinsic motivations. For instance, Blohm & Leimeister (2013) found that offering points in crowdsourcing could enhance participants' sense of flow and immersion, which further motivates them to produce high-quality results. In a similar vein, Goh *et al.* (2017) suggested that awarding points and badges could satisfy the motivational needs for autonomy and competence in mobile crowdsourcing games. Feng *et al.* (2018) based on motivational affordance perspective and discovered that points and feedbacks could motivate solvers to participate in microtask crowdsourcing by fulfilling their intrinsic needs for self-presentation, self-efficacy and playfulness. On the other hand, some studies have also suggested that gamification elements could as well intrigue solvers' extrinsic motivations such as extrinsic need for reputation or recognition, thereby instigating their participation (Blohm & Leimeister, 2013).

Apart from the well-received logic of "gamification-motivation-behavior", prior research has also implied that some gamification elements (e.g., points, badges, leaderboard) might work as effective non-monetary incentives in addition to the monetary rewards in compensating for the solvers' efforts and enhancing their fairness perceptions, which further motivate them to contribute (e.g., Kawajiri *et al.*, 2014; Melenhorst *et al.*, 2015). For instance, solvers with more points are trusted by crowdsourcers as competent service providers (Feng *et al.*, 2018) and possess more chances of winning the bids. Therefore, awarding points is an effective way to reward the solvers' efforts. Apart from that, badges and leaderboard might also play similar roles as points in acknowledging solvers' efforts. Aside from this traditional PBL-triad (i.e., points, badges, leaderboard), feedbacks from the crowdsourcing firms, be it positive or negative, might also work as a useful mechanism to recognize the efforts of the solvers. According to the organizational justice theory, employees will commit to their organizations and conduct organizational citizenship behavior (e.g., working hard) when they perceive that they are treated fairly by their employers (Greenberg, 1993). Therefore, employers can motivate their labors to work harder by offering monetary or non-monetary rewards to recognize their efforts (Greenberg, 1993). Extrapolating to the context of crowdsourcing, the crowdsourcers could make use of the gamification elements (e.g., points and feedbacks) as effective non-monetary incentives to strengthen solvers' justice perceptions, thereby sustaining their participation. However, in both the gamification and crowdsourcing literature, there is scant research trying to link the gamification elements to the justice perceptions and participation behaviors of the solvers.

In the gamified crowdsourcing literature, points, leaderboards, badges/achievements, levels, progress, feedback, and virtual objects are the most frequently mentioned gamification elements (Morschheuser *et al.*, 2017). In the crowdsourcing platform examined in the current study, points and feedbacks are two salient gamification elements, while leaderboards, badges, and virtual objects are not present in this platform. Besides, solver levels overlap with points while progress overlaps with feedbacks in this platform. Hence, in the current study, we specifically focus on points and feedbacks and empirically examine their effects on solvers' justice perceptions and participation behaviors.

Points are typically rewarded for the successful completion of specified activities within the gamified environment, and serve to numerically represent a player's experience and capability (Morschheuser *et al.*, 2017). In the online crowdsourcing platform of this study, points are rewarded when solvers participate and win the tasks. Points are not redeemable for money but could increase the solvers' levels, which is a key criteria when crowdsourcing firms select the winners of the tasks. Hence, points represent a *capability-related non-monetary incentive* that acknowledges the efforts made by the solvers. Gamification elements only work when individuals pay attention to them. Because individuals perceive these elements differently, conceptualising their outcomes as perceptions is critical for the generalisation of our research findings. Hence, we follow the typical practices of past studies, which conceptualize technical elements as user perceptions. We define point-rewarding perception as the solvers' perception of non-monetary incentive mechanism through which the crowdsourcing platform can compensate them for their jobs. Apart from points, verbal feedbacks for solvers' submissions are provided by the crowdsourcing firms regarding the quality of the submissions (Ye & Kankanhalli, 2017). One crowdsourcing task may receive thousands of submissions. When a solver's submission receives feedbacks from the crowdsourcing firm, be it positive or negative, the solver will feel that his efforts has been recognized by the firm, thereby developing a sense of fairness. Hence, feedback giving denotes a *task-related non-monetary incentive* that can enhance the solvers' justice perception. We thus define feedback-giving perception as the solvers' perception of non-monetary incentive mechanism through which the crowdsourcing firms can acknowledge the work of them. Combining the above together, this study conceptualizes two gamification elements perceptions as point rewarding perception and feedback giving perception, and examines their roles as non-monetary incentives to motivate solvers' participation through their justice perceptions.

In terms of the justice perceptions, as illustrated above, procedural justice concerns with the fairness of the processes or procedures of decision-making, while informational justice deals with the adequacy of explanation behind the process and outcome. Therefore, both of these two justice perceptions center on the processes through which decisions/outcomes are made (Greenberg, 2001). In crowdsourcing platforms, points are allocated based on the solvers' performance, while feedbacks are provided as a factual evaluation of the submission quality. These two gamification elements are more related to the outcomes (quality of the submission), rather than the processes leading to the outcomes (evaluation processes by the crowdsourcing firms). In addition, information

regarding the evaluation processes and selection criteria are normally provided a-priori in the task description section, rather than being offered in the feedbacks for each submission. Hence, in this study, when we focus on point rewarding and feedback giving as two gamification elements in the crowdsourcing platforms, we apply only two dimensions of justice, i.e., distributive justice and interpersonal justice to investigate the relationship between gamification elements and solvers' participation.

RESEARCH MODEL AND HYPOTHESES

Drawing on the gamification literature and the organizational justice theory described above, we develop a model to explain solvers' participation in online crowdsourcing platforms as shown in Figure 1. Specifically, we expect that point rewarding perception and feedback giving perception positively affect solvers' perceived distributive justice and interpersonal justice which, in turn, positively affects solvers' crowdsourcing participation.

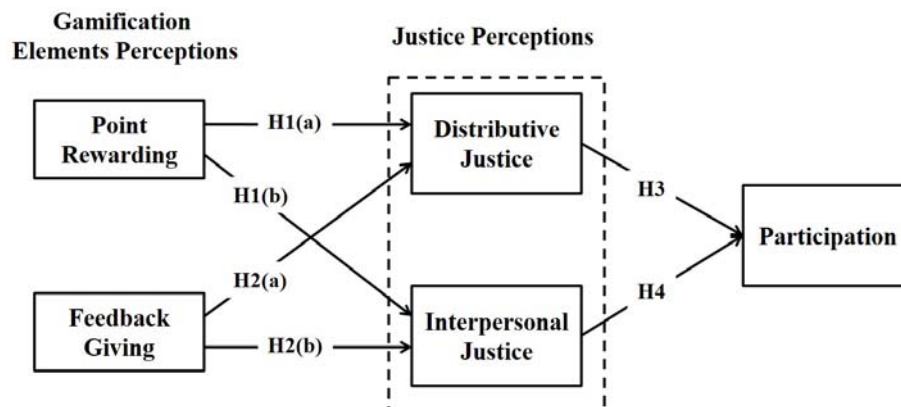


Figure 1: The Research Model

Point Rewarding Perception

Point is one of the most frequently discussed gamification elements in crowdsourcing literature (Morschheuser *et al.*, 2017). The crowdsourcing platform in the current study is equipped with noticeable point rewarding mechanism. As solvers take part in crowdsourcing contests and win the bids, they will receive a certain amount of points as non-monetary incentives apart from the predetermined monetary rewards (Morschheuser *et al.*, 2017). A preponderance of managerial literature (Abdullah & Wan, 2013) indicates that providing non-monetary rewards is an important part of an overall employee compensation plan. In the online crowdsourcing platform, solvers typically devote a great amount of physical/cognitive and emotional efforts to winning the bids. Rewarding solvers with non-monetary incentives such as points indicates that the platform acknowledges the emotional efforts of the solvers. Hence, points provided by the crowdsourcing platform influences the emotional outcome (i.e., a major part of distributive justice) on the solver side. Meanwhile, solvers tend to consider the platform who provides the points to be responsive. This in turn leads to a perception that the crowdsourcing platform treats solvers with respect and politeness, i.e., with interpersonal justice. Therefore, we hypothesize,

H1: Point rewarding perception leads to higher perceptions of (a) distributive justice and (b) interpersonal justice by solvers.

Feedback Giving Perception

Apart from points, another salient gamification element used in the crowdsourcing platform of the current study is feedback giving. After a crowdsourced task is completed and the winning bid(s) is selected, the crowdsourcing firm will be urged to offer clear and reasonable feedbacks/responses to each of the failed submissions, illustrating the reasons why these submissions are not selected. Past research (e.g., Blohm & Leimeister, 2013) has found that solvers have a normative expectation to receive an explanation of the outcome of their failed submissions. The act of providing feedbacks first fulfill solvers' expectation. Second, if the selection criteria of the crowdsourcing firms is rather ambiguous or subjective, the provision of feedbacks can make the final decision at least partly "justifiable". Feedbacks on the quality of the submissions could make the solvers view the final decision as the only feasible or option, which in turn make the final decision of the crowdsourcing firm emotionally acceptable (Morschheuser *et al.*, 2017). Giving feedbacks also demonstrates that a crowdsourcing firm concerns about the failure of individual solvers and puts sufficient effort to compensate the failed solvers. This will generate the perceptions that submissions are treated with respect by the crowdsourcing firm. Therefore, we expect that

H2: Feedback giving perception leads to higher perceptions of (a) distributive justice and (b) interpersonal justice by solvers.

Distributive Justice and Interpersonal Justice

Research on organizational justice has found clear evidence that perceived justice has an impact on individuals' attitudes and behavior. Individuals who perceived themselves as treated unfairly will experience distress, and this distress will motivate efforts to restore fairness within the relationship; failing that, individuals will seek ways to terminate the relationship (Greenberg, 1993). Prior research has mostly agreed that both distributive and interpersonal justice will affect individual behavior. In the context of crowdsourcing, there has been a few research showing that solvers' crowdsourcing participation behavior is affected by distributive justice (Franke *et al.*, 2013) and interpersonal justice (Zou *et al.*, 2015). Thus, we expect

H3: Perception of distributive justice is positively related to solvers' crowdsourcing participation.

H4: Perception of interpersonal justice is positively related to solvers' crowdsourcing participation.

We also include gender, age, education level, industry background in our model as control variables that might affect solvers' participation in crowdsourcing tasks.

RESEARCH METHODOLOGY

We collect data from the target population (i.e., solver participants) of a large micro-task crowdsourcing platform through an online survey. All the constructs in our theoretical model are latent variables, which are best studied using the survey approach (Kankanhalli *et al.*, 2015). It is worth noting that the online crowdsourcing platform in this study (i.e., Zhubajie.com) corresponds to the type of competition-based crowdsourcing platform, as most of the tasks in this platform are crowdsourced based on a competitive mode by the crowdsourcing firms. A crowdsourced task may receive thousands of submissions from individual solvers, but only one or a handful of qualified submissions will be selected and financially rewarded by the crowdsourcing firms. When one submission is selected and financially rewarded, the solver who provided this submission will receive a certain amount of points. Besides, the crowdsourcing firms can autonomously provide feedbacks to every submission for their crowdsourced tasks. Generally speaking, tasks crowdsourced in this platform fall into the category of "simple task with high outcome variety". Such tasks include logo design, translation, as well as Website design, which require a certain amount of creativity and expertise from the solvers.

Sample

We collected data through invitational private messages sent to registered solvers of the online crowdsourcing platform in this study. The invitational private message included an invitation letter and a link to the survey questionnaire hosted by an online survey platform (www.wenjuan.com) in China. Specifically, we obtained a list of registered solvers from the platform operator and randomly selected 1,000 solvers from the list. Then we sent out the invitational private messages to these solvers. 326 solvers responded by filling out the survey questionnaire, which results in a response rate of 32.6%. After deleting those incomplete responses and repeated responses, a total of 295 questionnaires were employed for data analysis. Table 1 demonstrates the demographic characteristics of the usable samples.

Measure	Item	Frequency	Percentage (%)
Gender	Male	169	57.3
	Female	126	42.7
Age	< 18	1	0.3
	18-24	96	32.5
	25-35	180	61.0
	36-50	17	5.8
	>50	1	0.3
Education level	High school and below	19	6.4
	College (Diploma)	90	30.5
	University	169	57.3
	Master	16	5.4
	PhD	1	0.3
Industry	Education	61	20.7
	IT service	75	25.4
	Manufacturing	40	13.6
	Financial service	9	3.1
	Traditional services	42	14.2
	Others	68	23.0

Measures

Where available, the constructs in the conceptual model were operationalized using existing instruments adapted from past studies to enhance validity. Otherwise, new instruments were developed based on its definition, interviews with subjects and a review of previous gamification and crowdsourcing literature. Please find the items in Table 2.

Table 2: Operationalization of Constructs			
Constructs		Items	Source
Point Perception (PNT)	Rewarding	PNT1	Adapted from (Feng <i>et al.</i> , 2018)
		PNT2	
		PNT3	
Feedback Perception (FEB)	Giving	FEB1	Adapted from (Feng <i>et al.</i> , 2018)
		FEB2	
		FEB3	
Distributive Justice (DIS)		DIS1	Adapted from (Skarlicki & Folger, 1997; Zou <i>et al.</i> , 2015)
		DIS2	
		DIS3	
		DIS4	
Interpersonal Justice (INT)		INT1	Adapted from (Colquitt, 2001)
		INT2	
		INT3	
		INT4	
Solver Participation (PAR)		PAR1	Adapted from (Wu & Sukoco, 2010)
		PAR2	
		PAR3	
		PAR4	

Notes: All items are based on 5-point Likert scale (1 = strongly disagree to 5 = strongly agree)

To enhance the validity of the newly developed instruments (i.e., instruments for point rewarding and feedback giving), we conducted exploratory interviews with eight crowdsourcing solvers to identify what gamification features they recognized and perceived when using this platform. We also conducted a pilot test with 40 individuals to validate the new instruments. Following the procedures introduced by past research, items for all constructs are tested with a two-stage Q-sorting process to enhance their content validity, convergent validity as well as discriminant validity. All instruments were measured using five-point Likert-scales anchored from “strongly disagree” to “strongly agree” (See Table 2 for the instruments). Items from English were translated into Chinese and given to six information systems professors who were proficient in both languages for reverse translation. We then carefully considered all controversial translations.

RESULTS

Partial least squares (PLS) was adopted to analyze the survey data. PLS-SEM instead of co-variance based SEM is suitable for analyzing the model with formative constructs (Wetzels *et al.*, 2009). Following Wetzels *et al.* (2009), bootstrapping was

performed to test the statistical significance of path coefficients. In the model tested, all constructs were modeled as reflective. SmartPLS 2.0 was used for data analysis.

The Measurement Model

Convergent validity is assessed by (1) reliability of items, (2) composite reliability of constructs (>0.7), (3) average variance extracted (AVE) (>0.5), and (4) factor analysis results. Examining each item's loading on its corresponding construct assesses reliability of items (Standardized Factor Loading > 0.7). In this study, the loading of each item meets this criterion (Table 3). Regarding internal consistency (reliability), composite reliability scores and Cronbach's alpha scores for every construct (as shown in Table 4) are well above 0.70, which is the suggested benchmark for acceptable reliability. AVE measures the amount of variance that a construct captures from its indicators relative to the amount due to measurement error. It is recommended to exceed 0.50. Table 4 shows that the AVE score for every construct, ranging from 0.73 to 0.77, satisfies this requirement. In addition, to show good convergent validity in factor analysis results, all of the items should load highly on their own latent variables. Factor analysis results in this study (see Table 3) are satisfactory according to these criteria.

Table 3: Exploratory Factor Analysis Results

	1	2	3	4	5
PAR1	0.85	0.15	0.17	0.13	0.12
PAR2	0.83	0.14	0.12	0.10	0.16
PAR3	0.81	0.10	0.22	0.17	0.06
PAR4	0.83	0.15	0.06	0.11	0.24
DIS1	0.15	0.82	0.23	0.12	0.12
DIS2	0.15	0.80	0.24	0.08	0.18
DIS3	0.12	0.83	0.22	0.15	0.11
DIS4	0.15	0.77	0.26	0.15	0.09
INT1	0.20	0.22	0.73	0.19	0.24
INT2	0.17	0.24	0.76	0.19	0.16
INT3	0.13	0.26	0.82	0.09	0.12
INT4	0.13	0.31	0.75	0.13	0.20
PNT1	0.18	0.16	0.18	0.24	0.77
PNT2	0.15	0.10	0.23	0.23	0.81
PNT3	0.20	0.19	0.18	0.18	0.80
FEB1	0.17	0.14	0.15	0.80	0.24
FEB2	0.13	0.14	0.14	0.84	0.22
FEB3	0.17	0.14	0.17	0.79	0.14
Eigenvalue	7.72	2.04	1.68	1.17	1.04
% of variance	42.88	11.31	9.35	6.50	5.78
Cumulative%	42.88	54.19	63.54	70.03	75.80

Table 4: Means, Standard Deviations, Scale Reliabilities, and Inter-Correlations

Variable	Mean	SD	CA	CR	AVE	PAR	DIS	INT	PNT	FEB
PAR	4.03	0.73	0.90	0.93	0.76	0.87				
DIS	3.69	0.79	0.89	0.92	0.75	0.39	0.87			
INT	3.90	0.64	0.88	0.92	0.73	0.43	0.61	0.85		
PNT	3.94	0.68	0.85	0.91	0.77	0.44	0.42	0.52	0.88	
FEB	4.06	0.76	0.84	0.90	0.76	0.39	0.39	0.45	0.54	0.87

Notes: Diagonal elements are the square root of the average variance extracted (AVE)

SD, standard deviation; CA, Cronbach's alpha; CR, composite reliability

Discriminant validity is assessed by examining the indicator-construct loadings and inter-construct correlations. As shown in Table 3, all indicators load more strongly on their corresponding constructs than on other constructs in the model. Table 4 shows the square roots of the average variance extracted (AVE) are larger than the inter-construct correlations. Overall, the constructs demonstrate strong discriminant validity.

Finally, we assessed the extent of common method variance (CMV) using the marker-variable technique. The marker variable utilized was fantasizing, which is theoretically unrelated and we examined correlations between the marker variable and other constructs. Fantasizing had been used as marker variable in several prior studies (e.g., Ye & Kankanhalli, 2017; Feng *et al.*, 2018)

and showed good validity in detecting CMV. The smallest correlation with fantasizing was -0.03 ($p>0.05$), indicating that CMV was not substantial in our study.

Hypothesis Testing

Hypothesis testing results are shown in Figure 2 and Table 5. Demographic variables (i.e., gender, age, education level and industry) were included in the analysis as controls for solver participation. None of the control variables except for gender ($\beta=0.12$, $p<0.01$) were significant, indicating that female are more willing to participate in crowdsourcing than male.

Consistent with our prediction, point rewarding exhibits a positive influence on distributive justice ($\beta=0.29$, $p<0.001$), hence supporting H1(a). Point rewarding also shows positive influence on interpersonal justice ($\beta=0.39$, $p<0.001$), supporting H1(b). Consistent with our prediction, feedback giving is positively related to distributive justice ($\beta=0.24$, $p<0.001$), supporting H2(a). The relationship between feedback giving and interpersonal justice is also significant ($\beta=0.24$, $p<0.001$), supporting H2(b). Moreover, as anticipated, both distributive justice ($\beta=0.21$, $p<0.001$) and interpersonal justice ($\beta=0.30$, $p<0.001$) exhibit positive relationship with solvers' participation, supporting both H3 and H4. Table 5 summarizes the results of the hypothesis tests.

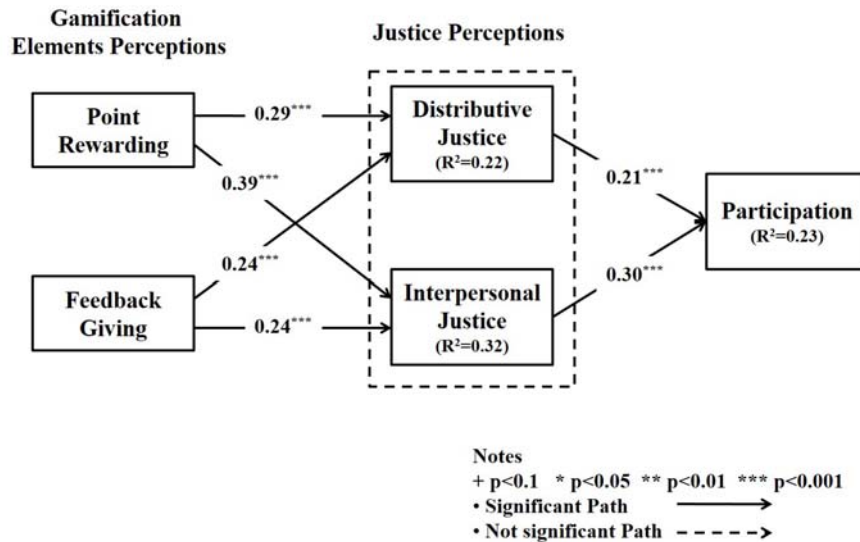


Figure 2: Hypothesis Testing Result

Proposed paths				Path estimates	p-levels	S.E.	Hypothesis tests
H1(a)	PNT	→	DIS	0.29	<0.001	0.07	Supported
H1(b)	PNT	→	INT	0.39	<0.001	0.06	Supported
H2(a)	FEB	→	DIS	0.24	<0.001	0.07	Supported
H2(b)	FEB	→	INT	0.24	<0.001	0.06	Supported
H3	DIS	→	PAR	0.21	<0.001	0.06	Supported
H4	INT	→	PAR	0.30	<0.001	0.07	Supported

DISCUSSION

Nowadays, individuals and organizations increasingly count on online crowdsourcing platforms for effective solutions and creative ideas (Ye & Kankanhalli, 2017). Motivating solvers to perform is the key to the sustainability of these online crowdsourcing platforms (Ye & Kankanhalli, 2017). How to encourage solvers to participate in solving crowdsourced tasks is always an important topic for researchers and practitioners. Considering this, we seek to enrich the understanding of solvers' participation in the crowdsourcing platforms. Empirical results support our hypotheses that the perceptions of two typical gamification elements (i.e., point rewarding and feedback giving) positively affect solvers' distributive and interpersonal justice perceptions. These two distinct types of justice perception, in turn, positively influence solvers' participation. Taken together, results of this study suggest that gamification elements indirectly influence solvers' participation in crowdsourcing platforms through both the distributive and interpersonal justice perceptions.

Theoretical Contributions

This study makes several important theoretical contributions. First, we enrich the literature on gamified crowdsourcing (Goh *et al.*, 2017) by theoretically conceptualizing gamification elements into point rewarding perception and feedback giving perception, and

theorizing and testing their impacts on solvers' justice perceptions and participation. This paves a way for future study on the impacts of gamification artifacts.

Second, past empirical literature on gamification has been limited to studying the impacts of gamification elements on solvers' motivations (Mekler *et al.*, 2017). Although prior research has inferred that some gamification artifacts may work as non-monetary incentives that supplement the monetary rewards in compensating solvers' efforts and enhancing their fairness perceptions (Mekler *et al.*, 2017), little research has empirically examined the effects of gamification artifacts on solvers' justice perceptions. This study extends previous gamification literature by theorizing and empirically validating the impacts of gamification element perceptions on solvers' justice perceptions in the crowdsourcing platforms. Results suggest that in crowdsourcing platforms, point rewarding and feedback giving artifacts can affect both distributive and interpersonal justice perceptions of the solvers.

Third, prior crowdsourcing research has been mainly limited to studying the impacts of different justice perceptions on solvers' participation (Zou *et al.*, 2015; Faullant *et al.*, 2017). This study enriches previous crowdsourcing studies (Franke *et al.*, 2013) by stepping further to explore and examine platform designs as antecedents for justice perceptions. Specifically, we conceptualize point rewarding and feedback giving as two typical gamification elements perceptions and bridge them with the distributive and interpersonal justice perceptions of the solvers. This extends our knowledge on how the crowdsourcing platforms can be designed to compensate the solvers and motivate them to participate.

Fourth, this study contributes to the literature on organizational justice theory. We link organizational justice theory with gamification literature to theorize on the impacts of gamification artifacts. As a result, we identify two gamification artifacts as the critical sources for solvers' distributive and interpersonal justice perceptions. This adds to the development of organizational justice theory.

Practical Implications

From a pragmatic view, we provide insights to firms and crowdsourcing platform operators on how to encourage solvers to participate in crowdsourcing. Specifically, this study contributes to practice in three ways. First, it provides suggestions for encouraging solvers to participate in crowdsourcing through designing an effective point rewarding mechanism. On one hand, results suggest that a well-designed points system could promote solvers' participation in crowdsourcing by enhancing their distributive justice perception, that is, the evaluation of fairness of economic and socio-emotional outcomes they receive. Crowdsourcing platforms should promote to solvers the notion that earning more points could be regarded by crowdsourcing firms as competent solvers and thus bringing more chances to win the bids. When solvers consider the points as valuable non-monetary incentives, they will believe that their emotional efforts are properly compensated and thus are more willing to sustain their participation. On the other hand, results of this study also indicate that rewarding solvers with points immediately after the tasks are completed could make them feel they are politely treated, thereby being more proactive in task participation.

Second, an effective feedback mechanism is also important. Crowdsourcing platforms could attempt to reinforce solvers' distributive and interpersonal justice perceptions by soliciting the crowdsourcing firms to offer prompt and constructive feedbacks for the submissions. Specifically, crowdsourcing platforms should encourage the firms to reply to as many as the submissions immediately after the task is completed. To achieve that, crowdsourcing platforms should design a function to remind the firms to select bids and provide feedbacks when the bidding period is ended. Additionally, crowdsourcing firms should be encouraged to be constructive when they provide feedbacks. Prompt and constructive feedbacks can reinforce solvers' sense of distributive and interpersonal justice which, in turn, enhance their crowdsourcing participation.

Limitations and Future Directions

We acknowledge some limitations in this study. First, different from prior research that typically adopted an experimental method to study the effects of gamification artifacts, we examine the effects of gamification artifacts through a cross-sectional survey, which has its own merits. Although the experimental method might be better in inferring the causal relationships among studied variables, the external validity and generalizability of the findings might be compromised. On contrary, survey could enhance the external validity and generalizability to a certain extent. Apart from that, in this study we operationalized the two gamification elements as solvers' perceptions, which are latent variables and are best studied with survey method (Kankanhalli *et al.*, 2015).

Second, as different types of crowdsourcing tasks require different amounts of efforts by the solvers, for tasks that are more complicated or large-sized, solvers have to devote a greater amount of time and efforts to complete them (Ye & Kankanhalli, 2017). In this situation, efforts can never be accurately measured and compensated by monetary rewards, solvers may value more on non-monetary incentives and place more emphasis on emotional and interpersonal fairness of the deals. Hence, our findings might be best generalized to large-sized or complicated tasks. We acknowledge that for small-sized or less complicated tasks, solvers might value less on the non-monetary incentives and care more about the immediate monetary rewards. Future research replicating our study should at least take the size and complexity of the crowdsourcing tasks into consideration.

Third, although we carefully select pertinent variables into our model based on theoretical foundations, we cannot exclude a possibility of omitting relevant variables. For example, our model focuses on two main dimensions of justice (distributive and interpersonal justice). Organizational justice literature suggests that there are other two dimensions of justice (i.e., procedural and informational justice). We refrained from including these two dimensions in our model because we suspected that points and feedbacks are not related to processes leading to the selection outcomes, about which these two dimensions of justice concern. However, we acknowledge that some crowdsourcing firms might still incorporate explanations of their selection processes in their feedbacks, which could influence the procedural and information justice perceptions as well. Future research should also account for this possible link.

This study opens up a number of exciting avenues for further research. This study shows the influences of two typical gamification artifacts on solvers' justice perceptions and participation. Yet, there is a range of gamification artifacts of which the effecting paths remain unknown. We encourage researchers to identify other gamification artifacts (e.g., badges, leaderboard) that may be important and to examine how such artifacts affect solvers' justice perceptions and participation in online crowdsourcing platforms.

CONCLUSIONS

Despite various measures taken, solvers' participation continues to be inadequate in online crowdsourcing platforms. Given the importance of solvers' participation, practitioners have expressed substantial concerns on encouraging such behaviors. To this end, we provide a theory-driven approach to evaluate the importance of gamification artifacts in helping practitioners to enhance the sustainability of crowdsourcing platforms via distributive and interpersonal justice perceptions. Our findings clearly indicate that the integration of gamification literature and organizational justice theory is essential for a better understanding of solvers' participation in the gamified crowdsourcing platforms. We believe that the model proposed in this study can serve as a solid foundation for future work in this important area.

ACKNOWLEDGMENT

This work is partially supported by grant 71702111, 71602122, and 71502114 from the National Natural Science Foundation of China, and grant 2017WQNCX142 of the Young Innovative Talents Project (Humanities & Social Sciences) from the Education Bureau of Guangdong Province.

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Credit Fraud Risk Detection Based on XGBoost-LR Hybrid Model

(Full Paper)

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ABSTRACT

For a long time, the credit business has been the main business of banks and financial institutions. With the rapid growth of business scale, how to use models to detect fraud risk quickly and automatically is a hot research direction. Logistic regression has become the most widely used risk assessment model in the industry due to its good robustness and strong interpretability, but it relies on differentiated features and feature combinations. XGBoost is a powerful and convenient algorithm for feature transformation. Therefore, in this paper, XGBOOST can be used to effectively perform the advantages of feature combination, and a XGBoost-LR hybrid model is constructed. Firstly, use the data to train a XGBoost model, then give the samples in the training data to the XGBoost model to get the leaves nodes of the sample, and then use the leaves nodes after one-hot encoding as a feature to train an LR model. Using the German credit data set published by UCI to verify this model and compare AUC values with other models. The results show that this hybrid model can effectively improve the accuracy of model prediction and has a good application value.

Keywords: Credit risk, XGBoost, logistic regression.

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INTRODUCTION

With the development of the economy and the change in the concept of personal consumption, the credit business has gradually entered people's daily lives. According to the Central Bank's financial statistics report, RMB loans for the whole year of 2017 increased by RMB 1.353 billion. Credit business is not only an important business of banks, but also a business that many financial institutions rely on to survive and develop themselves. The credit business is actually a kind of credit granting. The credit agency investigates the borrower's ability to repay and the willingness to repay the loan, and evaluates it to determine whether grant the loan and the duration and amount of the loan are to be determined. In credit risk, the most important is fraud risk that fraudster has no willingness to repay when applying for a loan. In order to cope with this risk, bank managers must find effective solutions in order to distinguish bad ones from applicants. Therefore, with the rapid expansion of the scale of credit business, fraud risk detection of lenders has become a very important task for banks and financial lending institutions.

Fraud risk detection allows the credit industry to benefit from improved cash flow, guaranteed credit collection, reduced potential risks, and better management decisions (Lee Tian-Shyug *et al.*, 2002). Obviously, for a large-scale lending business, the accuracy of the scoring model only increases by 1%, and it will bring significant benefits to credit institutions. Therefore, the research on the credit fraud detection model has practical significance.

RELATED WORK

The credit fraud detection model is actually a classification issue. It classifies lenders into two categories: "good credit" that is capable of fulfilling economic obligations, repaying loan interest interest, and "bad credit" that is rejected grant loans because of high probability of default (Bastos J, 2007). Traditional credit assessment mainly depends on professionals with rich experience in risk management to manually review the basic information and financial information of lenders. However, with the rapid increase in business volume, it is unrealistic to rely on traditional manual methods. The increase in the number of loan applicants has promoted the development of technologies that use quantitative models for assessment, making credit approval procedures automated and efficient, and capable of supervising borrowings.

Durand (1941) first analyzed the credit risk and for the first time built a consumer credit evaluation model using statistical discriminant analysis. The results show that the use of quantitative methods can achieve better predictive ability. Subsequently, Altman used a multivariate discriminant analysis method to create a classic Z-Score method to derive the probability of an enterprise's risk. This model has a good applicability in predicting the financial status of the company.

Traditional linear discriminant methods require data to satisfy a certain distribution and subject to strict assumptions. However, most of the data in the real world do not satisfy the above conditions, and there is a certain degree of collinear relationship between variables. Logistic regression is a credit scoring method that can effectively deal with binary classification problems. Due to its strong interpretability, it is widely used (Zhu Xiaoming & Liu Zhiguo, 2007). However, Harrell and Lee (1985) found that although the assumptions of the linear discriminant method are satisfied, Logistic regression can be as effective and accurate as LDA. LDA (Latent Dirichlet *al.* location) is a document theme generation model, also known as a three-layer Bayesian probability model, which contains three-layer structure of words, topics and documents. The so-called generation model, that

is, we believe that each word in an article is obtained through a process of "choosing a topic with a certain probability and selecting a certain word from the topic with a certain probability". The document to topic follows a polynomial distribution, and the subject to the word follows a polynomial distribution. Qin Wanshun and Shi Qingyan (2003) selected credit card data from a branch of a large commercial bank and constructed a personal credit scoring model based on Logistic regression to better distinguish "good customers" and "bad customers".

With the popularity of artificial intelligence, a large number of machine learning methods are gradually being applied in the credit domain. David West (2000) studied five neural network architectures: MLP、MOE、RBF、LVQ and fuzzy adaptive resonance theory neural network (FAR). Among the five structures, hybrid expert systems and radial basis neural networks have good performance. At the same time, this study also shows that logistic regression is a good alternative for neural models. Logistic regression is slightly more accurate than the average neural network model which includes some poor neural network training iterations.

However, a single model has its own advantages and disadvantages in terms of robustness, accuracy, and interpretability. Combining each model can combine the advantages of different models, and it is beneficial to enhance the model's generalization ability and enhance robustness.

Peng Runze (2017) uses SVM, RF, ANN, and GBDT as primary classifiers, and the secondary classifiers use logistic regression to build a two-level integration model. He found that the hybrid model is superior to a single machine learning model. The basic model of the Support Vector Machine (SVM) is to find the best separation hyperplane on the feature space so that the positive and negative sample intervals on the training set are the largest. SVM is a supervised learning algorithm used to solve the two-class problem. SVM can also be used to solve nonlinear problems after the introduction of the kernel method. Random Forest (RF) is an integrated learning model based on decision tree. It contains multiple decision trees trained by Bagging integrated learning technology. When inputting samples to be classified, the final classification result is determined by the vote of the output of a single decision tree. Random forest has good tolerance to noise and outliers, and has good scalability and parallelism for high-dimensional data classification problems. In addition, random forest is data-driven nonparametric classification method that requires only prior knowledge by training the classification rules for the learning of a given sample. GBDT is an algorithm that classifies or regresses data by using an additive model and continuously reducing the residuals produced by the training process. GBDT generates a weak classifier for each iteration through multiple iterations, and each classifier trains on the basis of the residuals of the previous classifier. The requirements for weak classifiers are generally simple enough and are low variance and high bias. Qin Wanshun and Shi Qingyan (2003) trained neural network models and combined the obtained scoring results as one of the explanatory variables with the remaining characteristic variables, then applying together to the Logistic regression model. However, due to the high correlation between the results obtained by the neural network and the dependent variables, the remaining features become unimportant, and multicollinearity problems are easily generated. Chen Qiwei *et al.* (2018) used XGBoost as a base classifier to construct a credit scoring model using data space, feature space, and algorithm parameter strategies, and then used a bagging method to learn a good integration model. Cai Wenxu, Luo Yonghao and Zhang Guanxiang (2017) combined leaf nodes that the GBDT generated with original features to form new features and input them into the LR model. Experiments have verified that the prediction effect of the model is far better than that of a single model. Logistic regression (LR) measures the relationship between the categorical dependent variable and one or more independent variables by estimating probabilities using a logistic function, which is the cumulative logistic distribution. Thus, it treats the same set of problems as probit regression using similar techniques, with the latter using a cumulative normal distribution curve instead. Equivalently, in the latent variable interpretations of these two methods, the first assumes a standard logistic distribution of errors and the second a standard normal distribution of errors.

Logistic regression has become one of the most commonly used models in the industry because of its simplicity, strong interpretability and good stability. However, the LR algorithm is a linear model and cannot capture nonlinear relationship. It requires a large number of feature transformations to find feature combinations. In 2014, Facebook (2014) introduced the solution through GBDT+ LR to solve feature engineering. The experimental results confirmed that GBDT is a powerful and very convenient method to implement feature nonlinearity and tuple conversion. The XGBoost that evolves and optimizes on the basis of GBDT can also obtain the importance of each feature in the model at the same time. It can be used as a criterion for determining the importance of features and can be used for simple and effective feature conversion and combination of features.

Therefore, in order to solve the shortcomings of the lack of accurate characterization of the nonlinear relationship by the logistic regression, we can use XGBoost to characterize the features and fuse the two models. The leaf nodes produced by XGBoost are feature combinations that describe the original features. By adding nonlinear expressions, the expression ability of the logistic regression model is enhanced, making the model more effective. To the best of our knowledge, there was no study on credit risk assessment by using this model fusion strategy, this paper fills in such a literature gap by fusing LR and XGBoost. In the personal credit assessment, this method makes full use of the advantages of LR and XGBoost, and can solve the inadequacies of a single algorithm, providing a new research idea.

MODEL STRATEGY AND DESIGN

From GBDT To XGBoost

GBDT(Gradient Boosting Decision Tree) was first proposed by Friedman(2002). It uses a serial approach to learn the weak classifier CART regression tree to reduce the bias and improve the accuracy of the prediction.

There is a training sample set:

$$D = \{(x_1, y_1), (x_2, y_2) \dots (x_j, y_j) \dots (x_m, y_m)\}$$

Here m is the number of training samples, x and y represent input samples and sample markers, respectively, and D is a set of training data and corresponding sample markers.

Gradient boosting is an additive model. The final result is the addition of the results of multiple decision tree trees. The additive model can be expressed as:

$$f_n(x) = \sum_{i=1}^n T(x_i; \theta_i) = \sum_{i=1}^n \beta_i h(x; \alpha_i) = f_{n-1}(x) + \beta_n h(x; \alpha_n) \quad (1)$$

Here $T(x_i; \theta_i)$ represents the i th decision tree and θ_i is the parameter of the i th decision tree. Each decision tree $T(x_i; \theta_i)$ can be represented by $\beta_i h(x; \alpha_i)$, where β_i refers to the coefficient of each decision tree and α_i refers to the parameters of the model.

The loss function can be expressed as:

$$L(y, f_n(x)) = L(y, f_{n-1}(x)) + \beta_n \sum_{k=1}^q j_k I(x \in R_k) \quad (2)$$

Here R_k denotes the k th leaf node and j_k denotes the value of the R_k leaf node. When x belongs to the value of the leaf node where R_k is located, the predictive value of this CART regression tree $h(x; \alpha_i)$ for x is j_k .

The idea of GBDT optimization parameters is Gradient, but it uses the idea of gradient descent method in the function space. Each iteration is to fit the residual, and use the loss function in the negative gradient value of the current model to fit a weak CART regression tree.

GBDT needs to be iterated many times to make the model have better accuracy. Chen Tianqi and Guestrin C(2016) have optimized this and proposed the XGBoost model. This model can be accelerated by using CPU multi-threaded parallel processing, and it performs great generalization ability and robustness.

Because the CART regression tree is easier to overfit, XGBoost adds a regularization term to the loss function:

$$\Omega(f(x)) = \gamma T + \frac{1}{2} \lambda ||w||_2^2 \quad (3)$$

Here T represents the number of leaf nodes, and $||w||_2^2$ represents the L2 regularization of leaf nodes. It can control the complexity of the model by controlling the value and number of leaf nodes. Optimizing γ is equivalent to pruning the tree.

In the feature of splitting selection, each time the attribute is scored using the following information gain formula, then the attribute value with the largest Gain is selected to split the existing leaf nodes.

$$Gain = \frac{1}{2} \left[\frac{G_L^2}{H_L + \lambda} + \frac{G_R^2}{H_R + \lambda} - \frac{(G_L + G_R)^2}{H_L + H_R + \lambda} \right] - \gamma \quad (4)$$

Here G_L, G_R are the first derivatives of the left and right subtrees respectively, and H_L and H_R are the second derivatives of the left and right subtrees, respectively. λ and γ are the coefficients of the L2 regularization of the corresponding value of the leaf node and the number of leaf nodes in the regularization term.

In addition, XGBoost uses a second-order Taylor expansion for the loss function. In the optimization process, not only the first-order derivative but also the second-order derivative is considered.

Model Design

Because of its good robustness and interpretability, logistic regression is very suitable for credit assessment. However, it is difficult to capture non-linear information, and careful engineering of feature engineering is required to ensure the accuracy of the prediction. In order to be able to use XGBoost for feature combination features, two models are merged: XGBoost and Logistic regression. Using data to train a XGBoost model, the samples in the training data are input to the XGBoost model to get the sample's leaf nodes, and the leaf nodes are used as features to train an LR model. The figure 1 is framework of based on XGBoost-LR ensemble model for personal credit risk assessment.

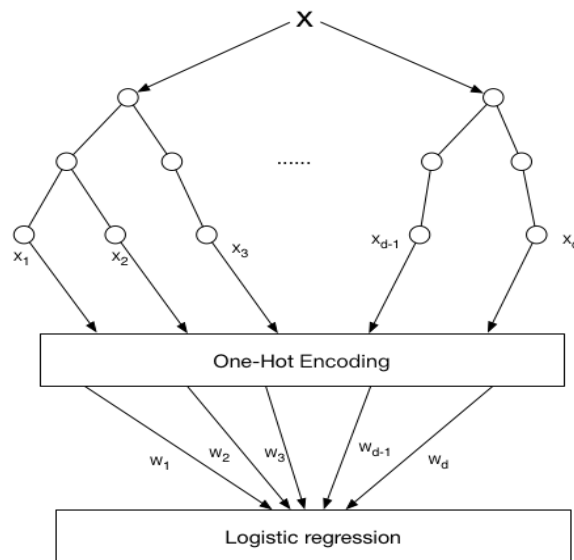


Figure 1: Framework of based on XGBoost-LR ensemble model for personal credit risk assessment.

The specific steps are briefly described as follows:

Step1: Divide the Data Set

Randomly divide the initial sample data into disjoint two parts: the training set and the test set. 80% of the samples were used as training subsets, and 20% of the samples were used as test subsets.

Step2: Data Preprocessing

the attributes in the system have different magnitude, using the data directly affects the results. Subsequently we need to compare the generalization ability of different models, and SVM is a distance-based algorithm, susceptible to the gap between the magnitude of the data. Therefore, the data needs to be normalized. This paper has adopted the maximum and minimum normalization method for the original data.

Step3: Build the XGBoost Model

For each sample, input to the CART regression tree, the value of the falling leaf node as the default probability, and then use the loss function in the negative gradient value of the current model as the residual to fit the next regression tree until finishing training.

Step4: Build XGBoost-LR model

After the sample is input into the XGBoost model, the value of the falling leaf node is coded as 1, the value of the non-falling leaf node is coded as 0, and the output of each leaf node is combined into a feature vector. The resulting vectors are used as the variables of Logistic regression to train the final hybrid model.

EXPERIMENTS

Data Preprocessing

As the current domestic personal credit data is difficult to obtain and confidentiality is strong, most studies mainly focus on the assessment of corporate credit risk, while less research on individual credit risk. This paper uses UCI public the German credit data set (1994) for model validation. The sample size in the data set is 1000, and the ratio of "good credit" customers to "bad credit" customers is 7/3.

There are 20 variables in the original data set, including 7 numerical variables and 13 qualitative variables. Ordered qualitative variables can be directly divided into numbers. Unordered qualitative variables need to be transformed into dummy variables using one-hot encoding. In the end, there are 24 variables, 1 dependent variable, and dependent variable = 1 means "good credit", dependent variable = -1 means "bad credit".

Model Training

Fraud risk detection is a binary problem, so in the XGBoost model, the negative binomial log likelihood is used as a loss function:

$$L(y, f(x)) = \ln(1 + \exp(-yf(x))), \quad y \in \{-1, 1\} \quad (5)$$

As mentioned before, XGBoost belongs to a classifier with a large number of hyper-parameters. The value of the parameter is crucial. Therefore, it is necessary to carefully select the parameter value. However, so far, there are only some heuristic methods,

there is no theoretical method to guide the choice of parameters. In this paper, the grid search method is used to select the parameters. The range of values for the hyper-parameters is shown in Table 1.

Table 1. Range of XGBoost Parameters in Grid Search

Parameter	Grid Search
Number of estimators	(20, 100, 10)
Learning rate	(0.01, 0.2, 0.01)
max_depth	(3, 10, 2)
min_child_weight	(1, 6, 2)
Column subsample ratio	(0.5, 1, 0.1)
Subsample ratio	(0.5, 1, 0.1)
Gamma	(0, 0.1, 0, 01)
lambda	(0.1, 0.8, 0.1)

Grid search uses 10-fold cross validation to perform parameter optimization. The training data is randomly divided into 10 disjoint subsets. Each subset is used as a validation set, and the remaining 9 subsets are used as training sets. After parameter optimization, the structure of the model was determined to be 40 CART regression trees. The learning rate of each tree was 0.01, the max_depth of the tree was 7, the Column subsample ratio was 0.6, and the Subsample ratio was 0.7. In order to prevent XGBoost's powerful fitting ability from overfitting, the L2 regularization penalty term was added. The lambda parameter optimization result was 0.3.

In terms of criteria, the type 1 error rate, type 2 error rate, and AUC on the test set are used as performance evaluation criteria for the model. The type 1 error rate indicates that there is a personal credit risk misjudged as no credit risk, and the type 2 error rate indicates that no credit risk is predicted to have a personal credit risk. In the area of credit risk assessment, there will be higher costs for misidentifying individual credit risk as having no credit risk, so the Type 1 error rate needs to be focused.

Model Results

In order to verify the validity of the proposed XGBoost-LR model, the paper compares the results of the five models: logistic regression classifiers, random forests, XGBoost, SVM, and naive Bayes algorithm using the original features. And compared with the model proposed by Cai Wenxu, Luo Yonghao and Zhang Guanxiang (2017) (marked as GLR), both using the same data training set and test set for training. All compared single models apply the default values of the model in the scikit-learn package.

Table 2. Performance comparisons for different classification and ensemble models.

Model	type 1 error rate (%)	type 2 error rate (%)	AUC(%)
SVM	7.75	81.03	74.53
Naive Bayes	25.35	37.93	71.6
Random Forest	13.38	68.97	71.98
XGBoost	8.45	65.52	77.34
LR	7.75	81.03	73.81
GLR	3.57	70.00	82.68
XGBoost-LR	3.57	65.00	83.21

From Table 2, it can be seen that in the five single models using the original features, the AUC value of XGBoost is the highest, which is 77.34%. Although Naive Bayes' error rate of Type 2 is lower than XGBoost, its Type 1 error rate is higher than XGBoost. However, the cost of type 1 error rate is much higher than that of type 2 error rate. In practice, it is necessary to control type 1 error rate. Therefore, overall, XGBoost outperform naive Bayes. The performance of SVM and LR is not much different from that of XGBoost, indicating that Logistic regression model is a competitive classification model.

For type 1 error rate and AUC, the two mixed models GLR and XGBoost-LR perform best, indicating that the combination of features can effectively improve the generalization ability of LR and fit the true distribution in the higher dimensional space, making the prediction more accurate. However, the GLR's AUC value is lower than that of XGBoost-LR, which also confirms that Shi Qingyan (2005) stated that the results obtained from the previous model have a high correlation with the dependent variables, combined with the remaining feature variables, and applied together to Logistic regression model is prone to multicollinearity problems.

Therefore, the leaf nodes obtained by XGBoost as variables of Logistic regression after one-hot encoding has the validity and feasibility.

Paired T-Test

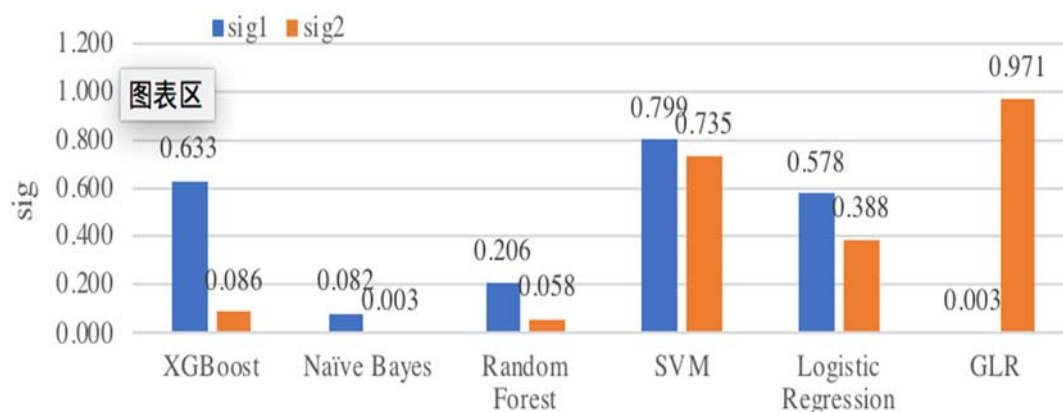


Figure 2: Sigs of paired-t-test of xgboost with other models with $\alpha=0.05$

In order to make the experimental results more reliable, the paired-t-tests were conducted respectively between XGBOOST-LR hybrid model and others models on the experimental results. The results are shown in Figure 2. Among them, sig1 represents the correlation of two sets of experimental data. And most sig1 values are greater than 0.05, indicating that there is no significant correlation between the two models. While the sig1 of GLR is less than 0.05, which is also consistent with the similarity of the two models. The sig2 value we are more concerned with is the key t-test result. If it is less than 0.05, there is a significant difference between the two groups. As can be seen from the above figure, the sig2 value of Bayes model is less than 0.05, indicating that there is a large difference between XGBOOST-LR hybrid model and Bayes. While the differences between GLR, SVM, LR and XGBOOST-LR are not significant. Considering that the mean error rate of XGBOOST-LR is the smallest one in the experiment, the test results also show that the XGBOOST-LR hybrid model is better than other models.

Interpretability

Interpretability is a very important part of fraud risk detection. Considering interpretability, the entry rules can be made, such as: address blacklist, phone blacklist, the number of loans is greater than a certain number to reject the applicant. So before calling the model, you can reject the application that is likely to be a fraudster, which reduce the cost of calling the model. Second, for banking financial institutions, they need to know which variables are more important in credit risk assessment and can be given more attention. The interpretability of XGBoost model mainly depends on two aspects: feature importance score and decision rules (Xia Yufei *et al.*, 2017).

After training in the XGBoost model, the importance of features is shown in Fig. 3. The larger the F value, the more important the features. The values of F3 (Purpose), F9 (Other debtors / guarantors), and F1 (Duration in month) are relatively large, which is consistent with intuition. The longer the loan period, the higher the likelihood of default. Therefore, in the credit risk detection, more attention needs to be paid to these three variables.

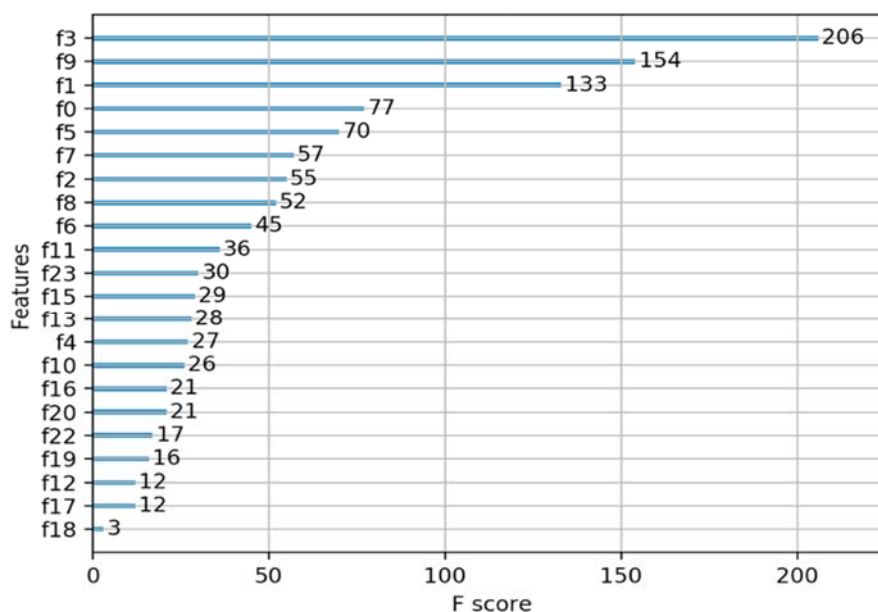


Figure 3: Feature importance scores.

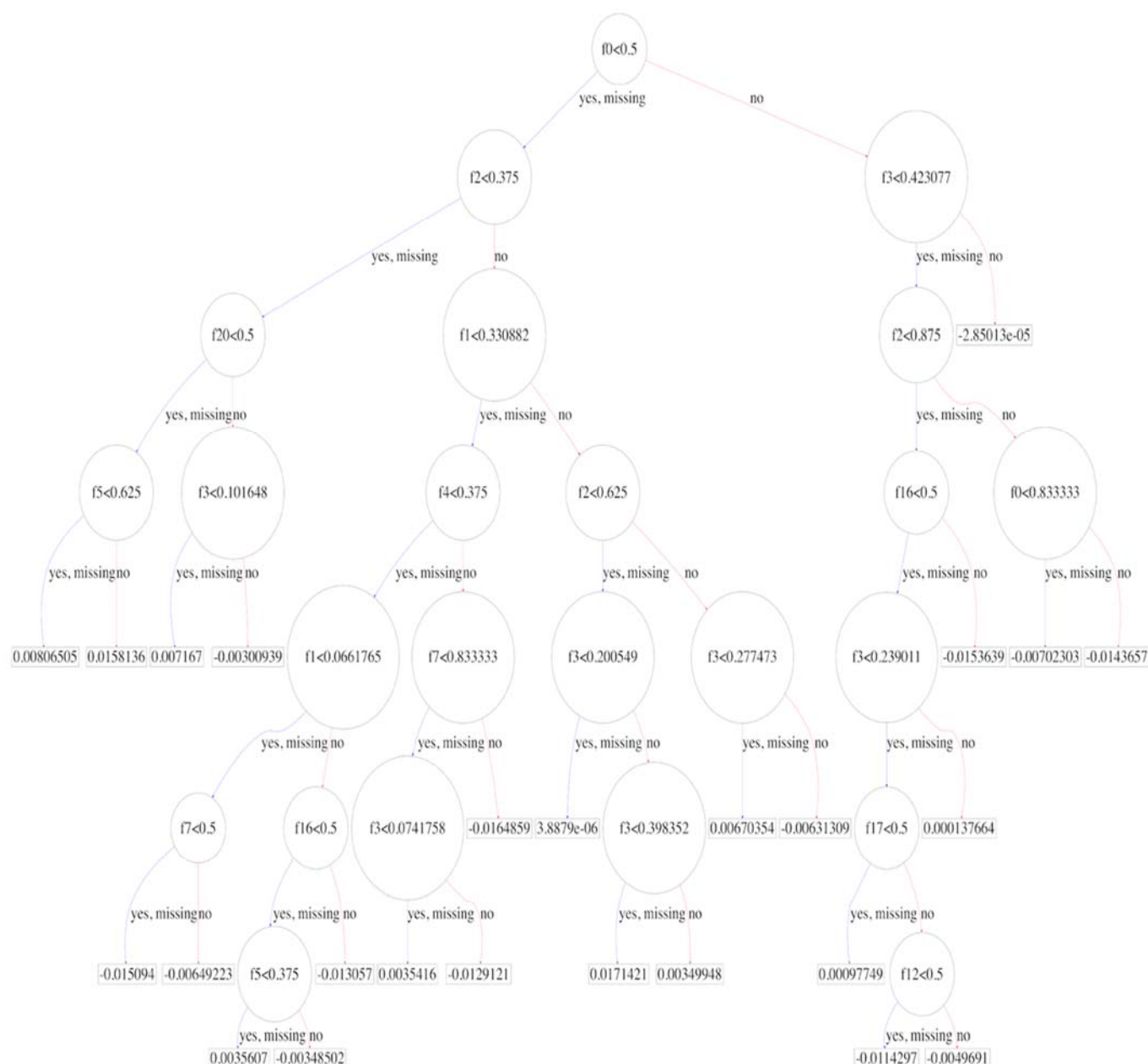


Figure 4: No.40 CART tree of XGBoost-based credit scoring model

The final XGBoost model was obtained by adding 40 CART regression trees. The 40th CART regression tree is shown in Fig. 4. Decision diagrams provide managers with clear and comprehensive decision rules. Applicants are divided into corresponding leaf nodes through a series of decision rules to decide whether applicants is the fraudster. This is a useful tool in the case of real credit scores.

CONCLUSION

With the expansion of the scale of the credit industry, personal fraud risk detection has become increasingly important. A model with a high accuracy rate can bring back significant losses to banks and financial institutions. XGBoost can be used to mine effective features and feature combinations. XGBoost is different from the random forest which is parallel combination strategy. It adopts a serial method and uses the loss function in the value of the current model's negative gradient approximation to fit the regression tree. The result verifies that XGBoost has better generalization performance than the random forest. The LR model is characterized by its simple operation, good robustness, and strong interpretability. However, its accuracy depends on the variables of the input. Then the feature engineering often depends on manual operations before. This requires experience and is not easy to have good results.

This paper uses the advantages and characteristics of the XGBoost and LR models for model fusion. Each leaf node of XGBoost is a combination of some features. By using all leaf nodes as features of the LR model, effective features and feature combinations are mined. The results also show that this hybrid model can improve the performance of a single model and have better generalization capabilities.

The future direction of work will focus on considering how to deal effectively with sample imbalances in this hybrid model., and using domestic credit data to better construct an XGBoost-LR hybrid model suitable for real credit business in China.

ACKNOWLEDGMENT

This work is supported partially by NSFC under the Agreement No. 61073020 and the Project of CUFE under the Agreement No. 020674115002, 020676114004, 020676115005.

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Getting Older Ones' Feet Wet: Older Adults' Adoption Intention of Gerontechnology of Mobile Bathtubs

(Full Paper)

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ABSTRACT

Global aging has led to increasing concern for the health and well-being of older adults. Family members generally care for older adults' needs, yet current trends suggest more independent lifestyles for older adults. Therefore, a better understanding of older adults' adoption intention of new gerontechnology is needed. This study adopts a two-stage approach (focus group discussions and survey research) to examine the factors of older adults' adoption intention of gerontechnology namely, mobile bathtubs. The findings show that perceived ease of use and perceived usefulness, along with specific design features of mobile bathtub were determinants of adoption intention among older adults.

Keywords: Mobile bathtubs, technology acceptance model, gerontechnology, older adults.

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INTRODUCTION

Demographic shifts in population aging have become a major cause for concern, caused by factors such as the rise in life expectancy rates at birth. This has resulted in an increased proportion of older adults aged 60 years or over to higher levels. The global population aged 60 years or over was reported at 962 million in 2017, more than doubling the figure reported in 1980 at only 382 million (United Nations Department of Economic and Social Affairs (UN DESA) Population Division, 2017, p.1). Interestingly, two thirds of the world's older persons are living in developing regions, e.g., such as Thailand and Malaysia, where their numbers are outpacing those in developed regions (UN DESA Population Division, 2017, p.1). Such a drastic demographic shift holds far-reaching implications for not just older adults themselves, but also for the remainder of the world's population, due to increases in the duty of caring for the older population. Therefore, new avenues are needed to successfully address the issues that come about with rising numbers of older adults worldwide.

One of the strategic approaches to this issue is through Gerontechnology, an emerging multidisciplinary field of research that aims to improve the daily functioning of older adults (Bouma & Graafmans, 1992, p.1-5). Gerontechnology enables the sustainability of an aging society by means of technology that helps older adults to enjoy a better quality of life (Van Bronswijk, Bouma, & Fozard, 2002), through combining both elements of gerontology and technology (Fozard *et al.*, 2000). Gerontechnology also highlights the potential behind the use of technology to bring about benefits to both aging and aged people (Chen & Chan, 2011; Fozard, 2005). This positions gerontechnology as a vital field of study in supporting older adults to move forward. Recent studies (Joseph *et al.*, 2016; Teh *et al.*, 2016) have explored the way older adults adopt new assistive technologies that aim to improve their daily quality of life. Therefore, this study examines one type of assistive technology: mobile bathtubs. This study focuses on the act of bathing, with the primary aim of helping older adults overcome physical limitations to independently and confidently bathe.

A two-stage approach (i.e., focus group discussion and survey research) was used to assess the perceptions and acceptance of older adults on mobile bathtubs. First, focus group discussions were undertaken to draw out the key insights on bathing, the use of bathtubs and the design of Plaxibath and Rotobath. Plaxibath and Rotobath developed by iMagic-BOX were specifically used as examples of mobile bathtubs due to their relative contemporary design, whose features were targeted towards older adults. Second, this study drew upon the Technology Acceptance Model (TAM) to examine the older adults' perceived ease of use and perceived usefulness, along with their attitudes towards specific design features of the Plaxibath & Rotobath.

LITERATURE REVIEW

A. The Loss of Independence in Late Life

A common issue as part of aging for the average older adult is related to mobility (Webber, Porter, & Menec, 2010). While much of the problems brought about by a decrease in mobility only rarely impede the quality of life of the average older adult, the question of healthcare and independent living comes to light. There exists a rising trend of older adults wanting to live independently, and this brings about various socio-cultural implications (UN DESA Population Division, 2017, p.1), such as the

likely decline in demand for nursing/old folks' homes in the coming future. Additionally, in the United States of America, the Association of American Medical Colleges (2017) declared shortages of the supply and demand of physicians to provide medical care for all the facilities across the nation, with nurses in the country facing similar issues (American Association of Colleges of Nursing, 2017). As for developing regions, most nations are ill-prepared for the incoming reality of this demographic shift, leading to makeshift, short-term solutions. Malaysia for instance, is plagued with some nursing/retirement homes operating without proper infrastructure (Abdullah & Lee, 2011).

Faced with limited options, it is often the case that for these older adults that as time progresses, it becomes increasingly likely that they will finally be unable to fully care for themselves. Many will either be unable to afford or simply prefer not to opt for homecare services, so the duty of care usually falls to the rest of the family. Unfortunately, as family members have their own lives to lead and commitments to their own nuclear families, providing care for the family's older adult(s) is understandably, either not possible or simply ineffective in most circumstances. As a direct result, family members can rarely devote themselves fully to caring for their old, thus in most situations family support can never truly be full-time support if the situation warrants.

B. The Issue of Bathing in Late Life

Faced with this situation, many older adults must negotiate basic, everyday activities independently despite their ever-increasing physical limitation. Focusing on long-term care, bathing quickly turns into one of the commonplace activities that becomes increasingly unfeasible to carry out independently. The Centers for Disease Control and Prevention (2011) identified that in the United States of America in 2008, approximately 21.8 million persons aged 15 years or above were involved in non-fatal, unintentional injuries, incurring approximately \$67.3 billion in lifetime medical costs with injury rates increasing with age, and coincidentally, most injuries in the washroom (81.1%) were caused by falls. Alternatively, Bagga *et al.* (2013) posits that in the United States of America from 2002 to 2010, amongst product related adult genitourinary injuries treated at emergency departments, injuries sustained in the bathroom were quite common. Altogether, bathroom fixtures and bathing products together accounted for 10.4% of such injuries, most often in the form of falls.

While these reports do not focus purely on accidents occurring during bathing, and do not make mention of whether these accidents occurred with or without assistance of a caretaker, there is sufficient cause for precaution- a combination of wet surfaces and movement difficulties usually results in unfortunate accidents. Hence, there is a great need for better understanding how older adults would perceive gerontechnologies that may assist them in this area. This paper focuses on one such innovation, mobile bathtubs, a rather novel solution—one that is relatively unexplored academically—that could potentially aid older adults in the act of bathing.

C. TAM and Hypothesis Development

TAM is regarded as an established model in understanding technology adoption behavior (Lim, 2018). TAM purports that adoption behavior is decided by the intention to use a particular system, which is consequently determined by perceived usefulness and perceived ease of use of the system (Lim, 2018). As such, TAM serves as an appropriate framework for understanding the effects of external variables on system adoption (Hong *et al.*, 2001), this paper seeks to empirically determine that such variables as perceived ease of use and perceived usefulness have significant positive effects on older adults' adoption behaviour of mobile bathtubs.

Davis (1989, p.320) described perceived ease of use as “the degree to which a person believes that using a particular system would be free of efforts,” whereas perceived usefulness is “the degree to which a person believes that using a particular system would enhance his or her job performance.” While Turner *et al.* (2010, p.471) reminds that “the TAM is not the end point of technology introduction,” for the purposes of this study, the focus is more on adoption intention, which allows greater understanding of what features a mobile bathtub would need to possess to appear attractive to Malaysian older adults as buyers/users. As previously mentioned, mobile bathtubs can be viewed as gerontechnologies that focus on improving older adults' experience of bathing, by emphasizing user safety and value-added features not found in regular bathtubs. Thus, in this study, perceived ease of use is an individual older adult's evaluation of how straightforward and simple a mobile bathtub like the Plaxibath and Rotobath are to use, whereas perceived usefulness is their evaluation of the utility provided by them. In essence, if a mobile bathtub is difficult or complicated to use, as well as not providing sufficient utility, its use would be avoided. Past studies (Segars & Grover, 1993; Gefen, Karahanna, & Straub, 2003; Hung, Lai, & Chang, 2011) provide supporting evidence of the significant positive effect of perceived ease of use on behavioral intention. Hence, there exists a strong likelihood that this positive effect extends to adoption intention as well. With TAM as a basis, we hypothesize that perceived ease of use and perceived usefulness of Plaxibath and Rotobath respectively will have a positive effect on adoption intention to use them. Therefore, we propose the following hypotheses:

H1: Perceived ease of use will have a positive effect on adoption intention of Plaxibath.

H2: Perceived usefulness will have a positive effect on adoption intention of Plaxibath.

H3: Perceived ease of use will have a positive effect on adoption intention of Rotobath.

H4: Perceived usefulness will have a positive effect on adoption intention of Rotobath.

In addition, an interesting phenomenon with regards to drivers of intentions and innovation adoption behavior is that consumers tend to display higher levels of adoption intention for innovations that are more complex, even though consumers generally adopt innovations with less complexity (Arts, Frambach, & Bijmolt, 2011). That considered, as this study merely focuses on the intention stage of technology acceptance and adoption, we hypothesize that certain specifically innovative design features of the Plaxibath and Rotobath would prompt a positive effect on adoption intention of them. For the Plaxibath, a drawbridge that lowers to form a ramp into the bathtub, which then closes to seal the entrance keeping it watertight. It also utilizes a safety harness to restrain the user for their own safety, preventing falls altogether during the actual bath/shower. As for the Rotobath, the bathtub would rotate on its vertical axis, allowing the user to walk into the bathtub, then it would lower itself to a lying position, and the user with it. The Rotobath also comes with the same safety restraints as the Plaxibath. Hence, we propose the following hypotheses:

H5: Attitude towards Drawbridge Design feature of Plaxibath will have a positive effect on adoption intention of Plaxibath.

H6: Attitude towards Safety Restraint Device feature of Plaxibath will have a positive effect on adoption intention of Plaxibath.

H7: Attitude towards Rotation Design feature of Rotobath will have a positive effect on adoption intention of Rotobath.

H8: Attitude towards Safety Restraint Device feature of Rotobath will have a positive effect on adoption intention of Rotobath.

METHODOLOGY

A. Focus Group Discussion, Survey Instruments and Study Design

The first stage of the study involved focus group discussions with 12 older adults (i.e. people older than 55 years of age) living in Malaysia. Informed consent was obtained from all 12 participants. The discussions were audio-recorded. As per Monash University Malaysia ethics guidelines, respondents can choose to withdraw from the focus group discussions at any time they wish should they feel uncomfortable in continuing with the focus group discussions. All focus group discussions were closely monitored by the lead researcher to ensure quality and consistency.

During the second stage of the study, a survey research was undertaken using a set of questionnaires which includes two sections: (1) Plaxibath; and (2) Rotobath. Thirty-seven older adults completed the Plaxibath questionnaire, and 36 of the same older adults completed the Rotobath questionnaire. All 37 participants are 55 years old or above living in Malaysia. The survey questionnaires included questions on demographic characteristics, attitudes towards the Plaxibath's and Rotobath's respective perceived ease of use, perceived usefulness, and specific design features. For this study, five constructs were measured and analyzed: (1) Perceived ease of use; (2) Perceived usefulness; (3) Attitude towards Safety Restraint Device feature; (4) Attitude towards specific design feature of each mobile bathtub, i.e., Plaxibath's Drawbridge Design & Rotobath's Rotation Design features respectively; and (5) Adoption Intention. There was a total of 19 items for the Plaxibath questionnaire and 21 items for the Rotobath questionnaire. Among these items, some items were adapted from an instrument developed in previous studies (Joseph *et al.*, 2016; Teh *et al.*, 2016) and some new items were introduced to measure the design features (e.g., "I like the idea of using the Rotobath"). The items were measured on a seven-point Likert scale (i.e. "1" = "strongly disagree" and "7" = "strongly agree").

DATA ANALYSIS AND RESULTS

A. Data Analysis of Focus Group Discussions

The audio taped data of focus group discussions were transcribed verbatim and analyzed using content analysis. First, all transcriptions were read carefully. Data were clustered together similar topics (e.g., bathing, Plaxibath mobile bathtub and Rotobath mobile bathtub). Several codes were developed for each topic.

B. Content Analysis

Bathing

1. *Importance of bathing* – All the 12 participants found bathing an important daily activity or a survival activity especially in the Malaysian tropical weather. Bathing to these participants was to clean themselves, a matter of hygiene, feel refreshed and comfortable.

2. *Method of bathing* – Bathing methods and habits differ with climate, geographical location (village or cities), and lifestyle. The pail and dipper ('gayung'), a traditional method of bathing apart from bathing at the waterfalls is still common in Malaysia. It was common to find concrete troughs of clean water (which eventually replaced the pail) from which clean water is scooped with a plastic dipper in bathrooms. Later due to western influence, long bathtubs and showers were introduced in Malaysia.

3. *Pail and dipper* – Among the participants, 17 percent mentioned that they still use the pail and dipper or bathe at the waterfalls when they returned to their hometowns/villages in a more rural setting compared to Klang Valley.

4. *Shower* – All participants currently used the shower as a method of bathing.

5. *Use of bathtubs* – All the respondents were not keen on using bathtubs as they were not culturally used to soaking in a bathtub. It is more of a western influence. The use of the bathtub was introduced during the British period as indicated by a 62-year-old male participant. For participants who have a shower unit and the bathtub, it is common to use the shower instead of the bathtub. Participants who have remodeled their bathrooms have removed the bathtubs. They considered it a waste of time and resources like water. A 71-year-old participant mentioned that his family member with bathing disabilities was reluctant to use the bathtub.

6. *Post bath cleaning of bathtubs* – After a bath, cleaning the bathtub was an additional task. This was indicated by 25 percent of the participants. If this was not done, there would be soap scum and grime left in the tub.

7. *Fear of falling (change in functional ability)* – All the participants expressed a need to feel safe when bathing. Extrinsic fall risks like a slippery floor after using soap or the lack of a grab bar was a concern for a few of the participants. Another participant mentioned that intrinsic factors like body imbalance has been an issue.

8. *Anticipation of bathing disability* – In anticipation of future bathing disability our participants have made changes or remodeled their bathrooms for themselves or their loved ones as they are caregivers. To them this is a phenomenon that is inevitable as they age. Water temperature adjustments when using a pail and dipper was an area of concern. Slip resistant mats were used by 17 percent of the participants. However, 33 percent of the participants found it difficult to clean the mould and grime off these mats and discontinued using them or did not use them at all. Other than mats, another participant was in favor of anti-slip tiles. A 71-year-old male focus group member raised the issue of the curved areas inside the tub which may be slippery and of danger to older adults. 17 percent of the participants had remodeled their bathrooms, removed the bathtub and installed a walk-in shower.

Plaxibath Mobile Bathtub

1. *Useful in nursing homes* – This mobile bath is useful in nursing homes for those who have mobility issues and are unable to walk due to a stroke as indicated by 50 percent of the respondents. A male, 65-year-old respondent mentioned that residents with restricted mobility are given a sponge bath in the old folks' homes. To these individuals, the Plaxibath would encourage or instill the willingness to shower.

2. *Useful for people with restricted movements* – Fifty-eight percent of the participants indicated that the Plaxibath will be useful for those with restricted movements. Two male participants aged 65 and 73 respectively, indicated that it would be useful for their loved ones due to their physical condition. They can have a proper bath using this mobile bathtub. Another concurred that it would also be useful for those who are paralyzed. In fact, it would be convenient for those who are immobile. A 65-year-old male respondent posited that it is not about independence but an assistive device that would allow the individual to have a bath that would make the person comfortable. The participants believed that this device would ease the burden of the caregiver. Twenty-five percent of the participants mentioned that the Plaxibath can be used as an alternative to carry their loved one to the bathroom for a shower. Some participants felt that this mobile bath may not indicate independence at their stage in life but for their loved ones under their care. In fact, two of the participants mentioned that this assistive technology will reduce anxiety.

3. *Cost* – 67 percent of the focus group respondents were concerned about the cost of the Plaxibath and Rotobath. They estimated the cost of the mobile baths to be between RM5,000 to RM10,000 for the Plaxibath and approximately RM10,000 for the Rotobath. One of the focus group members, a 65-year-old male would opt for a simpler substitute of bathing his loved one, if it is above RM5,000. A 71-year-old male participant supported this suggestion. Another respondent, a 75-year-old male pointed out that using a shower would be less expensive. In this case, cost will be an economic factor affecting technology acceptance and adoption.

4. *Design considerations (Spacious constraint)* – A 65-year-old -male participant asserted that the reality of modern living environment is space constraint. About 75 percent of the participants were concerned about the space in the mobile baths to maneuver the wheelchair. Wheelchairs come in different sizes. The participants were wondering as to whether the Plaxibath was spacious enough for wheelchairs. A 73-year-old respondent who is also a caregiver was concerned as to how this mobile bath would be useful for his mother with very restricted movements and who requires the assistance of two caregivers. Due to spacious constraint, a 66-year-old female participant indicated that when an older adult is being wheeled into the mobile bath, the older adult will be facing the wall & gadgets in the Plaxibath. There is no room to turn the wheelchair around. A 71-year-old participant, who is also a caregiver, indicated that he did not see the need of a wheelchair for the Plaxibath. If he could wheel himself into the Plaxibath, then he could wheel himself into his bathroom at home with the existing shower facility. In short, there is no need for the Plaxibath.

5. *Design considerations (Communication device)* – A 66-year-old respondent indicated that the communication device is helpful in the event of an emergency. However, another respondent (73-year-old caregiver) disagreed with him as in his mother's case, with two caregivers assisting her and this would be unnecessary. In place of the communication device, he would prefer a RM1000 reduction in the cost of the mobile bathtub. On the other hand, another respondent feared for the safety (being electrocuted) of the older adult using the communication device while bathing in the mobile bath.

6. *Design considerations (Hot air feature)* – The ‘hot air’ feature is deemed unnecessary in our tropical weather. The danger of the hot water pipes being overheated is a cause for concern for a 71-year-old male respondent.
7. *Design considerations (Safety)* – The overall safety in terms of electrical malfunction of the unit was raised by 42 percent of the participants. As mentioned in the earlier sections (communication device and ‘hot air’ features), respondents feared being electrocuted while bathing. One respondent cited reports of deaths while showering.
8. *Design considerations (Feeling claustrophobic)* – A participant indicated that older adults like his father are not happy to go into enclosed or small areas.
9. *Design considerations (Water level)* – There was a concern among the participants as to whether the water level could be adjusted according to the height of the individual. A 65-year-old male participant was concerned about the water level being below the human heart level due to medical reasons.
10. *Design considerations (Recycled water)* – The cleanliness of the recycled water was an area of concern for 67 percent of the participants. The issues raised were whether the water will be clear or cloudy and whether it would be free of bacteria after recycling. One of the participants, a 65-year-old male, was curious as to whether chlorine was used to kill the bacteria in the water while another participant indicated that only a membrane was used, and the water may not be clean.
11. *Design considerations (Special wheelchairs for the mobile unit)* – Three participants were curious if a special waterproof wheelchair would be provided for this mobile unit as the existing wheelchair of the older adult may not be suitable as it may be soiled or damaged.
12. *Design considerations (Maintenance)* – Another cause for concern was the regular maintenance of the mobile bath unit. A 64-year-old male participant was concerned about length of the warranty period. The malfunction or the regular servicing of the mobile bath unit is complicated compared to using a wheeled commode as highlighted by a 71-year-old participant. This notion was supported by three other members of the focus group.
13. *Design considerations (Mobility)* – Although it is claimed that both Plaxibath and Rotobath are mobile, they are not. The baths must be fixed in a position where there is a water inlet and outlet. Furthermore, a power source would be required. Thus, a 65-year-old male respondent mentioned that these units are not literally mobile.

Rotobath Mobile Bathtub

1. *Design considerations (Grab bars)* – The position of the grab bars provided are not ergonomically fitted as indicated by two of the participants. Fitting grab rails strategically was suggested.
2. *Design considerations (Sittings)* – Two participants raised their concern of the design of the seat in the Rotobath in terms of its weight and the overall weight of the Rotobath.
3. *Design considerations (Durable in appearance)* – Some participants indicated that one of the advantages of the Rotobath is its durable (solid) outward appearance.
4. *Design considerations (Medicated water)* – One participant suggested the use of medicated water for the Rotobath.
5. *Design considerations (Convenience)* – Most of the participants posited that the Rotobath is useful for those with restricted mobility and this unit enables a caregiver to assist the older adult.
6. *Design considerations (Cleanliness)* – A 73-year-old male respondent raised an issue of the difficulty of cleaning the body (back) of an older adult while soaking in a reclining position in the Rotobath.
7. *Design considerations (Relaxing and flexible)* – The Rotobath would be more relaxing for an older adult. This was a sentiment shared by 25 percent of the participants. If an older adult was not comfortable to recline and shower, then there is a choice of being in a raised position.
8. *Design considerations (Shower)* – One of the participants, a 65-year-old male, raised the issue as to whether it was possible to shower in the Rotobath in a seated position. However, a 64-year-old male participant, added that there was no shower unit in the mobile unit.

9. *Technology acceptance* – A 62-year-old female participant indicated that this product can be introduced to older adults, but she is not sure as to whether they will accept new technology. Her view is that safety of the bathtubs would be their concern.

C. Data Analysis of Survey Research

The findings of focus group discussions provided the basis for the development of the questionnaires. A total of 37 older adults participated in the survey research. Twenty-one participants were female (56.8%) and 16 participants were male (43.2%). Ten participants were between 55 and 64 years old (27%), 14 participants were between 65 and 74 years old (37.8%), 11 participants were between 75 and 84 years old (29.7%), and two participants were more than 85 years old (5.4%).

Reliability and validity of the survey instrument were assessed using Cronbach's Alpha (CA) and Average Variance Extracted (AVE) (see Tables 1 & 2). All CA values of both Plaxibath's & Rotobath's scales were greater than 0.70, providing a strong evidence of reliability. Discriminant validity was validated as all the square roots of AVE values were greater than the off-diagonal values in the correlation matrix.

Multiple regression analysis was performed (see Figs. 1 & 2). Perceived ease of use of Plaxibath ($\beta=0.224$; $p\text{-value}<0.05$) and perceived usefulness of Plaxibath ($\beta=0.769$; $p\text{-value}<0.001$) were positively related to adoption intention of Plaxibath. Perceived usefulness of Rotobath ($\beta=0.531$; $p\text{-value}<0.01$) was also positively related to adoption intention of Rotobath. However, perceived ease of use-intention relationship for Rotobath ($\beta=0.267$; $p\text{-value}>0.05$) was non-significant. Furthermore, attitudes towards drawbridge design feature of Plaxibath ($\beta=0.336$; $p\text{-value}<0.05$) and attitudes towards safety restraint device feature of Plaxibath ($\beta=0.445$; $p\text{-value}<0.01$) were positively related to adoption intention of Plaxibath. Attitudes towards rotation design feature of Rotobath ($\beta=0.567$; $p\text{-value}<0.001$) and attitudes towards safety restraint device feature of Rotobath ($\beta=0.345$; $p\text{-value}<0.01$) were positively related to adoption intention of Rotobath.

Table 1: Reliability and Validity Analysis for Plaxibath

	PUP	PEP	DDP	SRDP	AIP
PUP	0.907				
PEP	0.234	0.846			
DDP	0.562**	0.189	0.836		
SRDP	0.522**	0.12	0.495**	0.883	
AIP	0.821**	0.404*	0.556**	0.611**	0.972
CA	0.924	0.748	0.782	0.882	0.968
CR	0.965	0.881	0.867	0.934	0.981
AVE	0.822	0.715	0.698	0.780	0.944
ME	4.932	5.405	5.505	5.101	4.342
SD	1.339	0.882	0.776	1.200	1.749

Note: PUP=Perceived Usefulness of Plaxibath; PEP=Perceived Ease of Use of Plaxibath; DDP=Attitude towards Drawbridge Design feature of Plaxibath; SRDP=Attitude towards Safety Restraint Device feature of Plaxibath; AIP=Adoption Intention of Plaxibath; CA=Cronbach's Alpha; CR=Composite Reliability; AVE=Average Variance Extracted; ME=Mean; SD=Standard Deviation; ** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed). Values in both bold and italic are square roots of the Average Variance Extracted.

Table 2: Reliability and Validity Analysis for Rotobath

	PUR	PER	RDR	SRDR	AIR
PUR	0.888				
PER	0.583**	0.939			
RDR	0.679**	0.486**	0.824		
SRDR	0.431**	0.355**	0.268	0.889	
AIR	0.687**	0.577*	0.659**	0.497**	0.943
CA	0.954	0.929	0.878	0.892	0.937
CR	0.957	0.957	0.913	0.936	0.960
AVE	0.789	0.882	0.680	0.789	0.889
ME	4.403	5.148	4.172	5.160	3.639
SD	1.481	1.172	1.245	1.293	1.612

Note: PUR=Perceived Usefulness of Rotobath; PER=Perceived Ease of Use of Rotobath; RDR=Attitude towards Rotating Design feature of Rotobath; SRDR=Attitude towards Safety Restraint Device feature of Rotobath; AIR=Adoption Intention of Rotobath; CA=Cronbach's Alpha; CR=Composite Reliability; AVE=Average Variance Extracted; ME=Mean; SD=Standard Deviation; ** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed). Values in both bold and italic are square roots of the Average Variance Extracted.

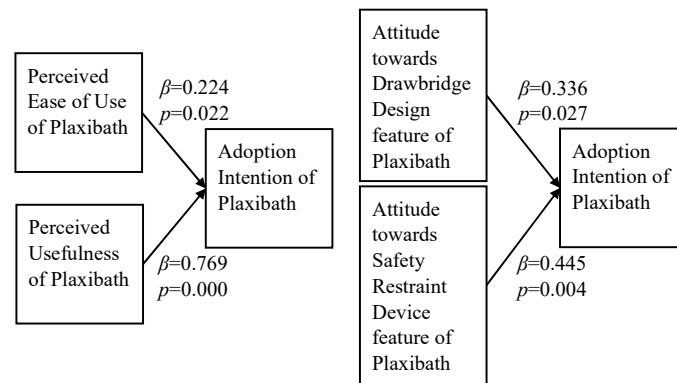


Figure 1: Results of Regression Analysis for Plaxibath (n=37)

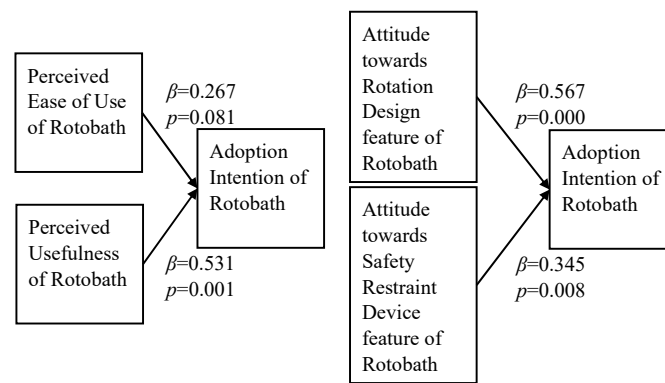


Figure 2: Results of Regression Analysis for Rotobath (n=36)

DISCUSSION

The findings of the focus group discussions highlighted many of the specifics of the PlaxiBath and Rotobath design components, often in conjunction to the Malaysian context. Regarding the Malaysian context, cultural aspects such as traditional bathing methods, climate concerns, bathing habits, economic factors, etc. were treated as important factors when considering mobile bathtubs. In addition, unsurprisingly, physical and medical safety was a recurring topic during the discussions and was given particularly special focus across the various features of the mobile bathtubs. In other words, the Malaysian context and safety were a constant priority to the Malaysian older adults engaged in the discussion. As such additional attention ought to be given to these considerations when designing mobile bathtubs (and possibly regular bathtubs as well).

The results of the quantitative analysis supported all hypotheses (H1 through H8) except H3. Specifically, the findings displayed that perceived ease of use and perceived usefulness, along with specific design features of the Plaxibath and Rotobath were clear determinants of adoption intention for them. Interestingly, a non-significant perceived ease of use-adoption intention relationship for Rotobath was found. One possible explanation is the degree to which using Rotobath is perceived as being difficult to use. Generally, ease of use more strongly inhibits behavior than intention, however ease of use's effect on intention can be a positive one, as perhaps prior to adoption, consumers underestimate the (potentially negative) role of complexity and are overconfident about the usability of the innovation (Arts, Frambach, & Bijmolt, 2011).

CONCLUSION

This paper contributes to a better understanding of older adults' adoption intention of mobile bathtubs built upon TAM, as well as practicality, for engineers/inventors by highlighting design features that older adults prioritize. Gerontechnology can serve a vital function in enhancing the quality of life of an aging population. With that in mind, from a practical standpoint, this study highlights the importance of ease of use, usefulness, and key design features in determining adoption intention of older adults for mobile bathtubs. While inventors/innovators seek to design technology-based products facilitating and enhancing wellbeing among older adults, focus on catering to potential users must also exist. This attention to both efficient design as well as understanding what attracts users to adopt new technologies is therefore vital to the adoption and widespread use of said new technology.

This study has two research limitations. First, the sample size was relatively small ($n=37$) in this study. Future research should increase the sample size in their data collection. Second, the older adults recruited in this study were Asians and the findings could differ with diverse ethnic groups. In future, this study should be replicated across groups of different ethnicities and cultural backgrounds.

ACKNOWLEDGMENT

The authors would like to acknowledge the financial support from iMagic-BOX (Project Code: BUS/MagicBox/09-2016/005) and Monash University Malaysia's School of Business, Gerontechnology Laboratory, Health and Well-Being Cluster, Global Asia in the 21st Century (GA21) Platform. They thank Teh Yi Ling, Chan Shi Yuan and Kuan Li Jean for their assistance in data collection. They also appreciate the participants' support during this study.

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How Online Customer Reviews Influence Credibility and Business Performance of Tourism Websites?

(Full Paper)

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ABSTRACT

Online customer reviews provide a rich shopping experience for potential customers and share information of products and services of tourism websites. Potential customers who have purchase intention can achieve useful information to decrease perceived risk with purchase uncertainty and help to make rational decisions. Prior research concentrates on how online customer reviews affect customer purchase intention, customer purchase behavior and website business performance, while all of the studies ignore the research perspective of website credibility. As credit is becoming a key factor to judge the operation quality of tourism websites, for filling the research gap, we firstly provide empirical evidence to explore how online customer reviews influence business performance with website credibility as an intermediary variable and additionally verify the significance of information quality as a moderator. The research findings show that the intermediary effects of credibility on online customer reviews and website business performance are significant, however, the moderate effect is not significant, which is distinguished from a large number of previous studies.

Keywords: Online customer reviews, website credibility, information quality, business performance, smart tourism.

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INTRODUCTION

In China, online comment function of websites gradually improves the effect of electronic word-of-mouth (e-WOM) on consumer purchase especially in tourism websites (ctrip, alitrip, tuniu, etc.), it leads to the influence of online customer reviews becomes important increasingly (Dellarocas, 2003; Mudambi & Schuff, 2010; Park et al., 2007; Yadav & Palou, 2014; Yin et al., 2014). Online customer review increases consumers' perception of usefulness of websites and promotes website profile (Kumar & Benbasat, 2006). As a feedback mechanism, online customer review provides an interactive channel for B2C e-commerce websites and consumers to make evaluations and influence consumer purchase decision through information transmission, it also can affect websites extensively, which makes both consumers and websites business benefit from each other (Jiang & Srinivasan, 2012; Sparks et al., 2016; Zhu et al., 2017). Compared with traditional mass media and advertising, consumers recognize e-WOM is more reliable and intuitive in reflecting quality of products and services and image of websites (Oh et al., 2016).

Duan et al (2008) found that when the number of e-WOM increased 10 percent, the hotel reservation number can increase 4.4 percent. Comparing with valance, volume of consumer reviews is more significant to movie revenues. They confirmed the positive influence of e-WOM on financial performance empirically. Nielsen Online Global Consumer Study (2009) found that consumer-generated word-of-mouth is the most credible method of advertising for about 70 percent customers. Browning et al. (2013) investigated the influence of online hotel reviews on consumers attributions of service quality and websites ability to control service delivery. They used an experimental design to examine the effects of four independent variables including framing, valence, ratings and target. The results showed that remark review related to core services have more positive influence on service quality.

Majority of previous research about online customer review tends to concentrate on the impact of e-WOM on customer sale decision and improvements of product quality, product sale and brand effect of B2C electronic commerce websites (Dimoka et al., 2012; Haubl & Trifts, 2000; Hu & Du, 2014; Rosario et al., 2016). However, little research elaborates whether online customer review affects credibility and business performance of tourism websites. To tourism websites, under the fierce competition environment with complex technology changes quickly, quality of product and service tends to homogeneity and no obvious difference in product (tickets, accommodation, catering, etc.) price, website credibility as a capability gradually plays a critical role to gain competitive advantage, "credit is equal to wealth" has become an underlying trend. Some scholars have engaged in the effect of website credit situation and online customer review on consumer purchase intention and the main influence factors about B2C websites credibility including tourism websites depending on exploring credibility (Floyd et al., 2014; Lin & Shen, 2015; Zhu & Zhang, 2010).

Thus we conclude our research question: for tourism websites, whether e-WOM has a significant impact on credibility and business performance? According to Ludwig et al (2013) and Tan et al. (2016), we have enough reasons to recognize information

quality may influence the effectiveness of e-WOM, therefore we introduce information quality as a moderator variable to examine if it provides joint impact for creditability and business performance of websites with e-WOM.

This research is organized as follows. Section 2 puts forward the theoretical hypotheses and conceptual model in this research. In Section 3, we ensure research variables and research instruments. Then, we test our conceptual model and hypotheses empirically through 158 usable sample from regions of Hangzhou, Xiamen, Beijing, Guangzhou and Xi'an in Section 4. We organize and illustrate related results in Section 5. In Section 6, we summarize theoretical implications and managerial implications. In Section 7, we come to the conclusion.

THEORETICAL BACKGROUND AND HYPOTHESES DEVELOPMENT

Online Customer Review

Online customer reviews play an important role for consumers in searching information and sharing past shopping experiences to make purchase decisions with wide coverage and fast transmission speed (Hoffman & Novak, 1996). Existing literatures involve in properties of electronic word-of-mouth mainly focus on review quantity, review quality, effect (i. e. positive or negative word-of-mouth) and visual cues such as words, pictures and other forms (Davis & Khazanchi, 2008). The higher the quality of online customer reviews are, the better the logical of contents are and the more comprehensive of products information provided, the greater the impact on consumers. Mudambi and Schuff (2010) pointed quality and extreme situation have influences to the usefulness of online customer reviews. They recognized review quality can increase confidence to consumers' purchase decisions, and high quality of online customer reviews always combine more commodity information to reduce the uncertainty of products commodity attributes to some extent and are considered to be more valuable. Amazon.com has posted over 10 million online customer reviews since 1995 to accept a lot of useful information for analyzing customer consuming preference and predicting customer purchasing behavior.

The same with the traditional word-of-mouth, online customer review also plays important roles in searching information, making purchase decisions, forming attitude or changing attitude, however, it shows a lot of persistence messages can be directly observed between strangers that traditional word-of-mouth can't achieve (Cheung & Lee, 2012). Online customer review can affect risk perceptions and product selections of consumers (Senecal & Nantel, 2004). Whatever in the contents of positive or negative, the quality of online customer review is the biggest impact on consumer purchase intention, which can overcome the limitations of information asymmetry from the existing reviews that can provide more specific and detailed information (Baek et al., 2015; Gensler et al., 2015). Usually, positive and supportive comments to business service and products can attract more consumers, neutral point of view is confirmed more useful, while compared with mixed reviews and neutral point of view, negative reviews are more persuasive to boycott the consumption, especially these comments are filled with anxiety and anger (Salehan & Kim, 2016; Yin et al., 2014; Zhang et al., 2010).

Creditability

In B2C electronic commerce, external information can trigger various psychological of consumers, rational consumers will make trust or distrust choice based on a variety of reasons for trading object such as businesses, services and products, which means whether or not customers will make an online purchase, with the passage of time and transaction process of propulsion, the steady accumulation of trust comes from consumers through the processing of quantitative results, will eventually lead to the occurrence of trading trust of individuals or websites (Chen & Tan, 2004; Gefen et al., 2003; Petersen et al., 2015). Website creditability represents a kind of credit relationship of three-way interaction composed by the buyer, the seller and tourism platform, which leads to the standard of each trading subject abides (all kinds of dominant or recessive subjects) by contracts namely in the e-commerce market, and the higher the standard is, the higher the creditability of tourism website is; on the other hand, the lower the standard is, the lower the creditability is, online merchants with high creditability are easily to win consumers trust. Website creditability is influenced by many factors, such as the creditability concept of traders including ethics, culture or moral and creditability willingness. Website creditability is different from online rating, it is a measurement of overall credit ability of the current website which is based on trust constituted multidimensional factors (Boštjan Šumak et al., 2016). In short, trust of a website is regarded as a kind of expectation, credit is the ability to accumulate expectation within a prescribed time period and creditability represents the current level of credit capability.

Montazemi and Qahri - Saremi (2015) collected 25265 cases from a meta-analysis, and build a structural equation model(SEM) to identify and examine factors that can affect consumers adoption of online banking. They find consumers trust in the online banking positively influences their intention of online banking application at the pre-adoption stage. As the precondition of credit creation, trust can affect consumers' choice to a certain extent according to the research above. B2C electronic commerce websites creditability consists of multidimensional identifications and can discriminate from traditional firms. Creditability evaluation is critical for websites' smooth and effective operation and risk control, which is often in the form of credit risk assessment (Feng et al., 2014; Liu & Cruz, 2012). Zhang, Tadikamalla and Shang (2016) propose a credit-risk evaluation composed by dynamic incentive factors, which is by way of a comprehensive method. Creditability should be determined by comprehensive qualitative

and quantitative indexes, which need to synthesize financial indicators, non-financial indicators, information guidance and future development trend (Hájek, 2011).

The Influence of Online Customer Reviews on Creditability and Business Performance of Tourism Websites

The consumers with shopping experience and product use experience reflect their true feelings independently through online reviews, especially the reviews with negative attitude can affect the potential consumers' perception of the sellers' credit (Sparks & Browning, 2011; You et al., 2015). Online word of mouth has significant influence for online rating (Moe & Trusov, 2011), online rating is the consumers' comprehensive evaluation to products' entire transaction process and the current level of business, it is a key influence factor to measure B2C e-commerce websites' transaction smooth and customer satisfaction, and it is an important part of website creditability. Therefore, we confirm that online customer review has positive impact on website creditability.

Kumar et al. (2013) confirmed online customer review had positive influence on sales and return on investment. Rishika et al. (2013) confirmed the effect of online customer review on customer shopping frequency and profitability. Most research about the influences of online customer review on business performance concluded mixed results and focus on the following main points, which are strong (including positive and negative) influence, negligible influence, uncertain influence and context-dependent influence (Chevalier & Mayzlin, 2006; Floyd et al., 2014; Gu et al., 2012; Sun, 2012). Business performance of B2C e-commerce websites is different from retail performance and financial performance, which is more macro and comprehensive to measure. Onishi and Manchanda (2012) used a system equations approach to explore the effect of activities of blogging and advertising on market outcomes in the industries of movie and cellular phone. Results show that both TV advertising and blogs have positive and synergistic effects on product sales and the volume of blogs, and are also predictive of the magnitude of them. At the same time, the research finds that the synergies between blogs and TV advertising have a stronger joint impact on business performance than the isolated effects of TV alone.

According to the related theory above, we propose the hypotheses as follows:

Ha1: Online customer reviews have a positive influence on creditability of B2C electronic commerce websites.

Ha2: Online customer reviews have a positive influence on business performance of B2C electronic commerce websites.

The Influence of Creditability on Business Performance of Tourism Websites

Creditability of B2C e-commerce websites reflects credit capability and risk control capability in a period with a lot of evidences prove its effect on tourism websites business performance from empirical research such as sales and price premiums. Tsai and Wu (2008) investigated a single classifier's performance as the base learner by using method of neural networks to compare with multiple classifiers and diversified multiple classifiers. Tsolas (2015) developed a two-stage DEA model to assess firm credit risk and further explores its influence on efficiency and effectiveness of operating performance. Website creditability is not only a measurement of a B2C e-commerce firm's current overall credit situation, also can compensate the limitations from the traditional enterprises compared with e-commerce enterprises, it can find out the current or potential weak links reference to rival for enterprises or industry benchmarking and take targeted measures, such as product, service and management field, etc., to improve business performance. According to the related theory above, we propose a hypothesis:

Hb: Creditability has a positive influence on business performance of B2C electronic commerce websites.

Information Quality

Information quality is a key factor that can influence various outcomes of online customer reviews such as knowledge sharing behavior, mobile device adoption, customer trust, customer satisfaction and even user loyalty, which has received a large number of attention recently (Durcikova & Gray, 2009; Kekre, Krishnan & Srinivasan, 1995; Kim & Han, 2011; Zhou, Li & Liu, 2010). According to a report by Nielsen (2012), 70 percent consumers indicated that they choose to trust online customer reviews about product. While there are several conditions reviews should satisfy, first, these information need to describe specifically, especially for the depiction of the details of products, such as whether consistent with the description of the merchant? The specific feeling for use of product (cost performance); secondly, some of these online customer reviews will express emotionally, such as enthusiasm comments of quite sure, negative comments of not support or comments of neutrality; third, the effectiveness of comments achieves a certain amount that will significantly influence customers purchase intension and purchase decision (Schindler & Bickart, 2012), thus dramatically affected the B2C e-commerce websites (platform) including airlines, resorts, restaurants, tourism and so on (Dellarocas, 2003; Mudambi & Schuff, 2010). Therefore, information quality is very important to measure the value of online customer reviews.

To illustrate, some B2C e-commerce websites may use platform loopholes in management rules to employ personnel to make false evaluations in order to increase online rating of product, which can make its online rating increase sharply in the short term to enhance its competitiveness; in addition, after the deal, if consumers don't evaluate the product or the service over a period of time, trading platform system will default to merchants high praise, above two situations may possibly cause online rating of B2C e-

commerce websites reflects the distortion in a certain extent; third, some professional judge can give malicious evaluations out of their own profit or helping businesses to gain higher online rating, in order to avoid three conditions above, improving authenticity and validity of online customer reviews and building a good information environment are challenges faced by e-commerce firms; four characteristics were emphasized by Wixom and Todd (2005), respectively are completeness, accuracy, format and currency.

Therefore, we introduce information quality as the moderator and propose hypotheses as follows:

Hc1: Online customer review augments information quality that the two jointly have a positive impact on creditability of B2C electronic commerce websites.

Hc2: Online customer review augments information quality that the two jointly have a positive impact on business performance of B2C electronic commerce websites.

According to the theory and hypotheses proposed above, a conceptual model of this study were developed, which is shown as Figure 1.

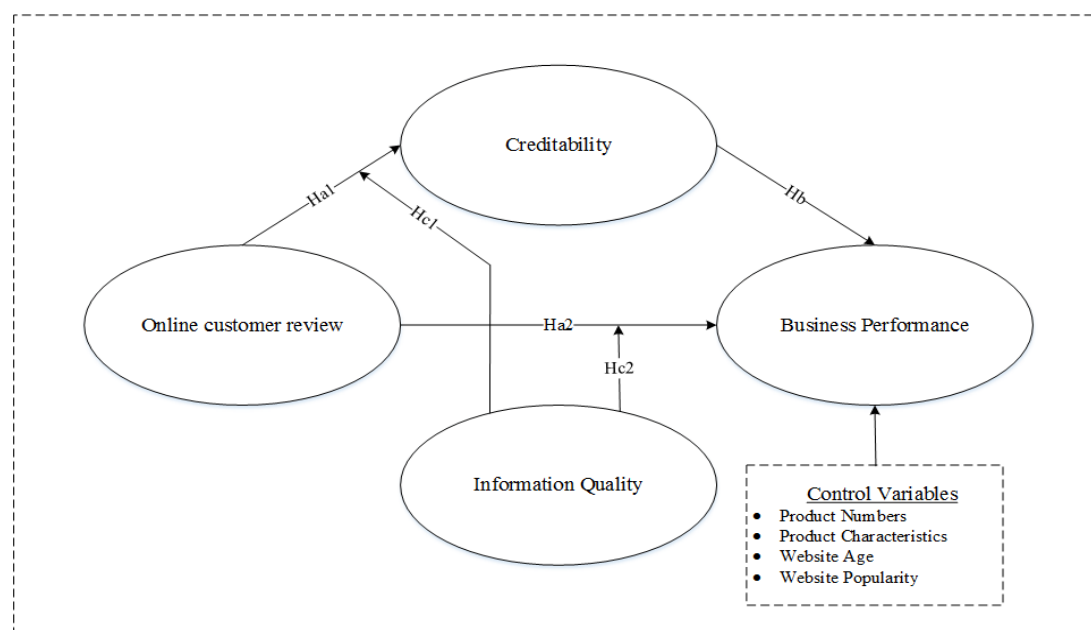


Figure 1: Conceptual model

METHODOLOGY

The scale developed in this research is composed by two parts, which are tourism website basic situation and scale subject (Hinkin, 1998). The scale subject online customer review, creditability and business performance of tourism websites. We develop the scale based on past related scales and literatures and take hierarchical multiple regression as our research instrument.

Sample and Data Collection

We selected respondents with ordering experiences in the tourism websites in the cities of Hangzhou, Xiamen, Beijing, Guangzhou and Xi'an according to tourist popularity and tourism website development status in China. We used three distribution methods: on-the-spot interview issue, online questionnaire and email. We issued 600 questionnaires from November 2017 to March 2018 and received 158 effective responses in total, the response rate is 26.3 percent. The descriptive statistics of our sample is shown as Table 1.

Table 1: Descriptive Statistics

Item	Characteristic	Frequency	%
<i>Product Characteristics</i>	travel tickets	55	34.8
	hotels	40	25.3
	tourist tickets	25	15.8
	restaurants	19	12.0
	tour guides	19	12.0
<i>Product Numbers</i>	Less than 50	10	6.3
	50~150	18	11.4

	150~300	37	23.4
	300~500	41	25.9
	more than 500	52	32.9
<i>Website Age</i>	less than 1 year	9	5.7
	1~2 years	23	14.6
	2~3 years	22	13.9
	3~5 years	21	13.3
	more than 5 years	83	52.5
<i>Website Popularity</i>	very low	7	4.4
	low	8	5.1
	ordinary	90	57.0
	high	43	27.2
	very high	10	6.3
<i>Education Background</i>	high school	11	7.0
	Bachelor's degree	58	36.7
	Master's degree	66	41.8
	Doctor's degree	7	4.4
	others	16	10.1
<i>Work Experience</i>	less than 6 months	14	8.9
	6 months ~ 1 year	29	18.4
	1year~3 years	24	15.2
	3 years~5 years	36	22.8
	more than 5 years	55	34.8
Total		158	100%

Instrument Development

For ensuring validity and reliability of the article, before developing the formal questionnaire, first we invited three experts whose research field focus on electronic commerce and five top managers who work at famous tourism websites. According to the situations of feedback we adjusted and perfect ambiguous items of the scale. Then, the revised scale was tested through effective respondents of ten local online shoppers with rich experiences on the tourism websites to assess the adequacy of scale structure and clarity of items' expression for further. At last, all the items of the scale we develop were accordance with the validity and reliability that the research required (Straub, 1989).

Operationalization of Constructs

We used multi-item reflective measures to handle all the variables in this research (on a five-point Likert scale). The latent construct that can interchange, covary and share a common theme caused the reflective indicators (Jarvis, MacKenzie & Podsakoff, 2003).

Business performance: we measure B2C electronic commerce websites business performance with four items that reflected a firm's ability to represent its effectiveness and efficiency in total, which included total [total .../Carrera2012/AppData/Local/Youdao/Dict/Application/7.0.1.0214/resultui/dict/result.html?keyword=sales](http://.../Carrera2012/AppData/Local/Youdao/Dict/Application/7.0.1.0214/resultui/dict/result.html?keyword=sales) .../Carrera2012/AppData/Local/Youdao/Dict/Application/7.0.1.0214/resultui/dict/result.html?keyword=volume, net earnings, service level and operation efficiency.

Moderator variables

Information quality was the only moderator variable in this research which represented the effectiveness of online information.

Control variables

There were four control variables as follows: (1) website age indicated years the website had been in B2C electronic commerce; (2) website popularity indicated the degree of the B2C electronic commerce websites are recognized by the public; (3) Product characteristics indicated the kinds of products websites managed belonged to; (4) Product numbers indicated the numbers of products websites owned.

MAIN RESULTS

Measurement Validation

We used SPSS 22.0 to examine reliability and validity about all the variables of online customer review, website creditability, business performance and information quality. We ensured an effective factor with several conditions put forward by Zhuang and

Lederer (2003): (1) characteristic root above 1; (2) total explained variance no less than 50%; (3) KMO above 0.5; (4) each variable's factor loading above 0.5; (5) Cronbach's alpha above 0.7; (6) Corrected item-total correlation above 0.35. Through the tests of reliability and validity, we can confirm variables of online customer review with four effective indicators, website credibility with four effective indicators, information quality with four effective indicators and business performance with four effective indicators, the related results were shown in Table 2. Then, we continued to examine the full scale until our research reached a good level of validity and reliability with KMO is 0.760 (>0.5), cumulative explained variance is 78.96% (>50%) and Cronbach's alpha is 0.750 (>0.7).

We used average variance extracted (AVE) and composite reliability (CR) to examine all latent constructs' reliability. Usually when AVE above 0.5 and CR above 0.7, we recognized a scale was reliable (Bagozzi & Yi, 1988). Our scale met both of the conditions that the measurement model own good results of reliability and validity in this research (AVE>0.5, CR>0.8). As shown in Table 3, related measurements of factor loading above 0.5.

We evaluated the discriminant validity through testing a cross-loading matrix. As shown in the cross-loading matrix (Table 4), we discovered that compared with the other constructs, all the measurement indicators loaded more strongly on the construct of themselves respectively. At the same time, the square root of AVE belonged to each construct was higher than the corresponding inter-construct correlation coefficient in the correlation matrix (Fornell & Larcker, 1981). These two criteria our model satisfied can represent a good discriminant validity.

Table 2: Factor Analysis Results (N=158)

Variable	Standard factor loading	KMO	Total explained variance	Corrected Item-Total Correlation	Alpha
<i>Online customer review</i>		0.723	74.448%		0.744
<i>ocr1</i>	0.807			0.491	
<i>ocr2</i>	0.713			0.616	
<i>ocr3</i>	0.785			0.482	
<i>ocr4</i>	0.673			0.572	
<i>Website Credibility</i>		0.776	90.582%		0.809
<i>wc1</i>	0.775			0.690	
<i>wc2</i>	0.936			0.625	
<i>wc3</i>	0.999			0.609	
<i>wc4</i>	0.913			0.585	
<i>Business performance</i>		0.739	87.701%		0.729
<i>bp1</i>	0.945			0.407	
<i>bp2</i>	0.779			0.523	
<i>bp3</i>	0.757			0.593	
<i>bp4</i>	0.998			0.564	
<i>Information quality</i>		0.787	82.850%		0.838
<i>iq1</i>	0.788			0.766	
<i>iq2</i>	0.788			0.763	
<i>iq3</i>	0.824			0.597	
<i>iq4</i>	0.915			0.562	

Table 3: Item Loadings, Cross Loadings, AVE and CR (N=158)

Variable	item	loadings			
		OCR	WC	BP	IQ
<i>OCR</i> CR=0.834 AVE=0.557	<i>ocr1</i>	0.583	0.138	0.060	0.005
	<i>ocr2</i>	0.515	0.377	0.096	-0.074
	<i>ocr3</i>	0.869	0.080	-0.073	0.061
	<i>ocr4</i>	0.524	0.474	0.014	0.097
<i>WC</i> CR=0.950 AVE=0.827	<i>wc1</i>	-0.133	0.812	0.337	0.074
	<i>wc2</i>	0.297	0.693	0.298	0.062
	<i>wc3</i>	0.332	0.750	-0.024	0.009
	<i>wc4</i>	0.064	0.766	-0.031	0.079
<i>BP</i>	<i>bp1</i>	0.215	-0.026	0.598	0.156

CR=0.927	bp2	-0.131	0.289	0.766	0.023
AVE=0.767	bp3	0.371	0.078	0.724	-0.028
	bp4	0.179	0.538	0.590	0.025
<i>IQ</i>	iq1	0.121	0.026	0.087	0.879
CR=0.899	iq2	0.073	0.037	0.110	0.875
AVE=0.690	iq3	0.022	0.084	-0.069	0.767
	iq4	-0.117	0.035	0.048	0.735
Note: OCR = online customer review; WC = website creditability; BP = business performance; IQ = information quality.					

Table 4: Discriminant Validity and the Square Root of AVE (N=158)

Construct	Min	Max	Mean	Std Dev	OCR	C	BP	IQ
<i>OCR</i>	1	5	3.79	0.695	<u>0.747</u>			
<i>WC</i>	1	5	3.38	0.925	0.516**	<u>0.909</u>		
<i>BP</i>	1	5	3.89	0.632	0.563**	0.503**	<u>0.876</u>	
<i>IQ</i>	1	5	3.94	0.846	0.105	0.132	0.122	<u>0.830</u>
Note: OCR = online customer review; WC = creditability; BP = business performance; IQ = information quality.								
* significance at the 0.05 level; ** significance at the 0.01 level; *** significance at the 0.001 level.								

Common Method Bias

To minimize common method bias (CMB), we prescribed a limit on respondents of our scale (top managers, ordinary management personnel, technician and business personnel of B2C websites), who can understand our research questions more clearly based on work experience in the part of data collection. Further for avoiding CMB, we examined the scale subject by means of Harman's one factor test with a result of in factor analysis without rotating principal component the biggest factor only explained 12.83% variance, no more than 40%, which can confirm the effective sample collected in this research was no serious CMB (Jarvis, MacKenzie & Podsakoff, 2003).

Hypotheses Tests

We applied hierarchical regression analysis compared three procedures to test hypotheses in this research. For the first procedure, we tested the impact of four control variables on the conceptual model; for the second procedure, we tested the impact of moderator variables on online customer review and two hypotheses with moderator variable; for the third procedure, we tested all the hypotheses. Two points of hierarchical regression analysis needed to be noticed: (1) each construct was measured by an average score of indicators belonged to itself; (2) we need to center four control variables for reducing the potential multicollinearity. Table 5 showed the results of the relationship among four control variables, online customer review, information quality and website creditability. Table 6 provided the main results of hierarchical regression analyses of the whole research model respectively.

Table 5: Results of the First Hierarchical Regression

Variable	Website Creditability		
	Model1	Model2	Model3
Product characteristics	-0.068	-0.060	-0.061
Product numbers	-0.051	-0.063	-0.063
Website age	0.061	0.080	0.080
Website popularity	-0.025	-0.025	-0.021
Online customer review		0.685***	0.507
Information quality		0.089	-0.083
Online customer review * Information quality			0.047
R ²	0.023	0.303	0.304
F	0.916	10.919**	9.359***
△ R ²	0.023	0.279	0.001
Note: * significance at the 0.05 level; ** significance at the 0.01 level; *** significance at the 0.001 level.			

Table 6: Results of the Second Hierarchical Regression Analyses

Variable	Business Performance		
	Model1	Model2	Model3
Product characteristics	0.004	0.022	0.025
Product numbers	0.011	0.017	0.017
Website age	-0.050	-0.053	-0.052
Website popularity	-0.010	-0.006	-0.014
Online customer review		0.355***	0.662***
Website credibility		0.215***	0.219***
Information quality		0.028	0.327
Online customer review * Information quality			-0.082
R ²	0.012	0.397	0.406
F	0.481	14.095***	12.729***
ΔR^2	0.012	0.384	0.009

Note: * significance at the 0.05 level; ** significance at the 0.01 level; *** significance at the 0.001 level.

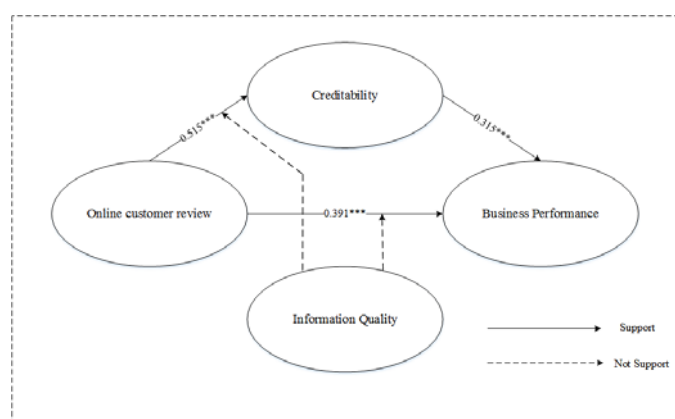
Through the coefficients of hierarchical regression analyses, we tested six models in total and the results showed that Ha1, Ha2 and Hb were supported ($p < 0.001$), while Hc1 and Hc2 were not supported ($p > 0.05$), which meant information quality as a moderator had not significant positive impact on the research model, Table 7 presented the summary results of all the hypotheses in our research. The hierarchical regression analyses also showed four control variables had not significant positive influences on the research model ($p > 0.05$).

Table 7: Summary of Hypotheses Test Results

Hypotheses	standardized coefficient	t	significance	support results
Ha1	0.515	7.518	***	+
Ha2	0.391	5.215	***	+
Hb	0.315	4.144	***	+
Hc1	0.085	0.553	>0.05	-
Hc2	0.054	-1.518	>0.05	-

Note: * significance at the 0.05 level; ** significance at the 0.01 level; *** significance at the 0.001 level.

Figure 2 showed our revised model and related coefficients.



Source: This study.

Figure 2: The Revised Model

DISCUSSIONS AND IMPLICATIONS

Theoretical Implications

Although the variables of online customer review, website credibility and business performance are not new concepts to existing literatures in e-commerce research field, while more related research has only focused on the role of EWOM in the context of online credibility, online product sales and business performance (Gu, Park & Konana, 2012; Kumar et al, 2013; Moe & Trusov, 2011). Relevant research in the context of website credibility is limited, which is possibly due to the credibility of B2C e-

commerce websites is a multidimensional concept and be lack of unified industry standard that lead to be difficult to measure. In this research, we add the website creditability as a mediated variable to the mechanism of online customer review affects business performance as a new perspective and understanding for B2C e-commerce websites to extend institutional cognition.

Online customer review has positive influences on creditability and business performance of B2C electronic commerce websites. As shown in Table 5, the results in Model 2 determine the significant effect of online customer review on website creditability with R-square changes was 0.279 and F-test was 10.919, both of which two conditions provided effective support to Ha1 (Carte & Russell, 2003; Cohen & Cohen, 1983). Our findings suggest that better online customer review can bring higher website creditability which will guide B2C e-commerce websites to take effective measures to illustrative EWOM such as providing effective product information and stimulating consumers' communication activities (Schlosser & Shavitt, 2002; Trusov, Bucklin & Pauwels, 2009). In Table 6, we can find the results in Model 2 show that the R-square changes was 0.384 and F-test was 14.095, both of which confirmed the significant effect of online customer review on business performance and provided strong support to Ha2, this finding come to the same conclusion with the past research (Gu, Park & Konana, 2012); second, creditability has positive influence on business performance of B2C electronic commerce websites. As shown in Table 6, the results in Model 2 with the R-square changes was 0.384, F-test was 14.095 (Beta = 0.215, $R^2 = 0.397$, $p < 0.001$) indicated that Hb was supported, which meant B2C e-commerce websites should pay more attention to credit development and credit evaluation to achieve better business performance; third, all of four control variables have no significant influences on the research model among online customer review, creditability and business performance of B2C electronic commerce websites. Integrating the related results in Table 5 and Table 6, we can find four control variables of product characteristics, product numbers, website age and website popularity have no significant influences in our research with all the significant levels above 0.05; fourth, information quality has no significant influence as a moderator, this result may be led not only due to information coverage, information redundancy and information diversity (Aggarwal & Singh, 2013; Agrell, 1997; Anderson & De Palma, 2013), but also due to customers have clear willingness to purchase. Some purchase habit or brand loyalty cannot be interference by information quality easily, and some dissatisfaction reviews may just lead to a transitory bias (Trocchia & Lockett, 2013). At the same time, context may affect the perceived information quality of consumers (Wien & Olsen, 2012). Ziegele and Weber (2015) had proved that single customer review was more effective than aggregate reviews, which may aggregate information whatever the quality was that may not affect consumer's purchase intention significantly. In Table 5, the joint impact of information quality and online customer review on creditability was not significant (Beta=0.047, $\Delta R^2=0.001$), in Table 6, the joint impact of information quality and online customer review on business performance was not significant (Beta=-0.082, $\Delta R^2=0.009$).

Managerial Implications

The managerial implications in this research are for both online customers or latent online customers and B2C e-commerce websites. For online customers and latent online customers, our research recommends to ascension to participate in the enthusiasm of online reviews and increase the effective frequency of online reviews. Feedbacks and sharing behaviors of online experience and production experience can not only help B2C e-commerce websites to improve creditability and business performance (e.g enhancing service, rational pricing), but also can help more customers (no matter with existing purchase experience or potential customers) to provide visual information, make more reasonable purchase decisions and expectations. Customers can make online reviews as a way of supervision for B2C e-commerce websites. They should take effective measures to attract more consumers to take part in online reviews. B2C e-commerce websites should attach great importance to the online reviews, and actively improve products quality and service consciousness provided according to this basis. Second, B2C e-commerce websites should make efforts to improve creditability to promote business performance and win the competitions.

LIMITATIONS AND FUTURE RESEARCH

There were three limitations in our research that can be further extended in future. First of all, our usable sample size of 158 was limited that only combined B2C e-commerce websites from five cities of Hangzhou, Xiamen, Beijing, Guangzhou and Xi'an in China, where the tourism and e-commerce are flourishing and active. Thus, for conducting our research results can be widely applied we should expand our research sample that come from different regions in China or other countries.

Second, online customer review in this study we focus on were from B2C e-commerce websites or the platform provider, while we didn't consider other varieties channels of online customer review, such as online BBS, blog, WeChat, community, etc (Mudambi & Schuff, 2010; Aggarwal & Singh, 2013). Different online review channels can show different review content, review form and customer characteristics segmentation that may present more abundant, more substantial and more perfect information.

Third, we used four indicators to evaluate creditability of B2C e-commerce websites, which needed more evidence in the future. Credit is a multidimensional concept on the basis of accumulation of trust, and creditability represents the credit value over a period of time in our research. Also, the assessment of creditability can be explored from different perspectives.

CONCLUSIONS

This research extends understanding about online customer review. Online customer review has positive impacts on both creditability and business performance of B2C e-commerce websites. Additionally we find that website creditability has positive impact on business performance, which is an innovative conclusion for B2C e-commerce websites. We discover that information quality negatively moderated the relationship between online customer review and website creditability and the relationship between online customer review and business performance. These interesting findings address the research gap of creditability of B2C e-commerce websites and extend understanding of online customer reviews. Collectively, all the findings set unambiguous guidance for future research and managerial practice.

ACKNOWLEDGEMENT

The work described in this article was supported by Young Core Teachers Training Program and Interdisciplinary Team Program in Zhongyuan University of Technology, China.

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How Social Anxiety and Social Factors Influence and Moderate Social Commerce (Full Paper)

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ABSTRACT

Following the fast growth of social networking sites (SNS) such as Facebook, Twitter and LinkedIn in the cyber world recently, social commerce has become an important emerging issue on the Internet. Researchers have studied not only online factors but also offline factors, according to the offline-to-online consumer-behavior model. Hence, this study applied approaches to social anxiety, online social interaction and online social support to comprehend the influences of social commerce intentions. After the research survey collected data from SNS (Facebook) users for one month, the researcher analyzed the data and made several findings. First, social anxiety positively moderates the relationship between online social support and social commerce intention. Second, online social interaction directly and indirectly affects social commerce intention through online social support. Theoretical contributions and managerial implications are also discussed, providing several future research directions and suggestions for scholars and SNS operators, respectively.

Keywords: Social anxiety, online social support, online social interaction, social commerce

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INTRODUCTION

Since social networking sites (SNS) emerged in the cyber world, many online users have joined and become members of them. SNS are applications that enable online users to connect with each other by creating personal profiles and supplying information, inviting friends and colleagues to access their files, and sending e-mails, instant messages, and footage between friends. These personal profiles can include various types of information including photos, videos, audio files, and public bulletin boards blogs (Kaplan and Haenlein 2010). Through the inter-personal social activities, which are based on various applications, SNS members act to develop their social lives and accumulate social capital (Boyd and Ellison 2007).

Offline and online user behaviors have become important research topics recently (Koufaris 2002), and both online and offline influences such as personality and psychological factors have played important roles for users taking part in SNS (Amichai-Hamburger and Vinitzky 2010; Nadkarni and Hofmann 2012; Yang *et al.* 2012). Social anxiety and the online-to-offline factor have received increasing empirical attention in recent years (Pierce 2009). Whereas most studies of social anxiety have focused on computer-mediated-communication (CMC) for Internet use compared with face-to-face (FTF) interactions (Prizant-Passal *et al.* 2016), this research tries to make progress in investigating social commerce on SNS for socially anxious users who might also need shopping information for commercial reasons.

Socially anxious individuals are also called social phobia and are increasing dramatically in parallel with the Internet's rapid growth (Anderson and Hope, 2009); they often fear to talk in public or meet with strangers and are uneasy about making new friends in the real world (Chang *et al.* 2014; Okamoto 2015; Pierce 2009; Prizant-Passal *et al.* 2016). Therefore, for those users who have high social anxiety, SNS may be regarded as a good environment to develop their personal social life because individuals in SNS are invisible, allowing them to avoid physical face-to-face contact and feel more comfortable (Pierce 2009; Prizant-Passal *et al.* 2016). Hence, they may be more willing to contact and interact with others online compared to offline. Moreover, social commerce has developed through the sharing of information, knowledge and shopping experience with regard to products or services with other online users, and this can be considered a type of e-word-of-mouth (eWOM; Liang *et al.* 2011; Liang and Turban 2011). It is burgeoning tremendously due to the growth of SNS users' population (Ng 2013; Shin 2012). According to the report of Forrester Research (Anderson *et al.* 2011), the social commerce market will grow up to about US\$30 billion in U.S. by 2018. Moreover, since socially anxious individuals seem to feel comfortable in computer-mediated-communication (CMC) interactions (Caplan 2007; Prizant-Passal *et al.* 2016), they may be more likely to participate in SNS and adopt social commerce than other users.

This study attempts to explore how the offline factor and social anxiety influence online social behavior such as social support and social commerce on SNS (Liang *et al.* 2011; Liang and Turban 2011). This research also selects online social interaction as an antecedent to predict online social support leading to social commerce intention (SCI). The results could provide suggestions to SNS operators on how to run SNS more effectively and efficiently from users' personal perspective. The main purpose of the study is to investigate whether socially anxious individuals prefer to adopt social commerce in SNS, as many studies have shown that they feel more comfortable on the Internet (Caplan 2007; Pierce 2009; Prizant-Passal *et al.* 2016). In summary, the purposes of the study are to:

- I. Explore how the offline factor and social anxiety influence social interaction, social support, and SCI

- II. Understand social anxiety as a moderator that influences the relationship between social support and SCI
- III. Comprehend the effects of online factors, social interaction, and social support on SCI

LITERATURE REVIEW AND THEORETICAL DEVELOPMENT

2.1 Social Exchange Theory

Social exchange theory proposes that individuals' social behavior is the result of an exchange process, and the purpose of the exchange is to maximize benefits and minimize costs (Leventhal *et al.* 1980; Molm 1997; Thibaut and Kelley 1959). According to this theory, people consider and measure the potential benefits and costs of social relationships. When the costs exceed the rewards, people will terminate or abandon that social relationship. The costs, involving cognitions or perceptions, are seen as negatives to the individual and are equivalent to putting money, time, and effort into an interpersonal relationship. The benefits are the things the individuals acquire from relationships, such as friendship, emotions, companionship, and social support. The theory proposes that individuals essentially take the benefits and minus the costs in order to determine the worth of a relationship. Positive relationships are those in which the benefits exceed the costs, while negative relationships occur when the costs are more than the benefits (Cherry 2013). Therefore, the theory suggests that individuals employ cost-and-benefit analysis to evaluate their social relationships and engage in social exchange only when the benefits outweigh the costs (Blau 1964; Homans 1958).

2.2 Social Compensation Theory

Social compensation theory proposed that individuals who are high in social anxiety and low in social skills typically have difficulties forming interpersonal relationships in face-to-face interactions and will adopt online activities to compensate for deficits they encounter in the offline world (Poley and Luo 2012). Furthermore, the Internet offers an alternative approach to nonsocial uses such as information seeking or playing games, exacerbating social withdrawal. However, it is also possible for shy individuals to utilize the Internet to fulfill their social life and enhance their social relationships by finding friends and building friendships by facilitating social interactions that might be considered more difficult during physical face-to-face interaction (Amichai-Hamburger and Vinitzky 2010). Hence, socially anxious individuals turn to the Internet to communicate with and form relationships with peers, because these interactions are more difficult in person (Laghi *et al.* 2013). Therefore, this study will adopt this theory in order to explain the relationship between the behaviors of socially anxious individuals and the adoption of social commerce intention (SCI).

2.3 Social Anxiety

Social anxiety, which is the same as the otaku phenomenon (Galbraith 2010), is defined as "a state of anxiety resulting from the prospect or presence of interpersonal evaluation in real or imagined social settings" (Leary 1983); it is characterized by an extensive fear of being evaluated by others (Wieser *et al.* 2010); and it is also regarded as a form of shyness (Madell and Muncer 2006). It is an anxiety disorder characterized by intense fear of social situations causing considerable distress and impaired ability to function in at least some parts of daily life (Prizant-Passal *et al.* 2016). Socially anxious individuals describe their personal relationships with family, friends, and even partners as damaged (Erwin *et al.* 2004; Whisman *et al.* 2000). The Internet can be considered a communication tool to avoid contacting people face to face (Prizant-Passal *et al.* 2016). Therefore, the recently fast-growing SNSs provide socially anxious individuals with a good environment to communicate with others and help them to expand their social life in the cyber world.

2.4 Online Social Interaction

Individuals develop a preference for online social interaction as an alternative to face-to-face communication because they perceive it to be less threatening and perceive themselves to be more efficacious when interacting with others online (Caplan 2007). Researchers have identified two primary uses of online social interaction. One is that users can find others with similar interests, ranging from romantic relationships to social networks (Correa *et al.* 2010; McKenna *et al.* 2002). Another major usage is to maintain pre-existing social connections in actual life (Ellison *et al.* 2007). Most online users visit SNSs to keep in touch with persons they already know in real life (Lenhart, Purcell, Smith, and Zickuhr 2010). In addition, studies have also found that many relationships first formed online result in real-world contacts (Ross *et al.* 2009).

2.5 Online Social Support

Social support refers to an individual's experiences of being helped by people, being responded to, and being cared for in that individual's social group (House 1981). Because social support can create warmth and understanding for an individual, it can also be treated as a responsiveness to satisfy one's psychological needs (Maslow, Frager, Fadiman, McReynolds, and Cox 1970). Moreover, the definition of social support varies from study to study; it is widely acknowledged that social support has multiple dimensions: emotional, instrumental, appraisal, and informational (Bo 2008; House 1981).

The experiences of social support by socially anxious individuals in a social network may also help them to avoid negative experiences (e.g., economic or legal problems) that otherwise would increase the probability of psychological or physical disorder (Cohen and Wills 1985). When SNSs have entered people's lives in recent years, the role of the Internet has changed to become an effective and efficient way for individuals to facilitate social interaction (Liang *et al.* 2011).

2.6 Social Commerce in SNS

Following the fast-growing development of popular SNSs such as Facebook, LinkedIn, and Twitter, social commerce has become an important discussion topic (also known as a social business) in the virtual world. Social Commerce Today (2011) defined SC as “The use of social technology in the context of commerce for selling with social media.” It involves adopting Web 2.0 social media technologies and infrastructures to support online interpersonal interactions to acquire shopping information about products and services. Also, it refers to transactions via social media, and delivery of e-commerce activities, usually by applying Web 2.0 software in social media (Liang *et al.* 2011; Liang and Turban 2011). Hence, SC can be regarded as a branch of e-commerce that involves adopting social media as a platform to assist e-commerce processes such as transactions and activities.

Dennison *et al.* (2009) defined SC as having taken e-word-of-mouth (eWOM) where it never existed before in online shopping. Online users are now seeking ways to learn from each other’s shopping expertise and experiences in order to get more information to make effective purchasing decisions. Simply speaking, SC is word-of-mouth utilized in e-commerce. Regarding social commerce, actual behaviors are difficult to quantify, and intention is a common measurement for behavioral researchers to predict possible human actions. A large body of research has proven that behavioral intention has a significant correlation with actual behavior such as the theory of reasoned action, the theory of planned behavior, and the technology acceptance model. Hence, this study utilizes social commerce intention (SCI) to represent social commerce (Liang *et al.* 2011).

METHODOLOGY

3.1 Research Framework

The research framework is shown in Figure 1. The study seeks to explain the relationships among social anxious, online social interaction, online social support, and social commerce intention. Online social support is hypothesized as being an important mediator between online social interaction and social commerce intention. In addition, social anxiety is also hypothesized as moderating the relationship between online social support and social commerce intention.

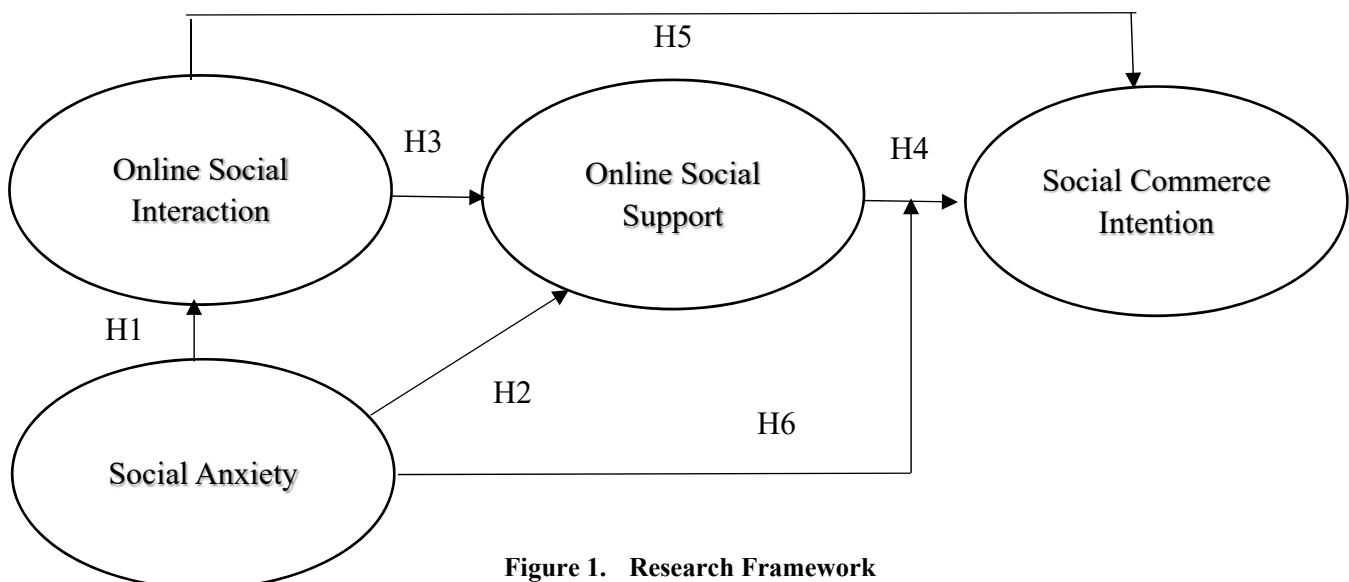


Figure 1. Research Framework

3.2 Research Hypothesis

According to the social compensation theory, socially anxious individuals are unfamiliar with their social interpersonal skills with other persons compared to face-to-face interaction. Moreover, human beings need social interactions to fulfill their social needs for belonging and support (Maslow *et al.* 1970). As a result of this, they will visit SNS more frequently to compensate for their struggles in interpersonal relationships in real life and will develop or maintain new interpersonal relationships in the virtual world (Zywica and Danowski 2008). Therefore, they may engage more online social interactions to compensate for what they have suffered or lost in real life. Furthermore, social anxiety is positively associated with online social interaction because the Internet provides opportunities for less stressful interactions compared to those in real life (Caplan 2007; Prizant-Passal *et al.* 2016). Therefore, this study proposes the following:

H1: Social anxiety is positively associated with online social interaction.

Because social support creates warmth and understanding for individuals, it can also be treated as a form of responsiveness to satisfy one’s psychological needs for users (Maslow *et al.* 1970). Moreover, following social exchange theory (Blau 1964; Homans 1958), SNS users may accept social support from other users who will return their social support in the future, creating mutual social support. It is uneasy for socially anxious individuals to conduct social interactions with people in real life. According to social compensation theory, users with high social anxiety may prefer to receive higher social support from other SNS users for the compensation of offline behavior (Poley and Luo 2012). Hence, this study suggests:

H2: Social anxiety is positively associated with online social support.

Social support is one of the benefits of relationships and an important factor in causing people to want to maintain interpersonal relationships. Individuals will try to reciprocate social support from others and will behave similarly in social interactions. Therefore, frequent social interaction with friends and neighbors can be interpreted as a high level of social support (Rook 1984). Human beings need social interactions to satisfy their social needs for belonging and support (Liang *et al.* 2011; Maslow *et al.* 1970). Hence, SNS is a platform for online users to interact with each other and to exchange informational and emotional support with their knowledge and personal experiences (Kaplan and Haenlein 2010). Therefore, this study hypothesizes:

H3: Online social interaction is positively associated with online social support.

Based on social exchange theory, when individuals acquired benefits from others, they reciprocate others' support (Cropanzano and Mitchell 2005; Emerson 1976). A growing number of studies have provided concrete evidence that CMC can indeed help form and maintain online relationships that can facilitate the exchange of social support (Alam *et al.* 2011; Bo 2008; Ellison *et al.* 2007; Jang *et al.* 2016; Steinfield *et al.* 2008). An SNS is an IT platform for online users to share different kinds of support such as emotional and informational support with each other. The interchange motivation resulting from the perception of social support encourages online users to share purchasing experience, shopping information, product knowledge, and even brand loyalty with their online friends by e-word-of-mouth (eWOM) and to receive feedback from other online users. Hence, online social support enhances the social commerce intention on SNSs.

Moreover, Liang *et al.* (2011) conducted their study on Plurk, a microblog SNS site, and their results confirmed the relationship between online social support and social commerce intention. Therefore, this study proposes:

H4: Online social support is positively associated with the online social commerce intention.

Chen *et al.* (2011) stated that WOM is a well-established construct in the marketing literature (Arndt, 1967). Dennison *et al.* (2009) defined social commerce as the type of WOM utilized in e-commerce, and SC could be considered a form of social interaction in which shopping information and purchasing experiences are exchanged. Furthermore, when online users conduct more online interactions about products and services information, knowledge, and shopping experience with others, these actions will create a special atmosphere leading to a stronger social commerce intention (Liang *et al.* 2011). Ultimately these online users could interact and exchange their shopping experience and product information more effectively. Hence, this study proposes:

H5: Online social interaction is positively associated with social commerce intention.

Previous research has found that the most socially anxious individuals are likely to strengthen their Internet interactions in order to avoid face-to-face interactions (Erwin *et al.* 2004; Prizant-Passal *et al.* 2016). In addition, Kraut *et al.* (2002) suggested that socially anxious individuals who spent a large amount of time interacting with others on the Internet were more likely to express greater comfort in Internet interactions and higher reliance on the Internet as a social outlet to the exclusion of face-to-face interactions. These people were more inclined to proclaim they are comfortable initiating and maintaining online compared to face-to-face conversations with others and prefer discussing their problems with others on the Internet rather than face-to-face socially.

Following the above statements, socially anxious individuals have an intention to explore the relationships they desire in a less threatening manner than traditional face-to-face interactions that others may use (Stevens and Morris 2007). Virtual social situations are especially suitable for measuring overt attention in an ecologically valid environment (Mühlberger *et al.* 2008). Thus, socially anxious individuals may prefer and trust online users' opinions and experiences rather than people in real life. Therefore, this study assumes:

H6: Social anxiety positively moderates the relationship between online social support and social commerce intention.

3.3 Research Method

This study applied the partial least squares (PLS) method for structured equation analysis to test the causal effects of the research model. PLS includes a measurement model and a structure model simultaneously (Hair & Anderson 2010). The measurement model tests the relationship between observed and latent variables. The structure model, which is based on certain assumptions, explores the causal effects of latent variables. The study adopts SmartPLS 2.0 to analyze the measurement model and the structure model simultaneously. The validity of the constructs was assessed regarding unidimensionality, internal consistency, convergent, and discriminant validity.

RESULTS AND ANALYSIS

4.1 Data Collection

Because the questions based on the literature review are presented in English, and the samples in this study do not use English as the official language, this study translated them from English to Chinese. To ensure the measurement of items with precise interpretation from English to Chinese, this study proceeded backward, translating the questionnaire items with the help of four professionals who were Ph.D. candidates in e-commerce with sufficient English proficiency. They translated those items forward (English to Chinese) and backward (Chinese to English) several times until the meaning of the items was consistent.

Because Facebook is the most popular SNS for providing research samples under scrutiny (Valenzuela *et al.* 2009), this study chose Facebook users as the target SNS users in order to test the research model. College students from a university provided the samples for the pretest. Seven items with low loadings were deleted. The questionnaires were distributed online for college and MBA students in computer labs from March 1 to April 10, 2015. Out of 450 samples, 23 samples with incomplete data were dropped, resulting in an effective sample collection rate of 94.9%.

Female and male samples account for 62.2 % and 37.7%, respectively. The distribution of gender is similar to the survey by Smith (2015). Most of the respondents are college students, aged less than 22 (83.8%), and have more than two years of SNS experience (78.5%).

4.2 Reliability and Validity

The construct measurements, including questions, loadings, and sources, are shown in Table 1. All of them have standardized loadings ranging from 0.72 to 0.95. A higher value represents a stronger relationship between the item and its corresponding construct, and a value larger than 0.7 is considered acceptable (Chin 2010).

Table 1 Measurement Items

Constructs	Item	Questions	Loadings	Source
Social Anxiety	Sax1	Afraid (Sum up 24 items from Liebowitz's Social Anxiety Scale)	0.91***	(Liebowitz <i>et al.</i> 1985)
	Sax2	Avoidance (Sum up 24 items from Liebowitz's Social Anxiety Scale)	0.95***	
Online Social Interaction (Social Benefits)	Sbe1	I am treated better in my online relationships than in my face-to-face relationships	0.90***	(Caplan 2007)
	Sbe2	I am more confident socializing online than I am offline	0.89***	
	Sbe3	I feel safer relating to people online rather than face-to-face	0.89***	
Online Social Interaction (Social Control)	Sco1	When I am online, I socialize with other people without worrying about how I look	0.74***	(Caplan 2007)
	Sco2	I can control how others perceive me when online	0.83***	
	Sco3	When I am online, I socialize with people without worrying about relational commitment	0.75***	
Online Social Support (Emotional Support)	Ems1	When faced with difficulties, some people on Facebook are on my side	0.90***	(Krause and Markides 1990)
	Ems2	When faced with difficulties, some people on Facebook comfort and encourage me	0.93***	
	Ems3	When faced with difficulties, some people on Facebook listen to me talk about my private feelings	0.72***	
	Ems4	When faced with difficulties, some people on Facebook express interest and concern in my well-being	0.90***	
Online Social Support (Information Support)	Ims1	On Facebook, some people offer suggestions when I need help	0.87***	(Krause and Markides 1990)
	Ims2	When I encounter a problem, some people on Facebook give me information to help me overcome the problem	0.92***	
	Ims3	When faced with difficulties, some people on Facebook help me discover the cause and provide me with suggestions	0.89***	
Social Commerce Intention (Giving)	Giv1	I am willing to provide my experiences and suggestions when my friends on Facebook want my advice on buying something	0.83***	(Liang <i>et al.</i> 2011)
	Giv2	I am willing to share my own shopping experience with my friends on Facebook	0.92***	
	Giv3	I am willing to recommend a product that is worth buying to my friends on Facebook	0.92***	
Social Commerce Intention (Receiving)	Rec1	I will consider the shopping experiences of my friends on Facebook when I want to shop	0.87***	(Liang <i>et al.</i> 2011)
	Rec2	I will ask my friends on Facebook to provide me with their suggestions before I go shopping	0.88***	
	Rec3	I am willing to buy the products recommended by my friends on Facebook	0.86***	

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table 2. CR, AVE, Correlation between Constructs, and Square Roots of AVE

Latent Variable	CR	AVE	1	2	3	4
1. Society Anxiety	0.93	0.87	0.93			
2. Social Interaction	0.86	0.51	0.14	0.72		
3. Social Support	0.93	0.66	0.13	0.23	0.81	
4. SCI	0.93	0.68	0.12	0.17	0.45	0.82

Notes: CR=Composite Reliability; AVE=Average Variance Extracted; Numbers on the diagonal (in boldface) are the square root of the average variance extracted (AVE). Other numbers are the constructs' correlation.

Table 2 lists the results in which composite reliability (CR) ranged from 0.86 to 0.93, and average Variance Extracted (AVE) ranged from 0.51 to 0.87. Composite reliability represents the ratio of a scale's estimated true score variance relative to its total variance, and AVE measures the reliability of the latent variable component score. These values all exceeded the recommended score of 0.7 for CR and 0.5 for AVE (Fornell & Larcker 1981), indicating the study has reliability and convergent validity. For the discriminant validity, the square root of AVE for a given construct was compared with the correlations between the construct and another construct (Fornell & Larcker 1981). The square root of AVE, the numbers on the diagonal, were greater than the off-diagonal elements in the corresponding rows and columns, demonstrating an adequate discriminant validity for the study.

According to Harmon's testing for measuring CMV (common method variance; Babin *et al.* 2016), all of the indicators are measured by factor analysis with one factor. If the extraction sums of the squared variance are more than 50%, it may have CMV problems. The extraction sum of squared variance for all of the items of the constructs in the study is 31.57 %, indicating that common method biases are unlikely to contaminate our results.

4.3 Model Fit Evaluation and the Hypotheses Testing Results

Hair *et al.* (2014) proposed that the most widely applied way of measuring the structural model is the coefficient of determination (R² value). It is a measure of the research model's predictive accuracy and is calculated as the squared correlation between a specific endogenous construct's actual and predicted values. The R² of the research is 0.11, 0.16, and 0.21, which all exceed the acceptable level (Henseler *et al.* 2009).

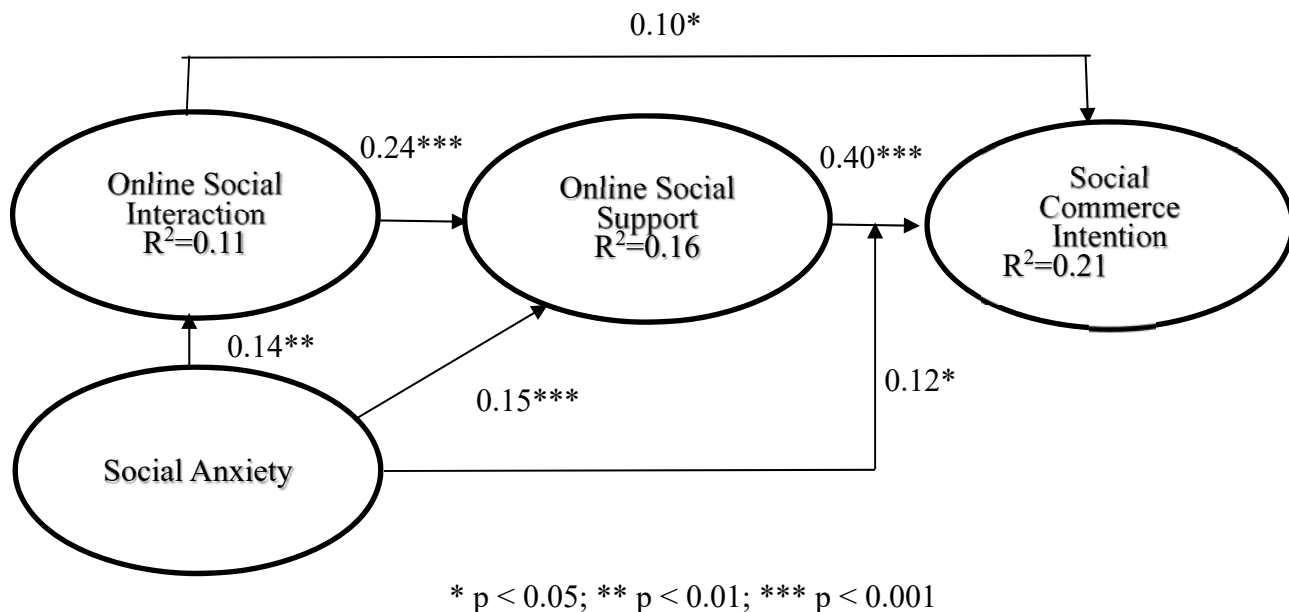


Figure 2 Results of the PLS Analysis

Figure 2 shows the results for Hypotheses 1 to 6. The results support all of the hypotheses in the study. Moreover, social anxiety positively moderates the relationship between online social support and social commerce intention (coefficient = 0.12*), and it could thus be a major finding of the study that socially anxious users are like to transform online social support into social commerce intention compared to other users.

DISCUSSION AND CONCLUSIONS

5.1 Discussion

The importance of social commerce has been noticed by several large online companies. Google charges its advertisers to post product information, and Amazon has developed a shopping information-sharing system to promote other books. The development of SNS has even raised the importance of SC. Facebook, the SNS with the most users in the world, recently added a “buy” function on its website to encourage SC. Researchers have initiated studies of SC, but this paper is the first attempt to

include the offline factor and social anxiety in the model in order to investigate its influence on SC. The results supported all of the hypotheses indicating that socially anxious individuals will be more likely to interact with others online, receive higher social support, and show a higher intention of social commerce. Online social support is affected by social interaction and has a positive impact on SCI, consistent with the results by Liang *et al.* (2011). In addition, social anxiety is found to moderate the relationship between social support and SCI in which socially anxious individuals will have a stronger relationship between social support and SCI. This implies that socially anxious individuals may likely to access support and have more intentions for social commerce compared to other users. Hence, SNS operators may want to focus more on these socially anxious users as a higher potential customer base for promoting social commerce on SNS.

5.2 Theory Contribution

This study applied social compensation theory and social exchange theory to explain how socially anxious users behave online toward social commerce. Social compensation theory states that people may show different characters or behaviors in various environments, and the results of this study assert that the theory is suitable for explaining offline-to-online (O2O) effects for SNS users. Moreover, socially anxious users have higher social interaction and social support leading to greater SCI. These results confirm the claims of social exchange theory that online social interaction and online social support, including information and emotional support, positively influence SCI. Therefore, social exchange theory successfully depicts how people behave in the virtual world.

More importantly, most prior research studies on social anxiety focused on the different behaviors of face-to-face (FTF) and computer-mediated-communication (CMC), whereas this study emphasized the role of social commerce in SNS. In addition, this study may be the first to investigate the moderating role of social anxiety toward social commerce, and the results have confirmed the hypothesis.

5.3 Managerial Implication

The major finding of this research is that social anxiety significantly moderates the relationship between online social support and social commerce intention. Socially anxious individuals will show a stronger relationship to online social support and social commerce intention than users with lower social anxiety. Therefore, SNS becomes a suitable environment for socially anxious users to develop their social relationships and social life because human beings have a requirement for social interaction. These individuals may face difficulty in social activities in real life, but they will exhibit higher social interaction and social support on SNS and will eventually show higher SCI. Therefore, SNS operators could enhance their websites so that their users can interact comfortably and freely with others without any social pressure.

Second, online social interaction has direct and indirect influences on SCI through online social support. These results indicate that increasing online social interaction with other users not only directly affects SCI but also increases online social support, which indirectly influences SCI. Essentially, people need social interactions to satisfy their social needs for belonging and support both in virtual and real life (Maslow *et al.* 1970). SNS operators may find ways to encourage the social interactions among users such as responsive blogging, open forums, and so on. SNS operators may also implement some reward mechanisms for opinion leaders or forum managers of groups to enhance their reputation for sharing information (Wasko & Faraj, 2005).

5.4 Research Limitations and Future Research

First, this empirical study tested the research model based on samples from users of one SNS, Facebook, so the results may not be directly applicable to other SNSs such as Twitter, Line, and Groupon. The second potential limitation is that the analysis was based on survey data. Although the research has attempted to ensure that the survey was conducted in a rigorous way, what the users said may not be the same as what they do, and the result might be different from the actual user behavior. This is the inherent limitation of survey studies. The third potential limitation is that there are multiple types of social support in social networks. Only informational and emotional supports were included in this study. Hence the final result can only be interpreted in relation to these two chosen support forms. Finally, the study was conducted in one country with a fairly homogeneous population of users. Generalization to other forms of social support or other social and cultural environments needs to be further investigated.

Future study may include other social topics including social capital, social influence, and social identity and may study how socially anxious individuals behave in the virtual world while they have been proved to be high potential customers for social commerce on SNS when considering these e-commerce related topics. Moreover, other constructs such as commercial activity, social media, outcome measure, and so on are also important issues for social commerce since SNS has become a part of social life (Liang & Turban 2011).

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Identifying Factors Affecting Digital Transformation of SMEs

(Full Paper)

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ABSTRACT

The paper is motivated by a need to encourage a more profound understanding of digital transformation issues in the context of small and medium enterprises (SMEs). This paper aims to identify the essential factors that determine the digital transformation of SMEs. We began by reflecting on the concept and usage of digital transformation in companies of different type and size. With this appreciation, we then elaborated upon the challenges of digital transformation for SMEs. In this context, we overviewed the scientific literature concerning the factors which influence the process of digital transformation and are significant for SMEs. Finally, in the light of our reflections, we suggested the set of factors which should be taken into account moving towards the digitalization of SMEs. By focusing on the key factors of the digital transformation of SMEs, we provided some contributions. First of all, we articulated a categorization regarding internal and external factors in relation to the digital transformation of SMEs. Future research should pay more attention to external factors, and verify empirically the significance of the factors identified.

Keywords: Digital transformation, digitalization, factors, SMEs.

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INTRODUCTION

Increasing use of information communication technologies (ICT) has a major impact on companies' productivity, and their innovation capacity. European Commission (2015) highlighted that the "smart" use of ICT is an important success factor for the competitiveness of European companies, in particular for small and medium enterprises (SMEs). The "smart" use of ICT in companies leads to digital transformation, which refers to the optimization of organizational processes, by using technologies to improve the performance. Companies are confronted by various challenges in the implementation of digital transformation, but they are required to reconfigure the business in line with these challenges to improve performance. Reflecting on this argumentation, digitalization issues in the context of SMEs, factors influencing the digitalization processes and important activities to be managed in SMEs are still significantly under-researched.

Considering that several literature reviews have been made analyzing digital transformation by revealing its concept, this article differs from previous literature reviews as it focuses on the factors for the digital transformation of SMEs. Most often, digital transformation and its aspects are analyzed in relation to large companies, by arguing that it is easier for them to embrace digital transformation due to available / more accessible resources and skills. However, taking into account, that SMEs are essential to maintaining steady economic growth, especially in the European Union, it is relevant to analyze what determines the digital transformation of SMEs. Therefore, this paper aims to identify the essential factors that determine the digital transformation of SMEs. In the light of our reflections and argumentation, we contribute by identifying and suggesting the list of internal and external factors, and also by disclosing the peculiarities of the digital transformation of SMEs.

The paper's structure is as follows: issues concerning the phenomenon of digital transformation and its challenges for SMEs; elaboration of methodology; identification of factors affecting the digital transformation of SMEs; concluding remarks.

THE PHENOMENON OF DIGITAL TRANSFORMATION AND ITS CHALLENGES FOR SMEs

The integration of technological innovations which according to McKinsey & Company experts were structured into four clusters of Industry 4.0 innovations such as 1) data, computational power, and connectivity; 2) analytics and intelligence; 3) human-machine interaction; 4) digital-to-physical conversation (McKinsey & Company, 2015), are a part of digitalization processes and digital transformation and can enable achieving competitive advantages for companies. Reis et al. (2018) support Ebert and Duarte (2016) and state that "the society as a whole is facing a fast and radical change due to the maturation of digital technologies and their ubiquitous penetration of all markets" (Reis et al., 2018, p. 411), companies are facing ever tougher competition due to globalization by the increased demand from customers (Westerman et al., 2011). Due to this, companies are seeking to survive and attain competitive advantages by going to be digital (Bharadwaj, 2000).

Several literature review studies attempted to reveal the phenomenon of digital transformation by revealing its concept. Digital transformation can be understood as “the transformation of socio-technical structures that were previously mediated by non-digital artifacts or relationships into ones that are mediated by digitized artifacts and relationships” (Yoo et al, 2010), which refers to the optimization of organizational processes with the aim of operational excellence by data-based workflows (Lederer, Knapp, & Schott, 2017), and by using the technology to radically improve performance or reach of enterprises (Westerman et al, 2011).

Digital transformation is now critical for almost all companies. However, a lack of clarity can be highlighted concerning the notion of digital transformation especially among different stakeholders involved. Perspectives on digital transformation vary from a focus on technology to digital customer engagement and new digital business models. Reis et al. (2018) categorized digital transformation into three distinct elements: 1) technological – digital transformation based on the use of new digital technologies such as social media, mobile, analytics or embedded devices; 2) organizational – digital transformation requiring a change in organizational processes or the creation of new business models; 3) social – digital transformation is a phenomenon that is influencing all aspects of human life by, e.g., enhancing customer experience. Hence, the main advantage of digital transformation can be seen as a transformation in processes, activities, competencies, models of a company. Businesses are undertaking their digital transformations, rethinking what customers value most, and creating operating models that take advantage of what’s newly possible for competitive differentiation (Berman, 2012). Hagberg Sundstrom, and Egels-Zandén (2016) outlined the more all-encompassing digital transformation of retailing by discussing how it influences four elements of the retailer-consumer interface. The authors analyzed how exchanges are transformed through changes in communication, transactions, and distribution; how actors are transformed through the intermixing of humans and digital technologies, the increased blurring of boundaries, and new actors, roles and relationships; how settings are transformed to include traditional and new settings as well as their intermixing; and how offerings are transformed through changes of products and services, extensions of offerings and new forms of pricing.

Regarding the issue of the application of digital transformation, scientific experts, such as Nadeem et al. (2018), highlighted that digital transformation is widely affecting various industries particularly healthcare, telecommunications, automotive, banking and manufacturing sectors. Depending on the sector in which the company operates, the level of its digital transformation varies. It is noticeable that the level of digital transformation is also influenced by the changing needs of consumers, by the level of application of high technologies, by the position of company’s leadership, by the size of a company. According to Hess et al. (2016), digital transformation has become a high priority on the leadership agenda of many companies, but it is facing more difficulties than it has been expected (Zinder & Yunatova, 2016). Expanding the example of Aalto University (Collin et al., 2015), both challenges and opportunities of digital transformation within business companies are located (1) externally, i.e. related with the market, (2) internally, i.e. representing organizational and technical fields within the company, or (3) at the core of the company, i.e. activities and changes, addressed to core business (Collin et al., 2015). Hence it could be stated that application of digital transformations could be found at the micro (organizational) level but consequences could be seen at the mezzo and macro levels. On the other hand, mezzo and macro levels have economic, normative or coercive institutional pressures (DiMaggio & Powell, 1991; Burns & Scapens, 2000) which could create and stimulate challenges for the application of digital transformation at the micro level. According to multidirectional relation between different levels of digital transformation application and on the basis of the previous studies, it was disclosed that companies could face both external and internal challenges by implementing the digital transformation.

The wider use of ICT in the industry can address external challenges such as fast-changing customer needs, international competition, or technological change (Lederer, Knapp, & Schott, 2017). As Biahmou et al. (2016) stated a major challenge consists of constantly adjusting products and services to changing conditions and continuously optimizing supply chains by means of modern technologies. Furthermore, an industry itself can be a challenge for implementing the digital transformation in companies considering industry's specificity and maturity. On the other hand, Imran and Kantola (2019) stated that for optimal performance outcomes, significant operational changes in the external environment (i.e., changes in technologies and markets) must be matched with compatible inter-organizational changes. Contrary to sensing and reconfiguring dynamic capabilities, low levels of seizing are necessary for success in the context of new digital channels.

The internal challenges of digital transformation can be overcome through the perspectives of business models, technology, and knowledge (Moritz, 2016). From the perspective of business models, challenges may refer to the management aspects such as focusing on the end-to-end digitization of all physical assets and integration into digital ecosystems with value chain partners (Lee, Lee, & Chou, 2017), integration of “digital” into business models (Reis et al. 2018), and reshaping customer’s value proposition (Berman, 2012). Also, it may refer to the dealing with critical management issues (Horlacher & Hess, 2016), and dealing with changes of process and operations management (Dremel et al., 2017) to ensure the interoperability between different systems, standards, and formats used for electronic data exchange (especially to SMEs). It is also important to mention that financing the digital transformation is a big challenge especially for SMEs, due to the costs related to the identification, development, purchase, and integration of appropriate ICT solutions, which ensure the implementation of digital transformation. A significant challenge of the digital transformation is to focus on the knowledge and skills required. Knowledge capabilities can be seen as a challenge

which can influence the need for training and education to improve new professional skills and knowledge (European Commission, 2015). From the technological perspective, significant challenges of the digital transformation are related to the technology required. From the business organization point of view, the benefit from digital transformation implementation can be achieved only if the information system of the company is aligned with new technologies.

Another important challenge is a company's view of the technological solutions - most advanced SMEs to be more digitally oriented went through isolated solution instead of going through an integrated solution at the ecosystem level. Also challenges still exist concerning complexity and trying to achieve security and privacy level. Yin et al. (2016) researched secure and effective tele-healthcare services, which are aligned for future improvements as follows: self-learning and self-improvement, use of wearable devices, standardization, privacy and security are still a challenge. Viriyasitavat (2016) stated that dynamicity in real-time service workflow interoperation creates complexity, in which changes of services' attributes is in constant occurrence and need appropriate selection process. Piccinini et al. (2016) indicated that digitalization brings concerns of data security and privacy that can negatively influence users' acceptance of new mobility concepts. Kerravala (2017) confirmed that new digital-enabling technologies such as the Internet of Things (IoT) and the cloud are creating new entry points that hackers are exploiting at a furious pace. Also, the increased complexity of IT has made it significantly more difficult to secure the environment.

By overcoming the main challenges related to the implementation of digital transformation, it is possible for companies to gain not only a competitive advantage in the market but also to improve the performance. It is evident that, regardless of the sector in which the company operates, digital transformation and its processes are more frequent in large enterprises. It could be argued that it is easier for large enterprises to implement digital transformation because they have more resources (for IT infrastructure, skills upgrade). The benefit of digital transformation for large companies can be expressed in aspects such as improved competitiveness of the supply chain; increased innovation capacity through partnering with innovative SMEs; enhanced customer satisfaction through more flexible, personalized services; shorter time-to-market (European Commission, 2015).

However, not only large companies are operating and competing in global business environments. SMEs are essential to maintaining steady economic growth. A number of well-recognized characteristics differentiate SMEs from larger companies (Gilmore, Carson, & Grant, 2001). Constraints, the inherent characteristics of the owner/manager, the norms of the industry in which the firm operates, and the stage of the business life-cycle influence SMEs heavily (Carson & Gilmore, 2000; O'Donnell, 2011). SMEs face three broad types of constraints: limited resources, a lack of specialist expertise, and a limited impact on the marketplace (Carson & Cromie, 1990). Moreno, Pinheiro, and Joia (2012) emphasized that SMEs tend to suffer the most due to the highly turbulent and competitive environment in which they operate. Due to previously discussed challenges such as scarcity of resources (Chen, Jaw, & Wu, 2016), lack of knowledge, the technology required, and dealing with critical management issues, the implementation of digital transformation solutions in SMEs face difficulties and remains limited. The question might arise why digital transformation it is needed for SMEs? Studies have shown that digital transformation processes may enhance organizational performance (Cardona, Kretschmer, & Strobel, 2013; Gu & Jung, 2013) because of the transformations of key business operations, which affect products and processes. Furthermore, SMEs that make use of digital transformation processes may lead to effective use of information in enterprises and drive better business performance (Marchand, Kettinger, & Rollins, 2002), can access new market opportunities, gain new knowledge regarding their customers, and improve new product development processes more effectively (Neirotti, Cantamessa, & Paolucci, 2008; Setia, Venkatesh, & Joglekar, 2013), and may contribute to organizational impacts (Bayo-Moriones, Billon, & Lera-Lopez, 2013; Jean, 2007; Melville, Kraemer, & Gurbaxani, 2004). Moreover, the benefits of digital transformation for SMEs can include improved process efficiency (time and cost savings) and quality (reduced error rates), increased staff productivity, better customer satisfaction, easier access to new markets, strengthened business relations with big companies, ensured business agility, higher return on investments in ICT, reduced administrative overheads and greater focus on core business and wider market opportunities, such as source from a more extensive network of suppliers, and find new customers in new locations (European Commission, 2015).

The implementation of digital transformation leads to the benefits for SMEs, for large enterprises and the entire industry/economy alike. Hence it could be stated that digital transformation should enable innovation, cost-saving, and productivity in companies. Nevertheless, there are many challenges for companies to succeed in achieving these results and the total commitment of all companies (especially SMEs) internally as well as external alignment are needed. Knowing that SMEs have a significant impact on the industry/economy, it is necessary to analyze the factors that determine the implementation of the digital transformation of SMEs.

METHODOLOGY

We selected a systematic literature review to analyze and systemize current knowledge in the field about the factors that determine digital transformation. Systematic literature review contributed to the identification of factors affecting digital transformation.

Some research of digital transformation are already completed using ISI database (Reis et al., 2018); EBSCO Business Source Complete, Science Direct, and Google Scholar (Kiel et al., 2016), or top IS journals (Nadeem et al., 2018). Although the Scopus database has not been included in these research, ISI Web of Science, Google Scholar, and Scopus are recognized as the major bibliometric databases (Harzing & Alakangas, 2016). Furthermore, Harzing and Alakangas (2016) state that Google Scholar ensures the most comprehensive coverage but numbers there are higher in comparison to the ISI Web of Science and Scopus mainly due to the existence of duplicates. Moreover, Scopus has a higher number of articles in Social Sciences which is our area of the research. Therefore, we have limited our research to the Scopus database and were able to compare our results with previously published research on other databases.

Due to the core of our research topic, on the first step, we included “digital transformation” for the search in the title, abstract, and keywords. Secondly, we added “factors” and main keywords related to it that are commonly used as its synonyms for the determination action like “dimensions” and “variables.” We also added the keywords “model” and “framework” that often include factors. On the second step, we calculated articles with factors and its synonyms separately and, on the third step, we calculated articles with all them jointly as some of the synonyms were used together at the same article. No timescale was added.

Table 1: Summary of article inclusion and exclusion for the systematic literature review

Words used in search		Articles found	Articles passed exclusion criteria
“Digital transformation”		975	112
“Digital transformation” and	“factors”	201	27
	“dimensions”	93	8
	“variables”	54	7
	“model”	486	73
	“framework”	294	48
“Digital transformation” and (“factors” or “dimensions” or variables” or “model” or framework”)*		627	75

* Query string for the final search in Scopus: (TITLE-ABS-KEY("digital transformation") AND (factors OR dimensions OR variables OR model OR framework)) AND (LIMIT-TO(SRCTYPE, "j ") OR LIMIT-TO (SRCTYPE, "p")) AND (LIMIT-TO(SUBJAREA, "BUSI")) AND (LIMIT-TO(DOCTYPE, "ar") OR LIMIT-TO(DOCTYPE, "cp")) AND (LIMIT-TO(LANGUAGE, "English"))

Source: This study.

As exclusion criteria, we limited our research to business and management area (“business, management and accounting”) to exclude a considerable amount of articles that are related to IT but not with business and management. We also excluded articles that were written in different than English language avoiding misleading interpretation on terms and their meaning (Reis et al., 2018). The last criteria of exclusion were based on publication type and article type. 75 articles, that were published in journals and conference proceedings, excluding such document types as book chapters, conference reviews, and reviews, as well as such publication types like books, book series, and trade publications, were selected for the further quantitative and qualitative analysis to explore the tendencies in the field and ensure the match of content to exploration of digital transformation and factors affecting it (see Table 1). The search was completed on June 13, 2018.

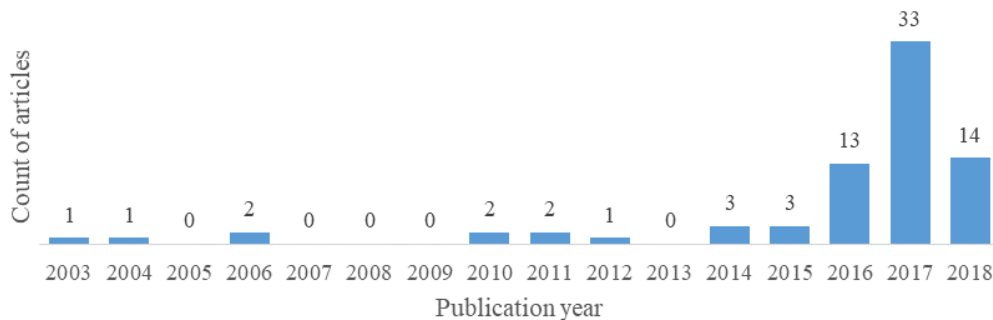
MAIN FINDINGS OF THE RESEARCH

Tendencies of the Digital Transformation Research Field

Quantitative analysis results showed the growing field of interest in digital transformation (see Figure 1). First researched article in Scopus appeared in 2003 with the next article in 2004. Some gaps were identified in the following flow of articles in years of 2005, 2007-2009 and 2013 with several papers in between. The breaking point was reached in 2016 when a total number of papers in the researched field was four times higher than in 2015. In 2017 it was almost three times higher than in the previous year. The lower number of 2018 reflects its current status.

The majority of articles were published in journals (50). Four articles were published in the Academy of Strategic Management Journal (3 in 2016 and 1 in 2017). Only Publishing Research Quarterly published articles in 2010 and 2014, and one article in the Journal of Cases on Information Technology was published in 2006. Other journals that published 2 or 3 articles did this between 2016 and 2018. Fewer articles were published in conference proceedings. Due to small numbers, no tendencies are visible.

However, it is worth to mention that as a conference topic the research field is developing since 2011 with research on a macro level and grows continuously without any gaps (see Figure 2).



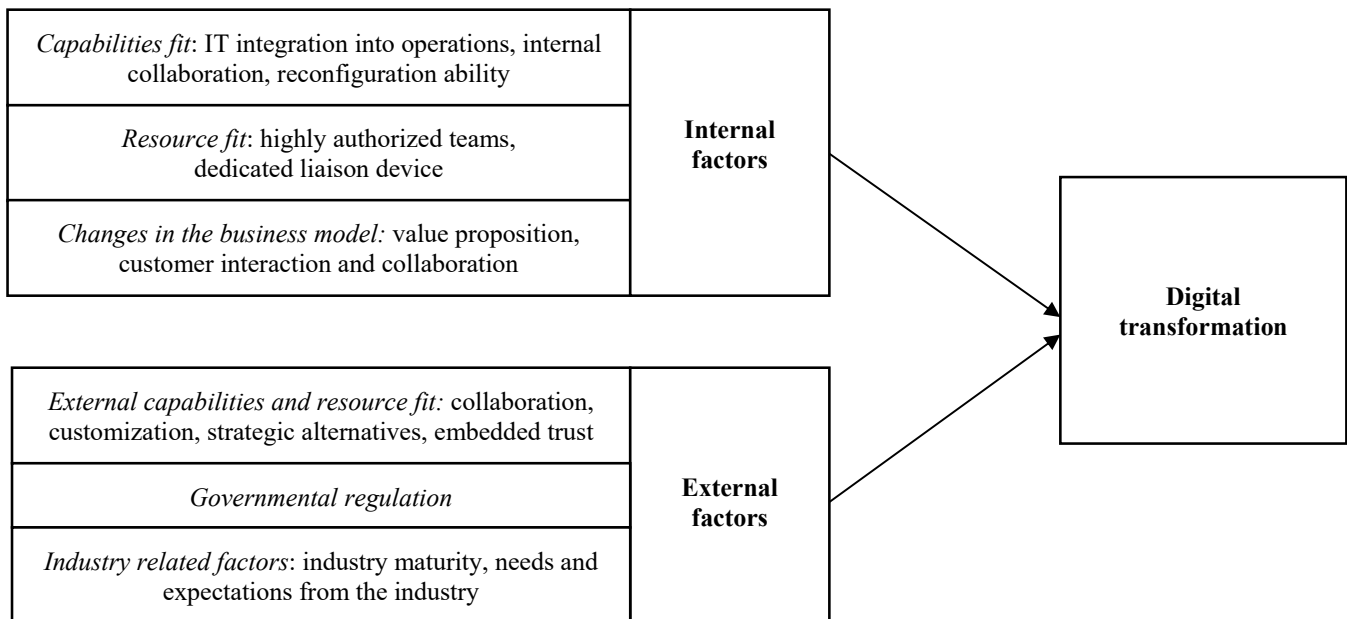
Source: This study.

Figure 2. Development of the research field on digital transformation and factors affecting it

The first step of qualitative analysis was on eliminating articles without available full-text files, research not about digital transformation in general, research about the internal structure of digital transformation instead of factors that determine it or individual factors. Further analysis of factors of digital transformation included 13 articles. The results are presented in the next section.

Factors Affecting Digital Transformation of SMEs

Summarizing the main results of qualitative research performed seeking to identify factors potentially affecting the digital transformation of SMEs we were able to list a set of main factors and to categorize them into internal and external factors (see Figure 3).



Source: This study.

Figure 3. Internal and external factors affecting digital transformation

Research results revealed **three groups of internal factors** that we identified as capabilities fit, resources fit and factors related to changes in the business model.

Capabilities fit. As Reis et al. (2018) observed, successful digital transformation requires a company to develop a wide range of capabilities, which will vary in importance depending on the business context and the specific company's needs. According to Liu, Chen, and Chou (2011), for a successful formation of capability fit an ability to integrate information technology into operations and collaboration between enterprise's departments as well as reconfiguration agility are critical aspects. Moreover, research

results revealed that information technology integration requires both - technological and strategic development (Bondar et al., 2017; Gölzer & Fritzsche, 2017; Kettunen & Laanti, 2017; Liu, Chen, & Chou, 2011; Remane et al., 2017). Therefore, reconfiguration agility based on Liu, Chen, and Chou (2011, p. 1738) “*refers to a firm’s flexible capability to embrace organizational structures, information systems and mindsets*” signifying the importance of organizational changes during the process of digital transformation.

Resources fit. Internal resources fit mainly refers to a dedicated liaison device and highly authorized team. Importance of dedicated liaison device is signified in the context of coordination and promotion regarding new structures of enterprise (Liu, Chen, & Chou, 2011). Remane et al. (2017) also emphasize the importance of the complex ecosystem of multiple actors. In other words, guaranteeing communication and sustainable relations among enterprise’s interface, existing service platforms and organizing model. Nonetheless, internal resources fit a highly authorized team is crucial (Bierwolf, 2016; Krüger & Teuteberg, 2016; Liu, Chen, & Chou, 2011). Moreover, Weber, Butschan, and Heidenreich (2017) explain the role of the highly authorized team by identifying the necessary competencies of human resources – cognitive, social and processual competencies - seeking successful digital transformation.

Changes in the business model. Another internal factor related to the success of digital transformation is necessary changes in the current business model (Berman, 2012; Kaltum, Widodo, & Yanuardi, 2016; Krüger & Teuteberg, 2016; Remane et al., 2017). As the core essence of business model is related to its value proposition and relations with customers, reshaping value proposition (Berman, 2012) and improving customer interaction and collaboration (Berman, 2012) through adjustments and changes in existing and potential customer contact points (Remane et al., 2017) are identified as main changes of business model that have an impact on overall business model and on the process of digital transformation.

Based on the results of the literature review we identified **four groups of external factors** potentially having a significant impact on the digital transformation of SMEs: capabilities fit, resources fit, government regulations and industry related factors. Noteworthy, external factors in the context of the digital transformation of SMEs have been significantly less addressed in scientific literature and therefore, identified external factors are reasoned only by a couple of scientific sources that have been included in the systematic analysis of the literature review.

External capabilities fit, and resources fit. Based on the results of a thorough analysis of performed case study, Liu, Chen, and Chou (2011) state that such external capabilities as collaboration and customization are crucial. According to Liu, Chen, and Chou (2011, p. 1736) “*collaboration is a recursive process whereby two or more organizations work together toward a common goal.*” Moreover, an effect of synergy achieved through the collaboration between different organizations also can be interpreted as a facilitator of digital transformation in SMEs. Factors of customization are directed to the ability to differentiate products or services based on the needs dictated by the market. As for the external resources fit, company’s historical path (existing strategic alternatives) and embedded trust (confidence in the reliability of another organization) may have an impact on the success of the digital transformation (Liu, Chen, & Chou, 2011).

Government regulations. Krüger & Teuteberg (2016) identified government regulations as one of the most important external factors impacting the process of digital transformation in the company. **Industry** related factors such as maturity of the industry (Krüger & Teuteberg, 2016) or specific needs and expectations of the industry (Biahmou et al., 2016) are also significant in the context of digital transformation. Noteworthy, these external factors were least analyzed in the selected papers. Therefore, further analysis and valence of the impact on digital transformation should be identified in the future research.

CONCLUDING REMARKS

Digital transformation is a highly relevant phenomenon though research into it is still rather young. Overview of the literature to date revealed that the implementation of digital transformation leads to multiple benefits for SMEs, large enterprises, and entire industries/economies alike. It can be concluded, that digital transformation could enable innovation, result in cost savings and increased productivity. Nevertheless, the total commitment of companies (especially SMEs) internally, as well as external alignment, are needed to reap those benefits. As SMEs have a significant impact on industry/economy, it is relevant to identify the factors that determine the implementation of the digital transformation of SMEs.

Systematic analysis of research publications on factors affecting digital transformation indicated rapid growth of interests in digital transformation topic over the past few years. Qualitative analysis to identify factors potentially affecting the digital transformation of SMEs enabled us to identify a set of main factors and to categorize them into internal and external factors. Internal capabilities fit, resources fit, and factors related to changes in the business model were identified as three main internal factor groups. As of external, following groups of factors were found: external capabilities fit, resources fit, government regulations, and industry related factors.

It is worth noting that the results of the literature analysis indicate that research to date has significantly less addressed external factors in the context of the digital transformation of SMEs. Therefore, in future research more attention should be dedicated to investigating external factors and their impact on the digital transformation of SMEs.

Main limitations of the research presented in the paper are the use of one term “digital transformation,” and a single database, which might have resulted in missing important, relevant research. A literature analysis additionally covering other academic databases and including synonyms or other terms used instead of “digital transformation” might result in different and more comprehensive outcomes. The factors identified by systematic literature analysis should still be tested and verified by empirical research. Further efforts to identify the main factors affecting the digital transformation of SMEs could also consider the findings of practitioners supporting the digital transformations, especially ones of SMEs.

ACKNOWLEDGMENT

This research was supported by the Research, Development and Innovation Fund of Kaunas University of Technology (PP32/1809).

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Improve Production Process Performance By Using Lean Management — A Case Study of Lady Underwear

(Full Paper)

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ABSTRACT

People around the world work every year to improve the requirement standards of various commodities. Product life cycles are getting shorter, replaced by a number of innovative products; thus, in order to adapt to social changes, companies must develop a number of innovative products to attract consumers to buy. In Taiwan, most development occurs in small and medium traditional industries. Women's underwear is a personal privacy product. As women are gradually being taken more seriously, women's underwear products are gradually increasing in value, but the women's underwear and underwear fabric design process is quite complex and time-consuming. To help enterprises improve production performance, this study introduces lean enterprise management, using IE tools for program analysis, which provides time to study the law, and 7S management practices, identifies problems, and proposes ways to improve in order to verify the practices and analysis of results. Research pointed out that introducing lean management for enterprises to improve process performance, so that women's underwear product processes achieve significant improvement, improved results as follows: Before and after the improvement, GAP reached 23.83%; product production time was reduced; employee take line operation time reduced; quantization benefits of \$1,909,425 improved the efficiency to \$1,023,225, putting the cost at \$106,200; and table bad rate increased the cost by \$780,000. These results show that in the present study, lean management practices successfully improved the production performance of the women's underwear industry included in this study. It is expected that the process improvements can provide a method for the lingerie industry to continuously improve and succeed in raising the performance feedback of employees to increase cohesion so that the company reaps more profits and benefits.

Keywords: Women's underwear industry, lean, 7s, program analysis, time study.

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INTRODUCTION

The global population and average number of people is increasing, gradually increasing daily necessities and other needs. The majority of demand is in the international market, so the industry has been actively developing new products and new equipment. The textile industry is currently Taiwan's industrial structure, the most complete production system, and is one of the main functions of the consumer market of textile raw material supply sources. Women in modern society pay more and more attention to lingerie fabrics, quality, and style, resulting in transitions in women's underwear brand products being sought in other ways. Product research and development performance, functionality, real-time market changes, the brand and needs of manufacturers, and other raw materials and materials have led to a certain amount of stock, likely to cause a huge increase in stock, for which management is not easy, leading to warehouse clutter and increased warehousing and staff time to pick up. In order to increase the competitiveness of enterprises, shorten production time, and reduce input costs to improve the process-oriented research for underwear and key job development projects, this project wants to help manufacturers effectively enhance corporate performance, creating a win-win situation for manufacturers and customers.

The objectives of this study are as follows:

1. Use 7S management practices to straighten, sweep, clean, ensure quality, ensure safety and conservation, and improve warehouse site problems.
2. Use 7S management and the existing management infrastructure to make certain adjustments, which will also ensure that underwear production site management achieves a certain level so that the whole production system uses a lean management system for continuous improvement.
3. Introduce lean management concepts to improve the company's visibility and demand and reduce unnecessary problems.
4. Use IE's seven tools program analysis method and time study to reduce waste and improve the underwear production line to improve the manufacturing process.

BACKGROUND

The content of this section is divided into the textile industry, women's underwear industry, lean management, PDCA, 7S management practices, IE's seven tools, lean management literature, the textile and garment industry, textile policy analysis, and manufacturing processes. The current status and evolution of some women's underwear industries, mainly in Taiwan, will be provided, as well as the main content of lean management, PDCA, 7S, IE's seven tools for documentation methods and techniques, literature, and finally, lean management applications in different fields of information to provide a clear understanding of how lean management works.

2.1 Textile and Clothing Industry SWOT Analysis

Superiority (Chung, 2015):

- Construction of a complete system supplier, in close connection with the upstream fiber, yarn, and fabric of the supply chain to ensure a fast response.
- Solid industry clusters, focusing on strategic alliances and technical cooperation to improve the hardware and software infrastructure, as well as a good investment environment.
- In recent years, the government created four modernizations of industry policy.

Weakness:

- Output is concentrated in the upper reaches of export-oriented, competitive prices vulnerable to fluctuations in climate impact.
- Innovative research and development and design of marketing talent, as well as inadequate investment.
- Mostly take orders OEM mode operation; lack of international brands and sales channels.

Opportunity:

- Fast fashion market rise, shorter product life cycles and increased demand for underwear.
- Growing importance of the governance of traditional industries.
- Foreign manufacturers come to Taiwan, commissioned by the processing and opportunity to increase cooperation.
- Consumer brand loyalty is not high; thus, enhancing the product's advertising and promotional activities to attract consumers is important.
- Cooperative education and cultivation of underwear design talent; transition from the OEM ODM own underwear brand, with international visibility and easy access to international markets.

Threat:

- Environmental issues derived from green trade barriers.
- The rapid rise of emerging countries such as China and Southeast Asian countries, the garment industry, and heavy investment in fiber raw materials, production technology, and low-cost products to China pose a threat.
- Internationally signed FTA with the RTA increases the pressure on China's exports.
- Taiwan businessmen can set up factories overseas, ensuring overseas transfer of production technology to local competition and the formation of the Taiwan situation.

2.2. Clothing Industry Manufacturing Process

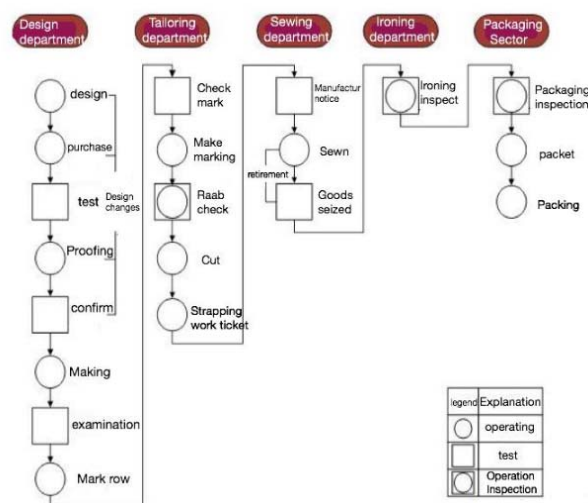


Figure 2.1 Clothing Textile Process Diagram
(Taiwan Textile Foundation, 2015)

2.3. Lean Management

Katayama and Bennet (1996) gave a brief definition of lean production, stating that “lean production is a dynamic system,” which requires less investment of resources, but it can get better, yielding high added value. This refers to a dynamic system; for example, Toyota implemented the Toyota Production System, as shown in Figure 2.7, which involves six main processes: (1) lean design, (2) lean supply, (3) lean manufacturing, (4) lean distribution, (5) lean, and (6) mining value. With these six processes and continuous improvement of the rotation, plus the five principles of lean, lean production forms the entire structure to achieve minimal investment to create products with high added worth.

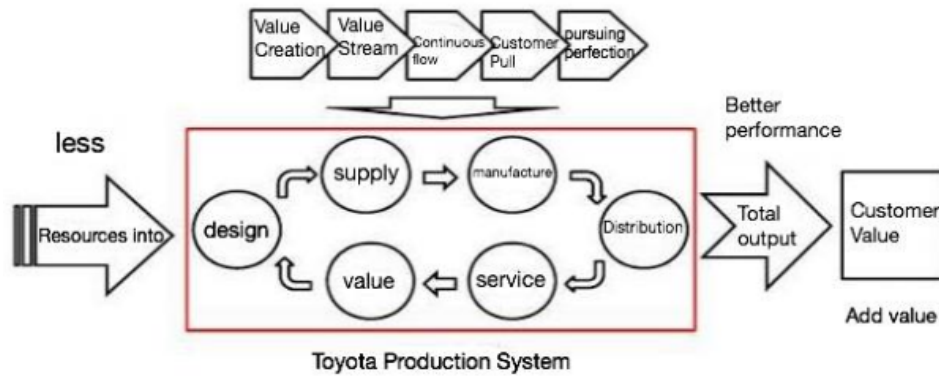


Figure 2.2 Lean Production System Diagram

2.3.1 Five Principles

These six processes and continuous improvement of the rotation, plus five lean principles—(1) value, (2) value stream, (3) flow, (4) pull, and (5) perfection—form the entire lean production structure to achieve the minimal investment to create products with high added worth (Womack and Jones, 2004).

2.3.2 Seven Wastes

The spindle lean production system was developed by the Toyota Production System founder, Ohno (1912-1990), called the father of Japanese resurrection and the production management godfather by the Japanese. He categorized the seven wastes as follows: (1) manufacturing excessive waste, (2) waiting, (3) waste handling, (4) processing itself, (5) inventory of waste, (6) the action of waste, and (7) producing undesirable waste.

2.4. PDCA (Plan-Do-Check-Action)

The PDCA (Plan-Do-Check-Action) cycle is a quality management cycle developed by the American scholar W Edward Deming to ensure the goal of reaching reliability and thus promoting continuous quality improvement. It is usually used to improve product quality and the production process.

- (1) Plan: Establish a clear vision, develop relevant programs, and determine the necessary procedures.
- (2) Do: This step is performed on the specified plans and procedures to collect the necessary information to provide the basis for further amendments and improvements.
- (3) Check: Product reliability assessment and evaluation of the reliability of operational control and auditing. This step involves collecting information on the research, design, and expectations to compare. These differences are the next step in the necessary data assessment.
- (4) Act: Between various operating units of the reliability of work coordination, improvement measures are set to improve the implementation of actions. This step is performed to find ways to reduce the considerable gap between program objectives and the implementation process, so that the next scheduled process will become more perfect.

2.5 7S Management



Figure 2.3 7S Schematic

2.6 IE's Seven Tools

The basic technique is motion study developed by the parent of industrial engineering (Taylor, 1911). These two inventions are based on an extension of the development so far. Practical work, continuing to use a variety of knowledge, discover, analyze, and summarize is summarized in the seven field engineering tools to improve the common methods, or IE's seven tools.

2.6.1 Process Analysis

The following questions (5W1H) are usually asked based on the analysis of the selected job regarding object, place, time, personnel, and methods: (1) Why, (2) What, (3) Where, (4) When, (5) Who, and (6) How. This is combined with the four ECRS principles (delete, merge, rearrange, and simplify) to improve and find smoother working practices and workflow.

2.6.2 Time Study

Taylor (1911) pursued a fair standard to measure the time required for a variety of work and training workers to work at a predetermined speed, thereby obtaining the most efficient results. The research was to determine the time required for one reasonable method of workload; time was the ultimate goal of the research. Considered a reasonable workload for both employers and employees as fair. In addition to a reasonably wide release time, employees should be committed to the implementation of production operations and abide by the established methods of work in order to obtain reasonable remuneration.

2.6.3 Motion Study

This is a subtle analysis of human movement during the operation of a variety of work, aimed at eliminating redundant operations to make the operation easy and effective to improve efficiency and reduce worker fatigue, as well as to develop best practices. Operator action will be implemented in order to record with a specific mark the hand and eye as the center of the human body in motion content to grasp the actual situation, and the recording of the chart is a basis to determine the action as good or bad to find a way to improve the focus of the analysis.

2.6.4 Work Sampling

This is the use of sampling methods of observation dispersed quickly and effectively to understand the truth of the matter and develop ways to improve. The main application checks the work setting and works to improve the standard time in practice. The work sampling method and time to study the law code table method are very similar; the differences in the code table method are the continuously short observation period of the operator or machine operations, application of high and repetitive short weeks away work, work and checking randomly over a long period, and decentralized earth observation of operator or machine, which is more suitable for non-repetitive jobs or longer work week processes.

2.6.5 Man-Machine Chart

This is a graphical study to explore the worker and machine operation process and to record and conduct further analysis to improve the waiting time to find out the working balance, reduce cycle time, maximize machine utilization, properly assign personnel, and determine the most appropriate method.

2.6.6 Foolproof

This is prevention of common life careless errors to prevent the risk of error and determine a foolproof mechanism to apply to the mechanical operation of the workplace, the general life of the product, and even word processing. The basic principles include the following four points: (1) make the job operation easier, (2) does not need to make the job skills and intuition, (3) ensure that the job is not in danger, and (4) ensure that the job does not rely on the senses.

2.6.7 Line Balance

Based on the job engineering sequential pipeline operations, the production target is calculated cycle time, split the job, or in combination; the load of each step is averaged to remove the production process of handling or stagnant waste, thereby producing a smooth flow to increase productivity. This is done to achieve the production line balance rate and per capita production increase, unit product cost reduction, and other results.

RESEARCH METHODS AND PROCESSES

3.1 Lean Management Import Steps

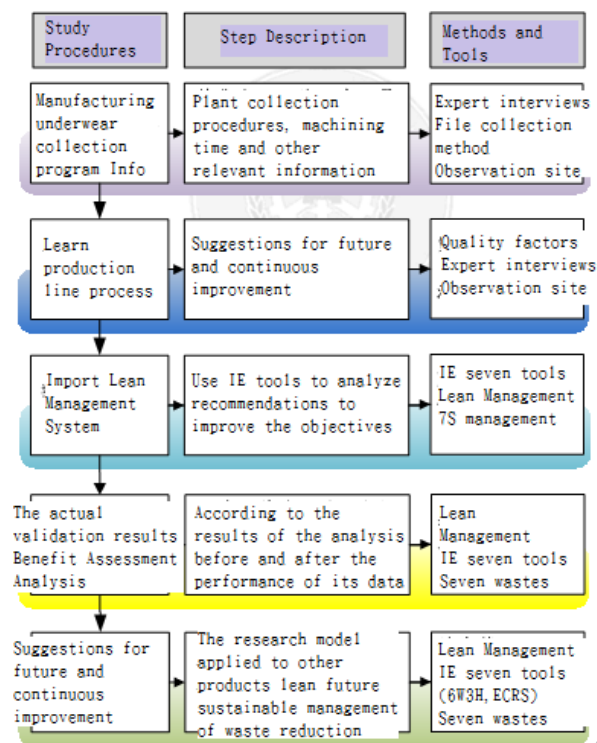


Figure 3.1 Study Flowchart

3.2 Lean Management Analysis Step

Step 1: Integrate lean management activities into the system. Step 2: Use IE's seven tools and look for value improvement tools after determining improvement targets. Step 3: Conduct application analysis of the target workstation job, as well as deeper analytical work.

Table 3.1 6W3H Asked France

6W3H	Question
Why	Why is this being done (purpose)
When	When should it be done (time)
Who	Who will execute it (equipment/person)
Whom	Who are the customers (Wacoal/case company)
Where	Where should it be implemented (place/position)
What	What to do (objects)
How	How to do it (method)
How much	How much does it cost (funding)

How many	To improve several production lines (program)
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Table 3.2 ECRS Analysis

ECRS	Explanation
Eliminate	Is it necessary? Why?
Combine	If the work cannot be canceled, you can consider the possibility of merging with other work.
Rearrange	Rearrange the order of the work.
Simplify	Simplify all work content and procedures.

Table 3.3 Program Focus Analysis

Engineering	Focus	Investigation of major projects
Overall	Is there a project that can be excluded?	Process number
	Are there workstations that can be combined?	Processing time
	Can you simplify the process?	The number of processes
Process	Is the process necessary?	Processing time
	Can you merge processes?	
	Can you change the order of processing?	
Examination	Is there a need to check?	Inspection method Check the time
	Will each product need to be checked?	
	Check whether the standards are appropriate. Can you reduce the number of inspections?	
Wait	Is there a long wait?	Waiting time
	Can the waiting time be eliminated?	Waiting times
Transport	Can you reduce the transportation distance?	The transportation distance
	Can you reduce handling times?	Handling times

WOMEN'S UNDERWEAR LEAN MANAGEMENT CASE VERIFICATION

This study focuses on the women's underwear industry in order to verify the substantive improvement in the status of the plant as a case study.

4.1 Case Company Profile

Founded in 1922, it is located in Taichung, and the brand is currently approached in the absence of the ability and talent development stage. The company is primarily an OEM manufacturer, one of Taiwan's traditional industries, and lacks a lot of work. It is focused on human services and the electronics industry. For the sake of innovation, the company completely eliminated the old employees and machines and shaved preconceived notions from OEM transformation into ODM to lay the foundation for the successful transformation of the case company. In response to the dramatic changes in the international competition, and internal and external business environment constraints, the case company's future development strategy is as follows:

1. The development of differentiated, multifunctional, and other products
2. Emphasis on innovation and design creativity
3. Development of own brand

4.2 Improvement Objectives

The case company's product categories are: recoil, pajamas, functional, health, clothing, standard, and numerous models of standard underwear products for maximum yield. Underwear is the company's biggest case and most stable product, so this study uses the case company's standard underwear products as the research object.

4.2.1 Before Improvement

This study will collect the required information as follows:

1. The working time of each workstation and employees: The factory production line time is 11 hours per day, minus one hour per day for meal breaks, which equals 10 actual working hours; after deducting machine malfunction, staff rest, maintenance, repairs, etc., the company's production capacity can be obtained, and gathering the actual number of jobs for each project personnel

member to improve workstations is required.

2. Product process will go through another workstation: This study will improve the target set for the standard underwear products and the understanding of the production process to collect information about the production line to better ensure that nothing is missing.
3. Standard underwear production process time: This study will improve the production of standard underwear products, provide in-depth understanding of the production process, and track the process of working hours, using the code table method of field to field observation. The observation environment must be comfortable, it must be easy to move, and it should not affect the position of product processing and operator work. After completion of the data collation, calculation will be conducted.
4. The sewing machine changeover time: The products of the case company come in many colors. In accordance with the manufacturer for replacement of wires of different colors, this study will record the time to take the wire and the wire change time; the multi-pen will be used to represent the average changeover time.

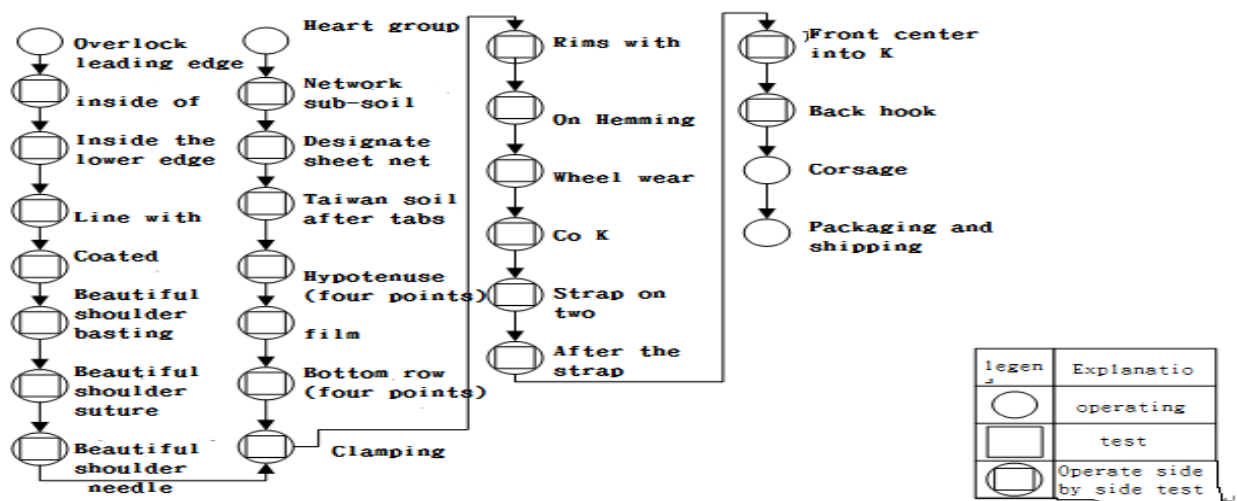


Figure 4.1 Flowchart of Standard Products

4.2.2 Causes and Methods

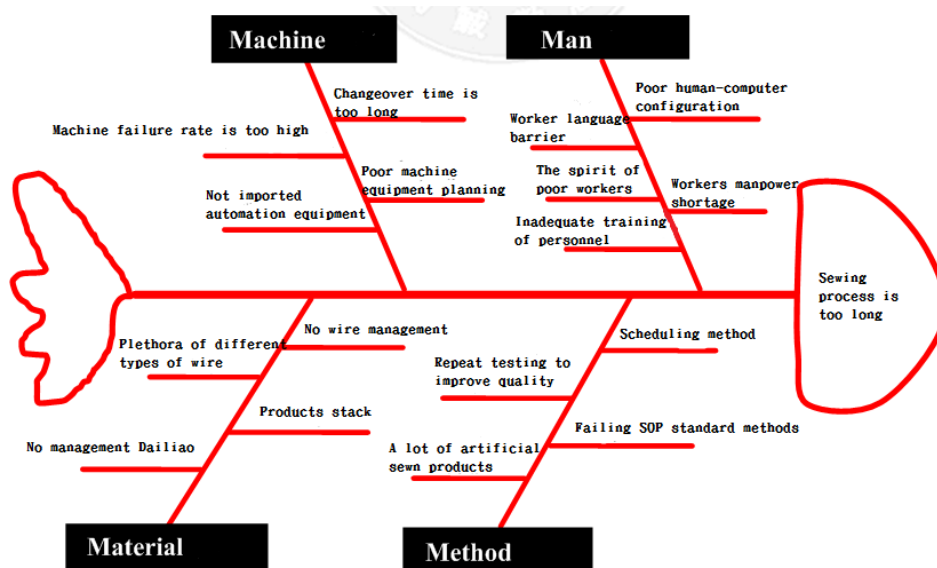


Figure 4.2 Process time characteristic fishbone diagram

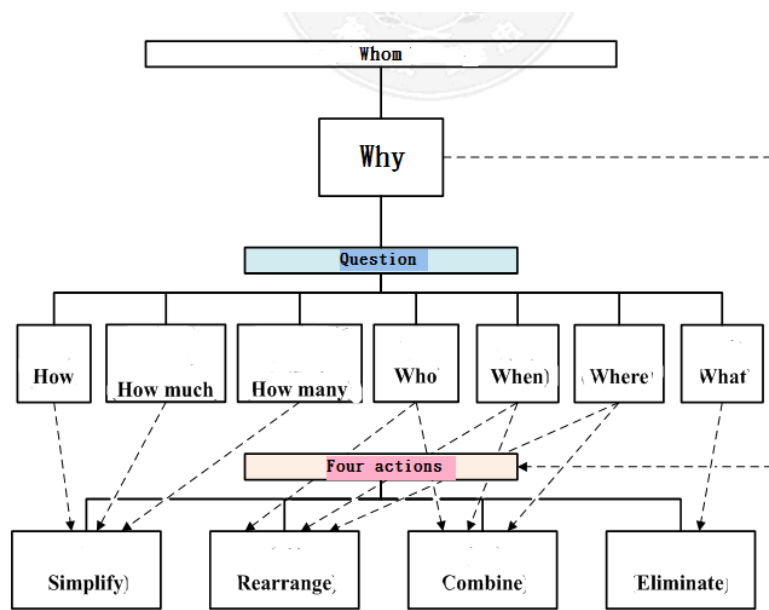


Figure 4.3 IE's seven tools and 6W3H-ECRS

4.2.3 After Improvement

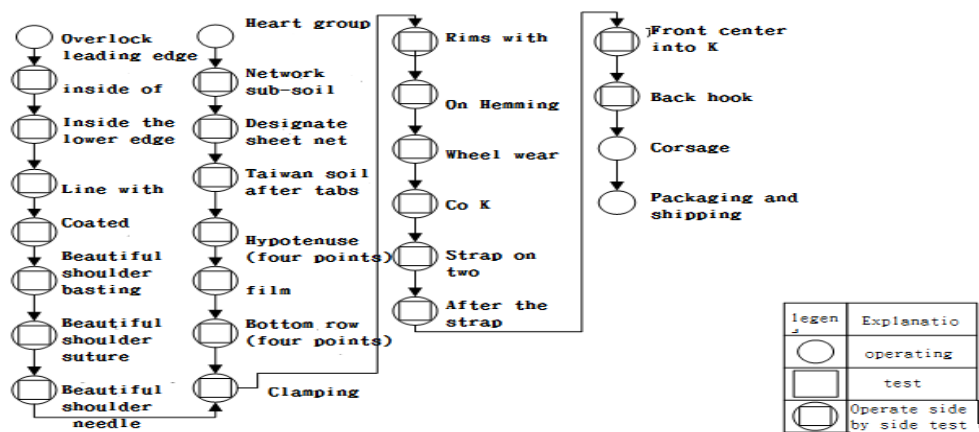


Figure 4.4 Pictures of improved operating procedures

4.3 Summary

This study will improve the target set for the production of the maximum number of products using program analysis to find out the case company's problem, determine the desired characteristics because of FIG rendering problems, measure the flow of work through the code table method along with the use of 7S management improvement, and finally, use the operation FIG procedures and processes to improve the program chart, comparing the difference between the front and rear to give the following results:

1. Improve underwear production performance.
2. Reduce the sewing machine to replace the wire operating time.
3. Improve the effectiveness of \$1,023,225 to \$1,909,425, quantify the benefits, costs \$106,200 investment, and enhance the rate of adverse cost to \$780,000.
4. Strengthen the concepts of the traditional industries of industrial engineering and lean management to enable enterprises to successfully implement continuous improvement and improve production performance. Related industries will want to study this model, which can be applied to other products to ensure smooth production.

Based on the above analysis, internal management attaches importance to management efficiency and stability, and it matches base type. Product service needs to attach importance to product quality and service diversity at the same time, and so it is suitable to

adopt follow-up type. External management is suitable for innovation type to cope with a rapidly changing market.

CONCLUSION AND SUGGESTION

5.1 Analysis Conclusion

The results of this study show that introducing the lean management system successfully reduced production time for the enterprise products, eliminated inventory waste, and improved corporate reputation while increasing the competitiveness of enterprises. The conclusions are summarized below:

1. The program can be used as a result of analysis with a characteristic diagram clearly showing the manufacturing process and waste issues, which suggests improvements and solutions.
2. The present study confirms that the company is introducing lean management cases successfully to resolve the problem and reduce changeover time for sewing machines; sewing machine changeover time reduced working time by 1296.60 seconds.
3. Regarding the company's production line, in terms of re-examination process improvement, production of each standard pair of underwear was reduced by 15.01 seconds, and the product production time was reduced by 3.3%.
4. The data will improve the results of cost-benefit, for which the quantization efficiency of \$1,909,425, \$1,023,225 to improve efficiency, input costs \$106,200, \$780,000 non-performing rate increased cost.

5.2 Study Suggestion

1. To improve the results in order to reduce the inventory, take line operator operating time, product testing time, and waste that may occur in other processes, further research can be conducted.
2. This study will improve the standard set underwear products. In the case that there are still many other products that have not improved, future researchers can explore different types of products.
3. The labor shortage has been the company's problem; the future of the company may involve the introduction of automated machines and auxiliary staff to manufacture products while lowering the rate of human action, improving production efficiency in order to cope with market changes.
4. It is recommended that the company involve computer and software companies to facilitate the management and use computer management for raw materials inventory, real-time inventory updates, inventory control, and reducing the waste of raw materials.
5. Visual management and board management can be used to enable staff to track the real-time status of the statistical production line, and production line staff can prepare the site in advance in order to promptly to solve problems.

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Influence of Media Richness of E-WOM on Consumers' Mental Imagery and Attitudes

(Full Paper)

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ABSTRACT

E-WOM has become a hot research topic. Based on the theory of media richness, this paper divides online reviews into three types according to the degree of e-WOM richness from low to high - "text", "text + image" and "text + image + video". From the perspective of mental imagery, this paper explores the consumer attitudes of these three kinds of reviews with different richness. The Experimental data analysis shows that compared with "text" reviews, "text + image" reviews have more significant impact on consumers' metal imagery and attitudes; as a form of high richness e-WOM, "text + image + video" has the most significant impact on consumers' metal imagery and attitudes. This discovery points out several meaningful directions for the further study from the perspective of media richness.

Keywords: Media richness; video review; mental imagery processing; attitudes

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INTRODUCTION

As an important part of e-WOM, online reviews are once regarded as an important part affecting product sales (Chevalier & Mayzlin, 2006). In addition to the product information displayed by merchants, product reviews on e-commerce websites affect consumers' perception of products (Klein, 1998). Research on the impact of reviews on consumers found that more than half of the respondents believe that online reviews have an important impact on their purchasing behavior. When product information is limited, consumers are more likely to refer to product reviews (Dai & Gu, 2017). Scholars have also done a lot of research to verify that marketers need to spend a lot of time and energy managing online reviews to meet consumer expectations (Qin, 2017).

With the development of the Internet, the speed and cost of uploading mobile short video is comparable to images. Social software Twitter, micro-blog and other short video sharing functions have been introduced. The development of mobile short video has brought the audience into the "second image reading era" (Chen & Xie, 2008). The mobile short video in UGC mode has maneuverability and authenticity, and can better meet the personalized needs of consumers (Dellarocas, 2003). Compared with words and images, mobile short video has a stronger appeal in information expression and is easier to produce. In view of the impact of mobile short video on users' decision-making process, major shopping platforms gradually introduce mobile short video reviews. Through dynamic video display products, consumers who browse reviews bring more sensory impact.

Online reviews have undergone an evolutionary process from lean to rich. Early studies on e-WOM mostly focused on single text reviews, and then evolved into a combination of image and text reviews. Since June 2017, China's largest C2C trading platform-Tianmao has allowed customers share their shopping experience by short video reviews, thus opening the domestic online video review market. Compared with traditional text and image reviews, video reviews allow publishers to have a more sophisticated channel to express their perception of the product, bringing other consumers a richer sensory experience. Now the research on the impact of image reviews and text reviews on consumers has been relatively mature. However, "text", "text + image" and "text + image + video" as different types of online review media richness, the impact of consumer attitudes and purchase intention differences is relatively scarce. Based on the perspective of mental image processing, this paper explores the impact of three different kinds of reviews on consumers' attitudes. We use Anova to analyze the effects of three types of reviews on consumer's affective attitude, cognitive attitudes and mental imagery processing. This article collects data through contextual experiments, and the marketing management inspiration is drawn finally.

LITERATURE REVIEWS

Research on the Influence of e-WOM Represented by Online Reviews

Scholars have done a lot of research on the impact of e-WOM, represented by online reviews. Since this paper mainly studies the impact of media richness of e-WOM on consumers' purchase intention, the following first discusses the impact of media forms of e-WOM. According to the different forms of e-WOM media, the corresponding research roles can be divided into

three categories - text reviews, image reviews and video reviews. Based on the research of text reviews, scholars have done a detailed and in-depth study on the impact of the quality of reviews, the number of reviews, and the validity of reviews (Song Yafei, Wang Xiuqin, 2011). On the research of image reviews, scholars have studied the consistency of image and text reviews. It is pointed out that the consistency of image and text reviews have obvious influence on consumers' purchase intention (Smith R A, 1991), and the ratio of image and text superposition reviews. Individual text reviews are more useful, and image reviews have a more significant impact on consumers' purchase of sensory products than non-sensory products (Lin Shuang, Lü Xingyang, Song Huilin, 2017). Compared with traditional text reviews and image reviews, video reviews presents relatively real visual information, expresses the user's experience of using the product in a dynamic and fluent way, and has an important impact on the perception of reviewers (Xu, Chen & Santhanam, 2015). Previous studies have involved text, images and video reviews, text reviews and image reviews are relatively mature, but the comparative study of video, image and text reviews on consumer impact differences is relatively lacking.

The Influence of Different Forms of Information on Consumer Behavior

Consumers often reference all kinds of information to assist their purchase decisions. The way information is presented has different effects on consumers, which can be categorized into verbal information and visual information. Formally, text is usually used as the representation of linguistic information, images as the representation of static visual information, and video as the representation of dynamic visual information. Rossiter believes that visual information has a dominant effect on human memory, which can trigger the processing of psychological images and enhance the memory of images (Rossiter, 1982). Babin found that the more specific visual information is, the more elaborate the processing that triggers self-imagery (Babin & Burns, 1997). The study of Bone indicates that situational credibility refers to the possibility of consumers imagining themselves in this scenario. The higher the credibility of the situation, the higher the self-relevance of consumers, and the higher the degree of mental image processing (Bone & Ellen, 1992). Yoo and Kim (2014) explored the impact of the degree of specificity of visual and linguistic information on consumers' perceptions, arguing that specific words and images will promote consumers' mental imagination, thereby creating better emotional perception. However, other scholars believe that Visual information only exists as an auxiliary role in the actual purchase process (Hughes et al., 2003). When there are many kinds of products, visual information will distract consumers' attention, and cannot quickly find useful product information, which is not conducive to consumer decision-making (Townsend & Kahn, 2014). Therefore, there are still many controversies about the influence of linguistic and visual information on consumers.

HYPOTHES AND MODELS.

Media Richness Theory (MCT) discusses whether a medium has the ability to transmit rich information (Daft & Lengel, 1986). Bodensteiner (1990) argue that whether the medium is rich or lean depends on its ability to share meaning. E-WOM is essentially a kind of mass communication. The richness of E-WOM is mainly distinguished by transmitting multiple clues and using the level of natural language. Individuals are influenced by two factors, equivocality and uncertainty, which determine their media choice behavior (Daft & Lengel, 1983). Fuzziness refers to the ambiguity of information (the sender and the receiver have different interpretations). Uncertainty refers to the gap between the amount of information needed to solve the problem and the amount of information possessed by the receiver due to the lack of information between the two parties (Mintzberg, 1981). Therefore, people face different information content and communication purposes, in order to reduce uncertainty and fuzziness, according to the amount of information carried by the media and the characteristics of the task to be handled as the basis for choice.

According to the definition of media richness, "text" reviews correspond to low-level e-WOM richness and can only convey linguistic information; "text + image" reviews correspond to medium-level e-WOM richness, which can not only convey linguistic information but also image information; "text + image + video" reviews correspond to high-level e-WOM richness can not only convey linguistic information, but also dynamic and fluent visual and auditory information.

Online reviews are generally referential as consumers' objective statements of products. Compared with simple "text" reviews, "text + image" reviews and "text + image + video" reviews contain both linguistic and visual information. Compared with single linguistic information, visual information can promote consumers to imagine their own use of the product scene, and enhance the psychological image processing of consumers (Rossiter, 1982). At the same time, the presentation of visual information is more intuitive and vivid, closing the distance between consumers and products, attracting consumers and promoting consumers' desire for products (Kim & Sharron, 2008). The combination of linguistic information and visual information can be considered to contain more information than single linguistic information. The multiple information makes consumers better understand information, reduces the uncertainty of product purchase, and has a clearer understanding of the product (Xu, Chen & Santhanam, 2015). Therefore, we put forward the following hypothesis:

H1: Compared with the WOM in the form of "text", the WOM in the form of "text + image" has a greater impact on user's mental imagery processing (H1a), affective attitude (H1b), cognitive attitude (H1c)

H2: Compared with the WOM in the form of "text", the WOM in the form of "text + image + video" has a greater impact on user's mental imagery processing (H2a), affective attitude (H2b), cognitive attitude (H2c)

Compared with "text + image" reviews, "text + image + video" reviews contain dynamic and fluent images, sounds and so on. The use of both linguistic and visual information is conducive to enhancing the effectiveness of information. Video, as a

higher-level form, will attract more attention from consumers (Connolly, 1980). Dynamic scenes and the fluency of the images make it easier for consumers to produce "visual depiction effect", imagine the scene of self-use products, and enhance the psychological image processing of consumers (Daft & Lengel, 1986). At the same time, the dynamic video screen switching, color, sound will attract consumers, promote the emotional experience of consumers, thus promoting their affective attitude. In addition, video contains more visual information, which can promote consumer's perception of the credibility of reviews, increase the persuasiveness of reviews (Xu, Chen & Santhanam, 2015), thus promoting consumer's cognitive attitude. Therefore, the following assumptions are made:

H3: Compared with the WOM in the form of "text + image", the WOM in the form of "text + image + video" has a greater impact on user's mental imagery processing (H3a), affective attitude (H3b), cognitive attitude (H3c)

In summary, the conceptual model in this paper are as follows:

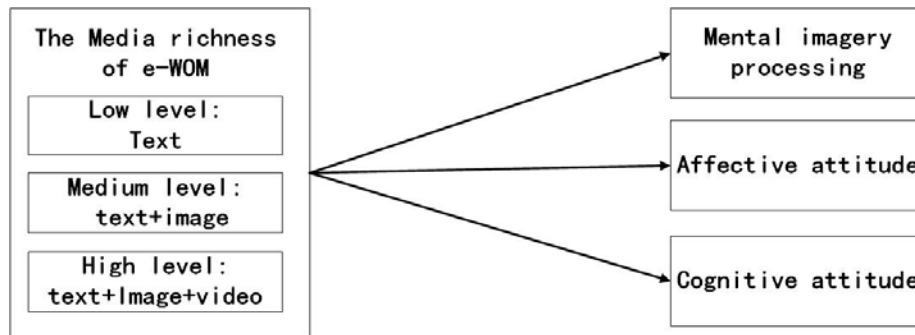


Figure 1: Conceptual Model.

EXPERIMENT PROCESS

In order to improve the validity of the formal experiment, it is necessary to screen the product type and experimental materials before experiment. Although product classifications are still widely accepted and discussed in the marketing literature, the relationship between search and experience is increasingly blurred in the Internet environment (Huang, Lurie & Mitra, 2009). On the one hand, consumer reviews provide indirect experience about the sensory aspects of a product, enabling consumers to have a full range of experience information on the Internet, which to some extent reduces the differences in certain product types (Park & Lee, 2009). On the other hand, some users provide reviews that can convert experience attributes into search attributes. For example, the taste and taste of food. In addition to video games and cameras as the classic representative of experience products and search products, but also chose backpack as a pure search products and pure experience products in the intermediate products (Xu, Chen & Santhanam, 2015). Therefore, according to the above research summary, this article controls the product type this variable, uses the backpack as the research product.

After determining the product, the selection of experimental materials, in China's B2C shopping website trading scale market share, Tianmao Mall occupies an important market share. Therefore, from the Tianmao Mall platform to search for the key word "backpack" and select the comprehensive ranking of the first product, we found that the product page contains a comprehensive review feedback mechanism, the number of reviews reached tens of thousands, in line with the standards of the products surveyed in this paper. Five groups of Video Reviews of the corresponding products are selected from each product page, and one image reviews is intercepted from each of the five groups of video reviews. One text reviews is compiled according to the video reviews to control the same reviews length (50 to 90 words). In order to avoid the impact of reviews validity and control the reviews validity to be positive, the respondents were shown five groups of "text + image + video" reviews. The respondents were asked to score according to the consistency level (Smith, 1991). Thirty participants were invited to participate in a pre-experiment to assess the consistency of the content expressed in videos, pictures and text comments. These comments are presented to the participants in projection form. Each slide shows a video comment, an image comment and a text comment with the same content, allowing the participants to score using the Likert 5-level scale, 1 means "very inconsistent", 5 means "very consistent." According to the evaluation results, a group of "text + picture + video" comments with the highest degree of consistency (the highest score) was selected as the experimental material.

The study selected students from a university in Sichuan Province as the experimental sample. The number of valid questionnaires was 300. According to the level of Internet word-of-mouth richness, the experiment was divided into three groups of experiments, each of which collected 100 valid questionnaires. Using the scenario experiment method, it was conducted separately in three classrooms, and three different experimental materials of Internet word-of-mouth richness (high/medium/low) were displayed to the respondents, and they were asked to complete the corresponding questionnaire and give certain rewards.

First, the participants were told to imagine that they were in need of online shopping for a product, and that they had sufficient ability to pay to rule out the impact of the price. At the same time, in order to avoid the interference of brand preference, the experiment carried out image blurring and text avoidance operation on brand information. The respondents are screened by

asking "whether to shop online" and "whether to view comments when online shopping". If one of the two questions answers "no", the questionnaire will be invalid. The experiment then passes through the slides, which in turn presents the scenario guides, the basic description of the product to the product, and the online review of the product. Among them, the low media richness of the word of mouth is selected by the "text + picture + video" comment in the "text" part, the medium media richness of the word of mouth by the "text + picture + video" comment in the "text + picture" part, and the high media richness of the word of mouth is indicated by the "text + picture + video" comment. After reading the online review, the participants were asked to answer questions related to the study (see Table 1). All variables were tested using the Likert 7 scale, with 1 indicating a very low degree and 7 indicating a high degree. The measurement items were derived from the existing literature, as shown in the table below. All variables were tested using the Likert seven-level scale. The measurement items were derived from the existing literature. The scales are as follows:

Table 1: Measurement Scale

Constructs	Item	Source
Mental imagery processing	You can fluently think of the image you use the product	Zhao, Dahl & Hoeffler (2014)
	You can clearly think of the image you use the product	
	You can imagine how you use the product	
	You can imagine what it looks like after using the product	
Affective attitude	This product attracts you	Holman (1986)
	You like this product	Kim & Morris (2007)
	This product impresses you	
	If you buy this product, you will feel very satisfied	
Cognitive attitude	The material promotes your understanding of product quality	Holman (1986)
	The product information reflected in the material is true	Kim & Morris (2007)
	The product information reflected in the material is rich	
	The product information reflected in the material is very useful	

DATA ANALYSIS

Descriptive Statistical Analysis

Table 2: Demographic Analysis

Characteristic variable	Number of Features	Number	Proportion
Gender	male	138	46%
	Female	162	54%
Age	Under 18 years old	16	5.33%
	18-22 years old	131	43.67%
	22 years old or older	153	51%
Education level	Specialist	47	15.67%
	Bachelor	181	60.33%
	Master degree and above	72	24%
Total		300	100%

As can be seen from the table, the ratio of male to female students in this survey is 46% and 54%, respectively, and the ratio is basically the same. According to the survey released by China E-Commerce Research Center, the sex ratio of online shopping groups is basically equal in 2017, and both groups have great potential. From the age point of view, young people over the age of 18 account for a large proportion of the subjects, of course, this has a lot to do with the test environment for the university campus. From the perspective of education, undergraduate and master students account for more than 80% of the proportion, and the survey results published by the China E-Commerce Research Center show that college students have become the main force of online shopping.

Table 3: Online Shopping Frequency Distribution

Online Shopping Frequency	Number	Proportion
At least once a month	203	67.67%
Not at least once in three months	70	23.33%
At least once every six months	21	7%
At least once in more than half a year	6	2%
Total	300	100%

According to the survey data, the online shopping frequency of the respondents was analyzed. By analyzing the online shopping frequency data of respondents, it can be seen that most respondents have more frequent online shopping frequency, and the number of respondents who have at least one online shopping per month has reached 67.67%, at least once every three months. The proportion of respondents to online shopping has reached 91%, so it can be seen that the respondents are familiar with the environment and process of online shopping, and understand the role of consumer reviews in the online shopping process.

Reliability Analysis

The reliability of the questionnaire reflects the consistency or stability of the questionnaire results. Consistency measures whether the same content is measured by the internal topic. This paper mainly uses the indicators reflecting the internal consistency to measure the reliability of the data. Generally speaking, the reliability of the questionnaire is considered to be ideal when Chronbach's alpha (CA in the table below), factor load, composite reliability (CR) is greater than 0.7 and AVE is greater than 0.5. In this paper, SPSS software is used to analyze the data, and the relevant indicators are shown in the table:

Table 4: Reliability Indicator Values.

Variable	Mean (Variance)	CA	CR	AVE
Mental imagery processing	3.98 (1.504)	0.867	0.874	0.636
Affective attitude	4.03 (1.435)	0.811	0.866	0.619
Cognitive attitude	3.98 (1.646)	0.777	0.913	0.726

As shown in the table above, Chronbach's alpha (CA) of each construct is greater than the recommended critical 0.7, indicating a higher measurement reliability; and the comprehensive reliability (CR) is also greater than 0.7, and the average variance extraction (AVE) is greater than 0.5, indicating good consistency between measurements.

Validity Analysis

Validity reflects the authenticity of the questionnaire to reflect the problem. At present, the two methods of discriminant validity are: (1) Comparing the correlation coefficient and mean variance between constructions, the former is less than the latter, and the discriminant validity is good; (2) If the factor load of constructions is greater than the factor load of each index, the discriminant validity is good. In this paper, correlation coefficient and factor load among variables are obtained by SPSS software. As shown in the table.

Table 5: Validity Index Values.

Variable	Measurement item	Mean (Variance)	Factor load
Mental imagery processing	I1	3.73 (1.904)	0.73
	I2	3.99 (1.901)	0.63
	I3	3.99 (1.906)	0.72
	I4	4.20 (1.821)	0.76
Affective attitude	E1	4.02 (1.830)	0.77
	E2	3.93 (1.916)	0.63
	E3	4.08 (1.961)	0.62
	E4	4.09 (1.703)	0.77
Cognitive attitude	C1	3.76 (1.926)	0.86
	C2	3.86 (1.966)	0.76
	C3	4.02 (2.092)	0.64
	C4	4.29 (1.949)	0.83

Table 6: Correlation Matrix

Variable	Mental imagery processing	Affective attitude	Cognitive attitude
Mental imagery processing	0.797		
Affective attitude	0.657	0.787	
Cognitive attitude	0.649	0.688	0.852

Note: The diagonal data is the arithmetic square root of the AVE of the corresponding construct.

The correlation matrix showed that the correlation coefficients of each variable were less than the arithmetic square root of the mean variance of each variable on the diagonal, which indicated that the validity of the questionnaire was good. The factor load of each variable is greater than that of other variables, which further shows that the constructions have good convergence validity.

Because of the high correlation coefficient between multiple constructions in the correlation matrix, the multicollinearity test is carried out in this paper. The results are shown as follows:

Table 7: Collinear Statistics

Variable	Tolerance	VIF
Mental imagery processing	0.493	2.027

Affective attitude	0.442	2.264
Cognitive attitude	0.454	2.201

At present, the commonly accepted rule of thumb for judging the existence of multicollinearity is that the variance inflation factors (VIF) are less than 10 or the tolerance value is greater than 0.10. The test results show that the highest value of VIF is 2.264 and the lowest value of tolerance is 2.027. Therefore, the multicollinearity problem is not a significant problem in this paper.

In addition, since the questionnaire data are collected from a single respondent, this paper uses Haman's single factor test to detect the existence of single factor bias. In this paper, exploratory factor analysis (EFA) is carried out, and the result of non-rotation has two factors whose eigenvalues are greater than 1 (variance extraction: 33%, 27%). Therefore, the consideration of common method errors in data collection does not pose a problem. The reliability and validity of the questionnaire were all qualified, so the hypothesis was tested.

Single Factor Analysis of Variance

Mental imagery processing

Descriptive statistics of mental imagery processing are shown in the table. One-way ANOVA was performed on the variable of mental image processing, as shown in the table. The results showed that the media richness of reviews had a significant effect on the processing of consumers' mental images [$F(2,297) = 104.669, P < 0.001$]. Further, we compare the three media richness in two categories (as shown in table). The results show that compared with the "text" form of e-WOM, providing "text + image" form of e-WOM can significantly enhance the psychological image processing of consumers ($P < 0.001$), so H1 (a) is established; at the same time, compared with the "text" form of e-WOM, providing "text + image + video" form of e-WOM. As a result, H2 (a) was established. Compared with the "text + image" form of e-WOM, the "text + image + video" form of e-WOM could significantly enhance the psychological image processing of consumers ($P < 0.001$), so H3 (a) was established.

Table 8: The Descriptive Statistics about Mental Imagery Processing

The Media Richness of E-WOM	N	Mean Value	SD	SE
1 (Low Level)	100	2.74	1.20	1.12
2 (Medium Level)	100	4.08	1.05	1.05
3 (High Level)	100	5.10	1.21	1.21
Total	300	3.98	1.50	0.09

Table 9: The Variance Analysis Results about Mental Imagery Processing

Source	df	Mean Square	F	Sig.
Inter-group	2	139.785	104.669	0.000***
Intra-group	297	1.335		
Total	299			

Table 10: The Multiple Comparisons of Media Richness on Mental Imagery Processing

(I) Group	(J) Group	Mean difference (I-J)	SE	Sig	95% Confidence interval	
					lower-bound	upper-bound
1 (T)	2	-1.34*	0.16	0.000***	-1.66	-1.02
	3	-2.36*	0.16	0.000***	-2.68	-2.04
2 (T+I)	1	1.34*	0.16	0.000***	1.02	1.66
	3	-1.02*	0.16	0.000***	-1.34	-0.70
3 (T+I+V)	1	2.36*	0.16	0.000***	2.04	2.68
	2	1.02*	0.16	0.000***	0.70	1.34

Affective attitude

We use one-way ANOVA to analyze the variables of emotion and attitude, as shown in the table. The results showed that the media richness of reviews had a significant effect on consumers' affective attitude [$F(2,297) = 153.826, P < 0.001$]. Further, we compare the three media richness in two categories (as shown in table). The results show that compared with the "text" form of e-WOM, the "text + image" form of e-WOM can significantly enhance the affective attitude of consumers ($P < 0.001$), so H1 (b) is established; at the same time, compared with the "text" form of e-WOM, the "text + image + video" form of e-WOM can be significantly improved. H2 (b) was established because of the enhancement of consumers' affective attitude ($P < 0.001$). Compared with e-WOM in the form of "text + image", e-WOM in the form of "text + image + video" could significantly enhance consumers' affective attitude ($P < 0.001$), so H3 (b) was established.

Table 11: The Descriptive Statistics about Affective Attitude

The Media Richness of E-WOM	N	Mean Value	SD	SE
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1 (Low Level)	100	2.76	0.968	0.097
2 (Medium Level)	100	4.10	0.808	0.081
3 (High Level)	100	5.23	1.235	0.123
Total	300	4.03	1.435	0.083

Table 12: The Variance Analysis Results about Affective Attitude

Source	df	Mean Square	F	Sig.
Inter-group	2	153.826	148.198	0.000***
Intra-group	297	1.038		
Total	299			

Table 13: Multiple Comparisons of Media Richness and Affective Attitudes

(I) Group	(J) Group	Mean difference (I-J)	SE	Sig	95% Confidence interval	
					lower-bound	upper-bound
1 (T)	2	-1.35*	1.144	0.000***	-1.629	-1.061
	3	-2.48*	1.144	0.000***	-2.761	-2.194
2 (T+I)	1	1.35*	1.144	0.000***	1.061	1.629
	3	-1.13*	1.144	0.000***	-1.416	-0.849
3 (T+I+V)	1	2.48*	1.144	0.000***	2.194	2.761
	2	1.13*	1.144	0.000***	0.849	1.416

Cognitive attitude

The results showed that the media richness of reviews had a significant effect on consumers' cognitive attitudes [F (2,297) = 121.523, $P < 0.001$]. Further, we compare the three media richness in two categories (as shown in table). The results show that compared with the "text" form of e-WOM, the "text + image" form of e-WOM can significantly enhance the cognitive attitude of consumers ($P < 0.001$), so H1(c) is established; at the same time, compared with the "text" form of e-WOM, the "text + image + video" form of e-WOM can be significantly improved. H2(c) was established because of the enhancement of consumers' cognitive attitudes ($P < 0.001$), and H3(c) was established because of the enhancement of consumers' cognitive attitudes ($P < 0.001$) by providing "text + image + video" e-WOM compared with "text + image" e-WOM.

Table 14: The Descriptive Statistics about Cognitive Attitude

The Media Richness of E-WOM	N	Mean Value	SD	SE
1 (Low Level)	100	2.60	1.03	1.10
2 (Medium Level)	100	4.05	1.17	1.12
3 (High Level)	100	5.30	1.44	1.14
Total	300	3.98	1.65	0.10

Table 15: The Variance Analysis Results about Cognitive Attitude

Source	df	Mean Square	F	Sig.
Inter-group	2	182.238	121.523	0.000***
Intra-group	297	1.500		
Total	299			

Table 16: Multiple Comparisons of Media Richness and Cognitive Attitude

(I) Group	(J)Group	Mean difference (I-J)	SE	Sig	95% Confidence Interval	
					lower-bound	upper-bound
1 (T)	2	-1.45*	0.17	0.000***	-1.79	-1.11
	3	-2.70*	0.17	0.000***	-3.04	-2.36
2 (T+I)	1	1.45*	0.17	0.000***	1.11	1.79
	3	-1.25*	0.17	0.000***	-1.59	-0.91
3 (T+I+V)	1	2.70*	0.17	0.000***	2.36	3.04
	2	1.25*	0.17	0.000***	0.91	1.59

CONCLUSION AND ENLIGHTENMENT

Research Findings and Management Implications

This study examines the impact of e-WOM richness on consumers' attitudes from the perspective of mental image processing.

At last, the experiment data analysis shows that compared with "text" reviews, "text + image" reviews and "text + image + video" reviews have more significant impact on consumers' metal imagery and attitudes; as a form of high-richness e-WOM, "text + image + video" has the most significant impact on consumers' metal imagery and attitudes. Through empirical research and data analysis, it is found that in marketing practice, marketers can encourage consumers to send more video reviews of products, promote reviewers' imagination of experiencing products, and pay attention to managing text and image reviews so that consumers can easily obtain information about products. Incentives such as coupons, rebates and other incentives encourage consumers to publish a variety of reviews, narrowing the gap between reviewers and products, rich information will reduce consumers' perceived risk of products, and promote consumers' decision making process.

Limitations and Further Research

There are still some shortcomings in this study. Because video review is introduced in China at a relatively short time, the number of reference groups is relatively small. In this paper, the experimental samples are all college students, whether the research conclusions are extended to other groups needs further validation by future research, businessmen should also increase the promotion of this form of reviews; second, the choice of experimental materials. With the development of network technology and the popularity of video reviews, this paper directly selects the knapsack as the intermediate product to carry on the experiment. It will be able to study the influence difference of e-WOM richness on different product types. We can also explore the relationship between mental image processing, attitudes and purchase intention in the future.

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Influencing Factors Analysis on Advertising Effectiveness of News feeds Ads

(Full Paper)

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ABSTRACT

News feeds ads has become one of the mainstream mobile ads. However, there are also a series of problems behind the success of feeds ads: inaccurate recommendations, information security issues, and so on. This paper studies the influencing factors of advertising marketing effect of information flow, and puts forward corresponding suggestions, which has important guiding value for enterprise marketing under the age of big data. This research uses news feeds ads as the object, adopts literature research methods, questionnaire analysis methods, etc. Through combing related documents, we have selected three evaluation indicators: advertising cognition, advertising attitude and advertising sales. In terms of aspects and advertisements, there are seven factors influencing the reliability of the platform, the popularity of the platform, the familiarity of consumer brands, the degree of consumer participation, the degree of consumer rejection of advertisements, advertising creativity and performance, and the targeting of advertisements. Put forward relevant hypotheses and verify the sample data through SPSS to draw relevant conclusions. The research shows that the reliability of the platform, the sensitivity of consumers to advertising, the familiarity of consumer brands, the degree of consumer participation, and the creative and targeted advertising all have a positive impact on the effectiveness of advertising. Based on the above conclusions, the author is the enterprise information. Streaming ads have made some targeted recommendations.

Keywords: News feeds Ads, influencing factors, advertising effectiveness.

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INTRODUCTION

With the rapid development of Internet technology and mobile Internet, and the increasing popularizing rate of smart phones, the number of mobile phone users in China is also continuing to expand. According to the report of the 41st China Internet Network Development Statistics, issued by CNNIC, as of December 2017, the total number of Internet users in China had reached 751 million, with a penetration rate of 55.8 percent, and the mobile phone users accounted for 97.5 percent. The proportion of mobile phone using continues to rise, the dominant position of mobile Internet is continuously strengthened, the Internet business model is constantly innovating, mobile advertising has become a crucial form of online advertising.

With the development of network technology, the speed of information communication is accelerated. With the increasing amount of information received by consumers, the autonomy and individuation of consumers are enlarged infinitely. The traditional advertising form can no longer meet the increasing demands of consumers, and its marketing effect is becoming worse. For example, nowadays the click rate of banner ads has fallen to less than 1% (including user misclicking). Users' growing aversion to traditional online advertising forms such as video pre-movie adverts and screen ads, which has disrupted the user's experience of using the site and not achieved the marketing results that ads want. Under such changes, how to accurately grasp the needs of consumers, excavate consumer pain points, find potential consumers, and realize precision marketing has become one of the severe challenges of companies today.

Nowadays, with big data and cloud computing technology maturing day by day, people have powerful data collection, storage and processing ability, and the dissemination of Internet information is more intelligent and personalized. Social media not only collects massive personal information of users, but also calculates, analyzes the information and combines with the interests and needs of users, and provides a more accurate and personalized advertising information push service for consumers. News feeds ads was developed and quickly became one of the mainstream mobile ads. Under the premise of giving full play to the commercial value of social media, the news feeds ads uses video, picture, hyperlink and other forms to accurately convey the advertising information to potential consumers, so as to achieve the purpose of attracting users to buy.

Specifically, Compared with traditional online ads, news feeds ads has the following three advantages:

- (1) For the platform, news feeds ads is not forced to insert ads when users browse or operate, which can balance business income and user experience.
- (2) For advertisers, news feeds ads can combine content with ads better. At the right time, they can be presented in the information that users are browsing, and good news feeds ads can allow users to spontaneously carry out secondary dissemination according to the characteristics of the platform, such as forwarding on Weibo, WeChat and so on.

(3) The traditional online advertising is that customers set time for the resource providers to place ads. While through big data and cloud computing technology to analyze a large number of user information, and the programmed buy, news feeds ads display the right ads to the right people at the right time and the right scene, whose delivery is more accurate.

In 2006, news feeds ads began appearing on social giant Facebook. Then foreign social media, such as Twitter, Instagram, began to adopt this new advertising form. In China, in 2013, QQ Space, Weibo, TouTiao and other media platforms gradually began to use news feeds ads and developed into one of the important ways of social media to monetize its traffic, and becomes the main source of social media mobile advertising revenue. WeChat, the most popular social networking app in China, also launched its first batch of news feeds ads in its circle of friends in January 2015. BMW China, Coca Cola, Vivo and so on are the first advertising providers of news feeds ads. The exposure rate of as many as 100 million times and the click rate of tens of millions of times make this new advertising form begin to attract attention from all walks of life. Baidu, which is dominated by search engine ads, began accessing news feeds ads in June 2016 in places such as Baidu's browser and its mobile phone's App home page.

It can be seen that news feeds ads is moving into people's life. So it is very important to study the influencing factors of its marketing effect.

With the advent of the mobile Internet era and the individualized development of consumer demand, enterprises should follow the trend, firmly grasp the "user-centered" marketing concept, rely on social media, such as Weibo, WeChat, to make full use of the characteristics of news feeds ads and constantly enrich the form of promotion of innovative products. Although there are different attitudes towards news feeds ads, it has to be admitted that news feeds ads can meet the individual needs of users more than traditional ads, and get a higher click rate and attention under the limited advertising expenses of advertisers.

This paper discusses the influencing factors on advertising effectiveness of news feeds ads, and chooses advertising cognition, advertising psychology and advertising sales as the evaluation index of this study. This paper also verifies and analyzes the influencing factors of marketing effect, and puts forward reasonable suggestions to enterprises and platforms according to the influence degree of different factors, which provides practical guidance for the marketing of enterprises.

THEORETICAL BASIS

The Concept of News Feeds Ads

Generally speaking, news feeds ads is a kind of native advertising, which is presented in a very natural way in the information that the user is reading or browsing, is similar to the friends' news feed with a high user rate. This kind of advertisement not only reduces the user's rejection psychology to a certain extent, but also reduces the interference to the user, and improves the user's experience of using the platform.

Relying on massive user data and information flow ecosystems, according to the needs of advertisers, news feeds ads can provide hundreds or even thousands of labels to subdivide and label users. The most commonly used and most direct indicators are geographic, gender, age, equipment, friendships, interest maps, etc. Where users often log in can determine the resident area, and even identify the occupation. Advertisers can choose according to the region when they place their advertisements. For example, if I have a real estate in Wuhan, I can choose Wuhan users to advertise. If I have a restaurant in Hongshan, I can choose the landing place to launch for the users of Hongshan. Gender and age are generally inferred from the user's profile or from the content of interest that the user normally searches for, thereby dividing the users. A person's purchasing power can be inferred from the price of a mobile phone. Friendships are also relatively simple. If a person's friend list is mostly rich, he is more likely to be rich. The map of interests infers the interests of users based on what they often search for. If a person often searches for something related to eating, the person is likely to be a gourmet who can be advertised for the relevant restaurant. If a person often searches for matching clothes, you can put in clothing advertisements, etc. According to different labels, selecting different target audience to push different advertising information can achieve the differentiated advertising putting, accurately position the audience and help enterprises to obtain more potential customers.

Moreover, news feeds ads can accurately capture the user's intentions from the user's daily data. Combining the interest and demand of the user, the advertisement can effectively reduce the interference to users, reduce the user's antipathy to the advertisement, and present the advertisement to the target audience. A good advertising or activity planning can also stimulate the initiative of users to actively urge users to forward advertisements or share them with friends and relatives.

Taking QQZone's news feeds ads as an example, the ads in Zone is very similar to friend trends. There are brand image and brand name, Different from friends' trends is only the two words "ad" in the upper right corner. If you want to share the advertisement with your friends, click on these two words, you can share the advertisement with QQ friends, Weixin friends, you can also directly share with Weixin friends circle. As for the promotion of the application, you can directly click on the image below the "download XX" to download the corresponding APP. The ads about activities can also be clicked directly below to "participate in activities" to participate in the activities organized by the enterprise. If you want to know more about the content of the advertisement, you can also click on the link below to see the details. If you don't like this kind of advertisement, you can choose to block it and choose the reason. Through these methods, the system can better understand consumers' behavior preferences and recommend suitable advertisements for users. In addition, if you need to promote, you

can click on the drop-down menu bar "I want to promote". Then you can jump to Tencent social advertising related introduction, click immediately to register, get advertising account, you can put in the corresponding advertising, which is easy to use.

Explanation of Advertising Effect

The Concept of Advertising Effect

Advertising effect refers to the social impact and effect of advertising information transmitted through advertising media. Generally speaking, this kind of influence and effect includes two aspects: communicating effect and marketing effect. The research and measurement of these two kinds of advertising effects can help enterprises to calculate whether every dollar spent on advertising is worth, and it is helpful for enterprises to make more effective advertising plans.

The narrow advertising effect refers to the direct economic benefits obtained through advertising, and generally refers to the increase in sales brought about by advertising. Broad sense of advertising effect refers to the realization degree of the purpose of advertising activities, and refers to the sum of direct or indirect changes caused by advertising in the process of communication, including economic, psychological and social benefits.

The Measurement of Advertising Effect

Advertising effect measurement refers to identify the benefits of advertising by scientific methods. The main methods include experimental analysis, questionnaire analysis, product sales effect analysis, market share analysis and so on. Among them, the experimental analysis method and the questionnaire measurement method are commonly used to measure the advertising effect from the perspective of consumers.

Considering the research content of the topic and the actual situation of the author, this paper chooses the questionnaire method to measure the advertising effect. The influencing factors and evaluation indexes of advertising effect are designed in the questionnaire to investigate the response of consumers to news feeds ads.

DESIGN OF RESEARCH APPROACH

Selection of Evaluation Indexes for the Effect of News Feeds Ads

According to the content and the influence range of advertisement, the advertising effect can be divided into three parts: communicating effect, economic effect and social effect. The communicating effect is the effect of advertising itself or the psychological effect on consumers. It generally refers to the impression of the advertising audience and the psychological changes caused by the advertisement, which is the core of the advertising effect. The economic effect of advertising mainly refers to the effect of advertising sales, which is the most basic and important effect of advertising activities, and is also the main basis for evaluating the advertising effect. Advertising social effect, also known as the reception advertising effect, refers to the role of advertising in the economic and cultural aspects of the whole society, value orientation.

After transmitting advertising information to the audience, consumers will have various psychological effects and behavioral responses. According to the degree of influence and the form of expression, advertising effect can be divided into the reaching effect, the cognition effect, the psychological change effect and action effect. The reaching effect mainly refers to the contact effect between advertising media and consumers. The cognition effect refers to the degree of consumer's attention and memory to advertising information. The psychological change effect refers to through the advertisement contact and the cognition, good feeling of advertisement goods or the service caused by the advertisement influence as well as the consumption desire change degree. The action effect refers to an act taken by a consumer to purchase a good, accept a service, or influence an advertisement's appeal caused by the advertisement.

Above all, Considering the high contact rate of news feeds ads itself, that is to say, with a very good reaching effect, so this paper selects the advertising cognitive effect, advertising psychological effect and advertising sales effect as the evaluation index.

Selection of Influence Factors for the Effect of News Feeds Ads

There are many factors that influence the effect of advertising, such as, platform, audience, media, and information. The interaction between the elements is also very complex. Therefore, when scholars study the influencing factors of advertising effect, they usually begin to study the purpose, and select a few factors to analyze. After studying the advertising model of new media (Mainly refers to online advertising), ShellyRodger and EstherThorson put forward the interactive advertising model. They pointed out that the factors that influence the effect of online advertising are divided into two parts: consumer factor and advertising factor. In addition, unlike the traditional network advertising model, feeds ad is a kind of advertising mode based on big data's accurate recommendation and spontaneous secondary transmission. Therefore, the advertising platform has also become one of the important factors affecting its advertising effect.

By arranging the existing literature on news feeds ads, from platform, consumer and ads aspects, this paper concludes the following 7 factors: reliability of the platform, the popularity of the platform, the brand familiarity of the consumer, the degree of consumer participation, consumer rejection of advertising, advertising creativity and performance, targeted advertising.

Platform

(1) Reliability of the platform

By arranging the existing research in China, it is found that the click rate of online advertising is closely related to the reliability of the platform, and a more credible media platform will make consumers have a more positive understanding of the information transmitted on it. Consumers are more likely to point to advertising information of more reliable websites or APP.

(2) Popularity of the platform

Traditional advertising studies have shown that advertising on media platforms with higher popularity produces better effects. For example, advertising on CCTV can raise awareness of advertising brands faster than local TV stations. A good platform can produce positive advertising effects, and the higher the popularity of the platform, the easier it is for consumers to have a positive understanding of the brand awareness in advertising.

Consumer

(1) The brand familiarity of the consumer

The brand familiarity of the consumer refers to the degree of familiarity with the brand, which is generally positively correlated with the number of times consumers contact the brand. Consumers have instinctive fear for unfamiliar brands and instinctive affinity for familiar brands. The study of Nathalie Dens, et al (2012) showed that consumers are more likely to remember familiar brands in advertising and develop positive attitudes.

(2) The degree of consumer participation

Common news feeds ads in life appear on social media such as Weibo, WeChat QQ and so on. Information on these social media is easy to share, likes, comments, and so on, and so is feeds ad on these social media. By arranging the literature, it is found that when an advertisement has more comments or likes, it is more likely to attract the attention of consumers, at the same time, it may have a positive impact on advertising cognition and psychology.

(3) Consumer rejection of advertising

Most consumers have natural rejection of advertising. Although the feeds ad greatly reduces the interference to the users of the platform compared with the traditional advertisement, it still inevitably distracts the user from his attention when he reads it. Feeds ad collects user's personal information in order to put it accurately. Users will worry about whether their privacy is leaked while using the platform. Therefore, it may have a negative impact on news feeds ads.

Advertising

(1) Advertising creativity and performance

Advertising is putting information into the minds of consumers and influencing their ideas and behaviour. In order to get information into the minds of consumers, the first thing is to be able to attract the attention of consumers at a glance. In most cases, a feeds ad consists of title and a picture or a short video. A good advertising creative picture, video, or title is more likely to attract consumers' attention and thus have a positive impact on advertising effect.

(2) Targeted advertising

Feeds ad is a kind of advertisement based on big data to carry on accurate put, which has strong pertinence, so it may have a positive effect on the effect of advertising.

Research Hypothesis

The Influence Relation between Platform Aspect and Advertising Effect

The platform aspect includes its degree of reliability and popularity. The research hypothesis is as follows:

Table1 : The influence relation between platform aspect and advertising effect

H1a : There is a positive relationship between platform reliability and advertising cognition.
H1b : There is a positive relationship between platform reliability and advertising psychology.
H1c : There is a positive relationship between platform reliability and advertising marketing.
H2a : There is a positive relationship between platform popularity and advertising cognition.
H2b : There is a positive relationship between platform popularity and advertising psychology.
H2c : There is a positive relationship between platform popularity and advertising marketing.

The Influence Relation between Consumer Aspect and Advertising Effect

The consumer aspect includes its degree of brand familiarity, consumer participation, and consumer rejection. The research hypothesis is as follows:

Table 2 : The influence relation between consumer aspect and advertising effect

H3a : There is a positive relationship between brand familiarity and advertising cognition.
H3b : There is a positive relationship between brand familiarity and advertising psychology.
H3c : There is a positive relationship between brand familiarity and advertising marketing.
H4a : There is a positive relationship between consumer participation and advertising cognition.
H4b : There is a positive relationship between consumer participation and advertising psychology.

H4c : There is a positive relationship between consumer participation and advertising marketing.
H5a : There is a negative relationship between consumer rejection and advertising cognition.
H5b : There is a negative relationship between consumer rejection and advertising psychology.
H5c : There is a negative relationship between consumer rejection and advertising marketing.

The Influence Relation between News Feeds Ads Aspect and Advertising Effect

The consumer aspect includes advertising creativity and performance, and pertinence.

The research hypothesis is as follows:

Table 3 : The influence relation between news feeds ads aspect and advertising effect

H6a : There is a positive relationship between advertising creativity and performance and advertising cognition.
H6b : There is a positive relationship between advertising creativity and performance and advertising psychology.
H6c : There is a positive relationship between advertising creativity and performance and advertising marketing.
H7a : There is a positive relationship between advertising pertinence and advertising cognition.
H7b : There is a positive relationship between advertising pertinence and advertising psychology.
H7c : There is a positive relationship between advertising pertinence and advertising marketing.

Research Questionnaire Design

Considering that most of the people around the author are college students, in the school, all kinds of notices are transmitted through QQ. Therefore, the frequency of daily use of QQ is high. In order to obtain effective sample data, this paper chooses the news feeds ads in QZone as the research object to design the questionnaire. 234 effective questionnaires were collected by "online and offline" questionnaires issuing method. The questionnaire adopted Richter 5 scale point system, designed 10 measure indexes including independent variable and dependent variable.

(1) Independent variable

From platform, consumer and advertisement aspect, this paper concludes the following 7 factors: reliability of the platform, the popularity of the platform, the brand familiarity of the consumer, the degree of consumer participation, consumer rejection of advertising, advertisement creativity and performance, advertisement pertinence. The questionnaire is designed as Table 4.

Table 4 : The questionnaire of independent variable

Variable name	Questions
reliability of the platform	1、 I think QQ is a reliable social media
popularity of the platform	2、 Most of the people around me know QQ
brand familiarity of the consumer	3、 I can often see news feeds ads in QZone
	4、 I have some knowledge of the brand in the advertisement
consumer participation	5、 I often like, comment, or forward ads
	6、 I often click on the "more details" in the ads to see the details.
consumer rejection of advertising	7、 The advertisement in QZone interferes with me.
advertisement creativity and performance	8、 I like the creativity of advertising in QZone.
advertisement pertinence	9、 The information provided by news feeds ads in QZone meets my needs.

(2) Dependent variable

The advertising cognition, advertising psychology and advertising marketing were selected as dependent variables. The questionnaire is designed as Table 5.

Table 5 : The questionnaire of dependent variable

Variable name	Questions
advertising	10、 I can get valuable publicity through advertising

cognition	11、 I know or enhance my understanding of the brand in the advertisement through advertising.
advertising psychology	12、 I was attracted by the news feeds ads I received, pictures, content, or videos.
	13、 I like some sort of feeds ad in QZone.
	14、 I think the feeds ad in QZone are reliable.
	15、 I'd rather click on ads on QQ than on some small sites.
advertising marketing	16、 I've downloaded apps through advertising (Chuchujie , JUMEI , Vipshop , PS Everyday, mobile games) , watched and concerned recommended Video.
	17、 I entered to other apps (JingDong, etc.) and bought the product through advertising.

VERIFICATION AND ANALYSIS OF THE FACTORS AFFECTING THE NEWS FEEDS ADS MARKETING EFFECT

Reliability and Validity Testing

Reliability Analysis

Reliability analysis is used to study the reliability and accuracy of quantitative data, especially attitude scale questions. In academia, α coefficients are commonly used to measure. If α coefficient is higher than 0.8, the reliability is high. If it is between 0.7 and 0.8, the reliability is better. If the value is between 0.6 and 0.7, then the reliability is acceptable. If this value is less than 0.6, the reliability is not good. Using SPSS to analyze the reliability of questionnaire data, the reliability coefficient is 0.808. This value is more than 0.8, which shows that the reliability and quality of the research data is higher. The results of the analysis are as Table 6.

Table 6 : Result of reliability analysis

Questionnaire question No.	deleted-items α coefficient	α coefficient
1	0.814	0.808
2	0.813	
3	0.818	
4	0.800	
5	0.802	
6	0.797	
7	0.845	
8	0.779	
9	0.780	
10	0.779	
11	0.782	
12	0.781	
13	0.783	
14	0.795	
15	0.802	
16	0.794	
17	0.796	

For deleted-items α coefficient, the reliability coefficient value was not significantly improved after the deletion of the analytical item, so all the items should be retained, which further shows that the reliability level of the data in this study is high.

Validity Analysis

Validity studies are used to analyze whether the research item is reasonable and significant, and the validity analysis uses the data analysis method of factor analysis to do the research. The KMO value, the communalities, the variance interpretation rate value, the factor loading coefficient value and so on are analyzed synthetically in order to verify the validity level of the data. The KMO value is used to judge the validity, the common degree value is used to eliminate the unreasonable research items, the variance interpretation rate value is used to explain the level of information extraction, and the factor loading coefficient is used to measure the correspondence relationship between the factor and the item.

First, the tests of KMO and Bartlett are given in Table 7.

Table 7 : Result of validity analysis

KMO value		0.834
Bartlett degree of sphericity test	approximate chi-square	730.507
	df	136
	P value	0.000

The table 7 shows that: KMO is 0.834, and over 0.6. So it meet the requirements of factor analysis. Bartlett degree of sphericity test $P=0.000<0.05$ also shows that research data is suitable for factor analysis

(1) Independent variable factor analysis

Using SPSS to have factor analysis of independent variable samples, seven principal component factors were extracted. The variance interpretation rates of the seven factors after rotation were 17.518%, 16.188%, 11.975%, 11.955%, 11.457%, 11.202%, 11.126% respectively. Cumulative variance interpretation rate after rotation was 91.421%. The results of the analysis are as Table 8 and Table 9.

Table 8 : Variance interpretation rates of independent variable samples

Factor No.	characteristic root			variance interpretation rate before rotation			variance interpretation rate after rotation		
	characteristic root	variance interpretation rate	Cumulative	characteristic root	variance interpretation rate	Cumulative	characteristic root	variance interpretation rate	Cumulative
1	2.809	31.214	31.214	2.809	31.214	31.214	1.577	17.518	17.518
2	1.523	16.922	48.136	1.523	16.922	48.136	1.457	16.188	33.706
3	1.145	12.726	60.862	1.145	12.726	60.862	1.078	11.975	45.681
4	0.873	9.705	70.567	0.873	9.705	70.567	1.076	11.955	57.636
5	0.755	8.387	78.954	0.755	8.387	78.954	1.031	11.457	69.093
6	0.648	7.199	86.153	0.648	7.199	86.153	1.008	11.202	80.295
7	0.474	5.268	91.421	0.474	5.268	91.421	1.001	11.126	91.421
8	0.399	4.429	95.851	-	-	-	-	-	-
9	0.373	4.149	100	-	-	-	-	-	-

Table 9 : Factor loading coefficient after rotation

Question No.	factor loading coefficient							communalities
	Factor 1	Factor2	Factor3	Factor4	Factor 5	Factor6	Factor7	
1	0.077	0.057	-0.132	0.072	-0.039	0.981	0.054	0.998
2	-0.163	0.064	0.105	0.94	0.062	0.07	0.113	0.947
3	-0.053	0.014	0.059	0.062	0.975	-0.038	0.137	0.981
4	0.18	0.16	-0.069	0.119	0.157	0.06	0.926	0.964
5	0.793	0.134	-0.24	-0.132	-0.183	0.027	0.216	0.803
6	0.863	0.28	0.036	-0.065	0.077	0.08	0.042	0.843
7	-0.108	-0.146	0.941	0.098	0.065	-0.138	-0.069	0.957
8	0.268	0.71	-0.308	0.362	0.081	0.099	-0.046	0.821
9	0.226	0.895	-0.032	-0.078	-0.031	0.018	0.23	0.914
Extraction method: Principal component analysis (varimax) rotation method: varimax								

The above table shows that: all the communalities values of research items are above 0.4, which means that there is a strong correlation between the research items and the factors. This questionnaire concludes the following 7 independent variables: reliability of the platform, the popularity of the platform, the brand familiarity of the consumer, the degree of consumer participation, consumer rejection of advertising, advertisement creativity and performance, advertisement pertinence. Most of the dimensions are the same as the questionnaire. A small number of changes have been made in consumer brand familiarity, advertising creativity and performance, and advertising pertinence. Rename the independent variables according to the title, as shown in Table 10.

Table 10 : Independent variables rename

Variable name	Questions
reliability of the platform	1、 I think QQ is a reliable social media
popularity of the platform	2、 QQMost of the people around me know QQ
Consumer sensitiveness to advertisement	3、 I can often see news feeds ads in QZone
brand familiarity of the consumer	4、 I have some knowledge of the brand in the advertisement
consumer participation	5、 I often like, comment, or forward ads
	6、 I often click on the “more details” in the ads to see the details.
consumer rejection of advertising	7、 The advertisement in QZone interferes with me.
advertisement creativity and pertinence	8、 I like the creativity of advertising in QZone.
	9、 The information provided by news feeds ads in QZone meets my needs.

(2) Dependent variable factor analysis

Using SPSS to have factor analysis of dependent variable samples, three principal component factors were extracted. The variance interpretation rates of the three factors after rotation were 35.224%, 18.009%, 17.474% respectively. Cumulative variance interpretation rate after rotation was 70.707%, as shown in Table 11 and Table 12.

Table 11 : Variance interpretation rates of independent variable samples

Factor No.	characteristic root			variance interpretation rate before rotation			variance interpretation rate after rotation		
	characteristic root	variance interpretation rate	Cumulative	characteristic root	variance interpretation rate	Cumulative	characteristic root	variance interpretation rate	Cumulative
1	3.746	46.824	46.824	3.746	46.824	46.824	2.818	35.224	35.224
2	1.16	14.5	61.324	1.16	14.5	61.324	1.441	18.009	53.233
3	0.751	9.383	70.707	0.751	9.383	70.707	1.398	17.474	70.707
4	0.669	8.36	79.067	-	-	-	-	-	-
5	0.509	6.367	85.434	-	-	-	-	-	-
6	0.477	5.965	91.398	-	-	-	-	-	-
7	0.402	5.027	96.425	-	-	-	-	-	-
8	0.286	3.575	100	-	-	-	-	-	-

Table 12: Factor loading coefficient after rotation

Name	factor loading coefficient			communalities
	Factor 1	Factor2	Factor 3	
Advertisement cognition 1	0.732	0.353	0.212	0.706
Advertisement cognition 2	0.798	0.06	0.21	0.685
Advertisement psychology 1	0.814	0.21	0.163	0.733
Advertisement psychology 2	0.727	-0.013	0.292	0.615
Advertisement psychology 3	0.4	0.702	-0.059	0.657

Advertisement psychology 4	-0.031	0.874	0.148	0.787
Advertisement marketing 1	0.499	0.086	0.621	0.642
Advertisement marketing 2	0.204	0.067	0.887	0.832

The Table 12 shows that: all the communalities values of research items are above 0.4, which means that there is a strong correlation between the research items and the factors. In the matrix, advertisement psychology 1 and advertisement psychology 2 are combined in advertisement cognition. Therefore, according to the specific questions of the questionnaire, the dependent variables of the questionnaire are renamed, as shown in Table 13.

Table 13 : Dependent variables rename

Variable name	Questions
advertising cognition and psychology	10、 I can get valuable publicity through advertising
	11、 I know or enhance my understanding of the brand in the advertisement through advertising.
	12、 I was attracted by the news feeds ads I received, pictures, content, or videos.
	13、 I like some sort of feeds ad in QZone.
advertising attitude	14、 I think the feeds ad in QZone are reliable.
	15、 I'd rather click on ads on QQ than on some small sites.
advertising marketing	16、 I've downloaded apps through advertising (Chuchujie , JUMEI , Vipshop , PS Everyday, mobile games) , watched and concerned recommended Video.
	17、 I entered to other apps (JingDong, etc.) and bought the product through advertising.

In summary, the questions set in the questionnaire can basically reflect the situation of each dimension, and the validity of the scale is good.

Correlation Analysis

Correlation analysis is used to determine the linear correlation and the direction of correlation between variables and researches the most common Pearson coefficient, the result is shown in Table 14.

Table 14 : Correlation analysis

No.	10	11	12	13	14	15	16	17
1	0.056	-0.046	0.075	0.05	0.225**	0.244**	-0.079	0.026
2	-0.02	0.035	0.014	-0.011	0.1	0.067	-0.039	-0.121
3	0.034	0.127	-0.026	0.099	0.05	0.305**	0.01	0.019
4	0.219**	0.231**	0.210**	0.244**	0.295**	0.288**	-0.004	0.104
5	0.332**	0.266**	0.285**	0.206**	0.18	0.134	0.106	0.334**
6	0.358**	0.199**	0.292**	0.354**	0.185**	0.289**	0.105	0.306**
7	-0.372**	-0.184**	-0.224**	-0.118	-0.351**	-0.235**	-0.166	-0.181
8	0.575**	0.502**	0.547**	0.542**	0.395**	0.198**	0.419**	0.303**
9	0.670**	0.555**	0.567**	0.508**	0.484**	0.360**	0.379**	0.349**
* p<0.05 ** p<0.01								

The above table shows that: (1) There is a significant positive correlation between "advertising attitude" and "platform reliability". A reliable platform makes it easier for consumers to trust advertising information on the platform. (2) There is no significant correlation between all dependent variables and "visibility of the platform", so there is no significant correlation between advertising effects and the visibility of the platform. (3) There is a significant positive correlation between "advertising attitude" and "consumer sensitivity to advertising". People who are sensitive to information flow advertising are more likely to have a positive advertising attitude. (4) "Advertising cognition and psychology", "advertising attitude" and "consumer brand familiarity" have a significant positive correlation, the more familiar brand advertising is easier to impress consumers. (5) "Advertising cognition and psychology", "advertising attitude", "advertising marketing" and "consumer participation" have significant positive correlation. The higher the consumer participation, the better the advertising effect. (6) There is a significant negative correlation between "advertising cognition and psychology", "advertising attitude" and "consumers' rejection of advertising". The more consumers' psychological rejection of advertising, the worse the effect of advertising. (7) There are significant positive correlations between "advertising cognition and psychology", "advertising

attitude", "advertising sales" and "advertising creativity and pertinence". The better the advertising creativity, the stronger the pertinence, the better the advertising effect.

RESEARCH CONCLUSIONS AND PROSPECTS

Research Conclusions

By using SPSS to analyze the correlation of sample data, it can be found that: There is a significant positive correlation between "advertising cognition and psychology", "consumer brand familiarity", "consumer participation", "advertising creativity and pertinence". There is a significant positive correlation between "Advertising attitude" and "platform reliability", "consumers' sensitivity to advertising", "Consumer brand familiarity", "consumer participation", "advertising creativity and pertinence". "Advertising sales", "Consumer participation", "Advertising creativity and pertinence" have significant positive correlation. There is a significant negative correlation between "advertising cognition and psychology", "advertising attitude" and "consumer rejection".

The model of research conclusions is as Figure 1.

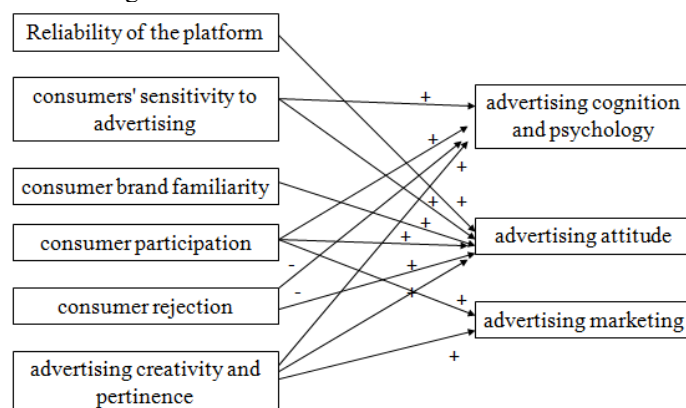


Figure 1 The model of research conclusions

Enlightenment on the Study

Based on the analysis of the above conclusions, this paper puts forward the following suggestions about advertising of enterprise news feeds ads:

(1) Enhance brand awareness

Consumer brand awareness has a positive impact on advertising effect. In the face of increased competition in the market, brand is the consumer's evaluation of the enterprise and its products and services. For example, when people mention Gree, we can think of air conditioners, of Haier, of big household appliances such as refrigerator washing machines, of Jiuyang, of kitchen appliances such as soybean milk machine. Therefore, enterprises should continue to enhance brand construction, improve brand reputation, and highlight their own brands in advertising design and delivery.

(2) Improve advertising interaction

Consumer participation has a positive effect on the effect of advertising. Therefore, when enterprises place information stream advertisements, they can find ways to increase the participation of consumers. For example, they can set up a comment lottery, forward it to friends with good gifts, keep up with hot spots and topics to conduct marketing, and strengthen the links between online and offline, do a good job in the purchase of goods drainage channels and so on.

(3) Improve the pertinence of advertising

Advertising pertinence has a positive effect on advertising effect. However, in the survey, it was found that only 4.27% of the users thought that "the information provided by the news feeds ads meets my needs." It shows that the pertinence of advertisements is relatively weak. Therefore, enterprises can take into account the different needs and interests of each consumer on the basis of existing news feeds ads, and formulate personalized marketing strategies.

(4) Pay attention to the design of advertising content

Advertising creativity has a positive impact on advertising. A good feeds ad should achieve high click rate on the basis of high display. How to increase the click rate is very important to an advertisement. Feeds ad is easy to be ignored by users while reducing user interference. Therefore, when making advertisements, enterprises should fully consider the needs of users, investigate the advertisements that consumers like, and find out the most attractive advertising forms.

Deficiencies in Research

The deficiencies in research include the following:

(1) There are some limitations in the sample, both in geographical distribution and occupation. The sample number is small, and most of the subjects are Wuhan college students.

(2) Influence factors of research are limited. There are many factors that affect advertising, and the relationship between them is very complex. Due to personal energy problems, only a small number of factors can be selected to study.

ACKNOWLEDGMENTS

This work was supported by The National Social Science Fund of China (No. 18BTQ081):“Research on the Cooperation Mechanism of Scientific Researchers in Virtual Academic Community”.

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K-Means Algorithm for Recognizing Fraud Users on a Bitcoin Exchange Platform

(Full paper)

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ABSTRACT

This paper addresses recognizing fraud users on a Bitcoin exchange website-bitcoin-otc. According to online rating records provided by the website, some users behave significantly different from others. Seeing that, the classical K-means clustering algorithm is proposed to identify these abnormal users. K-means algorithm is an unsupervised clustering algorithm that clusters users based on feature similarity. Therefore, performance of K-means algorithm relies on the features. This paper explored and found the best collection of features based on real record data, e.g., mean of total ratings sent. Since the selected features are not observed for record set, the website should offer these features for potential traders.

Keywords: K-means algorithm, P2P website, Fraud detection.

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INTRODUCTION

On 1 January 2018, the price of Bitcoin was 13,412USD (as shown in Figure 1), which is 13 times compared with the price of the same day of 2017 (997USD). It increasingly attracts global investors to Bitcoin marketplace. However, Bitcoin is a decentralized digital currency that is transacted directly between users without any intermediation. As such, trading platforms mostly provide no authentication service, and the users are exposed to counterparty risk.

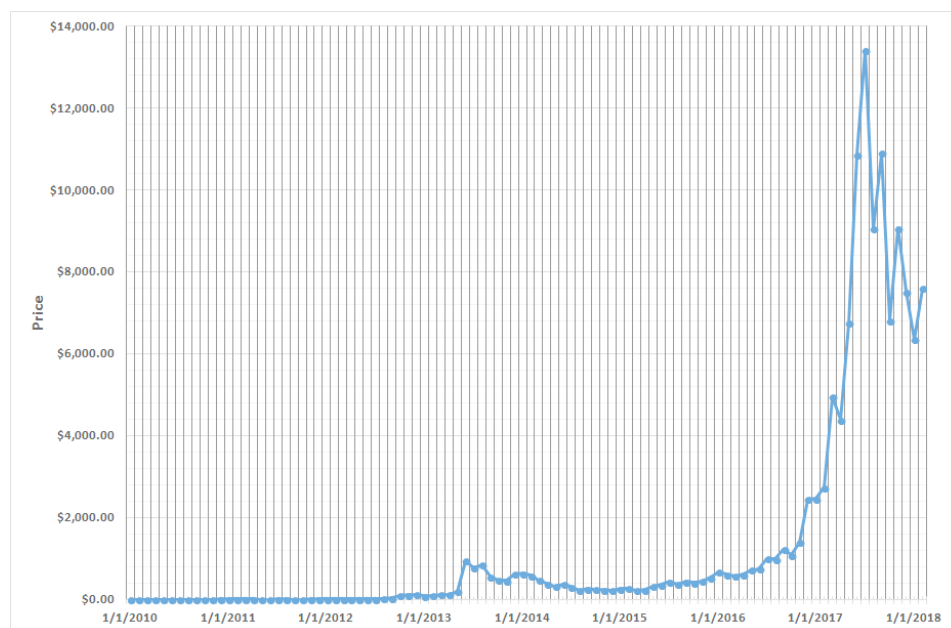


Figure 1: Line Chart of Bitcoin Price (from U.S. Finance Reference, <https://www.officialdata.org/bitcoin-price>)

To help users reduce trading risk, the websites usually offer a rating system along with the trading platform. On this system, users can give others ratings after transactions. For example, positive ratings mean that user trusts this person, while negative ratings for a person as a fraudster. It is suggested that user access to his counterparty's trade and reputation history firstly to avoid dealing with fraudster. The question is that the ratings are not foolproof. Fraudulent users can also inter-rate each other with positive ratings. As a result, normal users need to stay vigilant to be prey for fraudster.

This paper is motivated by the observation that behaviors of fraudulent users seem to be quite different from normal users. For instance, a normal user often received '+1' ratings from the counterparty, while a fraudster received '+10' ratings. So, we apply a classical clustering algorithm- K-means algorithm to recognize abnormal users from others. We further study the features for the K-means algorithm. A collection of features are chosen with the best performance of K-means algorithm.

This paper is organized as follows. Section 2 reviews the literature and K-means algorithm is described in Section 3. Then, the selection of features for the K-means algorithm is presented based on real data. Section 5 shows the results of data analysis. The last section concludes the whole paper.

RELATED WORK

When the Bitcoin was firstly invented as a form of electronic cash in November 2008, the price of bitcoin was nearly zero. Even on 1 January 2011, the price is 0.30USD per bitcoin. At that time, Bitcoin was argued to be not a currency rather a speculative asset (Corbet, Lucey, Peat, & Vigne, 2018). It was also beyond all people's imagination that the price is rising to 13412.44USD in 2018.

Since the price of Bitcoin rises exponentially, it has been a frequent target of attacks by financially-motivated criminals (Gandal, Hamrick, Moore, & Oberman, 2018). Researchers, therefore, focused on security and fraud detection of the Bitcoin ecosystem. For example, Ziegeldorf, Matzutt, Henze, Grossmann, and Wehrle (2018) proposed a novel oblivious shuffle protocol improves resilience against malicious attackers. Kumar, Spezzano, Subrahmanian, and Faloutsos (2016) represented Bitcoin transaction as a weighted signed network. In the network, edges are labeled with positive or negative weights to present the ratings the rater sent the ratee. They use the idea of HIT algorithm to measure how much a node is trusted by other nodes (Kleinberg, 1999). Maesa, Marino, and Ricci (2017) treated Bitcoin transaction as a simply graph and discovered that the graph was not a small world network with some unusual patterns. They explained that these patterns are probably due to artificial users behaviors. Kumar et al. (2018) proposed a REV2 algorithm to improve the prediction of fraudulent users. In the paper, fraud detection is categorized into network-based fraud detection algorithm (Akoglu, Tong, & Koutra, 2015) and behavior-based fraud detection algorithm (Jiang, Cui, & Faloutsos, 2016).

The applied algorithm in this paper belongs to behavior-based fraud detection algorithms, namely the K-means algorithm. K-means algorithm, sometimes K-means clustering called, is a very popular and efficient algorithm for clustering analysis (Zhao, Deng, & Ngo, 2018). For example, the K-means algorithm was introduced to the recommender system (Kant et al., 2018), fashion design (Vincent, Makinde, Salako, & Oluwafemi, 2018), social network analysis (Liu, Ma, Xiang, Tang, & Zhang, 2018), network evolution (Yang & Chen, 2018) etc. Therefore, the K-means algorithm is adopted here to detect fraudsters. To improve the performance of K-means algorithm, initial cluster centers assignment is very important (Karegowda, Vidya, Jayaram, & Manjunath, 2013) (Sirait & Arymurthy, 2011). But, feature selection is another underestimated key to the success of K-means clustering (Mavroeidis & Marchiori, 2014). For example, linear discriminant analysis (LDA) with trace ratio criterion is used in the research (Wang, Nie, & Huang, 2014). This paper also addresses the feature selection problem. Based on the idea from Kumar et al. (2018), we explored a bundle of features to match the real data best, including features from network-based fraud detection algorithm, and behavior-based fraud detection algorithm.

BITCOIN TRADING PLATFORMS AND K-MEANS ALGORITHM

Bitcoin Trading Platform- Bitcoin OTC

Bitcoin OTC (<https://www.bitcoin-otc.com>) is an online marketplace for bitcoin trading. All transactions occurred on this platform are conducted directly between counterparties, without any guarantee from platform. All exchange risks are taken by buyers and sellers. To help users decrease trading risk (one of the parties did not pay), the platform offers a service named 'web of trust,' where users can access counterparty's reputation and trade history.

In this web database, the basic record of the user is:

id	rater nick	rater total rating	rated nick	created at (UTC)	rating	notes
		1061		2010-11-30 23:31:51	1	
		614		2011-02-21 05:49:06	7	
		481		2013-12-16 21:26:35	1	nanooooo!
		439		2014-04-24 03:57:20	5	.
		377		2014-02-23 05:34:06	4	several deals..Smooth™

(a) List of All Ratings the Ratee Received

id	nick	first rated (UTC)	keyid	total rating	number of positive ratings received	number of negative ratings received	number of positive ratings sent	number of negative ratings sent
		2010-11-08 18:14:09		801	226	0	206	9
		2010-11-08 18:35:30		95	39	3	43	2
		2010-11-08 18:35:39		-16	12	10	0	0
		2010-11-08 18:36:00		168	54	0	60	3
		2010-11-08 18:36:11		7	2	0	4	0

(b) List of the Aggregate Ratings of Ratee

Figure 2: A Snapshot of 'Web of Trust' on the Bitcoin-otc Website

The ratings are between -10 and +10 (integral value, and could not be set to 0). The higher score means that the ratee has better reputation in the exchange, and the lower score is the opposite. For example, according to a guideline of the system, a ratee is marked as '5' if 'you've had some good transactions with this person,' '-10' if 'person failed to hold up his end of the bargain, took payment and ran, fraudster.' Therefore, if a user is rated positively by most people he had traded with, he could be labeled as a trust-worthy user. Once a user was rated negatively by other people, the most time he would often be labeled as a fraudster. Generally, users on bitcoin-otc platform follow these intuitions and opinions:

Table 1: The Intuitions And Opinions of Evaluation

Ratings	Intuitions and opinions
Positive 'rating' value and high 'total rating' value	A trusted user, low trading risk
Low 'total rating' value and existing negative 'rating' value	Fraudsters, trading risk
Existing both positive and negative 'rating' value	Uncertain, high trading risk

However, these intuitions are not always right. Some fraudsters created several accounts who rated each other with high rating values. When other users browser the 'web of trust' database, 'total rating' value of the user is a large number. In this way, an innocent user often falls prey to fraudsters groups.

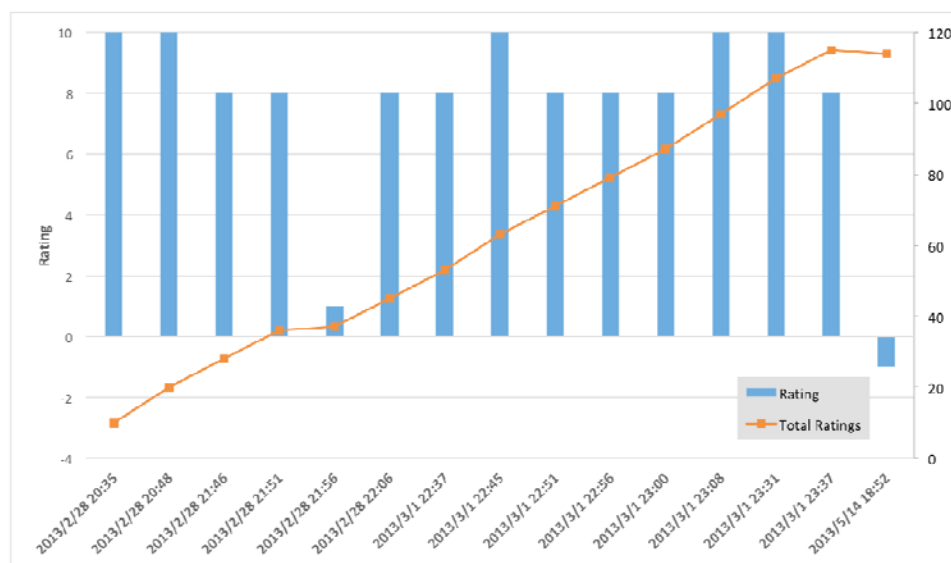


Figure 3: A Line Chart of Rating Time Series for a Typical 'Scammer'

As shown in figure 3, the user was rated '10' or '8' by 13 users in two days (from 28 February to 1 March). After that, the user got very high scores-115. Then, he was reported as a fraudster.

Comparing with the behavior of the fraudster in figure 3, a normal user's behavior is quite different (as shown in figure 4).

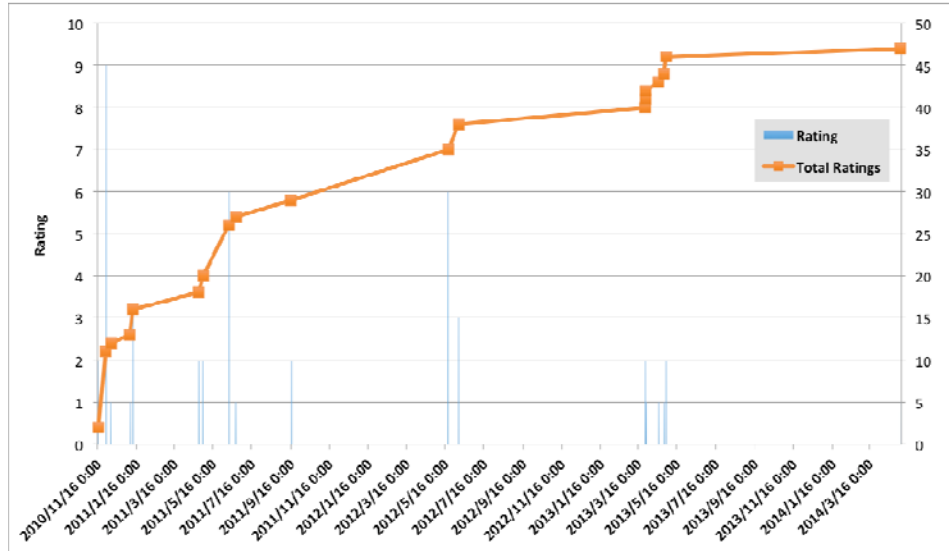


Figure 4: Line Chart of Rating Time Series for a User without Negative Ratings

In figure 4, the user got only 47 ratings in three and a half years. And the average rating received was 2.47.

Social Network Analysis Of The Dataset

This paper takes an open dataset called 'Bitcoin-OTC' collected by the network analysis project of Stanford University (<http://snap.stanford.edu>). The dataset contains 35,592 rating records among 5,881 users.

Firstly, a simple graph is built from the dataset, where each node represents a user, and each edge represents existing rating from a rater to a ratee.

With the social network analysis tool Pajek 5.05 (<http://mrvar.fdv.uni-lj.si/pajek/>), the basic statistical information is shown in the following table 2 (Kiss & Bichler, 2008):

Table 2: The Basic Information of the Rating Network

Feature	Definition	Evaluation
Total number of nodes	Total number of users	5,881
Total number of edges	Total number of rating of users	35,592
Average in-degree	The average number of ratings received by a node	6.0520
Average out-degree	The average number of ratings sent by a node	6.0520
Average clustering coefficient	The degree to which nodes tend to cluster together	0.2416
Network diameter	The longest distance between any two nodes	11
Average path length	The average of all the minimum path lengths between all pairs of nodes in a network	3.7189

K-means Clustering Algorithm

K-means algorithm is a kind of clustering analysis algorithm, which divides n sample points into k clusters. Sample points within cluster have high similarity, while sample points between clusters have low similarity. Similarity calculation is based on the average value of sample points in a cluster. The process of the algorithm is as follows:

- 1) In the dataset D , randomly select k points and assigned them to the initial cluster center, $C_i = P_{k_i}$ ($i = 1, \dots, k$);
- 2) For all P_j ($j = 1, \dots, n$) in D , calculate its distance to each cluster center C_i ($i = 1, \dots, k$);

$$d(P_j, C_i) = \sqrt{\sum_{l=1}^m (P_j^l - C_i^l)^2} \quad (1)$$

In (1), $P_j^i, C_i^l, (l = 1, \dots, m)$ are the features of sample points.

3) Find out the minimum distance between P_j and C_i , $C_o = \min d(P_j, C_i), (i = 1, \dots, k)$, and reassign P_j to the cluster C_o ;

4) Recalculated the features of clustering center $C_i^l, (l = 1, \dots, m; i = 1, \dots, k)$ based on the total J sample points in the cluster:

$$C_i^l = \sum_{j=1}^J P_j^l / J, (i = 1, \dots, k; l = 1, \dots, m) \quad (2)$$

5) Repeat step 2 - 4, until features of all center of clusters do not change anymore.

SELECTION OF FEATURES FOR K-MEANS ALGORITHM

Pretreatment Of Users

According to the analysis of users' behavior in Table 1, if a user had been rated with positive values by all users, it implied that the user was trusted. On the contrary, if a user had ever been rated with negative values by other users, it implied that the user was a fraudster. But due to existing of some scammers rated by other fraudsters with high ratings (as shown in Figure 3), not all users rated with positive values are really trusted. Seeing that, we use the K-means algorithm to separate 'suspects' from 'trusted' users. Before the K-means algorithm is used to classify suspect users from trusted users, we filtered those users that were confirmed as fraudsters (rated with negative values).

Table 3: The Pretreatment of Nodes

Name	Character	Number
Positive-class	nodes that have been rated with positive values by other users	4,604
Negative-class	nodes that have been rated with negative values by other users	1,254
Zero-class	nodes that have not been rated by other users	23

As shown in Table 3, 1277 nodes were removed from dataset because they were labeled as fraudsters by others.

Selection Of Features

Through the study of website users, this paper finds that it is not always effective to judge the credibility of accounts simply based on the score that they got. As shown in figure 3, for the designated user, between February 28 and March 1, 2013, 14 users mainly gave it a high score like +8 and +10. Nearly two months later, the user was scored '-1' for its abnormal behavior. However, its mean score given by other users is 8.2143 (115/14), which looks like an honest user. To more effectively determine whether users have exchange risks, this paper identifies the following 12 indexes analyzing the Positive-class nodes according to the three fields (source, target, rating) in the dataset.

Table 4: The Definition of Index

Number	Index	Definition
1	A1	number of total ratings sent
2	A2	number of positive ratings sent
3	A3	number of negative ratings sent
4	B1	number of total ratings received
5	B2	number of positive ratings received
6	B3	number of negative ratings received
7	C1	mean of total ratings sent
8	C2	mean of positive ratings sent
9	C3	mean of negative ratings sent
10	D1	mean of total ratings received
11	D2	mean of positive ratings received
12	D3	mean of negative ratings received

Classification And Characteristic Description Of Positive-class Nodes

To further discover the overall characteristics of Positive-class nodes, this paper excavates the characteristics of nodes which are significantly different from other user nodes.

It can be seen from the above analysis that the Positive-class nodes contain abnormal nodes, and their risks are mainly reflected in the abnormal score. Therefore, in this paper, the Positive-class nodes with abnormal 'mean of total ratings sent/received' will be regarded as abnormal nodes. Abnormal nodes are likely to be nodes with exchange risk.

According to the statistical information, the average of C1-index of Positive-class nodes is 1.5393, and the standard deviation is 1.8965. Therefore, Positive-class nodes are divided adopting triple standard deviations ($1.5393+3\times 1.8965=7.2289$) and the nodes whose value of C1-index is greater than 7.2289 are screened out as the abnormal users. For the convenience of description, such nodes are defined as Positive1-class nodes. Similarly, Positive-class nodes are divided adopting triple standard deviations ($=5.5038$) according to the average ($=1.6653$) and standard variance ($=1.2974$) of D1-index. For the convenience of description, such nodes are defined as Positive2-class nodes. The basic statistical information of these four types of nodes is shown in table 5.

		Positive0	Positive1	Positive2	Positive12
	Number of nodes	4,425	113	104	38
A1	Average	4.4573	1.2124	1.4327	1.2368
	Standard deviation	16.9492	0.7252	1.6474	0.6339
A2	Average	4.2328	1.2124	1.3462	1.2368
	Standard deviation	15.6425	0.7252	1.5122	0.6339
A3	Average	0.2245	0	0.0865	0
	Standard deviation	3.6398	0	0.6983	0
B1	Average	4.3590	1.2920	1.5865	1.3158
	Standard deviation	13.4024	0.7755	1.0391	0.6619
B2	Average	4.3590	1.2920	1.5865	1.3158
	Standard deviation	13.4024	0.7755	1.0391	0.6619
B3	Average	0	0	0	0
	Standard deviation	0	0	0	0
C1	Average	1.3168	9.5246	5.2284	9.5394
	Standard deviation	1.3674	0.8317	4.2028	0.8251
C2	Average	1.4665	9.5246	5.3820	9.5394
	Standard deviation	1.1901	0.8317	3.9266	0.8251
C3	Average	-0.5590	0	-0.2019	0
	Standard deviation	2.1635	0	1.3821	0
D1	Average	1.5198	4.0893	7.7972	8.8026
	Standard deviation	0.8342	3.6123	1.8900	1.5314
D2	Average	1.5198	4.0893	7.7972	8.8026
	Standard deviation	0.8342	3.6123	1.8900	1.5314
D3	Average	0	0	0	0
	Standard deviation	0	0	0	0

After analysis, the following conclusions can be drawn from table 5:

- (1) The value of A1-index, A2-index, B1-index, and B2-index of Positive1-class nodes and Positive2-class nodes are low. Their average of these four indexes are close to 1-2, but those of Positive0-class nodes are between 4 and 5.
- (2) The value of C1-index and C2-index of Positive1-class nodes and Positive2-class nodes are relatively high. Their average of these two indexes are both greater than 5, but those of Positive0-class nodes are between 1 and 2.
- (3) The value of D1-index and D2-index of Positive1-class nodes and Positive2-class nodes are relatively high. Their average of these two indexes are both greater than 4, but those of Positive0-class nodes are between 1 and 2.

This indicates that the behaviors of Positive1-class nodes and Positive2-class nodes are significantly different from other nodes. The frequency of total ratings sent/received of these two types of nodes is low, but the mean of total ratings sent/received of them is high.

RECOGNITION OF POSITIVE1-CLASS NODES

Research Approach

This paper applies the k-means algorithm to classify the Positive-class nodes and finally finds out the indexes which can identify Positive1-class nodes accurately.

First, input the original data and select different index combinations according to the actual situation to divide the Positive-class nodes into four categories by using the k-means algorithm. Then compare the original Positive1-class nodes with the classification

results to find the combinations of indexes with higher recall and precision. Finally, compare the indexes to obtain identification enlightenment of Positive1-class nodes.

Data Analysis

14 combinations of indicators with high recognition precision are listed below, and they are compared in groups.

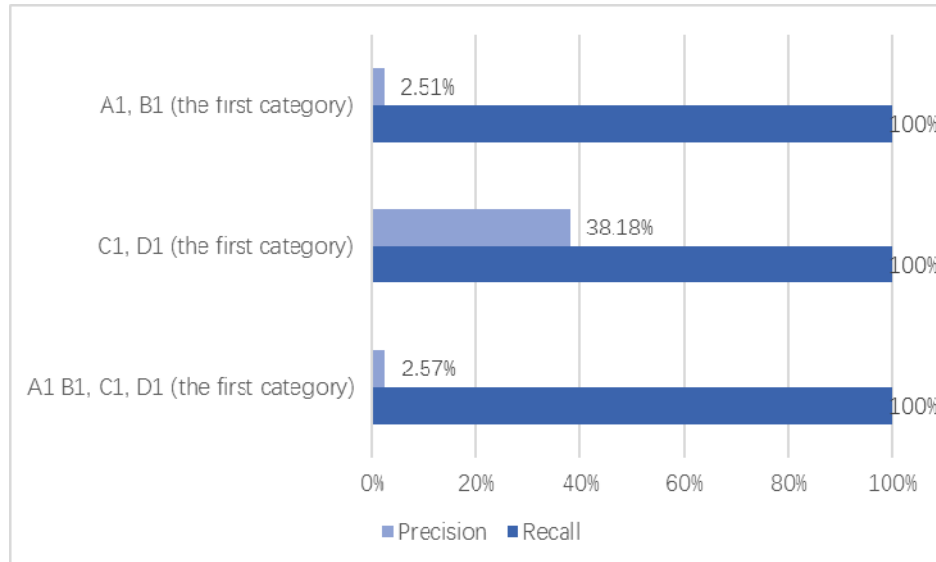


Figure 5: Comparison of the Recognition Effect Between 'A1, B1' and 'C1, D1'.

As shown in figure 5, on the premise that the recall is both 100%, the precision of the combination of A1-index and B1-index is only 2.51%, while the precision of the combination of C1-index and D1-index is 38.18%. Besides, the addition of A1-index and B1-index will reduce the precision of recognition of Positive1-class nodes. The precision of the combination of C1-index and D1-index is 38.18%, and after the addition of A1-index and B1-index, the precision is only 2.57%.

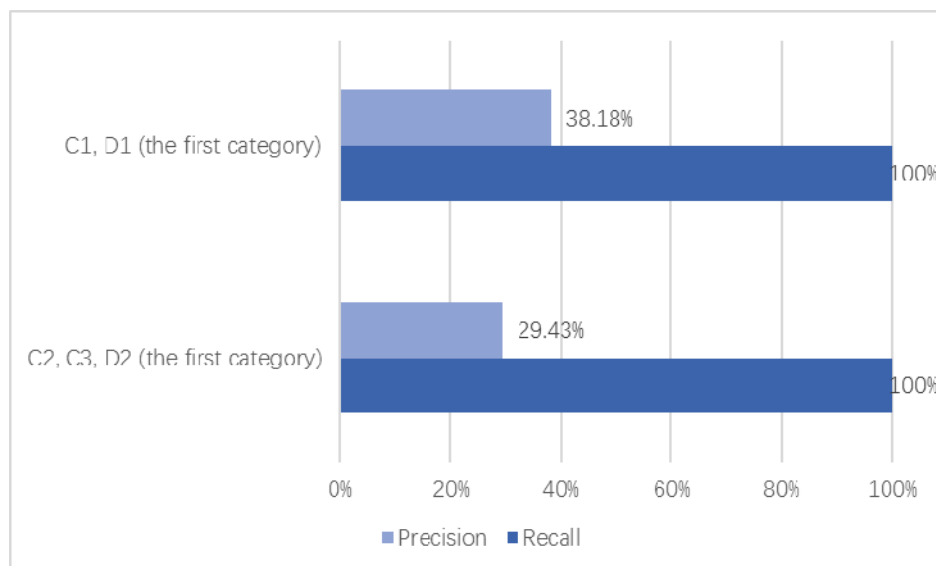


Figure 6: Comparison of the Recognition Effect Between 'C1, D1' and 'C2, C3, D2'.

As shown in figure 6, on the premise of the recall with 100%, the precision of the combination of C1-index and C2-index is 38.18%, while the precision of the combination of C2-index, C3-index and D2-index is 29.43%. This indicates that the precision of the combination of total mean indexes (C1, D1) is higher than that of the combination of positive (C2, C3) and negative mean indexes (D2).

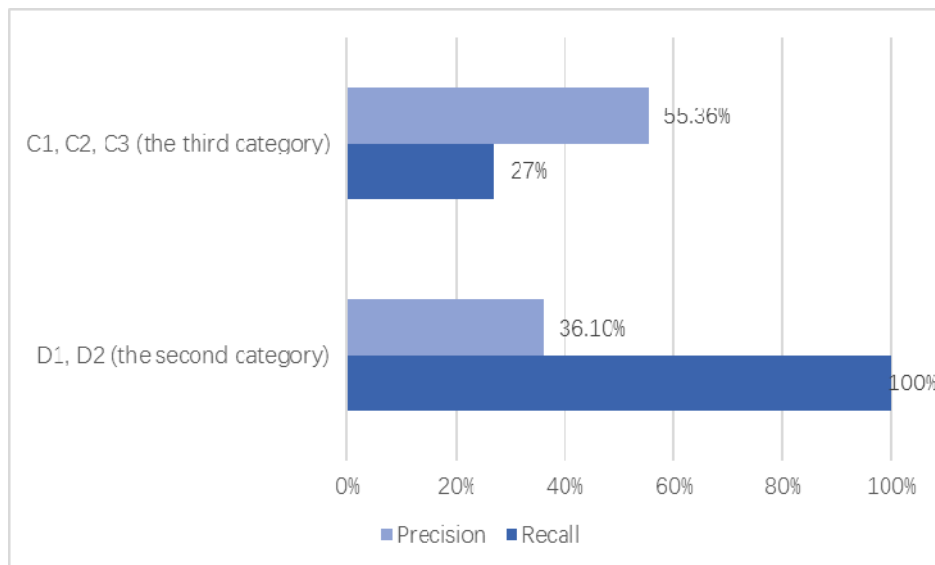


Figure 7: The Comparison of Recognition Effect Between ‘C1, C2, C3’ and ‘D1, D2’.

As shown in figure 7, under the condition that the recall is both 100%, the precision of the combination of C1-index, C2-index and C3-index is 36.1%. The recall of the combination of D1-index and D2-index is low, only 27%, but its precision is 55.36%. As the precision of identification is more important in the practical application, the precision is mainly considered here. It can be seen that the recognition precision of ‘ratings sent indexes’ is lower than ‘ratings received indexes’.

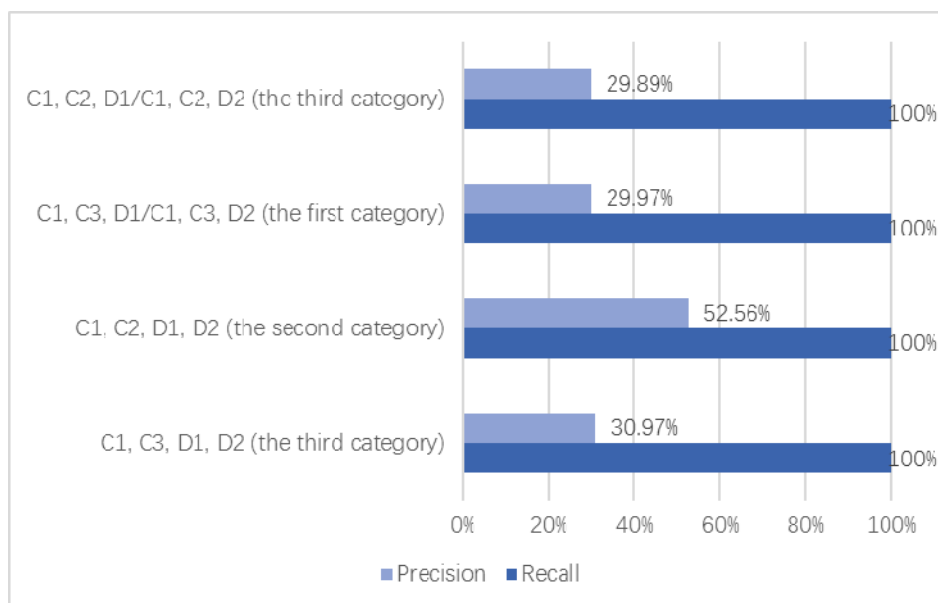


Figure 8: The Comparison of Recognition Effect Between ‘C2’ and ‘C3’.

As shown in figure 8, on the premise that the recall rate is both 100%, the precision of the combination of C1-index, C2-index and D1-index/C1-index, C2-index and D2-index is 29.89%, and that of the combination of C1-index, C3-index, and D1-index/C1-index, C3-index and D2-index is 28.97%. The precision of the combination of C1-index, C2-index, D1-index, and D2-index is 52.56%, and that of the combination of C1-index, C3-index, D1-index, and D2-index is 30.79%. It can be seen that the C2 index is more accurate than C3 in recognition. That is to say, comparing to the negative score sending to others, the positive score sending to others has higher precision in identification.

Finally, we combine indicators related to the mean score (C1, C2, C3, D1, D2) to identify Positive1-class nodes and find that this combination of indexes has the highest recall and precision.

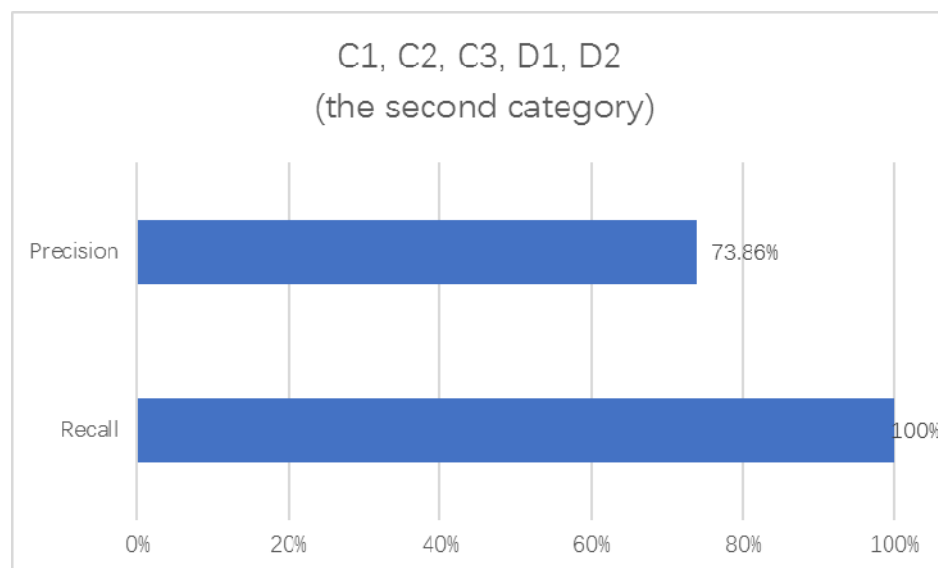


Figure 9: The Results of the Recognition of 'C1, C2, C3, D1, D2'.

Conclusion Of Identification

Based on the above data analysis, the following conclusions can be drawn:

Conclusion 1: In the identification of Positive1-class nodes, the number of total ratings sent/received is not the accurate recognition indexes.

Conclusion 2: In the identification of Positive1-class nodes, compared with the 'mean of negative ratings sent' indexes, the 'mean of positive ratings sent' indexes have more reference value.

Conclusion 3: In the identification of Positive1-class nodes, the precision of the combination of total mean indexes is higher than that of the combination of only positive or negative mean indexes. If ignore the positive and negative mean of ratings, only using the total mean of ratings to identify will reduce the recognition accuracy.

Conclusion 4: In the identification of Positive1-class nodes, the combination of mean indexes has the highest recognition accuracy.

CONCLUSIONS

Through the positive and negative scores between users, this paper finds the problem nodes which are different from the normal nodes. Then, the behavior characteristics of these abnormal nodes are found. The most important thing is that this paper finds the mean index combination (C1, C2, C3, D1, D2) which can recognize nodes having potentially risk accurately. It also certifies that the K-means algorithm is effective in recognizing 'potential fraud' nodes.

ACKNOWLEDGMENT

This work is partially supported by the Education and Teaching Reform Project of the South China University of Technology (Y9161010).

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Model-based reinforcement learning: A survey

(Full Paper)

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ABSTRACT

Reinforcement learning is an important branch of machine learning and artificial intelligence. Compared with traditional reinforcement learning, model-based reinforcement learning obtains the action of the next state by the model that has been learned, and then optimizes the policy, which greatly improves data efficiency. Based on the present status of research on model-based reinforcement learning at home and abroad, this paper comprehensively reviews the key techniques of model-based reinforcement learning, summarizes the characteristics, advantages and defects of each technology, and analyzes the application of model-based reinforcement learning in games, robotics and brain science.

Keywords: Reinforcement learning, data efficiency, optimizing, dynamic models, value function approximation.

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INTRODUCTION

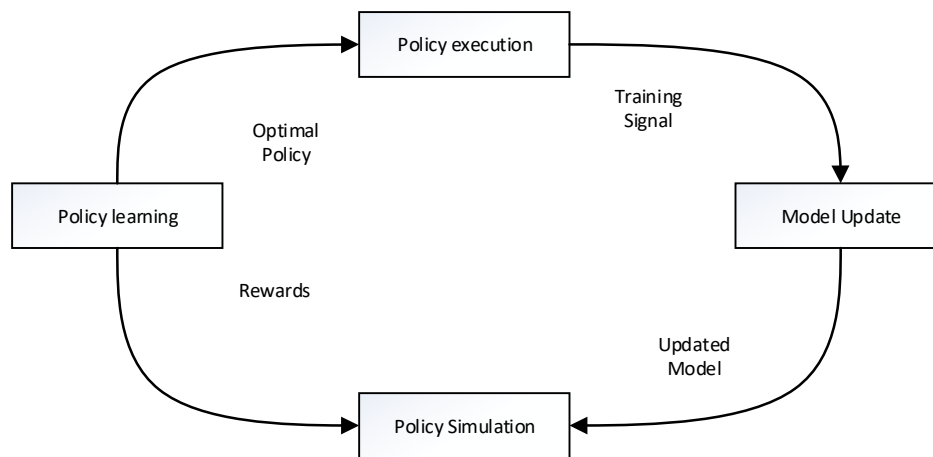
Model-based reinforcement learning refers to the establishment of a model according to the environment, so that the agent knows how the environment shifts the state and the feedback rewards, and then finds the optimal policy based on the model to get the maximum cumulative reward. With the development of deep learning (LeCun *et al.*, 2015) in recent years, model-based reinforcement learning has greatly improved in terms of data efficiency and generalization ability of models. With model-based reinforcement learning in the classic Atari games (Stadie *et al.*, 2015), Alpha Go (Silver & Huang *et al.*, 2016), face recognition (Rao *et al.*, 2017), robotics (Mordatch *et al.*, 2012), medicine (Hamaya *et al.*, 2016; Sharp *et al.*, 2015), brain science (Daw *et al.*, 2005; Niv *et al.*, 2007), automatic driving (Deisenroth *et al.*, 2013), natural language processing (Scheffler *et al.*, 2002) etc., gradually playing an increasingly important role, so it is necessary to a comprehensive review of the new developments in model-based reinforcement learning.

Kaelbling *et al.* (1996) reviewed the work of early reinforcement learning and the core issues from the perspective of computer science, including the compromise of exploration and exploitation, the construction of models to accelerate learning, and so on; Quan *et al.* (Quan *et al.*, 2018) reviewed three main methods of deep reinforcement learning and some frontier directions of deep reinforcement learning; Yuxi Li (2018) summarizes the algorithm and development of reinforcement learning from the basic elements of reinforcement learning; Dongbin *et al.* (2016) reviewed the algorithm of reinforcement learning and the future development from the perspective of computer Go; Wenji & Yang (2017) reviewed the problem of hierarchical reinforcement learning in dimensional disasters. It is worth noting that with the development of deep learning in recent years, model-based reinforcement learning has made great progress in the generalization of the model and data efficiency. Different from the existing review (Kaelbling *et al.*, 1996; Quan *et al.*, 2018; Yuxi Li, 2018; Dongbin *et al.*, 2016; Wenji & Yang, 2017), this paper focuses on the recent progress, advantages and disadvantages of the model-based reinforcement learning field.

PROBLEM DEFINITION

Reinforcement Learning (RL) (Sutton & Barto; 1998) refers to learning to behave optimally in a stochastic environment by taking actions and receiving rewards. Markov Decision Process (MDP) are meant to be a straightforward framing of the problem of learning from interaction to achieve a goal, the interaction between the agent and the environment is modeled as the MDP, it is, $[S, A, \mathbf{P}, \mathbf{R}, \gamma]$. Where S is the set of possible states of the agent; A is a set of actions; \mathbf{P} is the probability that the agent transfers from the current state s to the next state s' in the current action a ; \mathbf{R} is the immediate return that the action a transfers from state s to next state s' , γ is the discount factor, $\gamma \in [0, 1]$, indicating the difference between the future reward and the current reward, that is, the proportion of each reward is different. According to the environmental models, reinforcement learning can be divided into model-based reinforcement learning and model-free reinforcement learning.

Model-based reinforcement learning (Ray & Tadepalli, 2010) refers to learning optimal behavior indirectly by learning a model of dynamics by taking actions and observing the outcomes that include the next state and the immediate reward. The specific process is shown in Figure 1:



Source: Polydoros & Nalpanidis, 2017

Figure 1: Flow chart of model-based reinforcement learning

The difference between model-based reinforcement learning and model-free reinforcement learning is that model-based reinforcement learning does not require large number of trial and error experiments to generate optimal actions as model-free reinforcement learning. While model-based reinforcement learning is that the agent gets the optimal action by the transition model, the data efficiency of model-free reinforcement learning is lower because of the large amount of the trial and error experiments. However, model-based reinforcement learning can improve the data efficiency, it can quickly arrive at the near-optimal control with learned models under fairly restricted dynamics. When generalizing to the new environment, agents can rely on the learned models for reasoning. Therefore, the structure of this review is as follows: section 2 introduces the method of approximating value function in model-based reinforcement learning; section 3 discusses the method of dynamics; in section 4, the policy search methods are covered; section 5 presents the application in model-based reinforcement learning; section 6 summarizes this review.

VALUE FUNCTION METHODS

A method that the true value of value function is fitted by a certain function (linear function or nonlinear function, etc.) on a small part of the training sample called function approximation (Xian & Yongchun, 2018). In reinforcement learning, value function approximation is reflected in many algorithms: deep Q learning (Gu *et al.*, 2016) (DQN), double DQN (Van *et al.*, 2016), dueling DQN (Wang *et al.*, 2015), and so on. In model-based reinforcement learning, if the value function is approximated from the perspective of mathematics, it can be divided into two categories, namely the parameterized value function approximation method and the nonparametric value function approximation method.

A. Function approximation method based on parameters

The parameterized value function approximation method means that the value function can be approximated by a set of parameters θ . In general, the value function approximation can be written as $V(s; \theta)$. Therefore, when the structure of the approximating value function is determined, then the approximation of the value function is equal to the approximation of the parameter, and the update of the value function is equal to the update of the parameters. For example, approximating the dataset $\mathbf{T} = \{(x_1, y_1), (x_2, y_2), \dots, (x_N, y_N)\}$ with N training samples, firstly the method selects a set of the basis functions, and then sets the form of the function $V(x) = \sum_{i=1}^m \theta_i \phi_i(x)$ to obtain the parameters $\theta_1, \theta_2, \dots, \theta_m$ using the training data set and the optimized method. This parameter-based approach does not depend on the amount of data in the training set, the form of the basis function, the number of parameters, because they are given beforehand.

Initially, researchers used the Cerebellar Model Articulation Controller (CMAC) neural network (Albus, 1975) as a value function approximator. The biggest advantage of such a neural network is local approximation, and it has certain generalization ability. Since the neural network has the function of the cerebellum, it was originally used to solve the joint motion of the robot (Miller, Hewes *et al.*, 1990), and was later applied to the fields of robot control (Kim & Lewis, 2000), pattern recognition (Glanz & Miller, 1988; Herold *et al.*, 1989), and adaptive control (Chen & Chang, 1996; Kraft & Campagna, 1989). Although it converges faster than the BP network, as an online learning, it is still difficult to meet its rapidity requirements (Miller, Glanz & Kraft, 1990). Sutton *et al.* (Kuvayev & Sutton, 1996) used CMACs neural network as a value function approximator compared with the model-free method, and the model-based method has higher stability. With the rapid development of machine learning, Mnih, Veness *et al.* (Mnih, Veness *et al.*, 2015) proposed a general value function approximation method using supervised learning. Not only can it be generalized to state s but also generalized to target g ; Kamalapurkar *et al.* (Kamalapurkar *et al.*, 2016) used a neural network-like representation to approximate the optimal value function V^* and the optimal policy u^* . Such methods rely heavily on the initial model settings, so it is easy to fall into the local optimum.

B. Function approximation based on nonparametric method

The nonparametric value function approximation method does not refer to the function approximation without any parameters, but refers to the function approximation method determined by the samples which the number of parameters and the form of the base are not fixed. Common methods for nonparametric function approximation include nonparametric approximation methods based on kernel functions (Hang Li, 2012) and gaussian process-based methods (Rasmussen & Williams, 2005). In the nonparametric function approximation method, the data set $\mathcal{T} = \{(x_1, y_1), (x_2, y_2), \dots, (x_N, y_N)\}$ with the training sample N is approximated, and each sample will become a part of the function approximation, so it is called the approximation method determined by the samples. For example, in a kernel-based function approximation method, the final form of the approximation function is $f(x) = \sum_{i=1}^N \alpha_i y_i K(x, x_i)$. Where N is the number of samples and $K(x, x_i)$ is a basis function.

In model-based reinforcement learning, Jong & Stone (Jong & Stone, 2002) defined an approximation model from the samples, the goal is to approximate each transition probability distribution function P and the expected reward function R using the sample of empirical data D applying the value iteration to model-based reinforcement learning; Duan & Xu (Duan & Xu, 2007) used a network integrated with Fuzzy Inference Systems (Jouffe, 1998) (FIS) and neural network as a value function approximator on the soccer robot, the approximator can progress the mapping from state space to action space, which can effectively guarantee the stability and convergence of learning. Since the non-parametric value function approximation method is determined by the samples, the calculation speed is difficult to guarantee when the number of samples is very large.

TRANSITION MODELS

Model-based reinforcement learning is that agents learn a model from the dynamics and has strong demands on the dynamic model, that is, they can effectively and accurately predict future dynamic conditions. Depending on the model, model-based reinforcement learning can be divided into two types to fit the dynamic environment. They are reinforcement learning based on deterministic models and stochastic models.

A. Deterministic case

The deterministic model means that the agent has already known the transition model structure, and then makes action decisions, such as optimal control and trajectory optimization. Since the environment is known and the goal is to maximize the cumulative reward, then this type of problem becomes the environment giving the agent an initial state s_1 , and then the agent making a series of action decisions directly from the environment:

$$\alpha_1, \dots, \alpha_T = \underset{\alpha_1, \dots, \alpha_T}{\operatorname{argmax}} \sum_{t=1}^T r(s_t, \alpha_t) \text{ s.t. } s_{t+1} = f(s_t, \alpha_t)$$

In deterministic case, Erez *et al.* (Erez *et al.*, 2012) proposed a method combining off-line trajectory optimization and online model predictive control (Garcia *et al.*, 1989) (MPC), which can generate robust controllers for complex periods with unilaterally constrained domains; Mordatch *et al.* (Mordatch *et al.*, 2012) proposed a physical feature-based model that allows for efficient consideration of dynamic environment aspects in the internal loop of the optimization process; Liu *et al.* (Liu *et al.*, 2014) proposed a motion model, SteadyFlow, to represent adjacent video frames movements to achieve stability. The advantage of using a deterministic dynamic model in model-based reinforcement learning is that the deterministic dynamics can greatly improve the data efficiency and the disadvantage is that this model does not consider the potential changes of the dynamics.

B. Stochastic case

In a stochastic case, in general, we can fit the dynamics with models with Gaussian processes (Engel *et al.*, 2005) (GP), neural network models (Fragkiadaki *et al.*, 2015; Nagabandi *et al.*, 2017), or other models such as mixed Gaussian models (Cai *et al.*, 2016).

When a model with a GP (Rasmussen & Williams, 2005) is used to fit an unknown dynamics, based on the known input (x_t, u_t) , the agent establishes a Gaussian distribution $p(x'|x_t, u_t)$ based on the learning data, and obtains the output as x_{t+1} . McAllister *et al.* (McAllister, van & Rasmussen, 2016) used the GP as the environment learning model $p(x'|x, u)$ to maximize $\sum_t \log p(x'|x_t, u_t)$; Xuesong *et al.* (Xuesong *et al.*, 2009) transformed the reinforcement learning into a binary classification problem in the continuous state space. Then, based on the classification ability of GP model, the reinforcement learning policy is obtained. Engel *et al.* (Engel *et al.*, 2005) has proposed a GP time difference learning framework, and further considers the randomness and action selection of state transition; Ko *et al.* (Ko *et al.*, 2007) proposed an example application of GP model in reinforcement learning. The advantage of this model is that it can be used effectively and efficiently, and the disadvantage is that such a model is slow to calculate for a system with many data.

When using neural network model to fit the unknown dynamics, the input of the neural network is the matrix of states and actions (x_t, u_t) , the output is x'_t , and its loss function is Euclidean distance of the actual state x_t and the output x'_t , Fragkiadaki *et*

al. (Fragkiadaki *et al.*, 2015) proposed a model of a neural network similar to the recurrent neural network's (Graves, 2013) encoder-recurrent-decoder to predict human walking; Nagabandi *et al.* (Nagabandi *et al.*, 2017) parameterized the learned dynamics into a medium-sized deep neural network. The input is the action-state pair, and the output is the difference of the joint states, and the model is combined with the model predictive control (MPC) to achieve a high degree of sample complexity, so that the stable and effective gait can be obtained in various complex motion tasks. The advantage of this type of model is that the model is very expressive and good at using lots of data; but the disadvantage is that the performance is bad when the amount of data is not large enough.

Mixed Gaussian models are very common models in other models to fit unknown dynamics, and such models are used more in robots. The input to train the model is the combination of the current state-action pair and the next combination (x, u, x') , and then obtains the gaussian distribution $p(x_t, u_t, x'_t)$ and takes the conditional distribution to obtain $p(x'_t|x_t, u_t)$. Ha & Schmidhuber (Ha & Schmidhuber, 2018) proposed a model inspired by cognitive systems, which is divided into three parts: the variational self-encoding (Kingma & Welling., 2013) part, the mixed-density (Bishop, 1994) recurrent network (Graves, 2013) part, and the control part. The mixed density recurrent network partially outputs gaussian mixture, which is used to predict the distribution density of the next observation.

C. Model bias

The key challenge for model-based reinforcement learning is model bias, especially when the training is just starting and the data set is small, the learned model is inaccurate and the data efficiency is not high. In response to this problem, Deisenroth & Rasmussen (Deisenroth & Rasmussen, 2011) proposed an algorithm called probabilistic inference for learning control (PILCO), which has a big improvement in learning speed and has performed well in many tasks such as the swinging of the car (Hesse *et al.*, 2018) and the training of the robot arm (Deisenroth, Rasmussen&Fox, 2011). Nevertheless, the algorithm does not have the guarantee of global optimality, and the computational complexity increases exponentially with the dimension of data, which is difficult to apply to high-dimensional systems. Therefore, the researchers proposed some improved algorithms for the PILCO algorithm, using the bayesian depth dynamic model instead of the previous Gaussian model to solve the problem of time correlation without previously considering the model uncertainty between continuous state transitions (Gal *et al.*, 2016); Rowan McAllister *et al.* have used guided exploration (Thrun, 1992) to solve the problem that the PILCO algorithm did not use any possible exploration before (McAllister, van& Rasmussen, 2016) and also modified and extended partial observed MDP (POMDP) combined with PILCO algorithm, and has solved the problem of the influence of noise in the actual state (McAllister & Rasmussen, 2016); Higuera *et al.* (Higuera *et al.*, 2018) have proved that using neural network controller can improve the data efficiency of (Gal *et al.*, 2016).

POLICY METHODS

Trust region policy optimization (Schulman *et al.*, 2015) methods and depth deterministic policy gradient methods (Lillicrap *et al.*, 2015) are typical model-free RL methods to optimize policies. Model-free reinforcement learning methods have many advantages, such as they do not need to model the external dynamics, when the external dynamics is complex, it is the only random method available in the policy search algorithms. The solution to the stochastic policy search problem in reinforcement learning is to use the model to search policies. With the model, using model and model-based optimization can result in higher reward data and take advantages of demonstration to learn.

A. Dynamic programming

Dynamic programming (Sutton & Barto., 1998) (DP) is mainly to solve the problem of how to calculate the optimal policies after having a model that can perfectly simulate the MDP. The core idea of DP is to use the value function as a basis to guide the process of policy search.

In order to get the following policy v_k , the same operation is performed for each state s : the value of the current state s is updated to a new value, and the new value is followed by an old value and an instantaneous expectation reward, summed along all possible state transition probabilities. In this algorithm, each iteration of the operation updates the value of all states in reverse, resulting in a new value. The process is called policy estimation.

The reason why we want to calculate the value function under a policy is because we want to evaluate the policy. Assuming that the value function v_π of a certain policy is known, the method of choosing a better policy to proceed is called policy promotion.

When a policy becomes a better one by policy promotion, then a new policy is generated after policy iteration. Further optimized into a better policy after policy promotion, so that the update sequence shown in Figure 2 can be obtained.

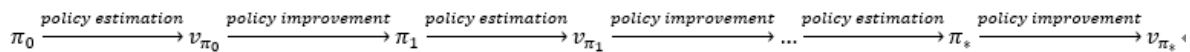


Figure 2: Using policy estimation and policy improvement to get a better policy

One disadvantage of policy iteration is that it includes a policy estimation every time during the iteration process, and the policy estimation itself is the iteration after iteration. By the end of the policy estimation, v_k can be guaranteed to converge to v_π accurately, but the calculation speed is very slow. The value iterative algorithm is to improve the policy after evaluating the policy of all the policies in an epoch, and obtain a greater convergence speed.

Song *et al.* (Song *et al.*, 2015) used DP in optimized hybrid energy storage systems to obtain optimal configurations for hybrid energy storage systems for electric city buses including batteries and supercapacitors; Askew (Askew, 1974) applied DP to limit water resource systems, achieving good performance with the possibility of failure; Wall & Fenech (Wall & Fenech, 1965) used DP algorithms to optimize minimum unit power costs in fuel management optimization for nuclear power plants. Although the DP algorithm is a classic algorithm in the optimization algorithm, in practical applications, as the data increasing, it will encounter dimensional disasters and there is no unified standard model for use.

B. Guided policy search

Since direct policy search can be effectively extended to high-dimensional systems, the effectiveness of this approach is greatly reduced for complex policies with hundreds of parameters. Because these methods require a large number of samples and often fall into poor local optimum. So, Sergey Levine proposed the Guided Policy Search (Levine & Koltun, 2013) (GPS) algorithm for this problem. The algorithm performs well for deterministic and linear dynamics, but it is very challenging for nonlinear dynamic systems and complex tasks. Nevertheless, the algorithm has a good starting for the following work.

Subsequently, some improved algorithms of GPS algorithm are proposed, including the cGPS (Levine & Abbeel, 2014) of gaussian controller under unknown dynamic conditions. The algorithm solves the learning problem of gaussian controller under effective unknown dynamic conditions by introducing iterative fitting local dynamic model and learning time-varying linear gaussian controller. A time-varying linear model with iterative modification is proposed to learn a group of trajectories, and then these trajectories are unified into a single control policy to increase the generalization of the dual GPS (Levine, Wagener & Abbeel, 2015). This algorithm can make the robot learn abundant interactive operation skills. The improved GPS algorithm (Levine, Finn, Darrell & Abbeel, 2015) is transformed into supervised learning, and then formalizes as an example of Bregman ADMM (Wang & Banerjee, 2013), the algorithm achieves local optimum and can be used to train the joint system of perceptual system and control system end-to-end. It is proposed to train a complex, high-dimensional policy with approximate mirror descent GPS (Montgomery & Levine, 2016) by alternating between reinforcement learning and supervised learning in the trajectory center, and guiding the connection between the policy search method and the mirror descent method. Sergey Levine proposes a new GPS algorithm which combines the random policy optimization based on path integral with GPS to train the high-dimensional nonlinear neural network policy for vision-based robots and improve their operation skills (Chebotar *et al.*, 2016) and so on.

APPLICATION

An important reason why model-based reinforcement learning is becoming more and more popular is that it is a theoretical tool for studying the behavior of agents. Undoubtedly, it is used by many researchers to build many applications, including robotics, games, and brain science. Model-based reinforcement learning is playing an increasingly important role.

A. Games

The DeepMind team applied model-based reinforcement learning to the Go robot, AlphaGo, the first artificial intelligence defeating the human professional Go players. Subsequently, a new version of AlphaGo Zero (Silver, Schrittwieser *et al.*, 2017) has been introduced, which alternates the optimization policy of policy iteration and Monte Carlo tree search (Chaslot, 2010) in reinforcement learning. This version is different from the old one: AlphaGo Zero completely abandons human knowledge and has defeated the old version of AlphaGo after three days of training from scratch.

The DeepMind team also achieved remarkable achievements in the deep reinforcement learning algorithm based on Atari video games. In 2013, using the improved TD-gammon's, the model-free reinforcement learning algorithm (Mnih, Antonoglou *et al.*, 2013) similar to Q-learning, it relied on continuous trial and error learning to finally become the game master AI system that defeated human professional players. The AI system playing the Atari game, Breakout, is beyond the human level. Later publishing a paper (Mnih, Veness *et al.*, 2015) using the reinforcement learning system to learn how to play 49 Atari games, the system can achieve human level performance in most games, but there is almost no progress in Montezuma's revenge game.

B. Robot

Model-based reinforcement learning has a wide range of applications in the field of robot, such as the application of robotic arms, unmanned aerial vehicle (UAV), and automatic driving. Researchers use a model-based reinforcement learning algorithm and apply it to the robotic arm to accurately grasp the object and place it in a specific location (Deisenroth, Rasmussen & Fox, 2011; Levine, Wagener & Abbeel, 2015), and can also push objects and deal with objects that can't be seen during training (Finn & Levine, 2016). In the field of UAVs, researchers have used the idea that birds can locate objects that heat around them, and developed a glider that can constantly locate and update the location of objects that heat around them (Reddy *et al.*, 2018). The simulation helicopter also trains the task of avoiding obstacles in (Guo, X 2017; Khan & Hebert,

2018). In the field of automatic driving, researchers successfully transfer the data from virtual environment to real environment (Pan *et al.*, 2017; Tan *et al.*, 2018), and can adapt to the sudden change of transfer probability in 3D navigation tasks (Corneil *et al.*, 2018).

C. Brain science

Brain science and cognitive neuroscience have always been the source of inspiration of reinforcement learning, and the source often brings revolutionary success to the reinforcement learning algorithms. Representatives of this direction, such as the DeepMind team's series of papers on memory (Wang *et al.*, 2018; Kirkpatrick *et al.*, 2016; Stachenfeld, Botvinick & Gershman, 2017). Dopamine is a well-known reward signal and is often considered an analogy of the reward used in reinforcement learning algorithms. Patients with Parkinson's disease leading to loss of dopamine are impaired in learning rewards, and many studies have indicated the important role of dopamine in model-free learning (Starkweather & Babayan *et al.*, 2017; Sadacca *et al.*, 2016). However, recent studies have shown that model-based reinforcement learning may also involve dopamine regulation (Smittenaar *et al.*, 2013; Deserno *et al.*, 2015), which increases the likelihood that model-based reinforcement learning may lead to learning disabilities in Parkinson's disease. Sharp *et al.* (Sharp *et al.*, 2015) evaluated that patients with Parkinson's were tested for dopamine replacement therapy and learning in a healthy control group. Surprisingly, disease or medication has no effect on model-free reinforcement learning. In contrast, patients who underwent drug testing showed significant obstacles in model-based reinforcement learning that were corrected by dopaminergic drug therapy. In addition, model-based reinforcement learning is positively correlated with individual measures of working memory performance, and the results suggest that certain learning disabilities in Parkinson's disease may be related to the inability to pursue rewards based on a full representation of the environment.

SUMMARY

Model-based reinforcement learning performs better in data efficiency than model-free reinforcement learning; but suffers from significant bias, since complex unknown dynamics cannot always be modeled accurately enough to produce effective policies. Model-free methods have the advantage of handling arbitrary dynamical systems with minimal bias, but tend to be substantially less sample-efficient (Chebotar *et al.*, 2017). It can be seen that although the research and application of model-based reinforcement learning has entered a new height compared to model-free reinforcement learning, it is extremely important for robotics, games and brain science, but relatively, these areas are not mature enough, there are still many problems to be solved, and the active participation and collaboration of researchers is needed.

ACKNOWLEDGEMENT

This work was supported by Beijing Municipal Commission of Science and Technology (Grant No. Z171100000117018), and Communication University of China (Grant Nos. CUC18A001, CUC18A003-3, 3132014XNG1454, 3132015XNG1531, 3132017XNG1724).

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On Online Engagement: Does the Leadership Style Matter?

(Full Paper)

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ABSTRACT

The news industry is facing tremendous changes. Integrating digital technologies into news practices has become the key to survival. Social media engagement editors are one of such innovations to respond to the challenge. Engagement editors are required to facilitate the functions of marketing, editing, content production, and data analysis. They thus play the role of boundary-spanner within and beyond the organizational boundaries. However, there are few studies to explore issues associated with the management of social media engagement editors. This research examines whether and how the leadership style (i.e., transformational and passive leadership style) influences engagement editors' job performance. We collected 122 valid responses, and used the SmartPLS 3 and SPSS 19.0 to analyze the data. Our findings indicate that performance of engagement editors is influenced by the leadership style; moreover, job autonomy mediates the positive effect of transformational leadership on engagement editors' job performance. Implications for the management of social media engagement editors are discussed.

Keywords: Social media, engagement editor, transformational leadership, passive leadership, job autonomy, job performance.

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INTRODUCTION

With the prevalence of the Internet and mobile devices, news organizations must adapt themselves to the trend of digital convergence. Social media is among the biggest game changers for news organizations. In the US, 70% of online users have Facebook accounts (Duggan & Smith, 2013); and half of those who frequent Facebook consume news through Facebook (Mitchell *et al.*, 2013). In fact, social media create much needed referral website traffic for such traditional news outlets as BBC, Financial Times, Guardian, and The Economist. With the application of multiple social media platforms, traditional news organizations can stay competitive. These news organizations bring their established credibility and brand recognition to the online news realm, putting small and young online news organizations at a disadvantage (Newman, Dutton & Blank, 2012).

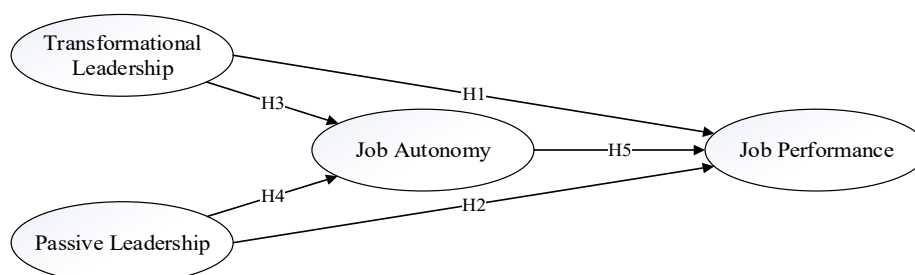
Both the established and young news organizations rely on social media engagement editors to engage their audience. The primary task of engagement editors is to establish and maintain relationships with audience on behalf of individual news organizations. Unlike traditional reporters, engagement editors mostly conduct their tasks online or through digital technologies. For example, engagement editors search news materials on the internet, interact with audience on social media platforms, and conduct interviews via such digital technologies as Skype or Facebook instant messaging. Given their proximity to the audience, engagement editors are able to form understanding about their audience and establish relationships with them (Chang, 2015).

According to Powers (2015), engagement editors should possess three key abilities. First, they must understand how social media work and exploit their technological affordance to detect potential public issues, and even to actively set the news agenda. Second, engagement editors should help coordinate the overall news production/dissemination process. For example, engagement editors can help customize news contents for different media carriers, or design and execute promotion activities to engage audience online and offline. Finally, engagement editors are also data analysts. Engagement editors must help analyze and interpret website traffic data, and make decisions about the engagement strategy and best temporal intervals for news posting on various social media platforms. In other words, engagement editors play the role of the boundary-spanner within and beyond the organization. How to manage and motivate engagement editors thus warrant scrutiny.

This paper aims to examine whether and how the leadership style influences job performance of engagement editors. We employ the conservation of resource theory to explore the research question. The conservation of resource theory argues that individuals have a limited stock of energy (Hobfoll, 2002). Supervisors can tap into employees' energy stock, draining it and causing poor job performance. Likewise, supervisors can also help refill or conserve the energy by motivating employees or providing support and correct guidance (Liu, Chua & Pavlov, 2016; Liu and Chua, 2016). There is a full range of leadership style, ranging from the most active to the least one, with transformational leadership and passive leadership representing the opposite ends of a continuum (Bass and Avolio, 1997; Bass 1998). On the other hand, job autonomy allows employees to work with a flexible schedule or self-governing working process (Morgeson *et al.*, 2005). Empirical studies indicate that job autonomy can boost employees' job satisfaction and thereby their performance level (Parker *et al.*, 2001). This research argues that both the leadership style and job autonomy influence the resource level of individual engagement editors. This paper should provide insight into the management of engagement editors.

LITERATURE REVIEW

Given the boundary-spanning nature, engagement editors' job includes both the execution of substantive and technical tasks (e.g., news posting at regular intervals), and those focusing on interpersonal and motivational aspects (Witt, Gerald & Ferris, 2003). Morgeson *et al.* (2005) distinguish job performance between task performance and contextual performance. Task performance refers to the activity based on a worker's prescribed role in an organization. Contextual performance, or citizenship performance, refers to the sort of activities not directly related to employees' prescribed duties. Most of these contextual works are voluntary in nature and contribute to the social and psychological core of an organization. In this study, we consider engagement editors' job performance include both elements. Figure 1 is our research model.



Source: This study.

Figure 1: Research model.

Conservation of Resources Theory

With interaction with the audience as their primary task, engagement editors play the role of the boundary spanner beyond the organizational boundaries. They thus are subject to more stressors that could drain their personal resources. For example, online bullying by haters can be stressful, depleting engagement editors' resources and leading to their reduced performance. According to the conservation of resource theory (COR), resources refer to any objects, personal characteristics, conditions, or energies that can help an individual alleviate threats or losses caused by stress (Hobfoll, 1988; Hobfoll & Shirom, 2001; Hobfoll, 2002). Individuals have to utilize available resources to maintain their performance levels. In organizations, management can provide support or guidance to increase and/or conserve employees' personal resources to mitigate the stress related losses (Hobfoll, 2011).

There are many forms of leadership (Bass and Avolio, 1997; Bass 1998). Active and effective leadership can boost employee morale and confidence, resulting in more personal resources and better performance (Bass and Avolio, 1994). This is because those leaders take into considerations individual needs and abilities of their subordinates, and motivate or instruct them accordingly (Zohar and Luria, 2004). Employees thus can perform better than they normally would.

The transformational leadership style is the most active and effective leadership style (Holtz and Hu, 2017). A transformational leader affects employees via four means, namely via providing idealized influence (i.e., charisma), inspirational motivation, intellectual stimulation, and individualized consideration (Bass and Avolio, 1994). That is, transformational leaders would adapt means to influence, inspire, and stimulate their subordinates to realize their potentials and achieve goals in accordance with their individual differences. For example, transformational leaders would allow employees to participate in the decision-making process as a way to realize their potentials (Barling & Kelloway, 2010). Transformational leaders also create lower power distance, intimate superior-subordinate relationships (Zohar and Luria, 2004), trusting relationships, identification (Walumbwa *et al.*, 2008), and perceived happiness (McKee *et al.*, 2011). That is, transformational leaders would rely on trust and compassion to maintain good relationships with subordinates.

In contrast, the passive leadership style, the polar opposite of the transformational leadership style, can lead to less relationship-oriented effectiveness due to the leader's inaction. Passive leaders tend to leave their subordinates by themselves after assigning the task; they only intervene, to punish workers or to remedy the bad outcomes, when employees make mistakes or fail to attain the expected goals. Passive leaders withdraw from managerial activities and avoid decision-making; consequently, workers feel dissatisfied and lack a sense of achievement (Bass, 1985).

Passive leadership is found to be prevalent; at least 20% of workers have experienced passive leadership (Aasland *et al.*, 2010). Passive leadership leads to decreasing job satisfaction and performance, and workers have no guidance to construct and enhance appropriate behaviors (DeRue *et al.*, 2011). Furthermore, Skogstad *et al.* (2007) discover that through role vagueness, conflict and workplace bullying, passive leadership cause employee psychological distress. Kelloway *et al.* (2006) suggest that passive leadership would lead to the impairment of the job security and safety climate. Harold and Holtz (2015) demonstrate that passive leadership style also relates to employee uncivilized behaviors.

We thus argue that transformational leadership will save and/or replenish engagement editors' personal resources, leading to better job performance. In contrast, passive leadership will deplete engagement editors' personal resources and reduce their job performance:

H1: Transformational leadership style will be positively related to engagement editors' job performance.

H2: Passive leadership style will be negatively related to engagement editors' job performance.

Job autonomy

Job autonomy refers to the degree of freedom workers perceive to have for making their own decisions (Hackman and Oldham, 1975). Job autonomy is important as it could affect an employee's sense of responsibility and task outcome (Baillien, De Cuyper, & De Witte, 2011). Empirical studies indicate that job autonomy provides workers with opportunities to demonstrate their abilities, has positively impact on workers' personal creativity, and inspires workers to familiarize with and attempt at new tasks (Morgeson, & Campion, 2003; Dierdorff, & Morgeson, 2007). When employees have a high degree of autonomy, they can decide by themselves when and how to carry out the task, making work more flexible (Dierdorff, & Morgeson, 2007). As Hon and Chan (2013) point out, transformational leadership provides high degrees of job autonomy and improves workers' self-efficacy. Transformational leaders support and encourage job autonomy, and consequently workers improve their self-governing ability and gain confidence. Dvir *et al.* (2002) demonstrate that empowerment is one of the key characteristics of transformational leadership. Casimir and Bartram (2006), studying customer service workers, discover that transformational leadership has positive impact on employee empowerment.

Passive leaders, however, tend to avoid responsibility, withdraw from helping workers, and absent themselves from times of need (Avolio *et al.*, 1999; Bass, 1998; Bass & Avolio, 1997). Passive leadership at once ignore managerial responsibilities and refuse employee autonomy. Hinkin and Schriesheim (2008) argue that passive management has a negative impact on subordinate-perceived role clarity, subordinate-rated leader effectiveness, and job satisfaction. Holtz and Hu (2017) demonstrate that passive leadership reduces employee trust and contributes to a sense of unfairness in workplace. Under passive leadership, engagement editors would suffer from vague roles and lack trust in management, leading to their unwillingness to take responsibilities for their jobs. Thus we hypothesize:

H3: Transformational leadership style will be positively related to engagement editors' job autonomy.

H4: Passive leadership style will be negatively related to engagement editors' job autonomy.

The most important aspect of job autonomy is that the workers are authorized to make their decisions; employee sovereignty most often leads to high job satisfaction and work engagement, reducing the turnover rate. A high degree of job autonomy greatly reduces job insecurity (Idaszak & Drasgow, 1987). Job autonomy allows workers to develop their ability to adapt and understand the importance of enhancing their knowledge and improving their skills. Loher *et al.*, (1985) suggest that job autonomy has a significant impact on job performance; autonomous working environment nourishes and facilitates employee responsibility, and after attaining task objectives, such sense of responsibility would increase job satisfaction.

Job autonomy has positive impact on job performance, creativity and knowledge sharing (Morgeson, DelaneyKlinger, & Hemingway, 2005; Cabrera, Collins, & Salgado, 2006; Pee & Lee, 2015; Llopis & Foss, 2016). Job autonomy is crucial for highly complex and diversified works that involve various knowledge and skills, and easily spark knowledge sharing behaviors (Whittington, Goodwin, & Murray, 2004; Coelho & Augusto, 2010). Creativity tasks often demand participation and mutual learning among co-workers, and such activities rely on highly flexible working schedule and operating methods. Thusly, the hypothesis goes as such:

H5: Engagement editors' job autonomy is positively related to their job performance.

METHODOLOGY

We used a survey questionnaire to collect data. We derived our measures from existing scales and adapted them to suit our research context. To better understand the work context and process of social media engagement editors, we interviewed 2 engagement editors and 3 managers in a social media news organization in Taiwan. After compiling an English version of the questionnaire, the survey items were first translated into Chinese by a research assistant. The survey items were next verified and refined for translation accuracy by two bilingual scholars. The Chinese version of the draft was then pretested with 2 senior news editors for examining face and content validity, resulting in modification of the wording of some items. We operationalized all constructs using multi-item reflective measures with a five-point Likert scale anchored from "strongly disagree" to "strongly agree." The measures are discussed below.

Based on Judge & Bono (2000), transformational leadership was measured with five items assessing the extent to which individual engagement editors perceive supervisors' leadership style that promotes the supervisor-subordinate relationship and individualized concern. Example items include "my supervisor talks to us about his/her most important values and beliefs" and "my supervisor spends time teaching and coaching." Passive leadership was measured by four items assessing the extent to which individual engagement editors perceive that supervisors withdraw from making decisions and managerial activities. Example items include "my supervisor spends his/her time trying to 'put out fires'" and "my supervisor fails to intervene until problems become serious." Job autonomy was measured by five items assessing the extent to which individual engagement editors have discretion to make decisions about their work (Breaugh, 1985). Example items include "I am free to decide how to go about getting my work done" and "I am able to decide for myself what my objectives are." We assessed job performance with

four items adapted from Witt and Ferris (2003). Example items include “I create effective working arrangements with team members and partners” and “I develop and maintain positive relationships without our audience.”

Sample and Data Collection

A cross-sectional survey was administrated to collect data from 150 social media engagement editors in 19 news organizations in Taiwan. One hundred and twenty-two responses were returned and valid for subsequent analysis, yielding an effective response rate of 81.3%. Table 1 exhibits the characteristics of the sample. Of the respondents, 71% were less than 30 years old, and 70% had experiences in managing online communities for less than 3 years. Our data reflects the reality that social media engagement editing is still in its adolescence in the news industry of Taiwan. Thus, most respondents are relatively young and junior.

Table 1. Profile of the respondents (N=122)

	No.	%
<u>Gender</u>		
Male	43	35
Female	79	65
<u>Ages</u>		
20-25	43	35
26-30	44	36
31-35	22	18
36-40	6	5
40 above	7	6
<u>Year(s) of experience in managing online communities</u>		
Less than one year	24	20
1-3 years	61	50
3-5 years	26	21
5-7 years	8	7
More than 7 years	3	2

Non-response bias was assessed using the procedure recommended by Armstrong and Overton (1977). By considering the last group of respondents as most likely to be similar to non-respondents, a comparison of the first and last quartiles of respondents based on return dates provides a test of response bias. No significant differences between the first and last quartiles of the respondents were found on firm size based on the independent sample t test ($p=0.681$). Accordingly, non-response bias should not be a serious concern in this study.

Data analysis

A PLS structural equation model (PLS-SEM) was constructed using SmartPLS Version 3.2.7 for measurement validation and hypothesis testing.

Assessment of common method variance

To assess common method variance (CMV), Harmon's single-factor test was conducted (Podsakoff *et al.* 2003). As expected, four factors with eigenvalues of >1 were extracted and collectively accounted for 68.82% of the variance in the data, with the first factor accounting for 37.07% of said variance, which indicates that CMV does not influence our model seriously.

Measurement model evaluation

We assessed the validity and reliability of the items and constructs according to the guidelines from Henseler *et al.* (2016) and Hair *et al.* (2017). Outer loadings for all items were higher than 0.7 and significant at 1% level except for three items (one of transformational leadership, one of passive leadership, and one of job autonomy), resulting in the items deletion (Hair *et al.* 2017). The ρ_A , composite reliability (CR) and Cronbach's alpha estimates, reported in Table 2, were above 0.7 for all constructs, indicating good internal consistency and the reliability of the scales (Hair *et al.* 2017; Henseler *et al.* 2016). We further assessed the convergent validity of our constructs based on average variance extracted (AVE). The AVE of each construct exceeded the minimum threshold value of 0.5 (Hair *et al.* 2017; Henseler *et al.* 2016). The combined results demonstrated sufficient convergent validity of the constructs.

Discriminant validity is established when (1) items load more highly on the construct that they are intended to measure than on other constructs, (2) the square root of the AVE by each construct is larger than the inter-construct correlations (Hair *et al.* 2017), and (3) heterotrait-monotrait ratio of correlation (HTMT) is significantly smaller than 1. Cross-loadings were computed by calculating the correlations between a latent variable's component scores and the manifest indicators of other latent constructs (Hair *et al.* 2017). Without exception, all items loaded more highly on their own construct than on other constructs. As shown in Table 2, the square root of the AVE for each construct was greater than the correlations between the construct and other constructs, indicating that all the constructs shared more variances with their indicators than with other constructs. All HTMT values, also

shown in Table 2, were significantly smaller than 1 with 95% CI, indicating clear discriminant between two constructs. Thus, our measures exhibited sufficient discriminant validity.

Table 2. Inter-construct correlations, reliability measures, and HTMT (N=122)

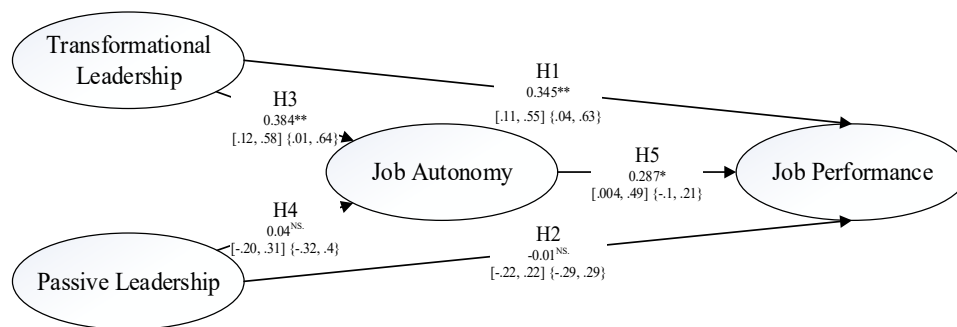
Construct	Items	ρ_A	Cron. α	CR.	AVE	1	2	3	4
1. Transformational leadership	4	.85	.84	.89	.68	.82			
2. Passive leadership	3	.94	.90	.94	.83	-.67 (.59; .86)	.91		
3. Job autonomy	4	.84	.80	.87	.63	0.36 (.22; .62)	-.22 (.12; .44)	.79	
4. Job performance	4	.82	.77	.85	.59	0.45 (.33; .69)	-.32 (.17; .52)	.41 (.18; .72)	.77

Note: (1) Square roots of average variance extracted are shown on the diagonal; (2) HTMT and their 95% CI are shown in parentheses (HTMT; 95% CI, two-tailed test); (3) the 95% CI of HTMT are estimated by 5,000 bias-corrected and accelerated bootstrapping with confidence intervals bias corrected (Henseler *et al.*, 2016).

Structural Model

We first assessed multi-collinearity by examining each set of predictor constructs separately for each subpart of the research model (Hair *et al.* 2017). In our model, all the variance inflation factors (VIF) of endogenous constructs are less than 2.2 which is well below the cutoff value of 5 (Hair *et al.* 2017), indicating no multi-collinearity problem in our model.

To assess the significance of the path coefficients in the inner model, SmartPLS was applied to generate 5,000 samples using a bootstrapping technique with the PLS algorithm, no sign changes, a path weighting scheme, a bias-corrected and accelerated CI, use Lohmoeller settings for initial weights, and two-tailed test (Hair *et al.* 2017). The full model has an adjusted R² of 25% for job performance and 11.4% for job autonomy. Figure 2 shows the result of structural model estimation.



Note: ** $p < 0.01$; * $p < 0.05$; NS. Not significant; CI bias corrected [2.5%, 97.5%]; {0.5%, 99.5%}

Source: This study.

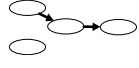
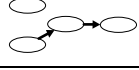
Figure 2: Result of structural model.

We first examine the direct effects of our research model. The results show that while transformational leadership (support H1: $p < 0.05$) has significant effect on job performance, passive leadership fails to do the same thing (reject H2: $p > 0.05$). Transformational leadership affects job autonomy positively (support H3: $p < 0.01$), whereas passive leadership does not influence job autonomy (reject H4: $p > 0.05$). Our analysis also reveals that job autonomy positively influences job performance (support H5: $p < 0.05$). Finally, the effects of the control variables on job performance are insignificant (i.e., years of experience in managing online communities, and gender).

To test mediating effect of job autonomy, we followed the guidelines suggested by Zhao *et al.* (2010) for justifying full or partial mediation and conducted the mediation regression method with bias corrected bootstrap approach for examining the significance of indirect paths. We then adopted the simple mediation model (Hayes 2013; Preacher and Hayes 2004) in order to test the indirect paths with single mediators in the model. Because these approaches are regression based, we used PLS algorithm to obtain latent variables of the research constructs as inputs for performing the mediation regression method and 5,000 resampling on SPSS macros provided by Hayes (2013). Based on these procedures, all indirect paths can be tested reliably and validly.

Table 3 summarizes the results of the mediation model. As suggested by Zhao *et al.* (2010), we first examined the significance of indirect effects. The results indicate that the indirect effect of transformational leadership on task performance through job autonomy is significant at $p < 0.05$ level since zero is excluded in the 95% confidence interval. The indirect effect of passive leadership on task performance through job autonomy is insignificant at $p < 0.05$. We then examined the significance of direct effect from independent variable to dependent variable with the mediator controlled in order to justify full or partial mediation (see column c' in Table 3). Consequently, job autonomy partially mediates the relationship between transformational leadership and job performance.

Table 3. Significance of single-mediator paths

Row	Graphical representation	c	α	β	c'	$\alpha\beta$	Sobel Z	Bootstrap 95% CI	Type
1		.43 (.00)	.38 (.00)	.29 (.00)	.32 (.00)	.11	2.34	.02, .25	Partial mediation
2		-.32 (.77)	.04 (.73)	-.04 (.00)	-.03 (.00)	-.04	0.33	-.05, .12	Nonsignificance
Note: c = the total effect of independent variable on dependent variable; α = the effect of independent variable on mediating variable; β = the effect of mediating variable on dependent variable when controlled independent variable; c' = the effect of independent variable on dependent variable when controlled mediating variable t values shown in parenthesis									

IMPLICATIONS AND CONCLUSION

This paper examines the research question as to whether and how the leadership style influences social media engagement editors from the perspective of COR. We discover that transformational leadership contributes to the improved job performance and autonomy; such finding is consistent with past literature. Transformational leaders care about employee needs and development, form trusting relationship with their subordinates, and utilize rewards and encouragement to increase employee motivation; transformational leaders are also willing to empower their workers by offering sufficient job autonomy. Consequently, the workers gain confidence and feel a sense of achievement. This finding is consistent with the research on job autonomy of news reporters (Wang & Huang, 2010). That is, the work of engagement editors is similar to that of news reporters; they have to manage various news issues and handle the chaotic and dynamic nature of news events; high degree of job autonomy helps engagement editors conserve resources and deal with challenges from ever-changing environment. Furthermore, this finding is in line with the literature on transformational leadership and self-determination: transformational leadership helps employees fulfill their internal needs and thusly increase the level of self-determination (Gilbert, Horsman & Kelloway, 2016).

While past literature mostly focused on the negativity of the passive leadership style, this research detects no significant negative effect of passive leadership. That is, although passive leadership does not contribute to performance, it inflicts no significant damage to performance either. Passive leaders basically leave their workers alone, avoiding decision-making and ignoring problems; they cannot enhance workers' appropriate behaviors (Harold & Holtz, 2015). Under passive leadership, supervisors and engagement editors share no trusting relationship, but they are not at odds either. Therefore, if engagement editors follow organizational rules, they should be able to maintain an acceptable level of performance (Liu, Chua & Pavlov, 2016). Furthermore, as passive leaders withdraw from involvement, engagement editors attain job autonomy from the structural design of organizations; thus, passive leadership has no significant impact of any kind on job autonomy.

To conclude, this paper finds that the transformational leadership style has a significant impact on job performance, with job autonomy partially mediating the positive relationship. Even though passive leadership has no negative impact on job performance, it is an ineffective style. As time goes on, without any supervisor involvement, employee performance and motivation would eventually deteriorate. Some researchers argue that passive leaders apply the non-involvement policy because they respect their subordinates, and such style contributes to employee creativity in certain situations (Ryan & Tipu, 2013). This study, however, suggests that while creativity is important to engagement editors, they are also greatly in need of supervisor support. Being the boundary spanners, engagement editors have to frequently engage in internal and external communications, and constantly consume personal resources to engage fans and defend the organizations from haters or any attack. The non-involving and withdrawing attitude of passive leaders most likely would make engagement editors feel desperate and exhausted, and eventually withdraw from their duty. Thus, organizations should not promote passive leaders.

This study has some limitations. First, this study conducted a cross-sectional survey. Our conclusion thus is only tentative. Second, this paper adopts perceptual measures that may not accurately reflect the true relationships between the constructs. We thus conducted a Harmon's single-factor test which indicates this limitation is not serious. Third, we only study social media engagement editors in the news industry. Future studies may consider other industries with a similar focus on online customer engagement (e.g., online retailing). This may enhance generalizability of our results.

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Peculiarities of IoT-Based Business Model Transformations in SMEs

(Full Paper)

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ABSTRACT

Internet of Things (IoT) is gaining much attention from practitioners and academia and serves as a business mean to increase efficiency and improve business processes. Since small and medium-sized enterprises (SMEs) play an important role in the market's value creation, it is particularly important to understand key aspects of IoT-based business model transformations in SMEs. However, the existing literature on IoT-based business models mainly focused on transformations in large companies. Therefore, this paper aims to identify the preconditions of adopting IoT in SMEs and possible resulting business model transformations. A systematic literature review was chosen as the main research method for this paper. Results of the analysis were summarized as the preconditions for IoT-based business model transformations using Osterwalder & Pigneur's Business Model Canvas concept as a basis.

Keywords: Business model; business model canvas; Internet of Things; IoT; SME.

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INTRODUCTION

According to European Commission (2015) "we stand on the brink of a new industrial revolution, driven by new-generation information technologies such as the Internet of Things (IoT), cloud computing, big data and data analytics, robotics and 3D printing". Even though technological innovations have a significant impact on both: society and businesses, IoT is considered to be the primary tool of Industry 4.0 which may bring significant economic benefits (Manyika et al., 2015) and provide speed, flexibility, and individualization. Nonetheless, nowadays we witness a struggle of introducing such innovations into business models.

The context of large companies usually dominates recent discussions of the IoT. However, SMEs play an essential role in the market's value creation. Therefore, it is imperative to consider how SMEs manifest such new trends, like IoT. Warrian and Southin (2017) and Nylander, Wallberg, and Hansson (2017) presented studies, which are related to the challenges faced by SMEs engaging in IoT solutions. The main results of their studies have shown that the most important challenge is the implementation and integration of new IoT based systems and solutions influenced by the resource scarcity, unstructured processes, competencies of the employees working with IoT, need for partnership, the need for support related to the government funding, business and innovation systems. The IoT presents a number of challenges for SMEs. However, to gain the opportunities and benefits that IoT can provide, the peculiarities of IoT use in SMEs need to be identified. Therefore, this paper aims to identify the peculiarities of IoT-based business model transformations in SMEs.

The main contribution of the research is the identified preconditions for IoT-based business model transformations using Osterwalder and Pigneur's (2010) Business Model Canvas concept as a basis.

The paper is organized as follows. Next section provides an overview of existing IoT and business model literature, followed by discussions on necessary preconditions to get ready for implementation of IoT-based business transformations. Based on the results of the literature review, the further section provides the research methodology, followed by the section in which peculiarities for IoT-based business model transformation in SMEs are presented. The paper is concluded with the conclusions, theoretical and practical contributions, limitations and suggestions for future research.

THEORETICAL BACKGROUND

The IoT has primarily been researched from a technical perspective, while research from the management point of view is only now gaining momentum. The IoT is used on a wide spectrum of activities, i.e., in the daily lives of individuals, operations of businesses, in processes of the public sector. Such a broad coverage of the IoT indicates that this technology can be applied to different business sectors, and will affect all kinds of industries.

According to Dijkman et al. (2015), the IoT refers to the interconnection of physical objects, by equipping them with sensors, actuators and a means to connect to the Internet. Atzori, Iera, and Morabito (2010) describe IoT as capable of using sensor and

actuator technology to gather data as well as to communicate with each other and the online world. Arnold (2017) explained that “IoT refers to the progressing digitization and smart connection of industrial manufacturing including all company functions, across all products and services, by integrating the entire value chain, resulting in novel business models, and by means of new digital technologies.” IoT implementation leads to different kinds of benefit, such as identified by Kiel et al. (2017, p. 5): “resource efficiency in terms of material usage, energy consumption, increased flexibility, optimized decision making, customization, highly profitable business models, demography-sensitive job design, and improved work-life balance.” To be able to keep up with the changes in technologies and get the predicted benefit, companies have to review their business model and take into account the impact of technological advances.

Kinderis and Jucevičius (2013) has identified three main dimensions of business model innovations. First, *digital dimension* - represented by innovative business models successfully integrating recent opportunities provided by information and communication technologies. Second, *strategic dimension* - business model innovation considered to be a part of the competitive strategy (e.g., innovative business models as a result of smart and successful business result related not only to technological but also to organizational and/or marketing innovations). Third, *technological dimension* - commercialization of business models and innovative technologies (business models are considered to support innovative technological-engineering solutions). Overall, business model innovations - the business model's improvement by implementing or adapting innovative solutions. Business model innovation can result in a competitive advantage, improvement of business process management, reduce costs and lead to better value offer to current or potential customers. Therefore, to innovate a business model, it is crucial to understand what a business model is and how it can be used in order to achieve a competitive advantage in the rapidly changing market environment.

Zott and Amit (2010) define a business model as a system where activities link together through the focal company and the surrounding network. “It is a description of the value a company offers to one or several segments of customers and of the architecture of the firm and its network of partners for creating, marketing, and delivering this value and relationship capital, to generate profitable and sustainable revenue streams” according to Osterwalder, Pigneur, and Tucci (2005, p. 10). Westerlund, Rajala, and Leminen (2011) note that the business model of a company depicts how it operates in the market and how it creates value. The company's activities can be explained the details by using the Business Model Canvas (Osterwalder & Pigneur, 2010). Ju, Kim, and Ahn (2016) state that building blocks of Business Model Canvas framework could be grouped into four main categories: infrastructure, value proposition, customer and finances related building blocks. The infrastructure of the business model represents key partners, key activities and key resources. The category of consumer includes components of the customer relationship, channels, and identification of customer segments. Finance category is related to the cost and revenue structure of a business model. Schneider & Spieth (2013) highlighted the necessity “to examine the complete set of business model components since they are closely interrelated and constitute a business model exclusively in their entirety.” However, in the light of technological transformations (such as IoT-based), it should be noted that the analysis of the business model must also change by taking into account the aspects of such changes.

Bohn et al. (2005) noticed that new business opportunities could be opened with the implementation of IoT. Oriwoh, Sant, and Epiphaniou (2013) highlighted that IoT provides excellent opportunities in terms of more efficient production, new data-driven services, and increased automation. Ju, Kim, and Ahn (2016, p. 889) agreed to this by arguing that “IoT allows companies to collect and exchange data and to accomplish tasks that were previously impossible, thus requiring new business models for a highly connected world.” As Turber et al. (2014, p. 18) emphasized, “IoT is expected to have a major influence on the nature of products and services, and in consequence on overarching business models (Yoo et al., 2010; El Sawy & Pereira, 2013), i.e., the overarching logic of how businesses work (Magretta, 2002)”. Therefore, IoT results not only in the extensive organizational opportunities but also in the challenges by changing and enabling novel business models, which leads to the new form of value creation. It worth noting that a number of studies investigating the new challenges in the topic of IoT in conjunction with business models are growing. The relations between IoT and business model are analyzed in various perspectives (for example, Cavalcante, 2014; Turber et al., 2014; Westerlund, Leminen, & Rajahonka, 2014; Weinberger, Bilgeri, & Fleisch, 2016; Tesch, Brillinger, & Bilgeri, 2017). Recent discussions on IoT are usually dominated by the context of large and high-level industrial organizations due to their ability to implement such type of technologies easier. Therefore, it can be assumed, that IoT can have a dramatic impact on manufacturing processes and business models of traditionally low-value industries or in SMEs. Nylander, Wallberg, and Hansson (2017, p. 1) highlighted that “for SMEs in business domains with little or no IT in their products or production processes, the threshold can be high to enter the world of IoT where products are transformed into services and all processes become data driven.” The results of research performed by Müller, Buliga, and Voigt (2018, p. 8) show that SMEs understand the potential benefits of adopting and implementing new technological solutions in business models but “are frequently aversive towards the costs incurred from <.> requiring new machinery purchase and/or the retrofitting of existing machinery as well as the integration of sensors and software”. Therefore, manufacturing SMEs often lack accurate and consistent information necessary to evaluate and adjust manufacturing performance (Müller, Buliga, & Voigt, 2018). Since SMEs play an essential role in the market's value creation, it is particularly important to understand critical aspects of IoT-based business model transformations in SMEs.

RESEARCH METHODOLOGY

This paper aims at identifying the peculiarities of IoT-based business model transformations of SMEs. The achievement of this aim is possible by reviewing relevant, existing, and academic literature. Due to this, authors saw a systematic literature review as an appropriate methodological approach. Systematic literature review contributed to the identification of preconditions for IoT-based business model transformations in SMEs using the Business Model Canvas concept as a basis.

Authors found some research related to the research topic of this paper (IoT-based business model transformations) was done by carrying out a systematic literature review. Some studies in this area are already completed by using different databases: Business Source Complete (EBSCO), Science Direct, and Google Scholar (Kiel et al., 2016); Business Source Complete (EBSCO), Science Direct, ABI/Inform, and Google Scholar (Arnold, 2017); ACM, IEEE and SpringerLink (Kinitzki & Hertweck, 2017). Authors collected data from two different databases: Science Direct and Google Scholar. Due to the degree of novelty of the research topic, it was decided not to restrict the systematic literature review by the selection of the time horizon for the sources and by the selection of journals.

After defined aspects (related to the database selection, time horizon, and journal selection) for the research, selection of the articles was specified (Fig.1). In the first step, relevant keywords were identified addressing the research aim of the paper derived from existing literature. The following keyword sample was revealed: “Industry 4.0”, “internet of things,” “IoT,” “business model,” “SMEs.” To link them, the combinations of keywords were used (allintitle: SME OR SMEs OR “small and medium enterprises”, “internet of things” OR IoT; allintitle: SME OR SMEs OR “small and medium enterprises”, “industry 4.0”; allintitle: SME OR SMEs OR “small and medium enterprises”, “industrial revolution”). The search was limited to the keyword reflection in titles of the articles. The database research and scan of the results’ titles initially identified 37 articles, which contained at least one of the keyword combinations in the title, and were relevant for this study.



Source: this study.

Figure 1. The selection process of articles

After removing duplicates from the sample, the search resulted in 31 articles. The articles that were written in different than the English language were also excluded to avoid misleading interpretation on terms and their meaning (Reis et al., 2018). 25 articles were left for analysis. In the following step, each of the authors read abstracts of the articles in order to assess their relevance to our research question. Furthermore, although analysis of the abstracts results showed that 15 articles could be relevant for the systematic literature review, due to the lack of the full-text access of the articles, three more articles were removed from the list. Thus, the sample was narrowed down to remaining 12 articles, which were read in their entirety by all authors. Additionally, the articles’ bibliographies were scanned to avoid leaving out potential relevant articles not registered in the searched databases. However, the later step did not result in the addition of any new articles. The primary requirement, the articles had to fulfill, was a strong relationship between the IoT, business models and SMEs. Five more articles were excluded from the analysis, as their focus did not match the research question of this study. A final sample of 7 articles was received. These articles were analyzed and insights categorized by all authors in relation to the concept of the Business Model Canvas. In the final step, all authors of the paper critically reflected and discussed the categorized insights. The results of a systematic research review can provide significant scientific benefits in the field of management by identifying the peculiarities of adopting IoT in SMEs for business model transformations.

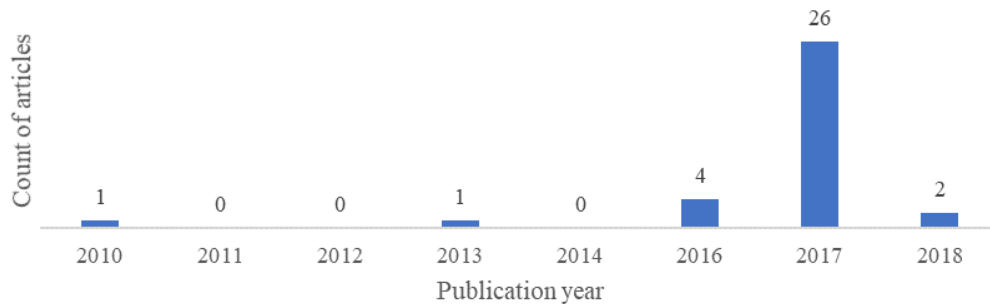
MAIN FINDINGS

Tendencies of the IoT impact of Business Models of SMEs Research Field

A systematic literature review analysis has been done by analyzing scientific sources that mention the keywords “SMEs” or “Small and Medium-sized Enterprises” in combination with “Internet of Things” or “IoT.” A literature analysis has shown that the IoT is often associated and even identified with the fourth industrial revolution, and in order not to miss significant publications related to the study, the keywords “industrial revolution” and “industry 4.0” were also included. The database research and scan of the results’ titles initially identified 37 articles, which contained at least one of the keyword combinations in the title, and were relevant for the research aim.

First of all, the systematic literature review made it possible to identify the tendencies of the research field of the IoT solutions and business models conjunction in the context of manufacturing SMEs (Fig.2). The results show that the first article in the analyzed topic appeared in 2010 with the next article in 2013. In accordance to search criteria, it was determined that the breaking point of

articles was reached in 2017. It is worth noting that in 2017 it was almost seven times higher than in the previous year. Its current status causes the lower number of articles in 2018.



Source: this study.

Figure 2. The number of articles in the research field of IoT and BM conjunction in manufacturing SMEs

According to selected search criteria, it was determined that articles were published in journals (19 articles), conference proceedings (8 articles) and other materials (10 articles). Two articles were published in Global Journal of Management and Business Research, and two more in les Nouvelles - Journal of the Licensing Executives Society, but other tendencies are not evident (due to the small numbers of articles).

The process of articles selection by applying exclusion steps (keywords, no duplicates, English language, relevance, quality), resulted in a final sample of 7 articles in the research field of IoT and business model conjunction in manufacturing SMEs.

IoT impact of Business Models of manufacturing SMEs

The systematic literature review in conjunction with the concept of the Business Model Canvas (Osterwalder & Pigneur, 2010) has made it possible to determine that the implementation of IoT solutions in the production processes of the manufacturing SMEs leads to significant changes in the business models of these companies. The most prominent changes of the business models of manufacturing SMEs caused by IoT noted in the research to date are related to the value creation process. Namely, these decisions change such building blocks of business models as value propositions (4), key resources (7), key partners (4), and cost structure (3). In the other building blocks of the business model changes are also occurring, although their evidence in the scientific literature is less frequently noted.

Table 1: Evaluation of manufacturing SME specific aspects of IoT-based changes to Business Models in selected articles

	Customer segments	Value propositions	Channels	Customer relationships	Revenue streams	Key resources	Key activities	Key partners	Cost structure
	1	4	2	2	2	7	2	4	3
Dassisti et al. (2017)		X				X			X
Kleindienst and Ramsauer (2016)	*	*		*		X	*	X	*
Nylander, Wallberg, and Hansson (2017)						X			
Moeuf et al. (2017)		X	X			X	X	X	
Müller et al. (2017)	X	X	X			X		X	X
Müller, Buliga, and Voigt (2018)				X	X	X	X	X	
Sommer (2015)		X		X	X	X			X

* More generally IT adoption related manufacturing SME specific aspects of Business Models covered.

Source: this study.

Figure 3 provides an overview of the changes of business model building blocks in SMEs due to the implementation of the IoT.

Key partners Strengthening the partnerships by increasing the trust	Key activities Better management of the information flows (thereby improving	Value propositions Product's quality improvement Ability to offer highly	Customer relationships Better information flow with customers	Customer segments Possibilities to address new B2B customer groups
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between partners Productivity of the entire production network of partners improvement Collaboration between SMEs in distributed production networks	management and control) Key resources Reorganization of production lines Workers' qualifications improvement and staff replacement due to the changing need for skills and knowledge set	customized products		
			Channels Delivery time reduction throughout the value chain	
Cost structure Cost Reduction due to increased efficiency of the production and reduced errors		Revenues streams Expected sales increase Possible changes to payment methods and processes		

Source: this study.

Figure 3: The summary of the IoT based changes to manufacturing SMEs business models

The impact of implementation of IoT solutions for the value creation processes in the manufacturing SMEs is most notable because of the need to re-organize production lines. Moreover, this implementation also requires to improve production workers' qualifications or even change staff due to the changing skills and knowledge set needed for the development of value-added IoT (namely, changing *key resources*; Dassisti et al., 2017; Kleindienst & Ramsauer, 2016; Nylander, Wallberg, and Hansson, 2017; Moeuf et al., 2017; Müller et al., 2017; Müller, Buliga, & Voigt, 2018; Sommer, 2015). Though Dassisti et al. (2017), stress that IoT solutions must rest on (and not replace) existing systems, hardware and software (such as ERP, MES, SCADA) and must require the minimal intervention of the end user at changing the use scenarios. Moreover, IoT solutions must be flexible for the subsequent interventions, i.e., must ensure the possibility to reutilize all the components if SME wants to scale up the overall system, and this indicates the scope of expected changes to these key resources. Authors also emphasize that introduction of IoT in manufacturing SMEs are expected to reduce the operators' learning curve.

Meanwhile, Kleindienst & Ramsauer (2016) note that for manufacturing SMEs implementing IoT solutions, the technical skills, and use of technology solutions interoperable with partner's systems are needed. According to them, the use of simulation tools for production (to produce the product and to overlook the production line) that are tailored to customers (employees) with inappropriate knowledge of simulation and enable them to get good results in a short amount of time should be chosen. Additionally, upgrade of the existing production line equipment is needed to enable (big) data collection, and multimodal assistance systems can help workers with their often diverse tasks.

Also, to make core activities of value creation more effective, the implementation of IoT solutions enables manufacturing SMEs to manage better the information flows, thereby improving management and control (changing *key activities*; Moeuf et al., 2017; Müller, Buliga, & Voigt, 2018). In turn, the better information flows reduce errors at all stages in the value chain and significantly reduce *costs* (Dassisti et al., 2017; Müller et al., 2017; Sommer, 2015).

The more efficient information flow, which is enabled by IoT solutions, also improves the exchange of information with *key partners*, increasing the trust between partners and strengthening the partnerships of SMEs (Kleindienst & Ramsauer, 2016; Moeuf et al., 2017; Müller et al., 2017; Müller, Buliga, & Voigt, 2018). Moeuf et al. (2017) note that IoT solutions implemented by manufacturing SMEs enable better information flow with suppliers and customers, provides the potential to improve the productivity of the entire production network of partners, and IoT (associated with RFID) could enhance collaboration between SMEs in distributed production networks.

The use of IoT offers opportunities to improve product quality, therefore, *value propositions* (Moeuf et al., 2017). On the other hand, implementation of IoT solutions is also perceived as possibly impeding one of the core strengths of SMEs, - the ability to offer highly customized products (Kleindienst & Ramsauer, 2016; Müller et al., 2017). Muller et al. (2017) argue that "SMEs might lose their core strengths such as providing individual and fast solutions, tailored to customer demands." Meanwhile, Moeuf et al. (2017) note that in IoT adopting SMEs utilization of the historical data helps to improve the product quality. They also estimate the potential to reduce the delivery time throughout the value chain (processing and execution time of orders, a collaboration between partners in the network, preserving customer data speeds execution of further orders; indicates changes to *channels*).

DISCUSSION

The analysis revealed that by implementing IoT solutions companies could open new business opportunities. On the other hand, IoT in manufacturing enterprises is intended for real-time interconnection of employees, objects, production machines, customers,

suppliers, innovations into one dynamically managed complex system (Bauer et al., 2014). Therefore companies could face the challenges of changing their business models. The implementation of IoT solutions to the companies' activities also leads to new forms of value creation.

The impact of IoT on business models was analyzed from various perspectives (Turber et al., 2014; Westerlund et al., 2014; Weinberger et al., 2016; Tesch et al., 2017). However, recent discussions are usually concentrated on technological foundations with a tiny touch on the managerial aspects. Moreover, there is a lack of research analyzing an IoT implementation impact on a whole business model. Recent discussions of the IoT related to the business model are usually dominated by focusing on large and high-level industrial organizations due to their ability to implement such type of technologies easier.

Kiel et al. (2017) presented an overview of the business model changes, which are influenced by the implementation of the IoT solutions in one of most detailed manner so far. It is noticeable that more or less all business model building blocks are affected. However, these changes are largely noticeable in large companies. All these changes, which are noticeable in large companies, also can be noticeable in SMEs, but the abundance of the changes depends on the SME's ability to implement IoT solutions (or depends on the SME's ability to invest in IoT implementation). Table 3 provides the changes of business model building blocks due to the implementation of the IoT as found by Kiel et al. (2017) along to findings of this study.

Table 3: The comparison of the changes to Business Model building blocks due to the implementation of the IoT

BM building blocks	Summarized description of changes (Kiel et al., 2017)	Summarized description of manufacturing SMEs' BM changes (this study)
Customers segment (Target customers)	New target customers are hardly addressed	Possibilities to address new B2B customer groups
Value proposition	New products, services, and solution packages based on the application of data mining and analytics; Optimization of production systems and processes.	Product's quality improvement; Ability to offer highly customized products (<i>might be impeded by IoT in some cases</i>)
Channels (Distribution channels)	Increasing orientation toward direct sales due to high customer consultation requirements	Delivery time reduction throughout the value chain
Customer relationships (Relationships)	Intensification due to required explanation of highly complex solution packages; Early integration of customers into product and service engineering fosters partner-like collaboration Interdisciplinary teams bear new contact persons originating in IT and R&D	Better information flow with customers
Revenues streams (Revenue model)	Experiences hardly any changes due to customer resistance	Expected sales increase; Possible changes to payment methods and processes
Key activities (Value configuration)	Increasing technology development activities, particularly regarding software development; Consequent service orientation requires extended customer-oriented communication and customer consultation activities	Better management of the information flows (thereby improving management and control)
Key resources (Core competencies)	Need for IoT-appropriate adaption of workforce qualification; Changing role of employees from operators to problem solvers; Increasing relevance of IT systems, cloud technologies, and software	Reorganization of production lines; Workers' qualifications improvement and staff replacement due to the changing skills and knowledge set
Key partners (Partner network)	IT suppliers and development partners, along with customers, serve as collaborative partners; Nevertheless, manufacturers draw on own know-how and key activities rather than on external partners	Strengthening the partnerships by increasing the trust between partners; Productivity of the entire production network of partners improvement; Collaboration between SMEs in distributed production networks
Cost structure	Rising expenses for IT and software; Decreasing production costs	Cost Reduction due to increased efficiency of the production and reduced errors

Source: Kiel et al. (2017) & this study

It is evident that some of the changes expected in manufacturing SMEs are not dependant on the size of the companies and are equally expected to occur in large enterprises as well as small (e.g., decreasing production costs, the need to reorganize the workforce to meet the needs of IoT enabled manufacturing). However, studies with a higher focus on manufacturing SMEs also identified specific changes that might not be perceived as significant in larger enterprises, therefore were might have been dismissed or not covered by studies without the focus on SMEs (e.g., possibilities to address new B2B customer groups, significant changes of partnerships).

CONCLUSIONS

Results of systematic literature analysis emphasize the importance of business model infrastructure and value proposition within the perspective of a business model canvas. The most prominent changes in the business models of manufacturing SMEs caused by the implementation of IoT solutions noted in the research to date are related to the value creation process. Namely, these decisions change such building blocks of business models as value propositions, key resources, key partners, and cost structure. In the other building blocks of the business model changes are also occurring, although their evidence in the scientific literature is less frequently noted.

The main results of the systematic literature review are the identified core expected changes in business models of the manufacturing SMEs.

The analysis within this paper is based on a literature review severely limited to articles with IoT and SMEs mentioned in titles, and some relevant research might have been missed by not expanding the search to abstracts and keywords. However, the findings provide the basis for a conceptual framework of the impact of IoT on business models to be developed and tested by qualitative (case studies) and quantitative (survey of manufacturing SMEs) methods by the authors in following stages of the research.

ACKNOWLEDGMENT

This research was funded by a grant (No. S-MIP-17-4) from the Research Council of Lithuania.

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Personalisation in Location-based Advertising: The Moderating Effect of Brand Familiarity

(Full Paper)

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ABSTRACT

The increasing adoption of location-based services and smart devices have propelled optimistic forecasts for location-based advertising as a unique and effective tool to improve consumers' attitude and purchase intention towards goods and services. While so, concerns regarding over the use of personalisation in a LBA context is prevalent. Given so, this study examines the influence of personalisation tactics on attitudes and purchase intention towards a focal product, with brand familiarity as a moderating factor, in the context of location-based advertising. It is hypothesized that high personalisation improves attitude towards a focal product and secondly, that high brand familiarity aids the resulting outcome of personalisation. Finally, it is hypothesized that attitude is positively related to purchase intention.

As a central part of the study, an experiment involving 100 participants was conducted. The experiment's stimuli involved the presence and absence of personalisation and brand familiarity respectively, forming a total of four equal participant groups. It was found that personalisation positively affects the effects of location-based advertising; while brand familiarity indeed moderates the effects of personalisation on attitudes. Specifically, high brand familiarity allows for heightened effects of personalisation on attitudes, while in low brand familiarity situations, the effects of personalisation in a location-based ad is negligible. Since so, brand familiarity is an evidenced boundary condition for the effective application of location-based advertising.

The study supports past research in establishing that brand familiarity lowers perceived risks and increases trust for location-based advertising, and that personalisation allows for more effective marketing messages. From a practical perspective, marketers of well-known brands should look to personalisation in location-based marketing opportunities to exploit their inherent brand value. On the other hand, less-known brands should look to improve their brand familiarity before applying personalisation in location-based ads.

Keywords: Location-based advertising, personalization and brand familiarity.

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INTRODUCTION

The "Global Location Trends Report 2016" by the Location Based Marketing Association (LBMA) reports that 75% of 253 global marketers, including that of BMW, Coca-Cola and Starbucks believe that Location Based Advertising (LBA) will open new doors for increased profits (Location Based Marketing Association [LBMA], 2017). In 2017, LBMA (2017) reports rising proportions of marketing budgets spent on LBA. The rising growth in popularity of wearables and heightened smartphone penetration rates presents marketers an unrivalled opportunity to deliver timely purchase triggers on a geographically targeted basis (Xu, Luo, Carroll, & Rosson, 2009). This is so, especially for brands who own retail stores or depend on physical footfall for events or roadshows.

LBA can be viewed as a subset of Location-Based Services (LBS), of which includes the mobile delivery of directions to places of interest, traffic information, emergency notifications and community services upon entering a geographically fenced area (Bruner & Kumar, 2007). LBA, on the other hand, is a specific type of mobile advertising which is delivered in accordance with a location trigger. This study adopts the following definition of LBA, which is refined from that of Bruner and Kumar (2007); LBA is thought to be a marketer-initiated mobile notification, customized for the recipient's geographic position. In context of this definition, LBA takes on the traditional significance of real-time marketing to meet consumers' needs at the correct time and place, as proposed by Oliver, Rust, and Varki (1998). At the same time, LBA undertakes a fresh medium for the consumers of today: mobile devices. While mobile devices take on varied forms like handheld laptops, e-readers, portable music players, for this study, mobile devices will be broadly defined as any handheld device that is capable of transmitting text advertisements according to an individual's geographic position.

LBA finds its significance in directly contributing to higher return-on-marketing-investment (ROMI). In many instances, LBA directly triggers increases in footfall, visits to stores and consequently transactions. According to statistics from eMarketer (2016),

global smartphone users will reach the 2.5 billion mark by 2018. Despite the rapid adoption of mobile connectivity, Forbes Corporate Communications (2016) reports that over 90% of retail transactions continue to occur in brick-and-mortar outlets. This implies that marketers should not merely seek to replace offline experiences with online ones, instead look to enable timely and seamless purchase processes that facilitate online-offline consumer journeys.

Presently, marketers are faced with a more complex consumer decision-making process, with personal, situational and physical factors affecting their decision-making processes more than ever. While LBA, a double-edged sword, presents unrivalled micro-targeting opportunities, brands at large hesitate to apply it today given certain scepticisms. Overarching considerations include limited indoor location technology and a premature, fragmented location ecosystem globally (Xu et al., 2009). An impeding factor for merchants at large includes user acceptance of such personalised marketing tactics, of which a rejection may create a negative backlash that is ultimately detrimental for the brand (White et al., 2007).

On this note, a clarification between the concepts of personalised marketing and LBA is necessary. Strictly speaking, LBA is a subset of personalised marketing, whereby individualized content is delivered to consumers through the use of automation technology. In this case, the basis of personalisation is the consumer's location. Other bases for personalisation marketing include consumers' preferences, behavioural tendencies and demographic characteristics. Given that LBA is a form of personalisation marketing, this study seeks to observe the effectiveness of further application of personalisation tactics, such as the inclusion of names or preferences within LBA prompts.

Marketers today struggle to articulate the optimal level of personalised marketing since mobile devices are deemed to be an item intricately woven into the lives of consumers. This increases consumer sensitivity to external infiltration; resulting in the "location paradox" by Rimkus (2000), whereby consumers expect to remain sufficiently anonymous yet receive context-sensitive information that LBA can provide. Earlier research reflects that consumers dislike a felt manipulation from brand advertising tactics (Campbell, 1995), which ensues to form negative perceptions of the brand itself and reduce purchase intent. Bruner and Kumar (2007) also reflect that consumers could view LBA attempts as spam information, thereby revoking all intended impact that leads to an eventual purchase. White, Zahay, Thorbjørnsen, and Shavitt (2007) assert that negative consumer responses to personalised marketing tactics may cause more damage to a brand, than a simple lack of response on a non-personalised marketing message - a stark reminder to observe consumer behaviour carefully.

Of the many factors that could impact the utilisation and efficacies of personalization in an LBA context, a significant moderating factor may be Brand Familiarity. The concept is basically referred to as the composite of knowledge structures in the minds of consumers towards a brand (Campbell & Keller, 2003). Findings from Kent and Allen (1994) reflect that brand familiarity weakens advertising wearout and moderates advertising interference. Given that the current study seeks to examine effects of personalised advertising in an LBA context, brand familiarity is naturally a variable of concern.

Lin, Paragas, Goh, and Bautista (2016) have applied a socio-technical analysis on the developing state of LBA, specific to the local context. The study affirms that Singapore is technologically-ready for LBA and the phenomenon has ample government support and industry pull. While so, the study also found that conservative marketers and negative consumer attitudes towards this new phenomenon alongside insufficient privacy and data regulations have hindered the diffusion of LBA locally. The current study will look to extend the efforts of Arora et al. (2008), bearing in mind the existing findings and thereby look to articulate factors that may aid the practical application of LBA locally.

Current studies largely focus on the potential and efficacies of LBA while exploring potential challenges such as consumer data privacy (Bruner & Kumar, 2007; Xu et al., 2009). There are also exploratory studies on the circumstances affecting personalisation efforts in other contexts such as email and mobile marketing (Postma & Brokke, 2002; White et al., 2007). However, there is an apparent lack in the amount of studies drawing attention to the specific factors that enable effective application of LBA. Accordingly, the study seeks to explore the effects of Personalisation, as moderated by Brand Familiarity, on the effectiveness of LBA, as would be measured in terms of attitudes and intentions such as a change in attitude towards the brand or product, or an intended visit to the physical store.

The research question in this study is as follows: "How does Personalisation influence the effectiveness of Location-Based Advertising for spontaneous purchases?" The current study contributes to existing literature by focusing on the relationship between personalisation, brand familiarity in the context of LBA, a currently understudied phenomenon. The study extends the efforts of Xu et al. (2009) who has previously observed the personalisation privacy paradox in context of LBA to determine factors for appropriate personalisation; as well as that of Komiak and Benbasat (2006), who have discussed the interaction between personalisation and familiarity in the context of recommendation agents. The results of this study will provide valuable insights and practical actionables for brand managers and marketers to effectively factor in brand familiarity in their considerations towards adopting LBA. It will also reveal consumer inclinations on personalisation tactics, in the context of LBA practiced in Singapore.

The rest of the paper is organised as follows. Next section looks to expound on the theoretical foundations of the study and review existing academic literature to derive a set of hypotheses for testing. It is followed by a description of the adopted research methodology. We then present the results of the study. Finally, the paper is concluded with a discussion of its key findings, theoretical and managerial implications as well as its limitations and recommendations for future studies.

THEORETICAL FRAMEWORK

Personalisation

This paper adopts a definition of the term ‘personalisation’ as a form of distinct marketing messaging that is tailored to an individual’s characteristics or preferences, as adapted from that of Postma and Brokke (2002) and Hoffman and Novak (1996). Arora et al. (2008) suggests that economists and psychologists have invariably supported the adaptation of the marketing mix to individual consumers, as underpinned by the economic practices of price discrimination or information processing models. Arora et al. (2008) assert that personalisation enhances the lives of consumers and drives engagement and loyalty by delivering marketing messages that anticipate and fit the expectations of consumers. If done right, personalisation can reduce acquisition costs by as much as 50 percent and increase ROMI by 10 to 30 percent (Ariker, Heller, Diaz, & Perrey, 2015).

Despite the apparent consensus towards personalisation, the advent of big data changes the nature of personalised marketing and has elicited much debate on its efficacies for today. By now, it is beyond clear that consumers interact with numerous data points each day, be it where they go, what they eat, who they meet and what they watch online (Amerding, 2017). This makes big data analytics a lethal, double-edged sword. Today, marketers can personalise marketing messages according to the preferences and behaviour of consumers, far beyond what they even know of themselves. While so, businesses bear the risk of over personalizing marketing messages which then incurs detrimental backlash from consumers against the brand. Big data is thus both a boon and a bane for marketers who practice personalised marketing, with marketers now having to rigorously consider the appropriate extent of personalisation in marketing messages.

Earlier research by White et al. (2007) clarifies that research thus far on the effects of personalising marketing messages towards consumers’ behavioural responses has produced mixed findings. The paper expounds on the term ‘Personalisation Reactance’, which serves to refer to ‘psychological resistance to subjectively inappropriate personalisation’. This phenomenon takes place when a consumer perceives himself or herself as constrained or threatened due to a sense of being overly identifiable by a firm. In other words, the consumer perceives the situation as invasive and manipulative (Campbell, 1995). The paper suggests that consumers may even ruffle up in response to solicited messages that are perceived to be too personal.

In other words, instead of friendly recognition, the level of personalisation suggests an inappropriate extent of familiarity with consumers’ preferences and behavioural inclinations. Brehm (1966) posits a similar psychological reactance, referring to a motivational state that emanates when a person perceives a threat to their personal freedom. Mitigating factors to the sense of personalisation reactance include (1) justification of the fit between the distinctive personal information utilised and focal offer; and (2) the perceived utility of the featured product or service within the offer. Brehm (1966) concludes by affirming that personalisation attempts in marketing must be justified and of high perceived utility to the consumer such that Personalisation Reactance would not be present.

It is observed that earlier studies (Brehm, 1966; Campbell, 1995; White et al., 2007) reflect a danger in inappropriate levels of personalisation that may incur a backlash from consumers, and hence a reduction in purchase intent. At the same time, personalisation that is sufficiently justified (i.e. perceived as relevant to the individual) and of high perceived utility will lead to targeted content that fulfills need and wants, thereby propelling positive attitudes.

In summary of the above subchapter, the relationship between Personalisation Tactics and the effectiveness of LBA, as measured by consumer attitudes, can be hypothesized as follows:

H1: Personalisation of LBA improves the attitude towards a focal product.

Moderating Effect of Brand Familiarity

Campbell and Keller (2003) theorize that brand familiarity is a crucial variable influencing consumer processing. This is corroborated by earlier research by Kent and Allen (1994), who assert that brand familiarity reflects the extent of a consumer’s indirect and direct interaction with a brand. Essentially, the difference between familiar and unfamiliar brands exist in terms of the knowledge structures that consumers store in their memory. Given differences in terms of brand knowledge, consumers likely differ in their manner and goals of processing content when being exposed to sponsored advertisements by familiar and unfamiliar brands. For example, when consumers are exposed to advertisements from a familiar brand, they are likely to update their current brand knowledge (Snyder & Stukas, 1999). On the other hand, novel advertisements for unfamiliar brands may invoke extensive cognitive processing that results in a more accurate view of the brand (Campbell & Keller, 2003). If so, brand familiarity will adversely affect the effects of personalised LBA.

On the contrary, an earlier study by Rose (2016) regarding the effects of brand familiarity on perceived risks and purchase intentions reflected important findings that brand familiarity aids consumers to perceive lower risks, thereby improving attitudes and purchase intentions for that brand. This is corroborated by findings from Monroe (1976). Ojo, Kesinro, and Akinsunmi (2015) who posit that brand recognition, which forms part of brand familiarity, is a determinant towards impulse purchases. Given that the current study tests LBA as a trigger for spontaneous purchases, perceived risks are necessarily low so that consumers proceed to purchase.

Hjarvard (2002) suggests that personalisation and branding practices are mechanisms to elicit trust in brands, while an important dilemma of trust lies in the perceived image of familiarity and proximity that a brand portrays. Consumers may have high expectations of brands who practice personalisation, especially familiar brands such as Amazon and Netflix. By extension, marketers can expect that brand familiarity serves to impact the effects of practiced personalisation tactics, either positively or negatively. Further, In a bid to bridge the gap between themselves and consumers, brands invest heavily in creating proximity, familiarity, and specificity. Simply put, brand familiarity is the starting point towards building trust, whereby personalisation is one of the manners in which brands apply to elicit further brand loyalty and thereby bring about positive purchase behaviour.

Generally, earlier studies such as Rose (2016), Monroe (1976) and Hardesty, Carlson, and Bearden (2002) posit that brand familiarity increases purchase intention by lowering perceived risks. Considering that consumers vary in their cognitive purchase processes for familiar and unfamiliar brands (Campbell & Keller, 2003), it is likely that familiarity adds to positive affections and thereby heightens effects of personalised advertising.

With the above understanding, the current study hypothesizes the following regarding the moderating effects of brand familiarity on the effects of personalisation, in the context of LBA.

H2: Personalisation of LBA is more favourable when Brand Familiarity is high than when it is low.

Attitude & Purchase Intention

Bruner (2007) suggests that purchase behaviour is an obvious consequence worthy of study due to its direct contribution in decision making. As much as marketers worry about consumer backlash and negative attitudinal effects regarding LBA, managers and business owners would find purchase intention an important determinant for decision making. The current study will hence look to test for resulting effects from attitude towards purchase intention.

While so, resulting purchase intentions differ across various purchase situations. Baumgartner (2002) categorizes purchase intentions into two distinct forms: 1) Deliberate purchases, which are predictable and routine, and 2) Spontaneous purchases, which are unpredictable. Spontaneous purchases usually include a. Promotional purchases, b. Exploratory purchases, c. Casual purchases and d. Impulsive purchases, all of which are specific target scopes for LBA in practice. This study will concern itself with how personalisation and brand familiarity interact to affect LBA in the context of a spontaneous purchase.

Academically, theories such as the Theory of Reasoned Action (TRA) and by extension, the Theory of Planned Behaviour (TPB) have established a clear consensus of attitude as a major factor leading to intentions that in turn leads to behaviour, be it volitional or otherwise (Fishbein & Ajzen, 1975). With the TRA and TPB as basis, the current study hypothesizes the following regarding the consequent effects of attitude on purchase intention.

H3: The attitude towards a focal product is positively related to purchase intention.

Figure 1 summarizes the hypothesized relationships of the current study between the key variables of Personalisation and Brand Familiarity. Essentially, the study tests for the effects of Personalisation on the effects of LBA, reflected by attitudes and purchase intention. This is hypothesized as a positive relationship. Brand Familiarity is thought of as a moderating variable that affects the direction and/ or strength between the independent and dependent variables. A basic moderator effect according to Baron and Kenny (1986), can also be understood as the interaction between the independent variable and a factor that 'specifies the appropriate conditions for its operation'. We do not rule out effects of personalisation and brand familiarity towards the construct of attitude that may not lead to a measurable change in purchase intention. Thus, the current study tests for the dependent variables of attitude and purchase intention separately and looks to draw correlations between attitude and purchase intention.

Conceptual Model

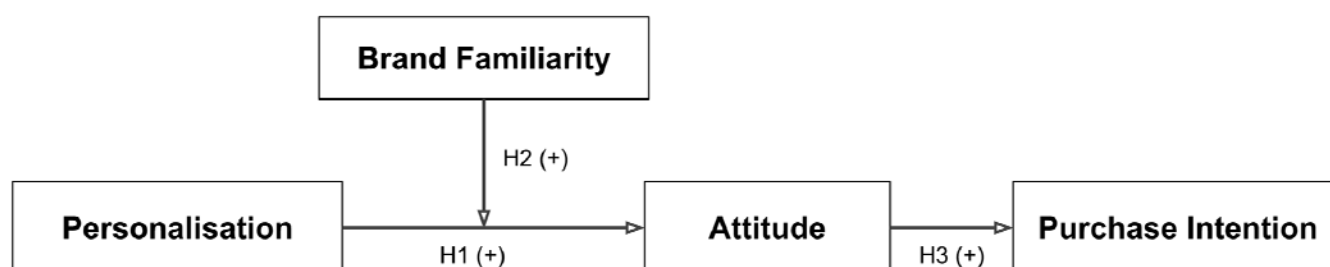


Figure 1. Conceptual model.

METHODOLOGY

Research Method

Participants

A total of 100 undergraduates and young graduates were recruited across institutions in Singapore. It was specified that participants should own a smartphone and allow the use of notifications prompts in their daily mobile usage. While there may be concerns over the use of student subjects, this should not limit the generalizability of the research findings. Undergraduates and graduate students are naturally a population of interest, since mobile devices are intricately integrated with the lifestyles of young people today, of which form the potential majority of the LBA audience. Participants were randomly assigned to a 2 (Personalisation: high, low) \times 2 (Brand Familiarity: high, low) full factorial design, with Personalisation and Brand Familiarity acting as between-subject factors. 100 participants are randomly allocated to the 4 conditions.

Stimuli

The fast-moving food and beverage product category was chosen as focal for this experiment for two reasons. Firstly, this category is highly relevant to the sampled population of tertiary students and young adults. Secondly, the study seeks to test for spontaneous purchase scenarios, of which fast moving consumer food and beverages are suitable in terms of price considerations.

As adapted from the design of Campbell and Keller (2003), a familiar and fictitious brand name was chosen in the fast-moving food and beverage product category - Starbucks Coffee Company and Caribbean Coffee Company. To manipulate personalisation, the current study takes reference from past examples of implemented LBA from Starbucks in 2014 (Simpson, 2016), so that a realistic situation is mimicked to the fullest extent. Participants will first enter their favourite choice of beverage (e.g. Vanilla Latte) in the first portion of the questionnaire. The input would be applied as merge fields for the experiment, which forms the next section of the questionnaire.

Participants under the tested scenario will be prompted a personalised notification, for example, "Hi Phil! You are near <Brand> at Plaza Singapura. Currently 50% off your favourite drink: <Favourite Drink Input>! Enjoy!". On the other hand, a non-personalised notification would prompt "Hi there! You are near <Brand> at Plaza Singapura. Currently 50% off all drinks! Enjoy!". Personalisation tactics applied are specifically the name field, as well as the 'favourite drink' field. These prompts are mimicked as from a third-party mobile promotions service provider, whom they would have agreed to allow notifications and use of personal data, as adapted from Xu et al. (2009). This would minimise noise that arises from data privacy concerns as that is not a factor of concern in this study, though it legitimately influences the outcome of location-based prompts, as asserted by White et al. (2007), Campbell (1995) and Brehm (1966) (See Appendix A).

A pretest was conducted amongst 10 participants. The objective of the pretest was to establish that the general populace is (1) familiar with the familiar brand, (2) unfamiliar with the fictitious brand and (3) perceive the fictitious brand as legitimate. The pretest also aimed to indicate that the test notifications are (1) perceived as legitimate and that the personalised notifications are (2) perceived as more personalised. The pretests also allowed for clear and neutral language to be applied in the survey to minimise bias and undue influence on respondents.

The outcome of the pretests reflected that the subjects thought of the familiar brand name as typical and representative, while the fictitious brand was unfamiliar. This corroborates with the stimuli applied by Campbell and Keller (2003), whereby brand familiarity was tested. No one in the pretest suggested that the notifications or the brands were not real, reflecting a good basis for manipulation.

Procedure

All participants were pre-screened; only those who owned a mobile device which allowed push notifications would be deemed qualified, as adopted from the design of Komiak and Benbasat (2006). Therefore, the participants were potential customers when they took part in the experiment. Participants were told that they had already given permission for a third-party location-based application to prompt them, should they be near a store of interest. This would aid to remove concerns regarding data privacy. Each participant took the experiment individually and was allowed to take as much time as needed. The procedures were as follows.

1. Participants were required to visit an online questionnaire that requests for the information required for personalisation, for example, their name and favourite beverage choice, amidst other demographic data such as age group and employment status.
2. The questionnaire presents a scenario in which respondents should imagine themselves on a leisurely day out at “Plaza Singapura”. As illustrated in 3.1.2 Stimuli, participants are presented with a push notification from the third-party location based application.
3. Respondents were then presented with the measurement items for the constructs representing personalisation, brand familiarity, attitudes and purchase intention.

In full measure, the current study adapts constructs from measurement scales applied in prior studies, to fit the LBA context. Manipulation checks were performed for the constructs of personalisation, as adapted from Komiak and Benbasat (2006), with five-items for measurement. Manipulation checks for brand familiarity include the use of a two-item for measurement, as adapted from Komiak and Benbasat (2006). Scales measuring attitude and intention from Taylor and Todd (1995) were applied, with a total of six-items. Apart from demographic attributes measured, all other measures are assessed with a seven-point Likert-type scale, anchored by 1 = strongly agree and 7 = strongly disagree (See Table 1 for the utilised constructs and measures).

Table 1. Constructs and measures.

Construct	Measure
PP: Perceived Personalisation (Komiak & Benbasat, 2006; Xu, Liao, & Li, 2008)	(PP1) I feel that the advertisement was tailored to me. (PP2) The contents in the mobile advertisement were in accordance to my preferences. (PP3) The brand understands my needs and wants.
BF: Brand Familiarity (Komiak & Benbasat, 2006)	(BF1) I am generally familiar with the brand. (BF2) I am familiar with the product offerings from the brand.
AT: Attitude (Taylor & Todd, 1995)	(AT1) I like the idea of purchasing this item. (AT2) It is wise to purchase this item. (AT3) My attitude towards purchasing from <Brand> is positive.
PI: Purchase Intention (Taylor & Todd, 1995)	(PI1) It is likely that I will utilise the promotion from <Brand>. (PI2) I am actively considering to purchase from <Brand>. (PI3) I intent to continually allow such prompts.

Data Collection

Data collection was conducted during the first two weeks of March 2018. Four online questionnaires were randomly assigned amongst tertiary students and young adults via the researcher’s personal contacts. Through this method, a total of 85 responses were collected over the two-week period. A small portion of the data was obtained from consumer flow points at “Plaza Singapura” to obtain a representative sample. “Plaza Singapura” was selected as a data collection point due to the use of the mall in the experiment stimuli, allowing for contextualisation, as well as its shopper demographics which are deemed appropriate for this study. For the second method, the researcher visited “Plaza Singapura” on a weekday in the afternoon, whereby shoppers were mainly aged 17-30. Similarly, through this method, a total of 23 responses were collected.

Convenience sampling was applied, with participants who indicated interest in taking part in the experiment being randomly allocated amongst the four scenarios. Emphasis was also placed on obtaining an even sample, as much as possible, in terms of gender distribution so as to minimize variances. The study has considered potential ethical concerns that may arise, such as the monetizing of collected data. To mitigate such conflicts, respondents were duly presented with a survey cover letter or disclaimers that assures them of the academic scope of the current study and promises confidentiality of their responses.

By the end of the data collection process, a total of 108 responses were collected. Amongst which, 6 responses were rejected due to invalid name and beverage choice inputs that would result in an invalid experiment stimulus. 2 samples were rejected due to the surveys being incomplete. This left the number of valid samples at 100 respondents.

Demographic characteristics of the respondents are displayed in Table 2. The age distributions reflect that the majority of respondents as from the age group of “18 to 24”, forming 80% of the sample size (n=100). This is in line with our target respondent demographic as earlier posited under 3.1.1 Participants. Gender distributions reflect a slight skew towards females, with 61% of the sample size, while males made up the remaining 39%. Additional data was collected on the employment status of the respondents, as purchasing power could be a potential factor leading to discrepancies in our findings. Most of the respondents indicated their employment status as students, with 67% of the sample size, while 10% and 23% were employed on a part-time and full-time basis respectively.

Table 2. Demographic characteristics of respondents.

Demographic Characteristics of Respondents (n=100)

Demographic Characteristics	No. of Respondents	Frequency (%)
Age Group		
18 to 24	80	80.0%
25 to 34	15	15.0%
35 to 44	2	2.0%
45 to 54	0	0.0%
55 to 65	3	3.0%
65 or older	0	0.0%
Gender		
Male	39	39.0%
Female	61	61.0%
Employment Status		
Student	67	67.0%
Employed (Part-Time or Project Basis)	10	10.0%
Employed (Full-Time Basis)	23	23.0%

Results

Internal Reliability

The measurement model was evaluated by examining the Cronbach's Alpha for internal consistencies pertaining to each construct in the applied questionnaire (see Table 3. Reliability Statistics). Nunally (1978) posits that Cronbach's Alpha values are adequate to signify internal reliability. More specifically, a rule of thumb to interpret Cronbach's Alpha values whereby $\alpha > 0.9$ indicates excellent internal reliability, $0.9 > \alpha > 0.8$ indicates good internal reliability, while $\alpha > 0.7$ indicates acceptable internal reliability.

The study had four constructs to be tested. Firstly, “Perceived Personalisation” saw a Cronbach's Alpha score of 0.92, with 3 items; “Brand Familiarity” obtained a Cronbach's Alpha score of 0.97 with 2 items. “Perceived Personalisation” and “Brand Familiarity” is deemed to have excellent internal reliability. The construct of “Attitude” obtained a Cronbach's Alpha score of 0.88 with 3 items; and lastly, “Purchase Intention” obtained a Cronbach's Alpha score of 0.89 with 3 items. Given so, “Attitude” and “Purchase Intention” have good internal reliability. Table 3, as follows, presents a summary of the Cronbach's Alpha values.

Table 3. Reliability statistics.

Internal Reliability Statistics

Item	Cronbach's Alpha	No. of Items
PP: Perceived Personalisation	0.92	3
BF: Brand Familiarity	0.97	2
AT: Attitude	0.88	3
PI: Purchase Intention	0.89	3

Manipulation Check

Manipulation checks for Perceived Personalisation (PP) and Brand Familiarity (BF) were conducted via independent sample t-Tests.

Perceived Personalisation There were 50 participants in the low and high personalisation groups respectively, forming balanced groups. A t-test was run to determine if there were differences in engagement to an advertisement between the groups due to the assumption of homogeneity of variances being violated, as assessed by Levene's test for equality of variances ($p = .000$). Consistent with our expectation, the level of personalisation was perceived to be higher for the group in high personalization condition ($M_{\text{high}}=6.08$) than the group that is in the low personalization condition ($M_{\text{low}}=5.14$). The result was statistically significant ($t(98) = -4.564, p = .000$). We now proceed to perform the manipulation check on “Brand Familiarity.”

Brand Familiarity There were 50 participants in the low and high brand familiarity groups respectively, forming balanced groups. A t-test was run to determine if there were differences in engagement to an advertisement between the groups due to the assumption of homogeneity of variances being violated, as assessed by Levene's test for equality of variances ($p = .000$). Consistent with pretests conducted, the level of brand familiarity was perceived as higher for the group that is in high brand familiarity condition ($M_{\text{h}}=6.08$) than the group that is in the low brand familiarity condition ($M_{\text{l}}=2.29$). The result was statistically significant ($t(98) = -17.669, p = .000$.) The results suggest a successful manipulation of both personalisation and brand familiarity variables.

Hypothesis Testing

The Effects of Personalisation on Attitude It was earlier hypothesized in H1 that personalisation of LBA improves the attitude towards a focal product. A one-way ANOVA was conducted to determine if the scores pertaining to attitudes would differ with different levels of personalisation (high vs. low). There was homogeneity of variances, as assessed by Levene's test of homogeneity of variances ($p = .284$). The Attitude score was significantly different between high and low personalisation groups ($M_{\text{high}} = 5.26, M_{\text{low}} = 4.77, F(1, 98) = 5.287, p < .05$). Thus, H1 is supported.

The Interaction between Personalisation and Brand Familiarity on Attitude The study also hypothesized in H2 that personalisation of LBA is more favourable when Brand Familiarity is high than when it is low. A two-way Analysis of Variance (ANOVA) was conducted to examine the interactions between the focal variable (PP), moderating variable (BF) and the dependent variable (AT). Homogeneity of variances was assessed by Levene's test. Results showed homogeneity of variances ($p = .098$). There was a statistically significant interaction between personalisation and brand familiarity on “Attitude” score ($F(1, 96) = 14.981, p < .001$). This reflects that brand familiarity has a moderating effect of personalisation on attitudes. Given so, an analysis of simple main effects for personalisation levels was performed. The ANOVA analysis of the difference scores reflected a significant main effect of high brand familiarity ($M_{\text{low}} = 4.76, M_{\text{high}} = 5.99, F(1, 96) = 20.938, p < .001$), and a non-statistically significant main effect of low brand familiarity ($M_{\text{low}} = 4.76, M_{\text{high}} = 5.99, F(1, 96) = .806, p = .372$). The representative marginal mean plot and clustered bar chart are respectively presented in Figure 2 and 3 as follows.

Given so, in a low brand familiarity context, personalisation efforts are found to have negligible effects on attitude; while in a high brand familiarity context, personalisation efforts have significant positive effects. In consequence, the obtained results lend support to H2.

The Effects of Attitude on Purchase Intention Thirdly, it was hypothesized in H3 that the attitude towards a focal product is positively related to purchase intention. A linear regression was conducted to understand the effect of “Attitude” scores on “Purchase Intention” scores. “Attitude” scores significantly predicted purchase intention ($\beta = 0.767, p < .001, R^2 = .49.1$), accounting for 49.1% of the variation in “Purchase Intention”, a substantial effect according to Cohen (2013). Therefore, H3 is duly supported.

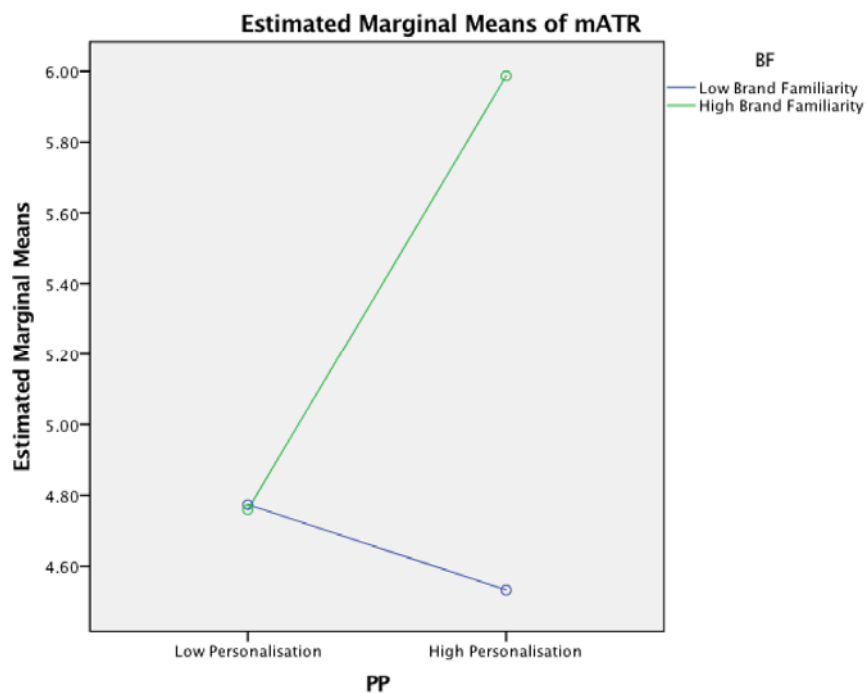


Figure 2. Marginal mean plot for attitude.

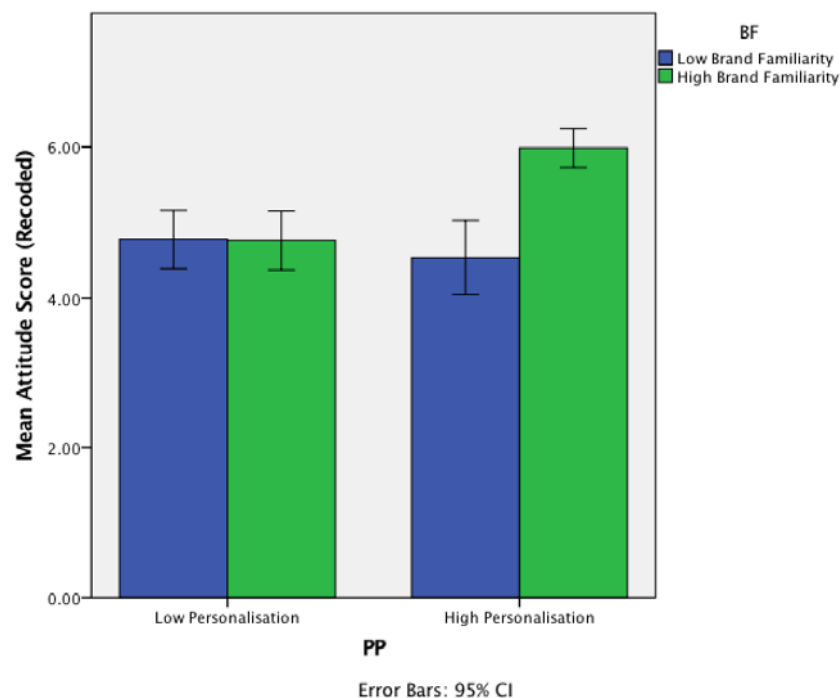


Figure 3. Clustered bar chart for attitude.

Summary of Findings To conclude the above testing of hypotheses, a summary table of hypothesis testing is presented as follows in Table 4. This research examined the interactions between dependent variables personalisation and brand familiarity and dependent variables attitude and purchase intention in the context of applied LBA. Overall, the results of the study support the initial conceptualisation.

Table 4. Summary of hypothesis testing.

H1	Personalisation of LBA improves the attitude towards a focal product.	Supported
H2	Personalisation is more favourable when Brand Familiarity is high than when it is low.	Supported
H3	The attitude towards a focal product is positively related to purchase intention.	Supported

Hypothesis testing for H1 revealed that Personalisation improves attitudes for applied LBA. Next, building on the assertion by Rose (2016) that brand familiarity aids to improve attitudes, hypothesis testing for H2 confirms that brand familiarity indeed moderates the effects of personalisation and resulting “Attitude” scores, whereby brands with high brand familiarity enjoy heightened results from personalisation efforts. In other words, personalisation is indeed more favourable in high brand familiarity contexts; while when brand familiarity is low, the impact of personalisation is likely non-significant on attitudes. Finally, the study affirms that attitudes are positively related to purchase intention in the context of LBA. This is corroborated by the well-researched Theory of Reasoned Action (TRA) (Fishbein & Azjen, 1975).

Altogether, the findings reflect that while personalisation itself results in a statistically significant increase in “Attitude” scores, brand familiarity is a crucial variable due consideration. The presence of high brand familiarity contributes by enhancing personalization efforts, and thereby increases purchase intention significantly. In contrast, for brands with low brand familiarity, personalisation does not make a statistically significant difference towards attitudes and purchase intentions.

CONCLUSION

The paper began by affirming the potential of LBA, a relatively new phenomenon in the arena of personalised marketing. As past research reveals, LBA has the potential to deliver timely, targeted content to consumers according to their location and thereby trigger purchases. While so, marketers hold back on applying LBA in their marketing plans, since it invariably presents new risks, such as “Personalisation Reactance” as examined earlier, that would produce costly harm to the brand. There is also a clear lack of research as to the suitability of firms to adopt LBA. Therefore, the study set out to examine the effects of personalisation and brand familiarity on attitudes and purchase intention in the context of LBA.

Like previous research findings, this study confirms that personalisation attempts aid to improve attitudes and hence inclinations to purchase. Further, it is found that brand familiarity moderates the effects of personalisation on attitudes, whereby high brand familiarity enhances the effects of personalisation. For brands with low brand familiarity, the application of high personalisation does not aid to improve attitudes. While there may be other factors that influence attitudes and purchase intentions, the study provides a clear insight that brand familiarity is a crucial variable in the practice of LBA. Brands that enjoy high brand familiarity are thus presented with an opportunity to further exploit their brand value by applying personalisation in their LBA attempts. This study therefore affirms the inherent value of brand building that gives rise to trust and hence, heightened ROMI when personalised marketing tactics are applied in a LBA context.

Theoretical Contributions

This study expands preliminary theoretical understandings regarding the currently understudied phenomenon of LBA towards a study of specific factors that contribute to effective LBA. The study has established that LBA is not equally effective for all situations and attempts to fill in the gap by providing the specific boundary condition of brand familiarity.

As previously mentioned, the current paper looks to extend efforts of Xu et al. (2009) who has previously observed the personalisation privacy paradox in context of LBA to determine factors for appropriate personalisation; while applying an interaction of independent variables like that of Komiak and Benbasat (2006), who have discussed the interaction between personalisation and familiarity in the context of recommendation agents. The current study has confirmed the efficacies of personalisation, which is heightened by the presence of high brand familiarity, in context of practiced LBA.

The study also corroborates with past research that has established moderating effects of brand familiarity on the consumer decision process amongst choices within an evoked set when generic advertising is applied (Baker, Hutchinson, Moore, & Nedungadi, 1986). The current study affirms that the moderating effects of brand familiarity is too, found to hold true in the context of LBA.

Managerial Implications

From a practical perspective, this study has implications for various players in the LBA industry: brands, marketers and LBA service providers.

First, since the study proves brand familiarity as a valid boundary condition, brands should look to conduct sufficient market research or a brand familiarity audit prior to implementing personalisation in LBA. Though the study has found a statistically significant difference for “Attitude” scores between high and low personalisation scenarios, such a small difference may not be sufficiently significant for managers to practice personalisation due to the costs involved. Warren (2001) reveals that costs of personalisation technology include spending for software for data collection, implementation services, manpower and the probable aid of a specialist consultancy. Since the study finds little difference between the resulting attitudes of the groups who respectively experienced low and high personalisation, marketers may not be able to justify ROMI for personalisation efforts from the outset, without the potentially heightened effects from factors such as brand familiarity.

Secondly, established and recognised brands in the likes of Starbucks Coffee, The Coca-Cola Company and Netflix should look to invest in high personalisation tactics in a LBA context. Though brands of all brand familiarity levels can opt to practice personalisation without harm, only brands with high brand familiarity will reap significant returns on their investment in personalisation efforts. This is corroborated by Rose (2016) who asserts that brand familiarity aids to reduce perceived risks and hence heightens trust. Specifically, top-of-mind brands in a local context such as Starbucks, NTUC Fairprice, McDonalds, Uniqlo and Zara can look to apply personalisation by including name fields and choice of favourite item, as proven successful in the current experiment. By extension, it is likely that other forms of personalisation such as the tone of marketing message, personalised discount codes, could be applied for similar results. That being said, the efficacies of various personalisation tactics are naturally a topic of interest for future LBA related research.

Finally, brands with low brand familiarity levels should look to improve its brand familiarity amongst the general populace via mass advertising tactics prior to implementing personalisation in LBA. Such mass advertising tactics include the use of online advertising, outdoor advertising or influencer marketing. These forms of marketing are in line with the application of LBA and hence deemed more likely to be viewed by the LBA audience. Specifically, influencer marketing can aid to quickly establish brand credibility, if the influencers have established prior trust before endorsing a brand (Zuercher, 2017). As of the current findings, brands which are relatively unknown or new should refrain from investing in personalisation when practicing LBA. Specifically, generic messages without customising name fields or focal items, such as “Hello there, here’s 20% off all drinks at fashion store, Monki, near you!” would suffice to achieve similar results as would a personalised message.

Limitations and Future Research

As with other studies, several limitations exist for the current study. First, the sample size ($n=100$) and sampling method are limitations of the study due to time and resource constraints. The study used a convenience sample in data collection through an online web-survey, towards which the study obtained a youth-dominated sample (age range = 18 to 25). There may be potential criticism as to the true representation of the population, thereby limiting generalizability. This is especially so since past research has revealed that attitudes towards personalised marketing differs amongst age groups, with 57% of 18 to 35-year-olds happy to receive them, while a mere 5% of those above 35 said they were (Gwynn, 2016). Future research should be conducted with a more diverse sample, with the use of other sample techniques such as stratified random sampling for improved generalizability.

The research was based on the declaration of willing respondents via a survey. Although experiments allow for better control over the test environment, the lack of a genuine context may compromise on the reliability of our findings. For example, should a consumer may be in a rush for his next appointment and thus has increased annoyance to any advertisement or prompt. This may ensue as a negative backlash instead of the positive results the study obtained within a controlled environment. It would be worth therefore, to conduct field experiments that better considers the intricacies and complexities of consumer decision making, thereby providing for high ecological validity.

Next, the study focused on a single prototype while designing the experiment, namely the use of fast moving consumer goods in the form of beverages to simulate a spontaneous purchase situation. LBA researchers such as Xu et al. (2009) present two distinct forms of purchase intentions, including that of deliberate purchases and spontaneous purchases. While researchers such as Bruner and Kumar (2007) affirm LBA for its potential to trigger impulse purchases, it is acknowledged that numerous consumer purchases involve deliberate purchases such as big ticket items like automobiles, consumer appliances or larger food and beverage expenditure. This would have implications on major brands such as BMW, Phillips, Paradise Group or Ray-Ban Sunglasses. Future studies could examine the applicability of the current study’s findings to varying purchase situations.

Third, since the current study focuses on the effects of personalisation or lack thereof towards attitudes, further examination as to the extent of personalisation is crucial. Though we have established that personalisation has its efficacies especially if applied by brands with high brand familiarity, it is also imperative to consider White et al.’s (2007) assertion that that negative consumer responses to personalised marketing tactics may cause serious damage to a brand, far beyond a simple lack of response to marketing strategies. Marketers would hence be in need of academic research that provides insights to fine-tune the personalised experience of its consumers, including aspects such as the tone of the message or the propensity of various age group towards

personalised marketing. Future research should build upon the findings of the current study to examine the type or extent of personalisation tactics in context of LBA.

Also, the usefulness of LBA may not be limited to brick and mortar retailers, though researchers assert that LBA makes the most sense for brick and mortar businesses that users frequently pass in their daily activities (Bruner & Kumar, 2007). In fact, brands without a local presence may eventually be able to find uses for it as well. Consider a consumer who has opted-in for marketing from an online kitchen accessories supplier, who receives LBA prompts when she approaches their local competitors and complementary businesses. It is potentially worthy to study such applications, which could contribute greatly to effective retargeting strategies for e-commerce marketers.

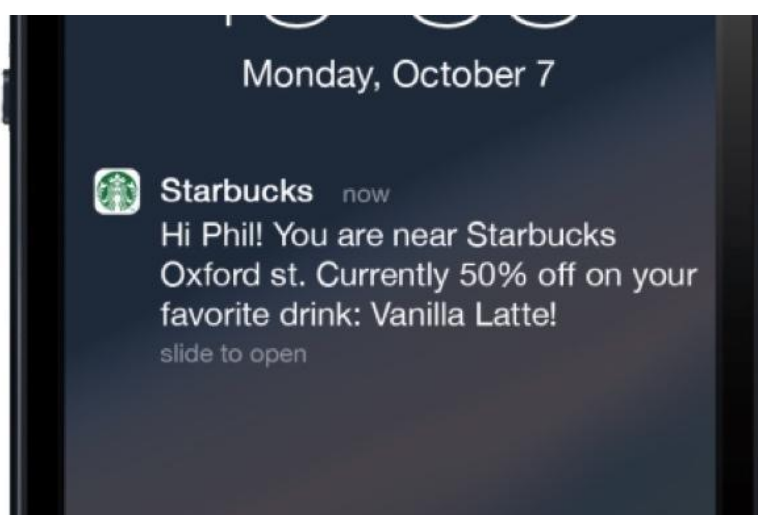
Finally, since the study has observed that the efficacies of LBA are not equal in all situations, future studies could look to identify the effects of alternative factors such as 'brand awareness', 'brand preference', 'data privacy assurance' or 'country of origin' on the application of LBA. The resulting outcome will prove to be useful for marketing practitioners as justification for potential ROMI, especially when marketers look to make a case for adopting LBA. More importantly, establishing the effects of these factors will aid to improve applied LBA results and hence improve the adoption rate of LBA.

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APPENDIX A: Manipulation (Mobile Notification)



A.1 Brand Familiarity: High; Personalisation: High

“You have given permission to a third-party location-based app to prompt you, as and when you are near a store of interest with a relevant promotion. You are currently having a leisurely time walking around at Plaza Singapura.

You have received this mobile notification from Starbucks Coffee Company, a modern coffee joint:”

"Hi $\{Q1/ChoiceTextEntryValue\}$! You are near Starbucks Plaza Singapura! Here's 50% off your favourite drink: $\{Q5/ChoiceTextEntryValue\}$. Enjoy!"

“The following questions measure your responses towards such a scenario. You will take approximately 5-10 minutes to complete the rest of the questionnaire.”

A.2 Brand Familiarity: Low; Personalisation: Low

“You have given permission to a third-party location-based app to prompt you, as and when you are near a store of interest with a relevant promotion. You are currently having a leisurely time walking around at Plaza Singapura.”

“You have received this mobile notification from Caribbean Coffee Company, a modern coffee joint:”

"Hello there! You are near Caribbean Coffee at Plaza Singapura! Here's 50% off our beverages today. Simply show this notification to our staff. Enjoy!"

"The following questions measure your responses towards such a scenario. You will take approximately 5-10 minutes to complete the rest of the questionnaire."

A.3 Brand Familiarity: Low; Personalisation: High

"You have given permission to a third-party location-based app to prompt you, as and when you are near a store of interest with a relevant promotion. You are currently having a leisurely time walking around at Plaza Singapura."

"You have received this mobile notification from Caribbean Coffee Company, a modern coffee joint:"

"Hi \${q://QID1/ChoiceTextEntryValue}! You are near Caribbean Coffee at Plaza Singapura! Here's 50% off your favourite drink: \${q://QID5/ChoiceTextEntryValue}. Enjoy!"

The following questions measure your responses towards such a scenario. You will take approximately 5-10 minutes to complete the rest of the questionnaire.

A.4 Brand Familiarity: High, Personalisation: Low

"You have given permission to a third-party location-based app to prompt you, as and when you are near a store of interest with a relevant promotion. You are currently having a leisurely time walking around at Plaza Singapura."

"You have received this mobile notification from Starbucks Coffee Company, a modern coffee joint:"

"Hello there! You are near Starbucks Plaza Singapura! Here's 50% off our beverages today. Simply show this notification to our staff. Enjoy!"

"The following questions measure your responses towards such a scenario. You will take approximately 5-10 minutes to complete the rest of the questionnaire."

Privacy-preserving Wi-Fi Access Scheme for VANETs

(Full Paper)

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ABSTRACT

Recently, great progress has been made in the study of Vehicular Ad Hoc Networks (VANETs) to solve road congestion and prevent traffic accidents. To pursue the life quality, driving comfort and entertainment requirements are necessary, such as surfing the Internet, searching nearby gas stations, restaurants, etc. Hence, vehicles have to access to the Internet via Wi-Fi hotspots provided by roadside units (RSUs). Obviously, the connection to RSUs reveals the driving routine. The location privacy of vehicles is seriously threatened. In this paper, we propose a novel approach to protect the location privacy while accessing to Wi-Fi hotspots (RSUs). We adopt the idea of 'off-the-record' communication to achieve the privacy property. In other words, the vehicle performs a deniable authentication with RSU while accessing to Wi-Fi hotspot and the participants should have the *deniability* capability. RSU provides the Internet service to the vehicle if authentication completes. On the other hand, this authentication conversation leaves no 'paper trail' and therefore, the vehicle can deny to a third party that the fact of the authentication occurred since the communication transcript could be produced (simulated) by others.

Keywords: Location privacy, Wi-Fi hotspots access, privacy-preserving authentication, deniability.

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INTRODUCTION

With the development of society, the vehicles have become the essential for people to travel. The increase of vehicles also brings many problems such as traffic congestion, traffic accidents and so on. Vehicular Ad Hoc Networks (VANETs) emerge to solve above problems, and hence have been highly concerned by automobile manufacturers, research institutions and governments. VANETs are the new large-scale mobile ad hoc networks composed of On-board Units (OBUs) and Road-side Units (RSUs). The communication between the OBUs and RSUs can realize efficient accident warning, auxiliary driving, road traffic information query, Internet services and so on.

However, VANETs encounter the great threat of privacy leakage while improving the security, efficiency and convenience of the transportation system. The traffic information such as speed, location, direction and the regularity of vehicle movement are useful for VANETs, but sensitive for users privacy. As people pay more and more attention to personal privacy, the design of an effective privacy-preserving mechanism has become a key issue in the successful deployment of VANETs.

On the other hand, vehicles need Internet service while driving to improve the quality of driving experience, such as surfing the Internet, searching nearby gas stations, restaurants, etc. Most applications support RSUs to use WLAN access mode to provide the Internet service for vehicles. The IP/MAC address is necessary for the authentication during the access procedure. Obviously, connection to RSUs which play the role of Wi-Fi hotspots leaks the drive routines of vehicles. Therefore, location privacy of the vehicle is focused while accessing to Wi-Fi.

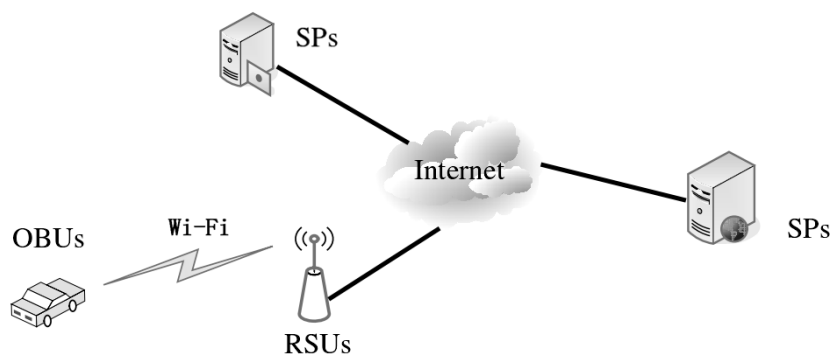


Figure 1: Vehicles Access to Wi-Fi Hotspots for Internet Service

Related Work

When the vehicle connects to a Wi-Fi hotspot to obtain the Internet service, this access point (AP) records vehicle information (e.g. IP/MAC address) from the authentication procedure. Since the AP location is fixed, this vehicle can be located obviously. Therefore, it is possible to pinpoint the location of a user to a particular depot, or a particular section of a square. Location privacy is necessary concerned while accessing to Wi-Fi for vehicles.

To address the location privacy issue in wireless environments, several approaches are proposed. Schilit, Hong and Gruteser (2003) proposed Wireless Location Privacy-preserving for the first time. This paper points out that with the development of Wi-Fi and location services, it will bring great challenges to user's location privacy. And assume some privacy risks, which now seems to exist. Then there are some K-anonymity schemes (Gruteser & Grunwald, 2003; Yang *et al.*, 2013) which are the most widely adopted. Such schemes attempt to fuzz the location resolution by hiding a mobile user from a certain range including $k-1$ other mobile users. However, considering the lightweight setup in Wi-Fi deployment sites, they are confronted with the challenge of lacking the trusted third party whose job is to relay the communication between the mobile users and the LBS provider. Titkov and Poslad (2003) realizes user anonymity through a Mediator Agent, either a user-controlled or a trusted-third-party mediator that separates mobile terminals from service providers on the fixed network. Raghunath and Narayanaswami (2007) works by examining each unique identifier that can be used to associate location information with a particular subscriber, and making each such identifier useless. Quigley *et al.* (2004) proposes location obfuscation: LBSs can only access a uniformly downsampled location information (with lower precision and lower geographical granularity) instead of exact client positions. Bellavista, Corradi and Giannelli (2005) presents the privacy-related extension of our proxy-based mobile agent middleware to support personalized service provisioning to Wi-Fi portable devices. Jiang, Wang and Hu (2007) obfuscate several types of privacy-compromising information revealed by a mobile node, including sender identity, time of transmission, and signal strength. Peng, Kaji and Kawaguchi (2014) presented an algorithm that determined the reliability of the user by considering the probability of both spatial and temporal to resolve the privacy problem in Wi-Fi based location estimation.

As far as we know, most of the existing schemes involve third party participation or fuzzy location based schemes. In a scheme with a third party, the assumption that a third party can be completely trusted is very strong. In the location based fuzzy scheme, SP can not get the exact location, thereby reducing the quality of service. In this paper, we propose a scheme that requires neither third party nor fuzzy location. This does not only protect the user's location privacy, but also does not reduce the quality of service.

Contribution

We propose a location privacy-preserving scheme while vehicles accessing to the Wi-Fi hotspots to obtain the Internet service. Different with the existing schemes, we adopt a novel idea to achieve the privacy property. We make use of the deniability to provide the conversations with 'off-the-record'. Technically, we employ the deniable authentication (Zeng *et al.*, 2018) as the building block to protect the location privacy of vehicles while connecting to the Wi-Fi hotspots. Vehicle submits its identity (i.e., IP/MAC address) to the server (RSU) to obtain the Internet service for the authentication. This is the evidence to disclosure its drive circuit and hence leak the location privacy. To meet the location privacy of OBUs, we require the authentication protocol satisfying the deniability. In the end of the execution of authentication, RSU can be convinced that OBU is the legal user to gain the Internet service. On the other hand, the deniability prevents that RSU to show the evidence to the third party as the conversation transcript can be simulated by anyone including RSU. Therefore, the location privacy of OBU is perfectly protected. We design this deniable authentication protocol by using the projective hash function (Zeng *et al.*, 2017).

Organization

This paper is organized as follows. We review the properties of projective hash function which is an essential tool to construct the protocols and the notion of deniable authentication in the section 2. We introduce the architecture of VANETs and the principle of Wi-Fi access in the model of VANETs in the section 3. We construct the deniable authentication based on the projective hash function and then instantiate this protocol to protect the location privacy while accessing to the Wi-Fi hotspots in the VANETs environment in the section 4. We analyze the security and performance of our proposed protocol in the following section and conclude this paper in the last section.

PRELIMINARIES

Projective Hash Function

Projective hash functions were introduced by Cramer and Shoup (2002) and later formalized by Benhamouda *et al.* (2013). The properties (projection and smoothness) of projective hash functions are used to achieve the authentication in our scheme. We first review the original definition of projective hash functions.

Definition. Define a domain χ and an NP language L with $L \subset \chi$. The projective hash function is over L . For a word $c \in L$, the value of this function can be calculated by either a secret hashing key hk or a public projection key hp with a witness ω of the fact that $c \in L$. Specifically, a projective hash function over $L \subset \chi$ is defined as follows.

- $HashKG(L)$: Use the L to generate a secret hashing key hk ;
- $projKG(hk, L)$: Use the hk generated in the previous step to generate a projection key hp , which is public;
- $Hash(hk, L, c)$: Use the hashing key hk and the word $c \in L$ to calculate the value of this hash function.
- $projHash(hp, L, c, \omega)$: output the value of this hash function by using the projection key hp , the witness ω for the word $c \in L$.

Projection. We say this hash function is *projective* if $Hash(hk, L, c) = projHash(hp, L, c, \omega)$. That means the value of the hash function can be computed even without knowing the secret hashing key hk .

Smoothness. This projective hash function is smooth if $c \notin L$, then $Hash(hk, L, c)$ is statistically indistinguishable from a random value. That means it gives no information about the hash value of any point out of L .

Deniable Authentication

Deniable authentication is first formally introduced by Dwork, Naor and Sahai (1998, 2006), which provides a property to facilitate privacy-preserving communication. The receiver is convinced that sender's authentication to some message m , however, will not be able to convince any third party that the fact of this authentication occurred as this communication transcript can be produced without the knowledge of sender's secret. With the implementation of deniable authentication to our application, Wi-Fi hotspots (RSUs) accepts vehicles (OBUs)'s authentication to the identity (IP/MAC address) while RSUs cannot convince anyone else that the fact of this service has been requested by someone. Therefore, when vehicle connects to Wi-Fi for Internet service, its identity cannot be the evidence in the authentication. In other words, connection to some RSUs do not imply the vehicle routine and the location privacy follows.

A secure deniable authentication protocol must satisfy the following fundamental security requirements.

- Authentication. The receiver can be convinced of the source and accepts the intended sender if the two parties follow the authentication protocol honestly.
- Deniability. The sender can deny its involvement in an authentication. The receiver accepts the authentication while can not convince a third party the fact of this authentication occurred. Formally, this property is captured by simulation. We require that the simulator can produce a communication transcript without sender's secret and the simulated conversation can not be distinguished.

SYSTEM ARCHITECTURE

In this section, we briefly introduce the VANETs system model, the Wi-Fi access model and the privacy requirement.

VANETs

The common VANETs system with privacy protection mainly consists of four entities: the Transportation Regulation Center (TRC), the road-side units (RSUs) and the on-board units (OBUs) equipped on moving vehicles. With the increasing demand for network, SPs has become a very important part of VANETs. The model for VANETs is shown in Figure 2. Concretely.

•TRC. TRC is the top management of the system, with sufficient storage space and computing power, generally considered to be completely reliable. TRC in our scheme is an institution which is in charge of identity authentication, issuing and recycling certificate of each vehicle. Moreover, TRC can trace the target vehicle which involved in a traffic dispute.

•RSU. RSU is the Infrastructure of Vehicle Ad Hoc Network, with strong storage space and computing power, generally considered to be not completely credible. RSU is responsible for receiving a certificate application from OBU, forwarding the application to the local TRC, and forwarding the response of TRC to OBU. RSU broadcasts road information and security information received from other RSU or collected by themselves, as well as providing OBU with Wi-Fi hotspots and OBU connections to Wi-Fi hotspots to enjoy network services.

•OBU. OBU is the infrastructure of each vehicle, with weak storage space and computing power, which is generally considered untrustworthy. Each OBU should broadcast its routine safety messages when they are on the road, such as position, direction, speed, traffic conditions and traffic events. Thereout, the communication between two vehicles or vehicle to RSU can assist drivers

to get a better awareness of their environment and take action earlier. OBU can also access network services via RSU Wi-Fi to improve the driving experience.

•SP. SP provides information services for registered OBU, such as location services, mail services, network services, etc. Although most of the SP does not depend on the vehicle ad hoc network, it is also a very important object in the vehicle network communication. So, the service provider is also an indispensable role in the model system model of the VANETs.

Wi-Fi access model

Wi-Fi (Wireless Fidelity), a short-range wireless transmission technology, enables users to access to the Internet within hundreds of meters and provides users with network services. The Wi-Fi access model is shown in Figure 3, and the Wi-Fi network structure is as follows:

- Station. The most basic component of the network.
- BSS. BSS(Basic Service Set) is the most basic service unit of the network. The simplest service unit can consist of only two sites. The site can dynamically associate to the basic service unit.

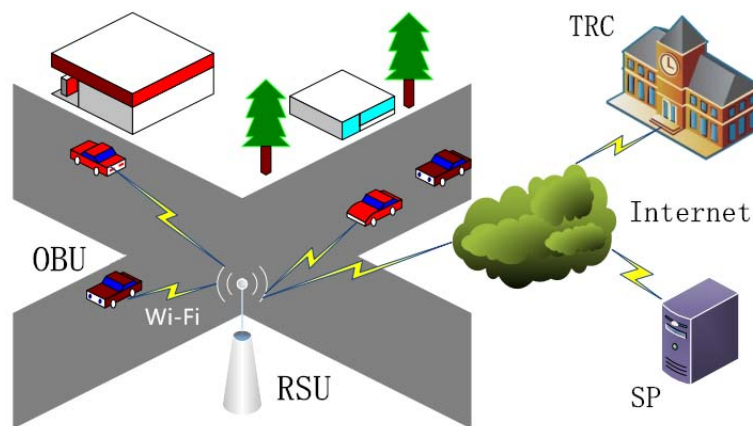


Figure 2: Vanets system model

- DS. The DS(Distribution System) is used to connect different basic service units.
- AP. The AP(Access Point) has the identity of the ordinary site and the function of accessing the distribution system.
- ESS. ESS(Extended Service Set) is composed of Distribution System and Basic Service Set. This combination is logical, not physical.
- Portal. It is also a logical element. Used to associate WLAN with wired local area networks or other networks.

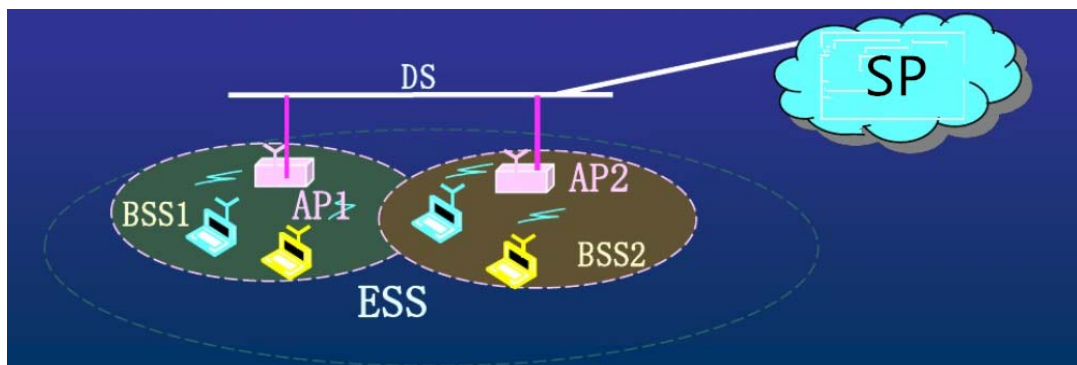


Figure 3: Wi-Fi access model

For the VANETs environment, the on-board Internet access mechanism can meet the needs for Internet access during travel, but it suffers the threat of location privacy. When vehicles access to RSU for Internet service, some regular access records(i.e., IP/MAC address, access duration, link bandwidth, and time between last visit, etc.) imply the footprints of vehicles. Since the RSU location is open and fixed. The vehicle location is also revealed if it has access to some RSU.

Privacy Definitions for VANETs

The privacy protection is the main challenge for VANETs. The sensitive information for users is the identity, the position and the requested service. The user has to show his identity when performs the authentication protocol. The identity protection requires the user identity is anonymous to anyone. The position and requested service belong to data privacy. When performs the VANETs authentication protocol, such information should be confidential to outsiders. Informally, the privacy requirements are stated as the following aspects:

Data privacy. Data privacy, is to protect the content of the communication itself is not known by entities outside the communication scene. For example, in Wi-Fi access, the RSU acts as a communication gateway, and the vehicle connects the Wi-Fi provided by RSU to communicate with SP. The vehicle is informed of the contents of its upload or download from SP, but in the process of communication, the transcript of the communication between the vehicle and SP does not wish to be obtained by a third party.

Identity privacy. Identity privacy, is to protect the identity of the communication entity is not known by a third party. Identity may be practical, but it can also be a e-mail address, employee number, etc. For example, when a vehicle accesses a email server via Wi-Fi, it does not want a third party to know its email address.

Location privacy. Location privacy, which protects the current or past communication location of the entity from being known outside the communication scene. For example, in Wi-Fi access, vehicles do not want SP to know where they are. If the communication location of the vehicle appears many times in the same family house, it can be speculated that the communication entity may be a member of the family, thus destroy the identity privacy of the entity.

By comparison, the challenge of location privacy protection is more prominent. The reasons mainly come from three aspects: (1) The quantity of location information is very large and it is very frequent to publish; (2) The change of location information is in accordance with the regularity of vehicle movement, and a very small amount of information leakage may give an attacker space for data mining. (3) Location correctness is the cornerstone of many vehicle applications and limits privacy protection.

OUR PROTOCOLS

In the process of the vehicle accessing to Wi-Fi hotspots, say RSUs, the IP/MAC address is the critical information submitted to RSUs. Therefore, the connection to RSU implies vehicle location. We adopt a novel idea to realize the location privacy while accessing to Internet via Wi-Fi hotspots. Since RSU knows the IP/MAC address of vehicle during authentication, the location privacy is preserved by deniability. The vehicle submits its identity (i.e., IP/MAC address) to RSU for authentication. RSU returns the Internet service to the corresponding vehicle if the authentication is valid. On the other hand, vehicle can deny the involvement in this authentication to the third party as this authentication is with ‘off-the-record’, RSU can not convince anyone else that the vehicle’s connection.

In this section, we first construct a deniable authentication protocol based on the projective hash function. Then we instantiate this deniable authentication to construct a privacy-preserving Wi-Fi access scheme for VANETs.

Deniable Authentication based on Projective Hash Function

We give a generic construction of authentication protocol with deniability based on projective hash function. For each participant P in the system, it obtains the key pair (SK, PK) by invoking the hashing key generation algorithm $HashKG(L)$ and the projection key generation algorithm $projKG(hk, L)$ respectively. The public key of P is $PK = hp$ and the private key of P is $SK = hk$. The sender S authenticates a message $m \in M$ to the receiver R and S wishes to deny its involvement after executing the authentication. S sends its public key PK to the receiver R . Upon the receipts of PK from S , R begins to interact with S to execute the authentication.

Key Generation.

This algorithm is done by each participant P itself. The private/public keypair of each P is $(SK, PK) = (hk, hp)$, where hk is the hashing key and the projection key hp is the projection key.

Deniable Authentication Protocol.

With PK , message $m \leftarrow M$ and NP language L . R picks a word $c \in L$ with the witness ω , sends $flow_1 = (m, c)$ to S .

Upon the receipt of (m, c) from R , S first computes the hash value by using the private hashing key hk and the word c , then hides this hash value by a secure commitment scheme COM . S does as following:

- compute $\sigma = Hash(hk, L, c; m)$ with the word c , the message m and its private key $SK = hk$;
- choose r randomly, compute $C = COM(\sigma; r)$;
- send $flow_2 = C$ to the receiver R .

Upon the receipt of the commitment C , R reveals ω and sends $flow_3 = \omega$ to S .

Upon the receipt of ω , S first checks that the value ω is indeed the witness for $c \in L$:

- check $projHash(hp, L, c, \omega; m) \stackrel{?}{=} \sigma$;

If this equation holds, S is sure that it can deny successfully later. Then, S reveals r to R . R calculates $\sigma = projHash(hp, L, c, \omega; m)$ and $C' = COM(\sigma; r)$. R is convinced S 's authentication to m if $C' = C$.

Authentication. If the sender returns the right σ implies the sender knows the corresponding private key of PK due to the smoothness of projective hash function. The soundness of the commitment scheme COM implies σ is calculated before R 's disclosure. The authentication follows.

Deniability. Since R reveals the witness ω in the step 3, anyone can generate the authentication transcript as the sender. Therefore, S can deny its authentication.

Privacy-preserving Wi-Fi Access Protocol based on Deniable Authentication

With the property of deniable authentication, we propose a novel approach to protect the location privacy while accessing to Wi-Fi hotspots in VANETs. In our construction, the vehicle submits its identity (IP/MAC address) to RSU to run the deniable authentication. We instantiate our construction by employing a concrete projective hash function. The notations of our scheme are listed in Table 1.

Table 1. Some Notations about Our Scheme

U_i	The vehicle i .
id_i	The identity of U_i .
IP	The user's IP address.
MAC	Media Access Control address.
(s_i, v_i)	The private/public key pair of U_i .
COM	A public commitment scheme

Let \mathcal{G} be a group of primer order p and $g, h \in \mathcal{G}$ the generators of \mathcal{G} . H is a collision-free hash function: $\{0,1\}^* \rightarrow \mathbb{Z}_p$. The system parameter $para = (\mathcal{G}, p, g, h, H)$.

Key Gen. Each U_i chooses $x_i, y_i \leftarrow \mathbb{Z}_p$, sets $h_{k_i} = (x_i, y_i)$, $h_{p_i} = g^{x_i} h^{y_i}$. U_i 's keypair is $(s_i, v_i) = (h_{k_i}, h_{p_i})$.

1. $U_i \rightarrow RSU$: U_i submits $m = id_i || IP || MAC$ to RSU to request the Internet service.
2. $RSU \rightarrow U_i$: Upon the receipt of message $flow_1 = m$, RSU chooses a random $\omega \leftarrow \mathbb{Z}_p$ and computes $c = (g^\omega, h^\omega)$. RSU sends $flow_2 = (m, c)$ to U_i .
3. $U_i \rightarrow RSU$: Upon the receipt of (m, c) from RSU , U_i first computes the hash value by using its private key s_i and the word c , then hides this hash value by a secure commitment scheme COM . U_i does as follow:
 - compute $\sigma = H(s_i, L, c; m) = g^{ax_i} h^{ay_i} g^{H(m)}$ with the word $c = (g^\omega, h^\omega)$ the message m and its private key s_i ;
 - choose r randomly, compute $C = COM(\sigma; r)$;
 - send $flow_3 = C$ to the receiver RSU .

4. $RSU \rightarrow U_i$: Upon the receipt of the commitment C , RSU reveals ω and sends $flow_4 = \omega$ to the U_i .

5. $U_i \rightarrow RSU$: Upon the receipt of ω , U_i first checks that the value ω is indeed the witness for $c \in L$:

-- check $(g^{x_i} h^{y_i})^\omega g^{H(m)} = \sigma$;

If this equation holds, U_i is sure that it can deny successfully later. Then U_i reveals r to RSU . RSU is convinced U_i 's authentication to m by calculating $\sigma = (g^{x_i} h^{y_i})^\omega g^{H(m)}$, $C' = COM(\sigma; r)$ and checks $C' = C$ or not.

Remark. With the development of vehicle networking industry, 5G network technology develops rapidly. (5G network has the characteristics of high transmission rate, low delay, high stability, flexible network architecture and so on.) Vehicle networking based on 5G is developing more and more rapidly in recent years, which provides a better network environment for the realization of our scheme.

SECURITY AND PERFORMANCE

We analyze the security and performance of our proposal in this section. We mainly discuss that how does our protocol achieve the privacy protection. Then we focus on the performance of this protocol execution.

Security Analysis

Vehicles in VANETs connect to Wi-Fi hotspots to obtain the Internet service. Obviously, this connection leaks vehicle location through authentication. Thus, we analyze that how does the user obtains the Internet service (Authentication) from accessing to Wi-Fi hotspots without privacy leakage (Location Privacy).

Authentication. Wi-Fi access requires user's authentication. The vehicle is authenticated by RSU if it can calculate σ . This value can be computed only by SK . Due to the computational binding of the commitment scheme and the smoothness of the projective hash function, no one other than U_i can forge the authentication. Concretely, U_i computes $\sigma = H(s_i, L, c; m) = g^{ax_i} h^{ay_i} g^{H(m)}$ by using its private key $h_{k_i} = (x_i, y_i)$. This value σ is accepted by RSU as it can produce the same σ by using the witness ω and U_i 's public key. Since the commitment scheme is sound, the committed value can not be modified to σ after the disclosure of ω .

Location Privacy. Our location privacy is achieved by the deniability. The tuple (id, IP, MAC) is submitted for authentication. However, it is the sensitive information for vehicles. The record of each connection to RSU with fixed location reveals vehicle location. If the user (vehicle) has the deniability property, the record of each authentication is not the evidence that this vehicle has been here before. Therefore, we require that this conversation transcript between U_i and RSU can be perfectly simulated and this simulation cannot be distinguishable. This is achieved by that RSU reveals the witness ω in the step 4. With ω , anyone can produce the right σ by $\sigma = (g^{x_i} h^{y_i})^\omega g^{H(m)}$. Therefore, there is no evidence that U_i has access to RSU . The location privacy of vehicle U_i follows.

Performance

Our proposal is a kind of cryptographic-based approach to protect user privacy in VANETs. The fundamental disadvantage of this category is the high computation and communication complexity. However, the main advantage of cryptographic-based approach is the strong privacy and security. It is inevitable to use cryptographic algorithms in order to preserve security.

We simulate the process of our scheme. We employ Inter Core i5 2.70GHz with 8GB RAM and the result is shown in Figure 4. We calculate the time it takes for OBU to authenticate under the security parameters $K1=256$ and $K2=512$, respectively. Obviously, the larger the security parameters, the longer the authentication time. In order to estimate the performance of our scheme accurately, as shown in figure 4, we have run the experiments several times under both security parameters. When the security parameter is $K1=256$, the first running-time is 1.971ms, the second running-time is 2.063ms, the third running-time is 2.153ms.... The average running-time under $K1$ is 2.095ms. When the security parameter is $K2=512$, the first running-time is 6.796ms, the second running-time is 7.326ms, the third running-time is 7.126ms.... The average running-time under $K2$ is 7.153ms.

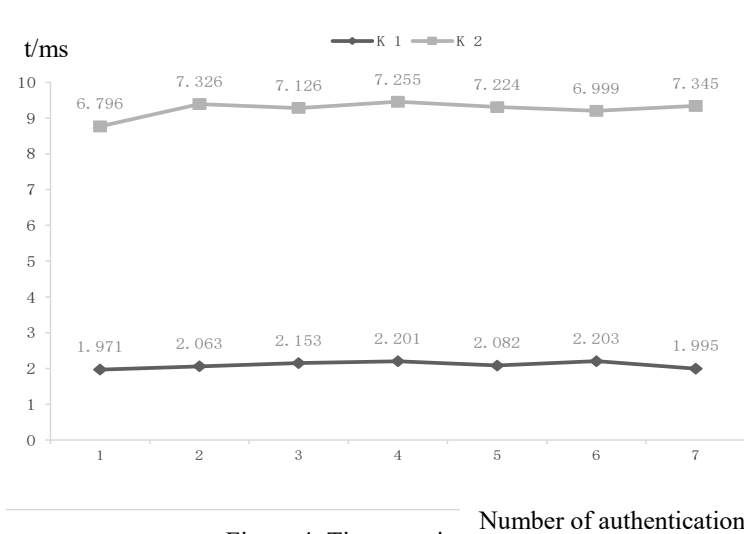


Figure 4: Time cost in authentication

CONCLUSION

In this work, we propose a novel approach that enables the user to access the Wi-Fi hotspots without location privacy leakage for vehicles in VANETs. We employ the deniable authentication to construct the protocol to provide the strong privacy. Although RSU obtains the user's identity from the authentication, it cannot convince anyone else that this user has connected to RSU, thus it has no evidence to locate this vehicle. More importantly, the 5G era is fast approaching. The 5G network technology will meet the need of high transmission rate and large capacity data processing in the vehicle network. We will consider this scheme based on 5G network in the future research.

ACKNOWLEDGMENT

This work is supported by Chunhui project of the Ministry of Education of China (Z2016150) and the National Key R & D Program of China (2017YFB0802300, 2017YFB0802000).

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Research on Construction Company's Strategy Transformation Based on BIM (Full Paper)

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ABSTRACT

This paper explores the strategic planning for a case company based on BIM transformation. This paper first analyzes the organizational structure and BIM strategy of the current case company, uses IDEF0 to build an existing business process model, and uses Time-Driven Activity-Based Costing (TDABC) to analyze the working time and manpower required under the existing business process; Using the Theory of Constraints (TOC) thinking process model to identify the fundamental factors of problems and bottlenecks in existing business processes, explore how to remove bottlenecks and re-engineer business processes through importing BIM; then propose future IDEF0 business process models; then use TDABC to analyze the working time and manpower required to import BIM business in the future. Through the future mode of operation and the time and manpower that can be streamlined, from the perspective of BIM's impact on the business activities of the case company, and refer to the BIM platform deployment, operation type and how to use BIM to provide services for BIM successful companies to propose a case company BIM platform setting strategy, optimal BIM platform structure, operation type and function items and operation function adjustment suggestions of the case company.

Keywords: Enterprise transformation, business process, BIM, organizational change, TDABC, TOC.

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THE BACKGROUND DESCRIPTION

Taiwan's construction industry is facing a different business world than before. The construction industry is one of the pillar industries of Taiwan's economy and plays an important role in economic and social development. As the government's policy to cool real estate speculation and labor regulations tightened, the competition in the construction market has become more intense. This has put a severe test on construction companies. The traditional construction industry's operation methods, management concepts, management models and business models have been difficult to adapt to the new economic environment and new ways of competition. An enterprise can continue to successfully survive and develop in a new business environment only through its own changes, or it will face a situation of being eliminated.

From the development direction of BIM in the international construction industry, it is not difficult to see that BIM management of construction enterprises is to break through the various information barriers existing in construction enterprises. It is necessary to fundamentally change the way in which companies collect, process, and use information, which leads to tremendous changes in organizational forms, and promotes business processes reengineering and even restructuring of organizational structures, and turns the original hierarchical structure into a "dynamic network" structure of precise, agile and innovative flat. Therefore, it is possible to maximize the production and operation mode of the company's operational efficacy..

THE RESEARCH OBJECTIVES

According to the above research background, Taiwan's construction industry faces many conflicts and difficulties such as stricter labor regulations, government's policy to cool real estate speculation, rising factor costs, overcapacity, intensified market competition, and slow pace of transformation and upgrading. From the perspective of external competition, a far-reaching BIM new technology revolution is taking place, and a new round of profound changes in the global construction industry is accelerating. At the same time, developed countries have implemented the "BIM" strategy and developed high-end construction industry in order to occupy a favorable position in the international economic competition. Facing the changes in the domestic and international industrial development environment and the competitive environment, it is particularly necessary and urgent to learn from the BIM strategy and promote the transformation and upgrading of the case company's construction industry. The case company's transformation through BIM strategy mainly hopes to achieve the following aspects:

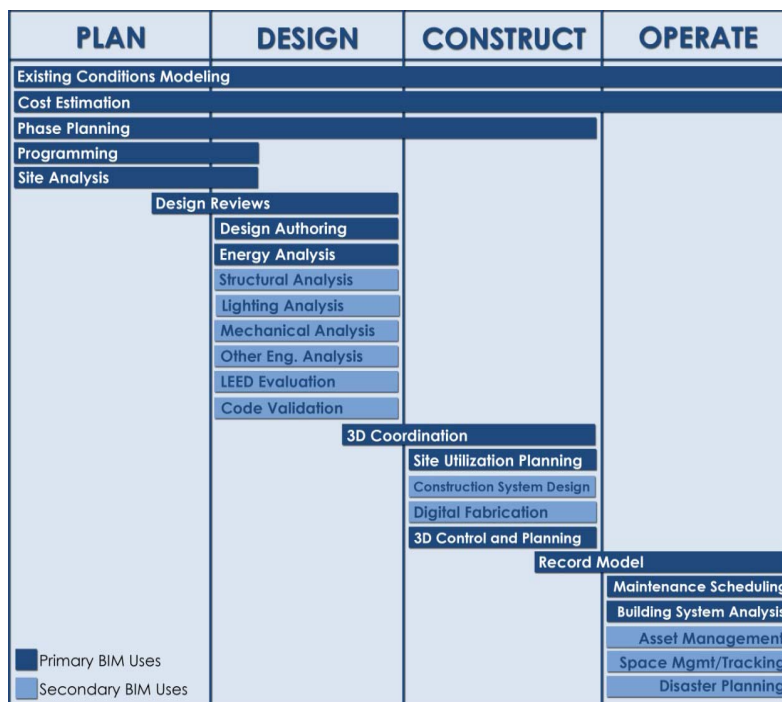
- 1) Intelligent and digital as the direction of the case company development
- 2) Re-construct the business process of the case company based on the perspectives of system, association, integration, collaboration and integration
- 3) Equip the case company with BIM technology
- 4) Development the case company construction project life cycle management
- 5) Develop the case company's BIM platform construction

LITERATURE DESCUSSION

Building Information Model (BIM)

BIM (Building Information Model) technology is a digital tool for engineering design, construction and management processes. The US National BIM Standard (NBIMS) has three definitions of BIM: 1) BIM is a digital representation of a facility (construction project) entity and functional characteristics; 2) BIM is a shared knowledge resource and is the shared information about the facility. It's a process that provides a reliable basis for all decisions in the facility's life cycle from concept to dismantling; 3) at different stages of the project, different stakeholders insert, extract, update and modify information in BIM to support and collaborative work that reflects their respective responsibilities. (NIBS, 2006)

The US bSa (building SMART alliance) proposed 25 different applications of BIM (Building SMART Alliance, 2010) in its "BIM Project Execution Planning Guide", as shown in "Figure 1: 25 different applications of BIM". As can be seen from Figure 1, the application of BIM runs through the entire life cycle of the construction project.



Source: BIM Project Execution Planning Guide Version 2.0.

Figure 1: 25 different applications of BIM.

Enterprise Transformation

In response to changes in the times, companies are gradually transforming through new digital technologies to drive changes in business models. According to Gartner (2014), 75% of the world's enterprises will be transformed into digital enterprises in three years or so. The digital transformation will be a complete change of the organizational structure of the enterprise, but also test the company's determination and resources. Many companies understand the importance of digital transformation for corporate innovation, but more than half of them have no corresponding strategies or stagnation.

Digital transformation will be the top priority for companies in the next three years. Most companies understand that digital transformation must cater to future technology trends, but most companies lack specific strategies and plans (Microsoft, 2017). If you want to get rid of the past and make a smooth transition, companies must actively face two major problems and challenges: Conflicts within the organization, resources and applications.

IBM (2011) proposed that enterprises have three ways to achieve transformation at the implementation level. The first transformation is to first establish a digitalized operating model, and then reshape the customer value proposition; the second transformation is the opposite of the first transformation, first to enhance the customer value proposition and then pay attention to the digital Operation. The third transformation is that companies need to break the framework and create new capabilities to achieve transformation.

The "silver bullet" theory of transformation ((Lynne, 1997) emphasizes the need to adopt a single method or process tool to change the performance and behavior of the company, including IT, process reengineering, total quality control, human resource management reform and new strategic solutions, etc. (Each single scheme is analogized to a bullet). Hammer and Champy (2006) proposed the concept of BPR. Subsequently, many scholars conducted in-depth research on the organizational transformation based on BPR. Henderson and Venkatraman (1994) as the representative scholars began to study the organizational transformation of IT enablement, and studied the organizational transformation path from the perspective of enterprise information system planning and enterprise strategy planning matching.

MIT Sloan Management Review published in 2015, *Strategy, Not Technology, Drives Digital Transformation* pointed out that the enterprise digital transformation perspective, in addition to IT technology level, also includes the required talent, thinking and digital transformation culture (Culture of Digital Business Transformation), and the key to its success or failure is not technology, but focus on a clear digital strategy.

Business Process Reengineering

In 1990, Michael Hammer proposed the concept of Business Process Reengineering (BPR). Process reengineering is a fundamental thinking and thorough rebuilding of the company's business processes. Its purpose is to achieve significant improvements in cost, quality, service and speed. It enables enterprises to adapt to the modern business environment characterized by customers, competition and change to the maximum extent. BPR emphasizes business process as the center and advocates fundamentally redesigning organizational structure and business processes. It is a cross-functional innovation for all business processes.

The theory of BPR breaks through the concept of traditional theory of division of labor. It emphasizes the replacement of the traditional "functionally oriented" organizational form with "process-oriented", which provides a brand-new idea for business management. Since the current enterprise is based on the theory of division of labor, the business process is divided and concealed by the organization. People are very familiar with departments, administrative or technical offices, and teams, but turn a blind eye to business processes. In fact, the process of the enterprise is the lifeline of the enterprise and determines the operational efficiency of the enterprise. Compared with the functional management concept based on the theory of division of labor, the theory of BPR has the following three salient features: The first is to emphasize the needs of customers. Since customers are no longer passive recipients of production products, but active determinants, companies must consider meeting the individual needs of customers. It can be said that the customer's demand is the most fundamental driving force for the company to carry out process reengineering. The second is to focus on overall optimization. The traditional organizational structure is divided according to functions. Each functional department performs its own functions and focuses on the optimization of its own departments. However, due to the lack of cooperation and coordination between departments, it is difficult to achieve the overall optimization of the enterprise. The theory of process reengineering is to re-establish the operating mechanism and organizational structure of the enterprise to achieve overall optimization. The third is to pursue a significant increase in enterprise efficacy. The process reengineering theory is not to pursue the gradual improvement of enterprise efficacy, but to improve customer satisfaction as the main direction, through the redesign of the process to achieve great improvement in enterprise efficacy.

After the theory of process reengineering was put forward, many companies in Europe and the United States invested heavily in reengineering the business processes of enterprises. Although the culmination of process reengineering has become a thing of the past, the redesign of processes and continuous improvement of processes are an eternal topic. Especially under the drive of the mobile internet, the company's processes must be designed and improved.

Process Measurement Technology: ABC and TDABC

In 1952, the American accounting scholar Professor Kohler studied the method of allocation of indirect costs, and put forward the concepts of operation, operation account, and operation accounting. This marks the birth of Activity-Based Costing. Activity-Based Costing (ABC) considers that production activities consist of a series of operations. The operation consumes resources, which in turn generates costs. Collect resource costs spent on the job or activity cost center through resource drivers. Then, through the activity drivers, the operation cost is collected into the target product. The production process is the operation chain, and the various main indirect costs that constitute the product cost are allocated by different resource drivers, activity drivers and workloads. More accurately reflect cost information. Operation is the activities provided by the company for the production of products. It is the intermediary of cost calculation and control, and also the presentation of business processes. ABC can comprehensively aim the entire enterprise operation process, effectively display the accounting management functions, and expand the scope of management. Robin Cooper and Robert Kaplan (1993) defined activity-based cost management as a series of actions using adequate activity-based cost information and articulated operational-based cost management from both operational and strategic aspects.

In the implementation, ABC has many insurmountable problems. For example, the implementation of ABC cost management system requires expensive funds, the information interview and investigation process is long, the cost of data storage, processing and reporting is high, and the maintenance and upgrade of the system is difficult. The calculation process is too complicated, and the above-mentioned shortcomings of the traditional Activity-Based Costing make the Activity-Based Costing low in adoption rate.

Kaplan, R. S. and Anderson, S. R. (2007) have improved ABC for this phenomenon and proposed a new concept of Time-Driven Activity-Based Costing. The investigation data and system update problems encountered in the implementation of the Activity-Based Costing in recent years have been explained in detail, and the reasons for these problems have been explained. At the same time, in response to these problems, an improved method - Time-Driven Activity-Based Costing is proposed. TDABC's invention does not need to obtain a large amount of data through survey interviews. It only needs two sets of parameters to calculate the product cost. That is, the time capacity that the resource can provide and the time of the work

consumed by each product. At the same time, because of the existence of time equations in TDABC, in the emergence of new products and operations, we no longer need to re-edit the entire model and assignments, only need to observe a new set of data and do a simple update. Then you can get accurate calculation results.

Process Problem Diagnosis and Improvement – TOC

The Theory of Constraints (TOC) was founded by Eliyahu M. Goldratt (1999). The meaning of TOC is to solve complex management problems in reality through the use of a set of simple logic deductions. On the surface, the more complicated and difficult the problem, the simpler the solution is. For enterprises, the main content of TOC is divided into two parts, one is where the enterprise should improve, and the other is how to better accomplish these improvements. TOC helps companies identify bottlenecks that constrain their development and take effective measures to improve the company's shortcomings to break through these bottlenecks and eliminate obstacles in the process of accomplishing corporate goals. As a system, the input and output of enterprises are divided according to stages or links. TOC believes that if there is a problem in the output of one link or several links in this system, this problem will also affect the next one or the next few outputs, which ultimately affects the capacity of the entire system and reduces production efficiency. This view is similar to the barrel effect, that is, the most critical factor affecting system output is the least productive link in the entire system. According to TOC, a series of tools have been developed to help companies more clearly understand their own measures and behaviors, and to know more clearly what factors in the business will have a favorable or adverse impact on the company's achievement of the goal. TOC points out the bottlenecks and constraints in the operation process for the company.

TOC provides several thought-technical tools for the improved process, helping to see the root of the problem and what the problem really needs to be solved at the time of the decision. TOC's technical tools include: Tools for describing causal relationships: Current Reality Tree, Future Reality Tree, negative effect branch diagram and transformation tree; tools for describing inevitability: Evaporating Cloud and the Prerequisite Tree.

CASE ANALYSIS

Case Company Profile

The case company was established in 1982 and is committed to residential construction. It has “construction 1”, “construction 2” and “leasing” departments. The construction division 1 has a number of construction companies, and it is stable to promote 3 to 5 cases every year. The total amount of the case is about NT\$4-6 billion. In addition to self-construction, it is also built with landlords in many places. With the joint efforts of more than 200 corporate colleagues, they have been adhering to the enterprise spirit of “sincere and practical” and have been doing sustainable service for 30 years. The three major business bodies - the construction business division 1, the construction business division 2, and the leasing business division are flourishing. Distributed in Xinzhuang, Taishan, Banqiao, Tucheng, Shulin, Taoyuan and other places, it has become a strong chain enterprise in the north of Dahanxi in New Taipei City. They are deeply immersed in the land, and they are constantly innovating in technology, seeking new changes, and striving for excellence. This is to provide high-quality related corporate services to the citizens, and hopes to promote the “quality of living space and the business vitality of real estate”.

In the operation of the company, it is inevitable to bear the risks. The various business bodies of the case company have encountered the test of the overall market and the environment. For example, when the construction department 1 develops land in the Greater Taipei area, it has already faced high land prices, and the urban area is increasingly difficult to obtain. The dilemma, coupled with the government's suppression of the housing market, is very obvious. The construction risks have increased a lot. Facing the fact that building materials, raw materials and wages have risen, the cost of construction has increased substantially, and the quality of construction has not been discounted. So construction profits have become less and less. Therefore, in the face of such adversity, the case company's founder and the cadres of the various departments have brainstormed, boldly innovated, and sought different solutions to open up another feasible way and continue to achieve success.

After a one-year strategic meeting discussion, the case company will move toward BIM to meet the new challenges brought about by the changes of the times. In particular, the case company's main business of construction has been operating for many years in the housing market where the bull market has ended. For sustainable operation BIM's business strategy must be adopted to meet the needs of the development of domestic smart buildings, green buildings, high-rise buildings and individualized buildings.

Description of the Case Company BIM Plan

Case company management problems

Case company management status: At present, the company's existing business adopts internal growth strategy. Safety, quality and service are the purpose of the case company's growth along the way, from the early low-rise bungalows to the high-rise buildings that are now on the 20th floor and above. The design is from the early brick structure, reinforced concrete structure to the steel reinforced concrete structure used in today's high-rise buildings. The construction technology and construction quality are constantly innovating and improving. Only by continuously improving and enhancing the market competitiveness can enterprises thrive. If they are not willing to launch new products to meet the needs of the public, they will soon be eliminated by the environment.

In the past, the case company established financial management, public works systems, personnel management, budget management and other systems. However, the lack of a unified information management platform, information feedback and analysis is not timely enough, information resources are not fully shared, cannot meet the needs of enterprise management information communication and sharing, resulting in information islands in various departments within the company. As the scale of business operations continues to expand, the need for information sharing and system integration is increasing.

The case company plans to use four years. With BIM as the core, the integrated BIM platform is used as the framework to solve the collaborative work of the organizational structure of the enterprise. Coordinate the management of various resources in the construction process (including labor, materials, equipment, time, funds, etc.) and the comprehensive planning, control, optimization and decision analysis of objectives (including schedule, quality, cost, safety, etc.) during the construction process, providing advanced and effective methods as the goal. Establish an integrated information resource management system of project life cycle management based on BIM to optimize the allocation of enterprise resources and enhance the core competitiveness of enterprises.

Important steps for the case company to import BIM

Below, we introduce BIM's BIM strategy establishment, business process reengineering, information integration, structure establishment and introduction of case-based reasoning case library from case company. These five aspects illustrate the transformation of case company.

(1) Establish a BIM strategy

Since this is the case company's first contact with BIM for the project, there is no experience in itself. In preparation for the BIM implementation, the case company has opened several BIM strategy meetings, inviting senior executives, external BIM consultants and experts to discuss BIM together. The implementation strategy of the future will establish an integrated dynamic BIM development strategy and name this project an integrated dynamic BIM information platform. The objectives of the integrated dynamic BIM development strategy are as follows: establish a BIM-centric collaborative platform to provide full-life cycle construction management to strengthen communication with project personnel, and directly connect with enterprise database, case library and component library to facilitate data management and facilitate project personnel can make full use of the company's database, case library and component library to improve project management efficiency and standards, improve the overall quality of the project, and form core competitiveness.

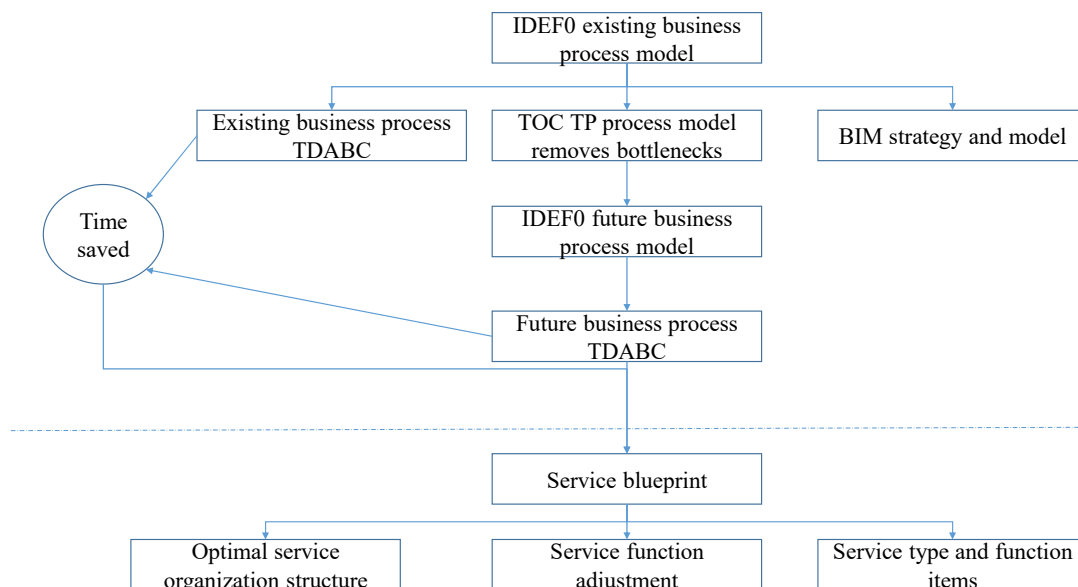
(2) Reengineering based on business processes of an integrated dynamic BIM information platform

The case company recruited several BIM process integration meetings, and successively interviewed the construction project department, the cooperation companies (owner, design, construction and supplier), the information department, and several representative construction project personnel. Understand the business and system requirements. And jointly discuss with the construction project department, the cooperation companies, the information room to discuss the existing and future operational processes of the integrated dynamic BIM information platform, the support of the current system and the inadequacies. Based on the integrated dynamic BIM development strategy established in the preceding paragraph, they will jointly develop the optimal operating procedures, functions and requirements in the future.

The case company project team first learned from the interviews about the current business processes of the construction project department, the cooperation companies, the information room, and the construction project-related units. Use IDEF0 to build existing business process models and use time-driven activity-based costing (TDABC) to analyze the time and labor required for existing business processes. Then use TDABC to analyze the working time and manpower required in the future business model, through the future work mode and the time and manpower that can be reduced. Then establish a service blueprint and adjust the organizational structure and service functions of the case company according to the service blueprint. The results obtained will be used in the next steps. The relationship between the models established in this step is shown in "Figure 2: business process analysis step diagram".

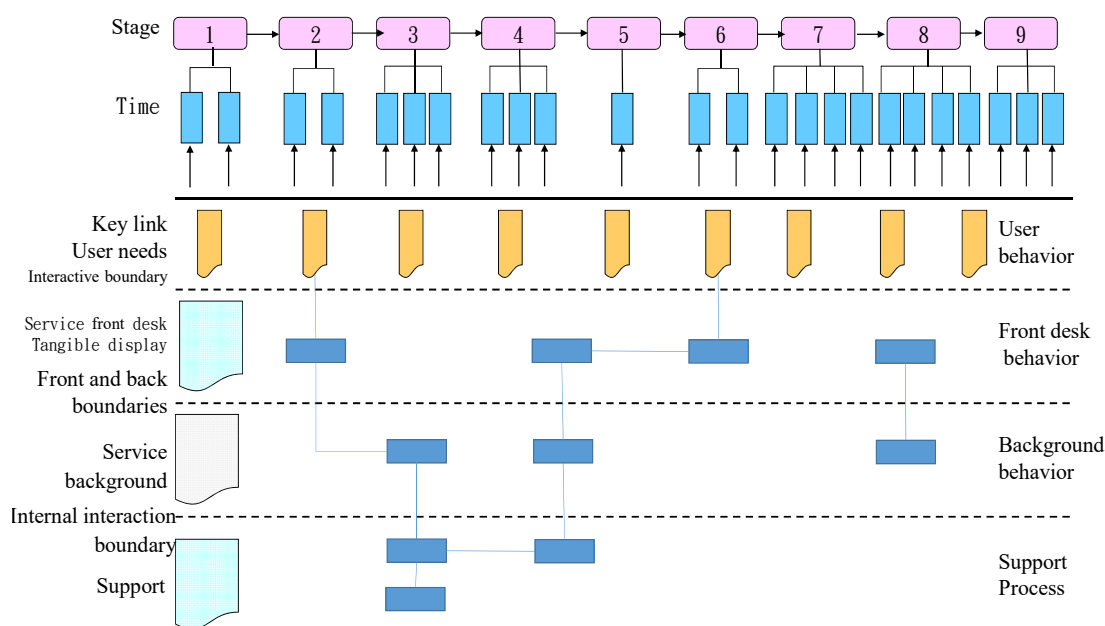
The service blueprint is a special and more practical system flow chart that stands in the user's position, describes the services required by users in each phase of each life cycle, and presents them in the form of a flowchart. The service blueprint is rooted in the user experience, enabling the service process to be displayed dynamically. Services are dynamic, experiential, and are usually generated immediately by users, personnel technology, and some static tangible material. The service blueprint has five components: User behavior, visible human behavior, invisible back-office personnel behavior, support behavior during service delivery, and tangible display during service, as shown in "Figure 3: business process analysis step diagram".

The service blueprint not only shows the entire service provision process of the dynamic construction project planning, execution, monitoring and user services, the front-end back-end and support work, but also shows the dynamic construction project planning, execution, monitoring and user service and user service contact process. Through the analysis of the service process, key points and overall service process, it can provide reference for the dynamic construction project planning, execution, monitoring and user services to improve the service experience.



Source: Case Company.

Figure 2 : business process analysis step diagram.



Source: Case Company.

Figure 3: service blueprint.

(3) Establish a data model that integrates BIM and the company's legacy systems

The case company established a unified data model of the integrated dynamic BIM information platform, and analyzed the data models of the current related systems one by one, including the content of the data, the relationship between the data, the data format and coding rules, and the unified data model was improved and revised. Establish coding rules for a unified data model. Analyze the core data and coding in the source system, and establish a mapping relationship with the information and coding of the unified data model. And analyze the interface, data interfacing content, interfacing way and timing between the future integrated dynamic BIM information platform and related data exchange systems.

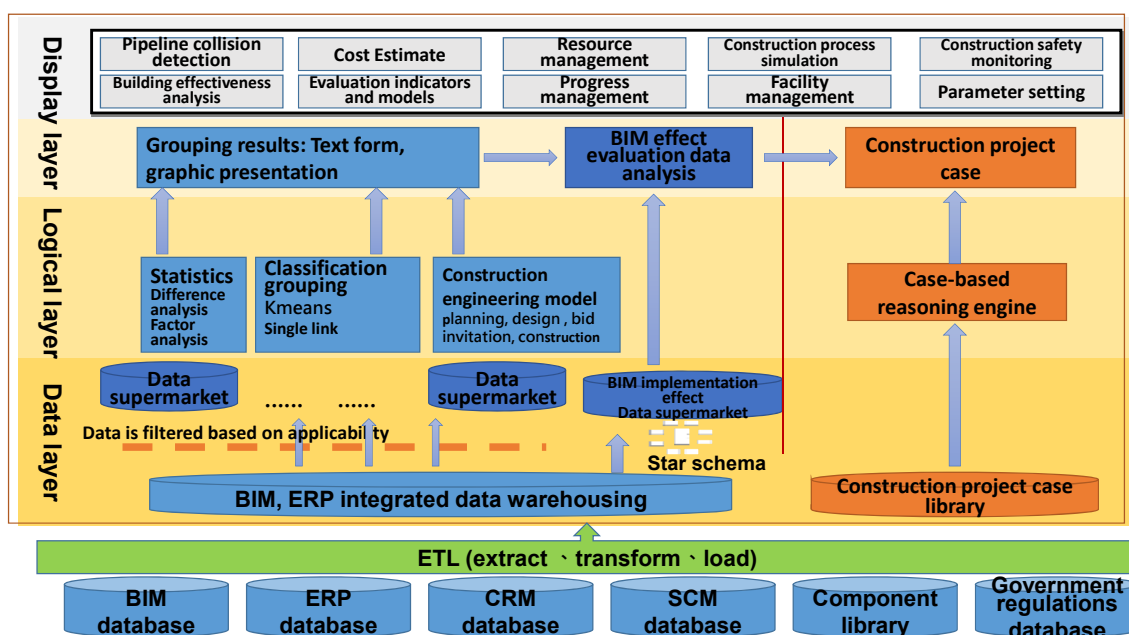
For the unified data model of the case company's integrated dynamic BIM information platform, it is first necessary to understand the correlation and data model of each related system, and to analyze the current situation of individual systems.

Due to the large number of systems to be analyzed and the different architectures and types, the main steps are to use software applications for reverse engineering: Including the user interface, functions, processes, system architecture, data structure, and mutual relationship of the current system. In order to avoid deviation from the design core during analysis, the analysis of the application software should be based on the system development file, and then analyze various processes according to the user operation mode, and finally return to the integration of the data stream, and clarify the exchange interface between systems.

The integrated data model is based on the BIM data model. By analyzing the data content involved in the BIM construction project decision-making process, various BIM construction project materials are integrated and stored in a unified format. According to the theme, through the professional model, the original data in different source databases are captured and aggregated to form a multi-dimensional perspective, which provides an integrated, unified and comprehensive data environment for decision-making analysis for case company construction project dynamic management.

(4) Plan, analyze and design the system architecture, functions and data flow of the future integrated dynamic BIM information platform.

The system architecture of the integrated dynamic BIM information platform is shown in “Figure 4: System architecture of the integrated dynamic BIM information platform”.



Source: Case Company.

Figure 4: System architecture of the integrated dynamic BIM information platform.

The platform data layer includes data from BIM, existing systems and a database of construction project cases. The logic layer includes statistical analysis, calculation and data exploration of data. The presentation layer contains system features. Among them, the design subsystem includes functions such as pipeline collision detection, building efficiency analysis, and cost estimation; the construction subsystem includes functions such as site management, resource management, schedule management, construction process simulation, and construction safety monitoring; the operation management subsystem includes facilities management, user management, space management, disaster prevention and other functions.

(5) Constructing a project component case library based on case-based reasoning

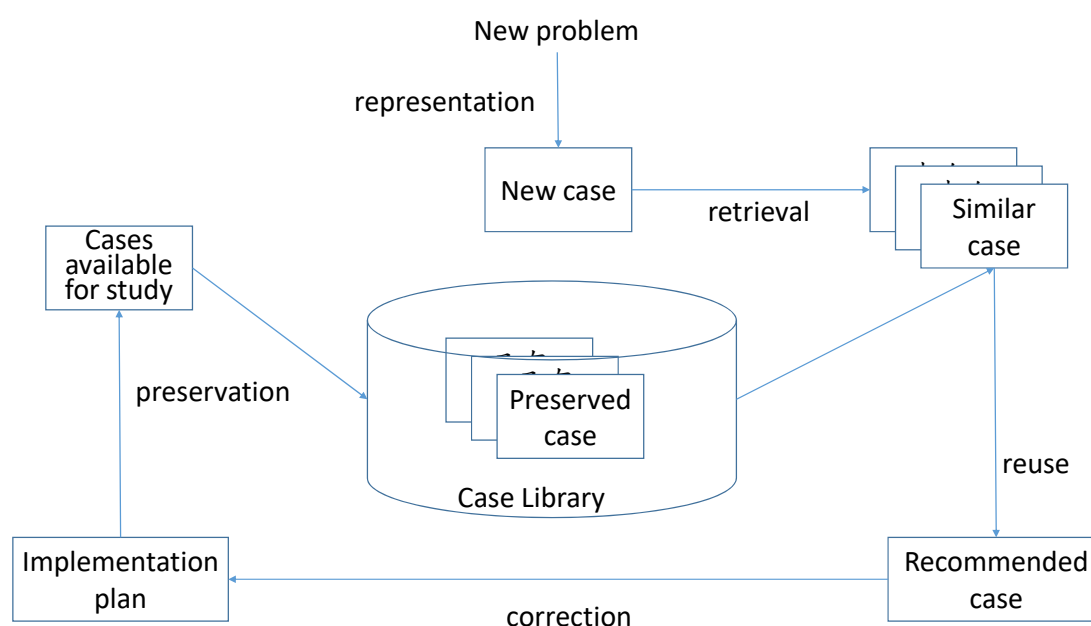
The case company also proposed the idea of the project component case library, stored the case classification of the construction project, and established a web-based construction project case database. Let the project company's construction project related personnel add various construction project cases to the database through the network, and continuously enrich the construction project case library to realize resource sharing. In the future, you can directly query the case or add cases through the network, learn from and draw lessons from the experience of construction projects in the past, and expand the case library.

To effectively and quickly extract solutions from past construction project components, case companies intend to use CBR methods that are self-learning, self-adjusting, and capable of applying tacit knowledge hidden in the case. The CBR method overcomes some shortcomings of the traditional expert system based on Rule-based Reasoning (RBR), such as difficulty in acquiring knowledge, system cannot self-learn, cannot solve new problems, etc. New problems and new components that frequently appear in construction projects can better apply existing component processing experience.

CBR is a relatively mature theory developed from the field of Artificial Intelligence (AI) (Michael, 2013). There are corresponding rules and standards for the structured representation of the case, database storage, case retrieval and matching, case adjustment, case correction and verification.

The design of the case library system mainly includes six aspects. The first five aspects are the operation procedures of the case library, namely: Case representation and organization, case retrieval, case reuse, case correction, case preservation and case library maintenance as shown in Figure 5. The sixth item is the system functional architecture design.

- (a) Representation of the case.
- (b) Retrieve the case most similar to the current problem from the case library.
- (c) Find a historical case where the solution is best suited to solve current problems from similar cases.
- (d) For the current problem, make appropriate corrections to the recommended solution to form the final recommended solution.
- (e) After the current problem is solved, it is determined whether it is preserved in the case library based on the decision on the similarity threshold.
- (f) Case library system architecture and functional planning.



Source: Case Company.

Figure 5: the main operational contents of the case library system.

CONCLUSION

After years of development, our country's construction companies are facing the harsh facts of low profits and fierce market competition. Due to the potential of BIM in terms of cost savings, improving efficiency, and enhancing competitiveness, etc., construction industry players are increasingly feeling that the widespread use of BIM has indeed brought many changes to the industry. In recent years, research on new IT adoption and enterprise transformation, etc. has always been an important issue in the field of management, and it has also received extensive attention from scholars. In order to accelerate the development of BIM, researchers have done a lot of research on the problems arising in the process of enterprise BIM adoption and transformation, and accumulated many results.

Based on this background and foundation, this research is based on the relevant theories and research literature on BIM and enterprise transformation. The introduction of BIM implementation transformation for case company, analyze from the five aspects of strategy, business process reengineering, information system integration, platform architecture and case library of case-based reasoning. The technologies that have contributed to the transformation of the case company include BIM in the field of architecture and CBR in the field of artificial intelligence. The methods used are BPR (Business Process Reengineering), TDABC (Time-Driven Activity Based Costing), TOC TP (Theory of Constraint, Thinking Process), DW (Data Warehouse), service blueprint, etc. The comprehensive application of these theories and methods helps the case enterprise transform.

We hope that the analysis of this paper can bring some reference to the construction industry engaged in transformation, and can provide some small help for the transformation of domestic construction enterprises.

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Research on Foreign Exchange Exposure of Enterprises in China: Taking Manufacturing Multinational Enterprises as an Example

(Full Paper)

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ABSTRACT

This study measures the exposure of sample corporates to the three types of foreign exchange and then determines factors affecting foreign exchange exposure through the cross-sectional regression model. The study finds: Firstly, the proportion of samples with significant foreign exchange exposure is about 50.79%, while the EUR exposure accounts for the highest proportion at 23.91%, and the USD exposure possess the lowest proportion at 10.08%; Secondly, the average of absolute value of USD exposure is the largest, suggesting that USD exchange rate fluctuations has a greater impact on the corporate values, compared to the EUR and the JPY. Finally, the corporate's scale is significantly positively correlated with the USD exposure, and the corporate's leverage level is significantly positively correlated with the EUR exposure.

Keywords: Manufacturing multinational enterprises, foreign exchange exposure, corporate characteristics.

INTRODUCTION

In recent years, China's foreign trade has achieved phenomenal growth. At the same time, as one of the important components of the national industry, China's manufacturing industry has also made great achievements and become a "world factory" that delivers products to the world. In 2016, the government launched the "Made in China 2025" program, which strengthened the determination to make China's manufacturing industry bigger and stronger and enhance its international competitiveness. Meanwhile, after years of development, the form of cross-border import has changed from personal act as purchasing agency to the standardization of cross-border shopping. With the application of artificial intelligence, VR and other manufacturing technologies, shopping experience and satisfaction of consumers will be further improved. With the promotion of "One Belt And One Road", new impetus will be injected into cross-border e-commerce. Therefore, with the frequent exchanges of international trade, manufacturing companies will inevitably be affected by exchange rate fluctuations.

With the implementation of the exchange reform in 2005, the unilateral exchange rate system between China and the United States has withdrawn from the historical arena and replaced by a managed floating exchange rate system. In 2016, the RMB was officially included in the SDR basket of currencies, which indicates that the RMB is becoming more international and market-oriented, and its exchange rate fluctuations will show a more obvious trend. As the dependence between China's economy and the external economy continues to rise, exchange rate fluctuations will cause listed companies engaged in foreign business to face huge foreign exchange exposure. The existence of foreign exchange exposure will affect the final profit of the enterprise through various factors such as cost and price. This is not conducive to the business development of the enterprise, but also causes a certain risk of evaporation of the stock market value of the enterprise. This was confirmed in the corporate survey report issued by the Ministry of Industry and Information Technology in 2010. Although during the 2008 financial crisis, as an emergency measure to stabilize the Chinese economy, China briefly restored the exchange rate system pegged to the USD, this only partially relieved the difficulties of enterprises under the financial crisis. With the gradual increase of the volatility of the RMB exchange rate, the import and export business of enterprises is still inevitably hit, and some enterprises have gone bankrupt because they cannot control the exchange rate risk in time.

Many scholars have previously noticed that the exchange rate fluctuation of the RMB against the USD will give enterprises a certain exposure to foreign exchange risk. Because the USD is the main pricing currency for commodities, its exchange rate fluctuations will have a certain impact on China's stock market by affecting the price of bulk commodities. However, the EUR and the JPY as international currencies not only have the characteristics of stable currency and economic stability of the issuing countries, but also one of the most common currencies in China's trade. Therefore, studying the exposure caused by the exchange rate changes between the EUR and the JPY also has certain research significance and value.

This paper empirically studies the foreign exchange exposure of Shanghai and Shenzhen A-share manufacturing multinationals due to changes in the three foreign exchange rates of the USD, the EUR and the JPY after the exchange rate reform in 2005, and make the In-depth exploration on factors that cause the exposure. Finally, based on the above research and analysis, the conclusion of this paper is drawn.

This paper will be divided into two parts. The first part reviews the theoretical analysis and empirical research on foreign exchange exposure, then uses Krapl's (2017) method to measure the exposure of Chinese manufacturing multinationals to the three foreign exchange currencies of the USD, the EUR and the JPY, and conduct relevant descriptive statistical analysis. The second part uses the significant exposure obtained in the first part to further discuss the influencing factors of foreign exchange exposure of manufacturing multinationals. Finally, the conclusions of this paper are given.

LITERATURE REVIEW

For the measurement of foreign exchange exposure, early research tends to use corporate financial indicators. However, due to the limitation of the company's information disclosure, some companies' financial indicator data cannot be easily obtained. In order to solve this difficulty, Adler and Dumas (1984) defined the foreign exchange exposure as the elasticity of the company's cash flow for exchange rate fluctuations, and took the "enterprise value is the discounted value of the company's future cash flow" as basic idea to use enterprise value replacing the present value of the company's future cash flow.

Based on the research results of Adler and Dumas (1984), Jorion (1990) introduced the market income factor and proposed the most widely used capital market model. After the introduction of Jorion's capital market model, scholars continued to use the model to conduct empirical tests using national data. Doukas *et al.* (1999) showed that 14.3% of Japanese companies have significant exchange rate risk exposures due to fluctuations in the USD exchange rate. Bartram (2004) found that 7.8% of non-financial companies in Germany have significant exchange rate risk exposures due to fluctuations in the USD exchange rate. Luo and Jiang (2007) used sample data of all listed companies in Shanghai and Shenzhen stock markets, and found that 17.8% of Chinese companies have significant foreign exchange exposure. Zhang (2013), based on the sample data of listed companies in Chinese energy industry, found that the sample of foreign exchange exposure was about 82%. Wang and Hu (2015) believed that among the Chinese manufacturing enterprises, the sample with significant foreign exchange exposure was about 11%.

However, the use of the traditional Jorion model to analyze foreign exchange exposure still has certain shortcomings. Bartram (2008) and Krapl (2017) have shown that although it is common practice to incorporate market yield control variables into the model, when the market yield factor exists in the model, the model measures only the exposure relating to the market index. Based on the comprehensiveness of the research, Krapl (2017) proposed a new measurement model of foreign exchange exposure including short-term interest rates and maturity spreads based on the original capital market model.

In addition, according to the results of Allayannis and Ofek (2001) with Li (2013), the exposure factors affecting foreign exchange risk can be roughly divided into the following three types: financial value preservation factors, operational preservation factors and corporate financial indicators.

Among them, financial value preservation mainly refers to the use of hedging instruments such as forward settlement and sale of foreign exchange to reduce the exposure of foreign exchange risk faced by enterprises. Li (2013) showed that the use of financial derivatives can reduce corporate exposure to foreign exchange risk. Gu and Deng (2007) believed that the fair use of futures and options can substantially eliminate the foreign exchange exposure of foreign-invested enterprises. Therefore, this paper hereby anticipates that foreign exchange exposure is inversely related to the use of corporate financial derivatives.

Operational preservation mainly refers to that enterprises can improve the company's operating level through strategic planning, thereby eliminating the long-term foreign exchange exposure faced by enterprises. This kind of strategic planning is mainly reflected in the overseas transfer of business operations. If the number of countries in which the company operates is more, the foreign exchange exposure will often be reduced or eliminated due to the inconsistency in the direction of currency exchange rate fluctuations in these countries. Pantzalis *et al.* (2001) used the number of countries in which overseas branches of enterprises exist in empirical research, and found that the more countries in which overseas branches are located, the smaller the foreign exchange exposure of enterprises. On the other hand, the overseas sales income ratio will also affect the size of foreign exchange exposure to a certain extent. Jorion (1990) showed that the company's foreign exchange exposure had a positive correlation with the company's export ratio, indicating Companies with higher export ratios tend to have greater exposure to foreign exchange. Therefore, this paper hereby makes an expectation: the foreign exchange exposure is positively correlated with the proportion of foreign sales, and negatively correlated with the number of countries or regions where the overseas branches of the enterprise are located.

In the choice of financial indicators of enterprises, Nance *et al.* (2008) showed that large enterprises often benefit from hedging foreign exchange risks due to economies of scale. However, large companies could also better acquire knowledge about risk management, so large companies were more likely to hedge foreign exchange risk. Similar ideas are able to apply to growth opportunities, liquidity and leverage. According to the optimal hedging theory, those growth-oriented companies were more likely to hedge foreign exchange risk to alleviate the problem of insufficient investment faced by enterprises. He and Ng (1998) showed that companies with low liquidity and high leverage had more incentives to hedge foreign exchange risk.

SAMPLE SELECTION, VARIABLE DEFINITION, AND MODEL SETTING

China started to implement a managed floating exchange rate system based on market supply and demand with reference to a basket of currencies in July 2005, making the RMB exchange rate mechanism more flexible. Therefore, this paper chose the

monthly data of RMB exchange rate from August 2005 to December 2017. As for the choice of foreign exchange currency, we choose three currencies, namely USD, EUR and JPY, because these three currencies are the world's major currencies and are frequently used in China's foreign trade activities.

The empirical research object selected in this paper is the multinational manufacturing enterprises listed in Shanghai and Shenzhen a-shares. Generally speaking, the sample enterprises should first meet the following three characteristics: Having international business; Belonging to manufacturing enterprises; Mainboard and small and medium enterprise board are listed. We take listed companies that meet the above three characteristics as the initial samples. On this basis, in order to ensure the integrity and continuity of data, we will further eliminate those enterprises that meet the following conditions: Suspension for more than half a year due to non-reform; the listing date was later than the sample start date of August 2005.

The data collected showed that a total of 507 listed companies met the above selection criteria at the same time. The data of sample enterprise information and related indicators are collected from the RESSET database, WIND database and BVD -- Osiris database.

Although there are a lot of literature with traditional Jorion model to analyze the foreign exchange exposure, but Krapl (2017) argue that, although the market yields control variables included in the model is a very common practice, but when the model yield factors exist in the market, the model is measured by the portion of the exposure associated with the market index. Therefore, Krapl (2017) proposed the foreign exchange exposure measurement model including short-term interest rate and term spread, as shown in Equation (1):

$$R_{i,t} = \alpha_{i,t} + \delta_i^D R_{x,t}^D + \delta_i^E R_{x,t}^E + \phi_{1,i} R_{ST,t} + \phi_{2,i} R_{DS,t} + \varepsilon_{it} \quad (1)$$

Among them, the $R_{i,t}$ as the stock yield, $R_{x,t}^D$ and $R_{x,t}^E$ for two kinds of exchange rate yield, $R_{DS,t}$ is a short-term interest rate control variables, $R_{DS,t}$ for the term spreads control variables.

This paper follows the model of Krapl (2017) and adopts the RMB exchange rate against the USD, EUR and JPY to establish the model as shown in Equation (2):

$$R_{i,t} = \alpha_{i,t} + \delta_i^U R_{x,t}^U + \delta_i^E R_{x,t}^E + \delta_i^Y R_{x,t}^Y + \phi_{1,i} R_{ST,t} + \phi_{2,i} R_{DS,t} + \varepsilon_{it} \quad (2)$$

The description of variables in the foreign exchange exposure measurement model described in Equation (2) is shown in Table 1.

Table 1: Explanation for Variables Used to Estimate Exposure

Variables	Explanation
$R_{i,t}$	The monthly return on the stocks of the sample enterprise i in the period t
$\alpha_{i,t}$	Constant term
$R_{x,t}^U$	The monthly rate of return of the RMB to the USD (the intermediate rate) under the direct quotation method of the period t
δ_i^U	The regression coefficient of USD yield, namely the foreign exchange exposure of sample enterprise i (USD)
$R_{x,t}^E$	The monthly rate of return of the RMB to the EUR (the intermediate rate) under the direct quotation method of the period t
δ_i^E	The regression coefficient of EUR yield, namely the foreign exchange exposure of sample enterprise i (EUR)
$R_{x,t}^Y$	The monthly rate of return of the RMB to the JPY (the intermediate rate) under the direct quotation method of the period t
δ_i^Y	The regression coefficient of JPY yield, namely the foreign exchange exposure of sample enterprise i (JPY)
$R_{ST,t}$	The control variable of short-term interest rate in t period is the one-year Treasury bond rate
$\phi_{1,i}$	The regression coefficient of the control variable of short-term interest rate
$R_{DS,t}$	The time spread control variable of t period is used for one-year and 15-year Treasury bond rates
$\phi_{2,i}$	The regression coefficient of the term spread control variable
ε_{it}	Residual item

In this paper, according to the practices of most previous literatures, the calculation methods of the monthly return rate of a single stock and the monthly return rate of exchange rate are all based on the first-order logarithmic difference of the monthly closing price. As for the calculation of short-term interest rate and term spread, this paper adopts the method of Bartram (2008) and Krapl (2017) to calculate the formula as shown in Equations (3) and (4) :

$$R_{ST} = \Delta SR / (1 + LR) \quad (3)$$

$$R_{DS} = \Delta(LR - SR) / (1 + LR) \quad (4)$$

Among them, Δ represents the difference between the current and previous values. SR is short-term interest rates, LR is long-term interest rates.

Next, this article will use the three groups of corresponding significant exposure of foreign exchange obtained by Equation (2), further reveals the affecting factors of enterprise foreign exchange exposure. Combined with the views of Li (2013) and Krapl (2017), the following variables are selected in the cross-sectional regression model:

The size of enterprise (S_i). The size of the company is represented by the total market value of the company's stock. The data is derived from the 2013-2016 annual report, and the average value of the four-year data is taken. Because this data value is large, it is processed logarithmically.

Enterprise's existing growth opportunities (M_i). The current growth opportunity of enterprise I is represented by the book value ratio. The data is from the 2013-2016 annual report, and the average value of the data is obtained in 4 years.

Liquidity of enterprise (L_i). The liquidity of enterprise is represented by the quick ratio, which is derived from the 2013-2016 annual report, and takes the average of 4 years of data.

The level of leverage for enterprise (Lv_i). The liquidity size of enterprise I is represented by the long-term debt ratio. The data is derived from the 2013-2016 annual report, and the average value of the data is taken for 4 years.

The export ratio of enterprise (FS_i). The ratio of overseas business revenue to the total business revenue of the company is expressed as the ratio of overseas business revenue to the total business revenue of the company. The data is from the 2013-2016 annual report, and the average of the data is taken for 4 years. The specific formula is as follows.

The number of countries or regions in which the overseas subsidiaries of enterprise are located (B_i). Refers to the number of countries or regions in which the parent company's overseas subsidiaries are located.

The use of financial derivatives to hedge foreign exchange risk (D_i). This refers to whether an enterprise uses financial derivatives such as forward trading to avoid foreign exchange risks during 2013-2016. If the enterprise carried out such business, it takes 1 for D_i ; if it does not, it takes 0 for D_i .

A control variable of the manufacturing sub-industry to which enterprise belongs Ind_j . This is expressed as a dummy variable.

All the above data are from the CSMAR database, the RESSET database, the annual report released by the China Central Depository & Clearing Co., Ltd. and enterprises.

Therefore, based on the above views and ideas, the following cross-section regression model is proposed in this paper:

$$\delta_i = \alpha + \beta_1 S_i + \beta_2 M_i + \beta_3 L_i + \beta_4 Lv_i + \beta_5 FS_i + \beta_6 B_i + \beta_7 D_i + \beta_j \sum_{j=1}^n Ind_j + \varepsilon \quad (5)$$

EMPIRICAL RESULTS

In this chapter, we will expand into two parts. First, in the first section, we will use the foreign exchange exposure measurement model to measure the exposure of each currency and conduct relevant descriptive statistics. Then, in the second section, we will use the foreign exchange exposure obtained in the first part to establish a cross-sectional regression model and conduct relevant descriptive statistical analysis of its influencing factors.

4.1 Descriptive Statistics of the Foreign Exchange Rate Exposure Measurement Model

For the dependent variables and major independent variables involved in the measurement of foreign exchange rate exposure, such as sample enterprise stock yield and the return of currency, their descriptive statistical results are shown in Table 2. There is no unit root of the variable data used in the model, and all variable sequences are stable sequences.

Table 2 reports the descriptive statistical results for the following variables in the exposure measurement model: Stock yield ($R_{i,t}$), inflation-adjusted monthly returns of three kinds of currency ($R_{x,t}^U$, $R_{x,t}^E$, $R_{x,t}^Y$), short-term interest rate ($R_{ST,t}$) and term-spread variables ($R_{DS,t}$).

Table 2: Summary Statistics

Variable	Quantile			Median	Standard Deviation	Skewness	Kurtosis
	P25	mean	P75				
$R_{i,t}$	-6.820%	0.880%	9.350%	0.880%	15.878%	-0.533	6.975
$R_{x,t}^U$	-0.400%	-0.150%	0.010%	-0.160%	0.587%	1.243	6.545
$R_{x,t}^E$	-1.440%	-0.160%	1.360%	0.000%	2.261%	-0.393	1.211
$R_{x,t}^Y$	-1.810%	-0.160%	1.450%	-0.120%	2.436%	-0.073	0.520
$R_{ST,t}$	-1.830%	0.001	2.650%	0.005	0.055	-0.586	4.236
$R_{DS,t}$	2.760%	-0.001	2.220%	-0.003	0.051	0.345	4.482

Table 2 results show that average stock return of samples is 0.88%, which means the enterprise value of sample is on the rise during the period of statistics. At the same time, we find that the standard deviation of the stock return of the sample is 15.878%, indicating that the overall stock price of the sample in the manufacturing industry fluctuated greatly during this period. In addition, the skewness of the return of USD is greater than 0, indicating that in the USD fluctuations, large positive fluctuations (appreciation) occur more frequently than large negative fluctuations (depreciation). However, the standard deviation of the return of USD is relatively small compared with the EUR and JPY indicating that the return of USD is relatively stable. In addition, we can find that the skewness of the return of EUR and JPY is -0.393 and -0.073, both of which are less than 0, indicating that large negative fluctuations (depreciation) occur more frequently than large positive fluctuations (appreciation) in the returns of EUR and JPY. The average return of USD is -0.15%, the average return rate of EUR is -0.16%, and the average return rate of JPY is -0.16%, indicating that the average return level of these three currencies is relatively close during the statistical period.

In addition, we also carry out Pearson correlation analysis for five independent variables in the model and use the Variance Inflation Factor (VIF) indicator to detect the multicollinearity between the model independent variables. Table 3 is divided into two parts. The first part describes the degree of correlation between variables by showing the correlation coefficient. The second part explains the multicollinearity size in the model by showing the VIF index.

Table 3: Statistical Analysis Results between Variables

Panel A: Correlation coefficients: currency returns and interest rate control variables					
	$R_{x,t}^U$	$R_{x,t}^E$	$R_{x,t}^Y$	$R_{ST,t}$	$R_{DS,t}$
$R_{x,t}^U$	1	-0.007	0.109	-0.021	0.000
$R_{x,t}^E$		1	0.199**	-0.074	0.218***
$R_{x,t}^Y$			1	-0.172**	0.047
$R_{ST,t}$				1	-0.791***
$R_{DS,t}$					1
Panel B: The VIF indicator between the independent variables					
	$R_{x,t}^U$	$R_{x,t}^E$	$R_{x,t}^Y$	$R_{ST,t}$	
$R_{x,t}^E$	1.145				
$R_{x,t}^Y$	1.118	1.054			
$R_{ST,t}$	2.945	2.805	2.668		
$R_{DS,t}$	2.995	2.728	2.668	1.000	

It can be seen from the Panel A that the correlation coefficient of the five variables does not exceed 0.3 except that the correlation coefficient between the short-term interest rate variable and the term spread variable is 0.791.

According to the general opinion of Gao (2000), when the VIF index is no less than 10, the multicollinearity problem between independent variables may be serious, and may have an important influence on the estimation value under the least square method. In our test results showing in Panel B, the VIF results between all independent variables are far less than 10, so it can be considered that there is no serious multicollinearity problem in the regression model.

Using the model shown in Equation (2) and the collected sample data, this paper respectively measured the foreign exchange exposure of the sample enterprises to the three currencies of USD, EUR and JPY. Table 4 reports the overall descriptive statistics of the three foreign exchange exposures.

Table 4: The Overall Descriptive Statistics

	Number	Mean	Minimum	Quantile			Maximum
				P25	Median	P75	
FX exposures	257	-0.472	-7.51	-1.306	-0.760	1.209	11.52

According to the results shown in Table 4, the average value of foreign exchange exposure of all sample is -0.472, which indicates

that when the average return of foreign exchange rate is positive (foreign currency appreciation and local currency depreciation), there is a negative impact on the stock prices of Chinese manufacturing enterprises.

Then, we conduct descriptive statistics on the three types foreign exchange exposure, and the results are shown in the Panel A and B of Table 5. Panel A classifies the foreign exchange exposure according to the different foreign exchange currencies, and reports the number and proportion of samples corresponding to each foreign exchange exposure, while Panel B conducts a descriptive statistical analysis of each foreign exchange exposure.

Table 5: The Overall Descriptive Statistics

Panel A: Statistical significance of three types of exposures						
Significant level	δ_i^U		δ_i^E		δ_i^Y	
	Number	Proportion	Number	Proportion	Number	Proportion
Sig.10	23	4.55%	43	8.50%	36	7.31%
Sig.05	19	3.75%	59	11.86%	37	7.51%
Sig.01	9	1.78%	18	3.56%	10	1.98%
Total	51	10.08%	121	23.91%	85	16.80%

Panel B: Summary statistics for three types of exposures				
	δ_i^U	δ_i^E	δ_i^Y	
Number	51	121	83	
Mean	-3.623	1.201	-1.009	
Median	-4.120	1.210	-1.064	
P25	-4.806	1.061	-1.254	
P75	-3.525	1.441	-0.908	
Maximum	11.52	2.48	1.05	
Minimum	-7.51	-1.14	-1.77	
Mean of absolute value	4.50	1.28	1.10	
The maximum of the absolute value	11.52	2.48	1.77	

The results presented in Panel A show that, on the whole, the proportion of samples with significant foreign exchange exposure is about 50.79%. Among them, EUR foreign exchange exposure accounted for the highest at 23.91% indicating that among Chinese manufacturing enterprises, those affected by EUR are the most. It was followed by JPY exposure at 16.80%, while USD foreign exchange exposure was the lowest at 10.08%. The above conclusions are in line with Li (2013) that the foreign exchange exposure of USD, EUR and JPY are roughly equal to each other.

According to the results shown in Panel B, the average foreign exchange exposure of USD and JPY was negative in all the significant foreign exchange exposure of the sample enterprises, indicating that the appreciation of USD and JPY against RMB would have a negative impact on the stock price for these enterprises as a whole. The average foreign exchange exposure of EUR (1.441) is positive, suggesting that for these companies as a whole, the appreciation in the EUR against the RMB would have a positive impact on share prices.

In terms of the absolute value of foreign exchange exposure, the USD has the largest exposure, at 11.52, followed by the EUR at 2.48 and then the JPY at 1.77. Among them, the average value of the absolute USD exposure is about 3.52 times of the EUR and 4.09 times of the JPY, indicating that among the three foreign currencies, the fluctuation of the USD exchange rate has the biggest impact on the stock prices of listed companies in the manufacturing industry.

4.2 Descriptive Statistics of The Exposure Factor Variables

The following is a detailed description of the factor analysis results of the three foreign exchange exposures of USD, EUR and JPY. Table 6 reports the results of a descriptive analysis, which is conducted on the mean value of the influencing factor variables of the three data sets.

Table 6: The Mean Value of Three Types of Foreign exchange exposure Factors

	δ_i^U	δ_i^E	δ_i^Y
S_i	15.869	15.893	16.108
M_i	1.080	1.132	1.103
L_i	1.250	1.255	1.268
Lv_i	0.162	0.168	0.188
FS_i	0.470	0.456	1.095
B_i	0.870	0.953	1.441

From the results shown in Table 6, we can see that the influencing factors of the three types of foreign exchange exposure groups have the following characteristics in the following aspects:

The enterprise scale. The average size of the three groups is similar, among which the size of the JPY group is relatively large, which is 16.108, followed by the EUR group is 15.893, and the size of the USD group is relatively small, which is 15.869.

Business growth opportunities. In terms of enterprise growth opportunities, the book value of the USD group which was 1.080, was relatively small compared with the average value of the other two groups, indicating that there were more high-growth companies in the USD group.

Enterprise liquidity. In terms of corporate liquidity, the average liquidity of the three groups is similar, among which the companies with the JPY group have relatively higher liquidity, whose quick ratio is 1.268.

Corporate leverage. The average level of leverage of the three groups is close, among which the companies of the JPY group have higher leverage, whose average long-term debt ratio is 0.188, while the USD group have lower leverage, whose average long-term debt ratio is 0.162.

Enterprise export ratio. In terms of the export ratio, the USD group and the EUR group have a similar export ratio of 0.470 and 0.456 respectively, while the JPY group had a significantly higher export ratio than the other two groups, which was 1.095.

Distribution of overseas subsidiaries. In terms of the number of foreign subsidiaries, the subsidiaries of companies with the JPY group are more dispersed on average, with 1.441, the EUR group is followed by 0.953, while the foreign subsidiaries of companies with USD group are relatively more concentrated, with 0.870.

The following is a regression analysis of three groups of factors affecting foreign exchange exposure. Table 7 reports the regression coefficients of the three groups and the relevant VIF indicators.

Table 7: Determinants of Foreign Exchange Exposure

	δ_i^U		δ_i^E		δ_i^Y	
	coefficient	VIF	coefficient	VIF	coefficient	VIF
S_i	1.037*	2.728	0.037	1.723	-0.002	1.720
M_i	0.260	3.457	0.027	1.847	-0.085	2.498
L_i	0.215	2.240	0.035	1.633	-0.019	1.634
Lv_i	-2.208	2.760	0.502*	1.636	0.069	1.647
FS_i	1.856	2.013	0.125	1.431	-0.077	1.721
B_i	-0.288	2.452	-0.025	1.782	0.004	2.073
D_i	-0.061	1.431	0.118	1.626	-0.052	1.840
Industry control	Yes		Yes		Yes	
Observations	51		121		83	

According to the results shown in Table 7, there is a significant positive correlation between company size and USD exposure. It suggests that the larger the company is, the higher the corporate dollar risk exposure is, which seems to contradict the traditional view offered by Nance *et al.* (1993) that large companies tend to benefit from the hedging of foreign exchange risk due to economies of scale. However, in the study by Gu (2012), we find a similar conclusion that companies with high leverage do not have lower foreign exchange exposure. According to the opinions of Gu (2012), the possible explanation for this phenomenon is that on the one hand, large enterprises are engaged in relatively more foreign trade activities; on the other hand, since China has not established a relatively mature and sound exchange rate hedging market mechanism, they will inevitably have greater foreign exchange exposure. By contrast, for companies in countries with relatively mature financial markets, as they can conduct trading operations in relevant exchange rate hedging markets, large companies are often able to reduce their foreign exchange exposure by their economies of scale. As Krapl (2017) has concluded, there is a significant negative correlation between the size and foreign exchange exposure of multinational listed companies in the United States.

Next, we will analyze the factors affecting EUR exposure. According to the results shown in Table 7, corporate leverage level and EUR exposure shows a significant positive correlation, indicating that the higher corporate leverage level is, the higher corporate EUR exposure is. This seems to contradict the conventional opinion offered by He and Ng (1998) that companies with high levels of leverage have more incentives to hedge foreign exchange risks. However, in the study by Gu (2012), we find a similar conclusion that companies with high leverage do not have lower foreign exchange exposure. According to Wang (2005) and Gu (2012), the possible explanation for this phenomenon is that when Chinese enterprises conduct financing, foreign debt is often favored by enterprises due to the features of large financing amount and long-term use, although foreign debt carries some foreign exchange risk. For companies with high levels of leverage in the EUR group, they may have large foreign exchange exposure because of their high levels of external debt.

Then, we analyze the impact factors of JPY exposure, and the results are shown in Table 7. According to the results shown in Table 7, we find that the regression coefficients of all the seven types of explanatory factor variables in the model are not significant at the level of 10%, indicating that the seven factors provided by the model had no significant impact on the JPY exposure of enterprises.

CONCLUSION

Through the foreign exchange exposure measurement model proposed by Krapl (2017), this paper conducts an empirical analysis of Chinese manufacturing multinational enterprises. The analysis shows that among the 507 sample companies, 257 companies have significant foreign exchange exposure. The impact of exchange rate fluctuations in different foreign exchange currencies on corporate value is also different.

In the descriptive statistics of all significant foreign exchange exposures, it is found that at the 10% level of significance, the proportion of samples with significant foreign exchange exposure is approximately 50.79%. In addition, the average value of foreign exchange exposure of all sample companies is -0.76, indicating that the average rate of return on foreign exchange rates is positive (foreign currency appreciation, local currency depreciation), which adversely affects the stock price of listed companies in China's manufacturing industry.

In descriptive statistics on foreign exchange exposures that distinguish foreign exchange types, it is found that the proportion of companies with exposure to EUR foreign exchange risk is the highest, at 23.91%, indicating that among Chinese manufacturing companies, the companies affected by the EUR were the most. Moreover, the proportion of companies with exposure to the JPY is 16.80%, while the proportion of companies with USD foreign exchange exposure is the lowest, at 10.08%.

In the significant foreign exchange exposure of all sample companies, the average foreign exchange exposures of the USD and the Japanese yen (-3.623 and -1.09) are negative, indicating that the appreciation of the USD and the Japanese yen relative to the RMB for these enterprises will adversely affect the market price. The EUR's average foreign exchange exposure (1.441) is positive, indicating that for these companies as a whole, the appreciation of the EUR relative to the renminbi will have a positive impact on the stock price.

From the absolute value of foreign exchange exposure, the dollar risk exposure is the largest at 11.52, following by the EUR risk exposure at 2.48 and the yen risk exposure at 1.77. Among them, the average value of the absolute value of the USD risk exposure is about 3.52 times that of the EUR and 4.09 times of the yen. This indicates that among the three kinds of foreign exchange, the fluctuation of the USD exchange rate has the biggest impact on the stock price of listed companies in the manufacturing industry. The impact of exchange rate fluctuations on the stock price of listed companies in manufacturing is minimal.

In the analysis of foreign exchange exposure factors, it is found that the company size and the dollar risk exposure showed a significant positive correlation, which is contrary to expectations, indicating that the larger the company size, the higher the corporate dollar foreign exchange exposure. Possible explanations for this phenomenon are that large enterprises are inevitably having greater foreign exchange risk because they are engaged in relatively large foreign trade activities on the one hand, and China has not yet established a relatively mature and sound exchange rate hedging market mechanism.

In addition, it is also found that the company's leverage level and the EUR risk exposure showed a significant positive correlation, which is contrary to expectations, indicating that the greater the company's leverage level, the higher the corporate risk exposure. A possible explanation for this phenomenon is that for companies with high leverage levels in the EUR risk exposure group, they may have a large foreign exchange exposure because of the higher level of external debt. Correspondingly, manufacturing multinationals with exposure to the EUR can also reduce the company's own foreign exchange exposure by appropriately reducing the company's leverage.

ACKNOWLEDGMENT

This work is partially sponsored by grant 14BGL186 of National Planning Office of Philosophy and Social Science, grant SC13A007 of Sichuan Philosophy and Social Science Planning Key Projects of China and grant XZX18011 of Project of Basic Scientific Research Operation of Central University of Southwestern University of Finance and Economics.

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Research on the improvement of ERP implementation in purchasing departments from the perspective of internal control

(Full Paper)

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ABSTRACT

With the wide applications and development of information technology and network technology, focusing on the background of ERP (enterprise resource planning) systems and people's reliance on both information system and accounting information systems, as important parts of ERP, plays a vital role in the management of enterprises. However, due to the continuous introduction of new innovations in the ERP system, enterprises continue to improve their competitiveness and management levels. When advanced ERP management can be practically implemented in the system, it will inevitably present difficult internal control measures, network environmental risks and many other problems. Then how to build the internal control system to ensure that enterprises in the pursuit of ERP information systems, simultaneously better serve the enterprise's own internal controls and management, and minimize the internal control and design defects. In addition to the system controls, in order to better conduct internal controls, one must deeply investigate the business processes, using necessary informational means, and constantly change their own architecture and business process reengineering (BPR), in order to technically improve the internal governance structure. Thus, the corresponding internal controls will include the system-oriented controls and the various business, personnel, and departments' overall grasp of the change. This encourages enterprises to seek reasonable ways, methods and ideas for continuous innovation. We should actively address and adjust the challenges brought by the internal control system of the accounting information system under the ERP environment, and make full use of ERP technology and BPR to realize the internal control norms of enterprises.

Keywords: Internal control, ERP implementation, business process reengineering, improvement.

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INTRODUCTION

In 1977, the International Association of Internal Auditors (Institute of Internal Auditors, abbreviation IIA), published the system auditable and controls (Systems assurance and control, referred to as SAC) report, As the first report combining the concept of internal control and ERP, it stated that information system development, may bring related risks to the enterprise, and the internal controls and development of information systems are closely related. In recent years, research on the relationship between accounting information systems and internal control, including: Ningjiawa (2010), John Morris (2011), Alexandra Kanellou, Charalambosspathis (2013) and Aiven (2008) show that ERP positively influences accounting information and practice and the effectiveness of internal controls. It is necessary to complement and develop the traditional internal control framework.

From the perspective of the impacts of ERP accounting information systems on internal controls: Qin Zhigang (2004) analyzed all aspects of the five elements of the impact analysis, and concluded that accounting information makes the enterprise internal controls over the scope, technology, and functions (Zhangyongfang 2008, Aiven 2008) change, thereby leading to the formation of accounting information with new characteristics. However, things usually have two sides, (Tri Ting 2011, Aiven 2008) also believe that accounting information will inevitably bring challenges to the original states of enterprises, For example, the existence of the form of expansion will increase the security risk of data, but also the organization of the enterprise to improve the structure of the higher level of the requirements.

From the aspect of the improvement of the ERP system and internal controls, is the results are mainly divided into the process improvements and overall improvements. In terms of process improvement, Tomas H. Davenport (1993), Xia Yong (2008), Chaoxiaoli (2016), Tri Ting (2011) All think that the use of information technology for business process reengineering, more satisfied with the ERP environment to establish an enterprise internal control framework requirements, ERP implementation and enterprise process reengineering has the role of mutual promotion, in this specific operation, the design of the minimum inventory early warning value (Gao Yingfo 2018), the Business Process Control points (Linjian 2011), and the procurement budget critical Control points (Chaoxiaoli 2016) are used to conduct corresponding studies of the specific internal control issues at the operational level. At the overall level, including the internal control environment (Robert N. Anthony 2010) Lăcrămioara-rodicăhurloiu, elenaBurtea, bianca-florentinapreda (2014), Internal control supervision and evaluation (Zhangyongfang 2008)), external audit

mechanism (Tong Zhang 2018), middle and high level ERP concept (Steven Scott Phillips 2012), technical safety and data security (Liu Weidong 2014, Zhou Yi 2018).

In a comprehensive analysis, most scholars have not studied this aspect deeply enough, and the relationship between theory and practice still needs to be improved, Sun Li (2015) proposed countermeasures to achieve effective internal controls based on the simple theory of the firm; Lu Yan (2017) studied and analyzed the issue without going into the business module; Huangjianfang (2017) introduced the ERP system implementation process stage, but this research also lacks a typical case study and analysis. Thus, along with the informationization degree unceasing enhancement, draws lessons from the Overseas Mature Experience Foundation, with our country enterprise's concrete situation unifies, the establishment of a targeted internal control system is still one of the developmental directions in the field of internal controls in China, and it also highlights the value of this study.

THE RELEVANT THEORY

Internal Control Theory

Internal controls, refer to the mechanisms that ensure the safety, integrity of and reliability property, and accounting information, improve business management, improve economic efficiency, and ensure the company's economic development. To ensure the normal conduct of the company's economic activities, the company takes a series of necessary management measures with respect to the internal management control system, in order to address the fierce external competition and internal management needs for the purpose of strengthening its continuous development. The COSO Committee issued the internal control program document called the COSO Report, which established the overall framework of internal controls and outlined, the five elements of internal control, including the control environment, risk assessment, control activities, information and communications, and monitoring, along with another five interrelated elements. Later, the modern internal control theory, represented by COSO, divides internal control into internal environment, goal setting, item identification, risk assessment, risk response, control activity, information and communication, monitoring eight elements, and further increases internal control to risk level. Later, but for China, the Ministry of Finance's "internal control basic norms" in the form of reference to the COSO report five elements framework, but also reflected in the content of the risk management eight elements of the essence of the framework.

ERP Information System Theory

The ERP (Enterprise Resource Planning Enterprise Resource plan), was first proposed by the Gartner Group Inc, a consulting firm in the United States. It aimed at optimizing the enterprise's material resources management, human resource management, financial resources management, and information resource management of the integrated enterprise management software. The core idea is to maximize the enterprise's upstream and downstream resources based on the effective management of the system. The 1990s, relying on computer technology, enterprises to continuously improve the external environment adaptability and comprehensive competitiveness, strengthen the enterprise supply chain management, but also how to gradually develop the enterprise internal resources overall planning to become effective use and management of the overall resources management thought of the qualitative leap. Compared with the previous, the integration of computer, Internet development, its stage contains more advanced management concepts, and realized the logistics, capital flow and information flow of integrated management, optimization and comprehensive integration of the enterprise resource allocation.

Business Process Reengineering Theory

Business process reengineering is a method of using information technology to fundamentally change enterprise processes and achieve major business goals. Business process reengineering was first established by the American business management master Michael. Hammer. He emphasized using business processes to transform objects and centers and established the goal of caring about customer needs and satisfaction. He stated that, existing business processes required fundamental rethinking and thorough redesign through, the use of advanced manufacturing technology, information technology and modern management tools. This would, maximize the functional integration of technology manage the functional integration. In the process, this would break the traditional functional organizational structure and establish a new process-oriented organizational structure, to achieve dramatic cost, quality, service and speed improvements in businesses.

THE CURRENT IMPLEMENTATION OF ERP SYSTEM ON THE IMPACT OF ENTERPRISE INTERNAL CONTROL

Internal controls and the ERP system are different from each other. The core of ERP system is to "plan", and the core of internal controls is to "control". The plan precisely needs the enterprise to use the means of control, and the object of control is also the enterprise's plan. The internal control thought to be embodied in ERP system, are the use of information technology to serve the business objectives of the enterprise. Both show the "You have me, I have you" relationship in good conditions. The internal controls play an important role in the ERP system, and the ERP system supports the internal controls. With the continuous development of information technology and the introduction of advanced ERP system, enterprises will inevitably have a huge change in the original internal controls, which will and impact their businesses.

Compared with the traditional accounting information system, the main changes of the ERP system are as follows: (1) The emphases

of their designs are different. The traditional accounting information system only designs the whole business process from the perspective of the whole enterprise and even the enterprise-centered upstream and downstream of the supply chain system are designed, more macroscopically. (2) There are different degrees of automation. The application of information technology allows enterprises in the accounting process to achieve a human-computer interaction mode. They can use accounting vouchers and other related financial information to implement basic automation. The ERP system directly from the original certificate, To reduce the impact of human factors on accounting data, effectively control accounting fraud, but also improve the security of information processing data. Accounting vouchers and other related financial information basic implementation automation, the system can automatically detect the subject code, accounting voucher code, date, amount, etc. (3) The accounting functions are different. The traditional accounting information system belongs to the afterwards control more, and the ERP system improves the enterprise's accounting efficiency, makes each core business function unify, realizes the integration and sharing of the information data of the internal resources, plays the function of control, forecast and decision-making, and improves the management efficiency of the enterprise, strengthen the financial forecasting, decision-making, and controls; and also improves the financial management of enterprises, This results in the full cooperation of various departments in order, to achieve the plan, adjustment the events and, controls, and give full play to the supervisory and decision-making functions. The ERP system implementation will inevitably have a certain impact on the internal controls of enterprises, mainly in the following areas:

Internal Control Environment

Flatten the organization

The organization level is reduced, the control responsibility is clarified, the decision-makers and the employees can communicate quickly, and the efficiency is continuously improved. Of course, in the information-sharing enterprise environment, the distance between departments is narrowed, and the coordination between departments and the overall management efficiency are improved.

The scope of control is expanded

The enterprise's internal prior control scope mainly included the personnel, finance, and information processing methods and procedures for the internal management and control of the enterprise. However, with the continuous development of ERP information system, the enterprise's internal control scope is constantly expanding. It no longer just encompasses people and the management system, but now focuses on the enterprise's internal management activities, such as the system development, software development, management model, supply and marketing, human resources and performance evaluation. In other words, for the overall management of enterprises, the collection of financial department and business unit data is also expanding, which will allow for the real-time control of the enterprise.

The form of the control program

"Human-Computer Interaction" mode will be used, so that accountants will have the help of computer functions and centralized data processing. Therefore, according to the functional division and the main division of labor internal controls are no longer applicable to enterprise management. This result in the accounting staff's function no longer being only accounting and supervision and expands the scope of the accounting staff, which may bring more work enthusiasm into the business management control decision-making.

Risk Assessment

During the extensive application and development of the ERP system, accounting personnel relying on computers to improve work efficiency. Based on information technology, the enterprise's control environment conducts the necessary risk assessments. Due to the expansion of the scope of the control environment, it changes the traditional risk control content and methods, and will also be affected by the risk of the information technology itself, such as: the intrusion of computer viruses, corrupted or forged data due to negligent controls and data damage and loss due to the faulty preservation of the data. Therefore the first input error or procedural failure will inevitably increase the risk of loss or errors. We need to strengthen the protection of our own systems, and fully develop the ERP system with its risk assessment advantages, to prevent and control the business process risk.

Control Of Activities

With the full use of ERP technology and the, "human-Computer Interaction" mode the focus of control moves from people and systems to people, and computers, which obviously increases the difficulty of internal controls. Control means can be changed, compared with the traditional control method, based on the enterprise business process that integrates or optimizes the program, it is more flexible. Internal controls are to achieve the optimal allocation of resources, and the use of an ERP system simplifies manual efforts by using information to monitor the efficient use of resources in the business.

Information Exchange And Communication

With the help of the ERP system and network technology, the speed of accessing the originally isolated and lagged financial information of the enterprise is effectively accelerated, which effectively integrates the enterprise flow, capital flow and supply chain. The efficient transmission and sharing of information provides for good communication conditions between the various departments of the enterprise, so that the financial department avoids the "island of information" and provides convenience and timeliness for the

users of the information. However, because the enterprise's organizational structure is not rigorous, the ERP system's powers and responsibilities may be ambiguous, which may cause each department in the enterprise to have unnecessary contradictions.

Supervision

In the ERP environment, many control methods and various procedures are completed through the computer, so the object of supervision from the management of people to the supervision of personnel and system security, Monitoring the system on time and controlling the control parameters and adjusting them in accordance with the procedures of the enterprise is an effective guarantee for the enterprise to implement the internal control.

PROBLEMS IN THE IMPLEMENTATION OF ERP IN PURCHASING DEPARTMENT AND ANALYSIS OF CRITICAL CONTROL POINTS

ERP Cannot Meet The Internal Control Requirements Of Its Own Defects

- (1) The ERP system authorization setting relies on the rigorous organization structure. With the help of the information, everyone in each department will be operating on the network, which requires the ERP system to be implemented with strict authorization. The problem is that ERP cannot detect fraud. Its authorization settings rely on the organization of the enterprise structure, and the internal controls are closely related to the company's poor organizational structure, which will naturally lead to ERP licensing setting problems. For example, sales and marketing managers are also authorized to manage the purchasing and marketing departments, which clearly violates the internal control that states that incompatible duties should be separated from the manager to eliminate decisions made for personal gain.
- (2) "Human-computer interactions" increase the ordinary and operational risks in the enterprise. The process is difficult to analyze and respond to enterprises in the introduction of ERP system, accompanied by the increase in the scope of risk, "human-computer Interaction" mode so that enterprises need to pay more attention to the computer system risk control, but the enterprise in the ordinary risk In addition, the ERP system is designed operated, and completed by human. High amounts of front-end input data that are used to determine the accuracy of a series of related works, will also increase the risks, and even affect management decision-making. However ERP also needs the large-scale front-end data to key points. Furthermore, the internal control measures of the enterprise must be embedded in the business processes, and the use of ERP can periodically generate relevant reports from various departments, such as: inventory reports, customer credit reports, forecast the company's sluggish inventory, the calculation of the stock Zhou Zhun rate of the enterprise information, In the business process will only be in the system for the implementation of the correct and wrong or beyond the circumstances of the judgment of the hint, this will only cause the final warehouse demand or the backlog of raw materials, will affect the normal production of enterprises. Therefore, the problem is that the enterprise has not yet reached the appropriate standard. Expectations such as the assessment of the risk period are, not used to analyze the changes in the external environment, and it is more difficult to identify the changes in the factors that affect the emergence of increased risk. This cannot be the middle link in the risk of information transfer to other management departments, The links between enterprises are not close, and it is not possible to take into account and attach importance to other risks through the occurrence of a risk; Of course, the system can not actively deal with these risks, ERP system has no advanced risk prediction model, the existing model is only to reflect the history, not the future factors into the model, There is not much impact on the future, more cannot replace the comprehensiveness of human judgment.
- (3) The construction enterprise that does not pay attention to control activity key point in the process design in order to carry out the effective control activity, nothing more than in the business process to add a number of new procedures to check the power of the department, of course, The "at what time and which link to add" problem increases the difficulty of control activities. Enterprises do not pay attention to the construction of the key points of control activities, or to the efficiency comparisons before and after procedure changes. Enterprises in the business process blindly increase the processes to achieve internal controls, and in the course of business add many links that will inevitably increase costs. Although the long-term optimization, will improve the management efficiency of enterprises, it will reduce the short-term efficiency of enterprises. This is the reason why modern enterprises pursue more short-term effects rather than optimizing processes.
- (4) The results of the implementation of the system are not strictly, positive evaluation feedback system for the internal controls. If the implementation is not smooth, it will feel like the internal controls are feasible. This judgment standard obviously has some subjectivity and lacks the rigor, of a positive evaluation feedback system. Unclear provisions will also create contradictions between departments. In the fragmented basic information input process, ERP cannot identify the accuracy of personnel information and supplier evaluation data is not comprehensive, which will impact the information exchange.
- (5) The ERP system has not yet reached a complete audit effect since it is not monitored by a special department determines whether it is in accordance with business processes to do. Therefore, ERP has not yet achieved full audit results. For the control that cannot be realized through automation, it also needs to be controlled by people, which will inevitably result in negligence and ineffective supervision.

General Issues Based On The Overall Dimension

- (1) There is a lack of in-depth understanding of the internal control management of internal controls. The internal controls are mainly based on the enterprises' control effectiveness and are not aware of how the internal controls of enterprises have been affected by accounting information. The introduction of an ERP system does not integrate ERP supply chain management into

the internal control of the enterprise. In general, the enterprise's internal control system only stays at the specific operational level, and the construction of a perfect internal control system needs to be further strengthened.

- (2) Managers do not pay attention to the implementation of the system with the continuous development of enterprises. To adapt to the changing external competitive environment, enterprises must introduce ERP information systems, according to the specific organizational structure of their enterprises and their business needs in order to establish a relatively flexible, personalized accounting information system. But the leadership of the internal control of the construction lack sufficient attention, resulting in the company only introducing the general-purpose ERP that is not set up in line with their own business process reengineering. Then, they rely on the information of the internal control system to improve the construction of the ERP, which actually does not require much. The implementation process will also be more staff members that do not pay attention to the phenomenon where a person responsible for multiple posts still appears. Therefore, the role of mutual control between the posts is not strong. Internal audit also did not play an effective role, and the lack of internal control of the evaluation process will affect the overall management efficiency of enterprises.
- (3) The enterprise's own internal control environment is too poor for the introduction of ERP technology. In the organization structure, the personnel must have permission to address problems that still exist due to negligence or unreasonable placement, the lack of scientific evidence, the enterprise's culture, the staff's evaluated capacity and human resources policies. The phenomenon of the structure and the number of posts causes the ERP system to have drawbacks with respect to the powers and responsibilities, which will be contrary to the ERP environment for internal control requirements.
- (4) Operations and maintenance have high costs. The adaptability of ERP as a kind of information technology is not strong. Its introduction, operation and maintenance require strong financial support, and for small enterprises this creates a certain pressure. In addition, in the ERP, its process is set according to the specific requirements of various departments. There are trade-offs and, there are no uniform standards. Therefore, enterprises cannot use a standard measurement and evaluation of the performance level of each department.
- (5) The operator of the ERP system in all enterprises have not been sufficiently proficient in recent years due to, the continuous introduction of ERP systems. However because the operator's own capacity is insufficient, the company's technical training is also insufficient, thus resulting in operators that do not understand the new business processes under the various modules and insufficient proficiency. This can easily lead to work errors. Therefore, in this state, effectively implementing and improve the internal controls of enterprises is impossible.

Specific Problems In The Implementation Of The Procurement Business Process

Problems arising from the actual work of the Procurement Department

The procurement personnel does not pay attention to the beginning data entry, which later causes the system to automatically generate data and the authenticity comes into question. The garbage data output adds some unnecessary work and troubles, and the procurement personnel sometimes proceed without the purchasing department manager's authorization. This allows the purchaser to complete the work in lieu the authorization. Since the accuracy of the front-end input data determines a series of related work, without the control of the procurement manager, the initial data monitoring and inspection abilities will be lost. After this failure fraud may also occur. This work is not rigorous, is bound to cause increased risk, and can affect management decision-making.

Although procurement personnel in accordance with the requirements of the early stage to do a large number of basic data work, but the enterprise has not improved the previous procurement department inventory backlog or is in short supply phenomenon, so that each procurement link cannot be carried out according to the main production plan smoothly. There is no detailed market research on the materials that have significant impacts on production. Therefore, the system includes the procurement lead time, master production planning, and BOM material levels. Small and important basic data information is not very clear, and only approximate subjective guesses. As a result, procurement impacts production. In addition, in the implementation process, because everyone's interests drive, do not want to be real-time control and supervision, so that the ERP system to enable enterprises to achieve the responsibility of clear, material control, reduce waste of the controlled state of the goal has not been achieved.

In the actual workflow of the purchasing operations, the procurement department does not to affect production. However, they do receive the blame of superiors, who have to borrow money to buy new raw materials. This causes capital tensions, supply chain ruptures and the excessive accumulation of raw materials in the warehouse, but it also reduces the turnover speed of capital, affects the performance and evaluation of the warehouse management. This causes dissatisfaction in the department and contradictions between the two departments appear. To solve the contradiction between the two, the internal control requirements of the procurement departments must occur in real time according to production plans for material procurement. However, they are also worried that the procurement department in order to shirk the responsibility of production demand, does not act in accordance with the provisions of the production department issued in the material demand plan. Both the procurement department manager and the warehouse management department manager must have consistent decision-making and agree to proceed smoothly. However, in the actual operations, there are two parallel control processes, and there may be inconsistencies and controversies that will affect the production department and normal material procurement and supply. In this way, it is easy for one side's mistakes to affect the other process, which decreases the efficiency.

When the purchasing department negotiates the price with the supplier, the original enterprise, in order to prevent the Purchasing department manager from gaining rebates, has designed the finance department to check the purchasing department manager according to the price list sent by the purchasing staff after asking the supplier. Such dual-line control will inevitably cause unnecessary contradictions and affect the progress of the entire process efficiency.

Supplier problems

The supplier's personal basic information is established, but there are often coding mistakes, no rules, and the product specifications, models, quotations and other material information are not well delineated and disclosed. Therefore, in the selection of suppliers, companies often spend much time checking the supplier's personal information and correctly matching the provided materials provided. This can also cause the ERP to be unable to directly match each supplier to material prices, specifications for comparison and trade-offs, in order to quickly and accurately select the right supplier.

Statistical supplier evaluation data is not comprehensive, and the supplier evaluation system is not perfect. Although the ERP system can establish the basic information of a supplier, but the evaluation criteria for suppliers can be too simple and, only provide the delivery time and quality. The cause of this phenomenon is due to the ERP receiving time point and the vendor's delivery time not being synchronized. As a result, the system cannot acquire the material in time to enter and leave the factory. In addition, evaluations are based on errors and, the same scoring standards, thus resulting in different characteristics of the manufacturers and rating inaccuracies.

For the previous frequent supplier, unilateral shortages of material occur and the evaluation results cannot be timely fed back to the procurement department. Therefore, the procurement of suppliers and the inquiries, parities, bids, and the implementation of the purchase price list, for the suppliers cannot occur in real time due to the possible credit risk and service quality of suppliers that affect making a reasonable choice. In addition, these need people to make comparisons, and ERP cannot identify the supplier's information and evaluation results. This is important and relatively irreplaceable to the company's production since it will have significant impacts on the suppliers. The first failure to supply raw materials will result in large losses for enterprises and therefore enhance its importance. Nevertheless, simply put, the contracted defaulter is subjectively identified as the supplier of the occasional credit risk. There is no significant impact on the enterprise by the supplier of these problems. In research, we must discover the real reasons for the risk and use a positive method to help to ensure the overall efficiency of the block chain. It is precisely because enterprises do not do so when these problems occur that causes, a vicious cycle of a significant quality of material purchases and declining productivity.

Problems with Warehouse Management

Before the supplier's material arrives, the warehouse management department inspects it. If it is approved, the direct warehousing reports this to the Finance department for payment. If it encounters unqualified deficient product, it reports this to the purchasing department, who negotiates with the supplier, and conducts bad article processing. The whole process appears to be very broad, and the control of the entire process is not very rigorous. To save labor costs, one person is responsible for a number of positions, including the regular quality inspection and complete acceptance, and there are no technical and quality checks. The responsibility for this is unknown, resulting in the production of numerous poor quality products.

Analysis Of Critical Control Points In The Process

Material requirement plan to release and purchase requisition link

Risks: Not in harmony with the requirements plan and without proper permission to address problems.

Control measures: (1) Procurement departments should be in line with the actual needs of the production department to prepare timely and accurate purchase demand plans, and actively adjust the procurement budget. (2) The warehouse management departments should do a good job of coordination and communication, effective diversion, and scientific procurement. (3) There should be clear responsibility and approval processes.

Select Supplier link

Risks: The supplier and purchasing department personnel show favoritism, the supplier's credit risks, and the supplier's product quality risks.

Control measures: (1) Scientifically and reasonably determine procurement pricing and a fair and impartial selection of appropriate suppliers (2) Establish a comprehensive evaluation system of supplier credit and improve the Supplier Management System. (3) Strengthen the establishment and supervision of the procurement contract system to ensure the procurement quality and the solve contract disputes. (4) Carry out the effective tracking of important materials provided by suppliers. (5) Enhance the authority and status of QC personnel.

The Purchase order approval link

Risks: Favoritism, neglect of duty, ignoring the careful examination of orders resulting in less or more purchase.

Control measures: (1) perfect the corresponding approval process (2) to the approval Department and personnel to do a good job of authority control and effective supervision, only authorized person can be approved and must be personally approved.

The completion of purchase orders and evaluation links

Risks: Errors frequently caused by evaluation, and the impact of performance evaluation on employee positivity.

Control measures: (1) Timely evaluate procurement staff performance and supplier credit issue and improve the relevant management evaluation system (2) Strengthen information the exchange between departments to evaluate the sharing and lessons.

Warehousing quality inspection links

Risks: the supervision of warehouse personnel is unreasonable or there is fraud, the acceptance of normative material loss, quality control and warehouse management duties are performed by the same person, and the lack of QC ability.

Control measures: (1) QC personnel and warehouse management personnel should not be the same person, and there should be effective separation of duties. (2) Establishment of a normative and scientific acceptance System. (3) Warehouse management personnel that accepts goods, the procurement of materials such as the quantity, specifications and other basic information must be consistent with the purchase order data. (4) Strengthen the quality inspection skills of QC personnel and improve the inspection technology. (5) The relevant departments should make timely processing decisions according to the actual situation.

The payment link

Risks: Inaccurate payments and delayed payment lead to upstream and downstream credit risk problems for enterprises.

Control measures: (1) Strengthen the supervision of financial personnel and responsibility training. (2) Strengthen the examination of the authenticity and legality of purchase invoices.

INTERNAL CONTROL FROM THE PERSPECTIVE OF PROCUREMENT DEPARTMENT ERP IMPLEMENTATION IMPROVEMENT MEASURES

Reconstruct The Organization Structure

There should be clear authority, to prevent fraud and to reconstruct the organization structure. The successful implementation of ERP relies on a strict organizational structure since the ERP cannot detect its own corrupt behavior. Therefore, the internal control environment requires the purchasing department to implement strict authorization settings for the ERP system, and the authorization setting depends on the strict organizational structure of the enterprise. Thus, to enact the ERP advanced management platform, we must first establish a good control environment, with a strict organizational structure a sound control system, and mutual restraint. If we model the strict approval system in this way, we can use the ERP system to prevent fraud and find job-compatible private interests and behaviors in order to achieve relatively strict authorization control.

Objective Assessment Of Risk, Use Of Advanced Technology To Identify Risk Prevention

Using large data to obtain the supplier's credit data

In many developing Internet technologies, the positive influence of large data on the quality of accounting information has been preliminarily confirmed. The credit information of the enterprise is converted from the information. In general, the credit information of the supplier is stored in the database only after processing the data of the enterprise in order to establish a uniform data format for the production enterprise credit reports. Therefore, only through the full use of large data technology by the supplier of the economic activities and the credit ratings from dynamic reporting can, an enterprise enact the early identification of the upstream risks and enact preventative responses.

Based on block chain technology to reduce the suppliers' risk

Enterprises order and procure raw materials according to market sales. This makes procurement the most important step in the supply chain. It purchases directly affects the later production quality and sales. Therefore, in the complex supply chain, the enterprise can use block chain technology to procure raw materials from the source. Block chain technology must require suppliers to provide specific information on raw materials, which will help enterprises understand partners or select partners by providing a reference through the use of two-dimensional code technology for raw materials in the production and the factory before the specific information identification. The manufacturing phase also provides detailed records of the production of various product workshops, including the production time and other information, which is coupled with the sales phase. Consumers with the products in their hands can scan the product two-dimensional code, which can directly obtain products information from the acquisition of raw materials to the production and circulation of all aspects. A chain of alliances can be built by the participants in the chain. Regardless of, which stage encountered errors, the various links can be traced back through the block chain in order to assign responsibility and

correct errors. In addition to the block chain technology being highly secure and tamper-resistant, which reduces the control risks for enterprises, it provides the necessary technical support for its internal management.

Based on backup management system risk prevention

While using information technology to improve work efficiency and strengthen internal controls, the information system will inevitably impact the enterprise risk. We need to actively conduct backup management. In the selection of backup system, to the system must meet the increasing requirements for the system capacity and ensure that the use of backup software for mainstream systems and database applications plays a certain supporting role. In the network background of the rapid development of information technology, the network data storage Management system is fully utilized, and centralized management is carried out through the specialized data storage management software to realize automatic backups, file archiving, data grading storage and disaster recovery.

Improve And Standardize Control Activities And Carry Out Business Process Reengineering

Through the analysis of the key control points of the purchasing department's business process, the BPR thought is used to reorganize the business process in order to strengthen the monitoring of the internal control activities, meet the requirements of internal control, improve the working efficiency and improve the operational management efficiency of the whole enterprise.

Establishing A Unified Basic Database And Perfecting The Information Communication Link

In the face of various information data generated by the purchasing department, it is necessary to establish a unified basic database to prevent the decrease of information isolation and protect the efficiency of information transmission sharing. Currently, the development of XBRL technology provides the same convertible format for the various valuable information of various departments, provides a more convenient channel for information exchange and communication, and realizes the goal of "counting one, sharing information". In addition, among the various business departments, there should be a mutual understanding and communications, and they should cultivate the awareness of and cooperation among the various departments. In addition, there should be clear responsibilities and influences for all department mutual constraints should control the overall operational efficiency of the enterprise in order to improve its purpose.

Upgrading Of Traditional Audit Instruments And Strengthening Of Internal And External Audit Collaboration

Auditors need to participate in the internal controls of the business process and the division of responsibilities between departments. With the continuous development of information technology and the economy, traditional audits also have higher requirements, including the expansion of the scope of the audits, audit technology and so on. Under the background of the "double trial system", the joint audit of the internal audit and the qualified external auditor has become a major feature of contemporary audits. Therefore, for internal audits, management should pay significant attention to the company's various aspects of the internal audit work in order, to lay a foundation for the development of the external audit. In addition, they should strengthen communication with internal auditors, make full use of internal audit results, and provide authoritative audit reports and guidance suggestions for the company. In other words, both of them are not only different from each other, but are also interrelated and complement each other. Under the premise of giving full play to their inherent advantages and maintaining objectivity and independence, the combination of the internal audit and external audit actively and effectively establish a good, long-term, good cooperative relationship that improves the overall audit quality and efficiency. It is more advantageous to supervise the supply chain of the enterprise and make corresponding guiding evaluations to improve the internal control efficiency of the enterprise.

Strengthening of Personnel Training in the System and Training Of Compound Talents

To guarantee the smooth operations of ERP, we must strengthen the system training for the personnel and cultivate the compounded talents that will become the key of the enterprise internal control construction. In the information background, we must improve the financial management staff recruitment threshold. The incumbent financial staff must conduct the necessary professional and technical training, accelerate the transformation of the traditional financial work, change the functions, increase the participation in the management of the enterprise, strengthen the supply chain work flow controls actively learn computer technology, enact flexible responses to solve various technical problems, and maintain good data integrity and sharing.

Strengthening the Focus of Leadership

The good and bad of internal controls are more depends on the level of attention of the enterprise's top leaders. Leaders should be aware of the use of advanced technology to improve efficiency, but also should ensure the overall management efficiency of enterprises. While revising and perfecting the internal control system, we should integrate the business process reengineering into the supply chain of the enterprise, and only establish an ERP system suitable for the development of the enterprise, to enhance the enterprise's competitiveness. Leaders should learn more advanced technologies and actively embrace and support innovative development projects.

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Research on Impulse Radio Ultra - wideband Positioning Method Based on Combined BP Neural Network and SVM

(Full Paper)

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ABSTRACT

Intelligent tour guide is a comprehensive service based on tourist's location, which is closely related to Geographic Information System (GIS), mobile positioning technology and Location-Based Service (LBS). But the intelligent tour guide field urgently needs the integrated positioning and navigation technology inside and outside the room. IR-UWB technology is suitable for positioning, tracking, navigation and communication in complex indoor environment, and is considered as the most potential indoor positioning technology to realize seamless connection between indoor and outdoor with outdoor positioning technologies such as GPS. However, one of the main problems facing IR-UWB positioning is Non-Line-Of-Sight (NLOS) error. Based on the advantages of BP neural network and support vector machine, this paper proposes a multi-model fusion algorithm to mitigate the NLOS propagation error of the time difference of arrival (TDOA) and the angle of arrival (AOA) of IR-UWB signal, and then uses TDOA/AOA hybrid positioning that mitigates the NLOS error. Simulation results show that the combined algorithm has stronger NLOS resistance and higher positioning accuracy than the single machine learning algorithm in mitigation NLOS errors.

Keywords: Intelligent tour guide, Non-Line-Of-Sight error, TDOA / AOA, hybrid positioning, multi-model fusion.

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INTRODUCTION

With the development of wireless communication technology, the demand for wireless positioning has increased day by day, and it has been widely used and can better meet the requirements of outdoor positioning. With the rapid development of China's tourism market and the continuous progress of tourism informatization construction, the emphasis on informatization, quantitative digital tourism and digital scenic spots has gradually shifted to intelligent tourism and intelligent scenic spots that emphasize humanized and intelligent services. However, the traditional outdoor positioning technology represented by GPS and cellular mobile positioning system is difficult to satisfy the tourist guide service with both outdoor scenic spots and indoor exhibition areas and exhibits, so the indoor and outdoor integrated positioning and navigation technology and its application in the field of intelligent tour guide need to be studied urgently (Yu, 2013). Impulse Radio Ultra-Wideband (IR-UWB) is a non-carrier communication technology and GHz bandwidth, with better penetration and anti-multipath characteristics, which can effectively reduce the transmit signal power and system complexity while providing centimeter-level positioning accuracy. It is an ideal indoor positioning technology (Hazas & Hopper, 2006).

The biggest factor affecting indoor positioning is the larger masking error caused by the NLOS propagation of the signal, which will lead to the distance measurement being positively biased and its distribution has a large gap with Gaussian distribution. Most of the traditional positioning algorithms are designed based on Gaussian or approximate Gaussian measurement error model, so the performance will decrease obviously in indoor environment. According to the current research situation, IR-UWB indoor precise positioning algorithms can be divided into five categories: based on signal direction of arrival (TOA) (Xu, Jiang & Sha, 2009), based on signal time difference of arrival (TDOA) (Gardner & Chen, 1992), based on angle of arrival (AOA) (Juan, Miguel & Angela, 2011), based on received signal strength indication (RSSI), and hybrid positioning algorithm. Literature (Yang, Huang & Zhu, 2007) discusses the TDOA / AOA hybrid positioning method, and proves that the hybrid positioning algorithm has higher positioning accuracy than TDOA and AOA single positioning algorithm in NLOS environment. Literature (Dong, Cui & Zhang, 2010) proposes to use the nonlinear approximation capability of BP neural network to mitigate the ranging error caused by NLOS propagation and improve the positioning accuracy. Literature (Wymeersch, Marano & Gifford, 2012) uses the waveform characteristics of the received signal and adopts SVM method to mitigate NLOS errors and improve positioning accuracy. But also ensure the stability of the positioning error. Therefore, this paper proposes a multi-model fusion localization algorithm based on BP neural network and support vector machine. Compared with the single machine learning algorithm, our method improves the localization accuracy and reliability.

TDOA / AOA HYBRID LOCATION BASED ON BP AND SVM

Measurement Error Models of TDOA and AOA

Let τ_i be the TOA measurement of electromagnetic wave between tag and base station BS_i . Since multipath and NLOS phenomena of IR-UWB signals in indoor propagation are the two main causes of TOA ranging error, τ_i can be expressed as:

$$\tau_i = \tau_i^0 + \tau_{ei} \quad i = 1, 2, 3, \dots, M \quad (1)$$

Where τ_i^0 is the ranging error caused by multipath propagation, τ_{ei} is the extra time delay caused by NLOS propagation, and M is the number of base stations participating in positioning. Further, there is TDOA measurement error:

$$\tau_{i,1} = \tau_i - \tau_1 = (\tau_i^0 - \tau_1^0) + (\tau_{ei} - \tau_{e1}) = \tau_{i,1}^0 + \tau_{ei,1} \quad i = 2, 3, \dots, M \quad (2)$$

Where $\tau_{i,1}$ is the TDOA measurement in indoor NLOS environment, $\tau_{i,1}^0$ is the TDOA measurement in LOS environment, and $\tau_{ei,1}$ is the NLOS error caused by NLOS environment. At present, there is no relevant research on statistical modeling.

Let α_i be the AOA measurement value between the tag and BS_i . Due to the system measurement error and the additional angle error caused by NLOS phenomenon, can be expressed as:

$$\alpha_i = \alpha_i^0 + \alpha n_i + \alpha_{ei} \quad i = 1, 2, \dots, M \quad (3)$$

In the formula, α_i^0 is AOA measurement value in line-of-sight environment, αn_i is system measurement error, and α_{ei} is additional angle error caused in NLOS environment, which is the main error of AOA measurement value. Since wall-to-wall propagation is closely related to specific environmental parameters, there is little statistical modeling research on it at present.

Error Mitigation Model Of TDOA/AOA Based On BP

At least four base stations are needed to obtain the three-dimensional position information of the target in the NLOS environment. Increasing the number of base stations can correspondingly improve the positioning accuracy, but the cost will also increase. The BP neural network model for mitigating TDOA and AOA measurements of four base stations consists of an input layer, an implicit layer and an output layer, as shown in figure 1.

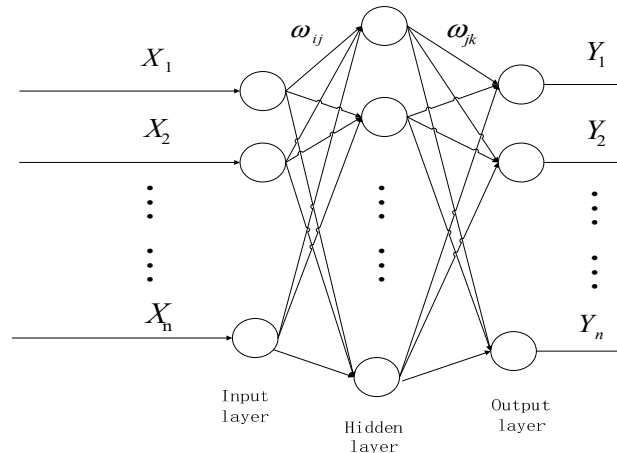


Figure 1: Topology diagram of BP neural network

The process of TDOA non-line-of-sight error mitigation based on BP neural network is as follows:

a) The input layer consists of three TDOA measurements and four AOA measurements provided by four base stations participating in the positioning. Input vector:

$$X = [TDOA_{21}, TDOA_{31}, TDOA_{41}, AOA_1, AOA_2, AOA_3, AOA_4] \quad (4)$$

b) The number of neurons in the hidden layer is usually obtained by the following formula:

$$m = \sqrt{n + l} + \lambda \quad (5)$$

Where n is the number of nodes in the input layer, l is the number of nodes in the output layer, all of which are 7 in this paper, and λ is a constant between 1 and 10. According to the calculation results of the formula and complexity analysis, the number of hidden layer nodes in this paper is 12.

c) The output layer consists of 7 neurons, and the output vector is the mitigated TDOA and AOA, and the formula is as follows:

$$Z = [RTDOA_{21}, RTDOA_{31}, RTDOA_{41}, RAOA_1, RAOA_2, RAOA_3, RAOA_4] \quad (6)$$

In the learning process of BP neural network, there are two learning stages:

(1) Calculating the output of each hidden layer and input layer from front to back;

(2) Error back propagation is used to correct the weights of each hidden layer and input layer from back to front.

This paper sets the input vector $X=[x_1, x_2, x_3, x_4, x_5, x_6, x_7]$ and the weight matrix from the input layer to the hidden layer $\omega=[\omega_1, \omega_2, \dots, \omega_{12}]$. Where ω_j is the weight vector corresponding to the j th neuron in the hidden layer. The output vector of the hidden layer is $Y=[y_1, y_2, \dots, y_{12}]$. The weight matrix from the hidden layer to the output layer is $v=[v_1, v_2, \dots, v_7]$, Where v_t is the weight vector corresponding to the first neuron in the output layer. The output layer vector is $Z=(z_1, z_2, z_3, z_4, z_5, z_6, z_7)$ and the expected output vector is $d=(d_1, d_2, d_3)$. The standard BP neural network excitation function adopts unipolar sigmoid function:

$$f(x) = \frac{1}{1 + e^{-x}} \quad (7)$$

Its value can be arbitrary, and its output value is between - 1 and + 1, continuously derivable, and

$$f'(x) = f(x)[1 - f(x)] \quad (8)$$

The transfer function uses the Purelin function: $g(x) = x$. The error function is

$$E = \frac{1}{2}(d - Z)^2 = \frac{1}{2} \sum_{t=1}^7 (d_t - z_t)^2 \quad (9)$$

The error gradient descent method is used to correct the weights, and the process is as follows:

$$\begin{cases} \Delta \omega_{ij} = -\eta \frac{\partial E}{\partial \omega_{ij}} & i = 1, 2, \dots, 7 \quad j = 1, 2, \dots, 12 \\ \Delta v_{jt} = -\eta \frac{\partial E}{\partial v_{jt}} & j = 1, 2, \dots, 12 \quad t = 1, 2, \dots, 7 \end{cases} \quad (10)$$

Where η is a scaling factor between 0 and 1, for the output layer, It can write as

$$\Delta v_{jt} = -\eta \frac{\partial E}{\partial v_{jt}} = -\eta \frac{\partial E}{\partial z_t} \cdot \frac{\partial z_t}{\partial net_t} \cdot \frac{\partial net_t}{\partial v_{jt}} \quad (11)$$

Where

$$\frac{\partial E}{\partial z_t} = -(d_t - z_t), \quad \frac{\partial z_t}{\partial net_t} = g'(net_t) = 1, \quad \frac{\partial net_t}{\partial v_{jt}} = \sum_{j=1}^{12} y_j \quad (12)$$

Similarly, for the hidden layer we can get

$$\Delta \omega_{ji} = -\eta \frac{\partial E}{\partial \omega_{ji}} = -\eta \frac{\partial E}{\partial y_j} \cdot \frac{\partial y_j}{\partial net_j} \cdot \frac{\partial net_j}{\partial \omega_{ji}} \quad (13)$$

Where

$$\frac{\partial E}{\partial y_j} = -\sum_{t=1}^7 (d_t - z_t) g'(net_t) \sum_{j=1}^{12} v_{jt}, \quad \frac{\partial y_j}{\partial net_j} = f'(net_j), \quad \frac{\partial net_j}{\partial \omega_{ji}} = \sum_{i=1}^7 x_i \quad (14)$$

So, We can finally get

$$\begin{cases} \Delta v_{jt} = -\eta \frac{\partial E}{\partial v_{jt}} = \eta (d_t - z_t) \cdot g'(net_t) \cdot \sum_{j=1}^{12} y_j \\ \Delta \omega_{ji} = -\eta \frac{\partial E}{\partial \omega_{ji}} = \eta \left[\sum_{t=1}^7 (d_t - z_t) g'(net_t) \sum_{j=1}^{12} v_{jt} \right] \cdot y_j \cdot (1 - y_j) \cdot \sum_{i=1}^7 x_i \end{cases} \quad (15)$$

The above is the adjustment process of weights in the two learning stages of BP neural network using gradient descent method, and the adjustment process of thresholds can be obtained in the same way.

TDOA/ AOA Hybrid Location Model Based On SVM

SVM method is a new machine learning method proposed by VA Pnik et al. according to statistical learning theory in the early 1990s. Based on the principle of structural risk minimization, the actual risk of the learning machine is minimized by properly selecting the subset of functions and the discriminant function in the subset, ensuring that the small error classifier obtained through limited training samples still has a small test error for the independent test set.

Its outstanding advantages are as follows: (1) based on the principle of structural risk minimization in statistical learning theory and VC dimension theory, it has good generalization ability, which is, small errors obtained from limited training samples can ensure that independent test sets still keep small errors. (2) The solution of support vector machine corresponds to a convex optimization problem, so the local optimal solution must be a global optimal solution. (3) The successful application of the kernel function transforms the nonlinear problem into a linear problem. (4) Maximizing the classification interval makes the support vector machine algorithm more robust. The structure diagram is shown in figure 2.

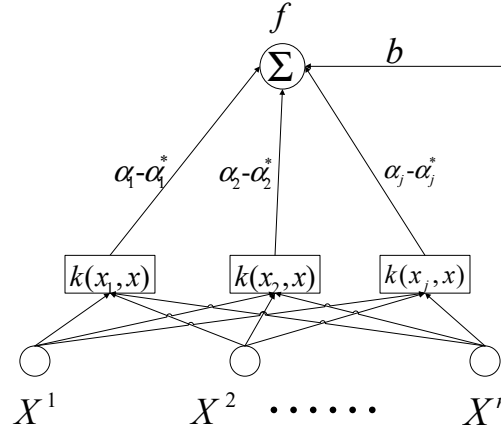


Figure 2: Basic structure diagram of support vector machine model

In this paper, multi-input multi-output SVM is used to mitigate TDOA and AOA NLOS errors measured by the system. The input vector is still three TDOA values and four AOA values measured by four base stations, $Y = [TDOA_{21}, TDOA_{31}, TDOA_{41}, AOA_1, AOA_2, AOA_3, AOA_4]$.

The output vectors are TDOA and AOA values that mitigate NLOS errors, $Z = [RTDOA_{21}, RTDOA_{31}, RTDOA_{41}, RAOA_1, RAOA_2, RAOA_3, RAOA_4]$. Before establishing the multi-input multi-output SVM regression model, we first construct l sets of samples of the support vector machine: $S = (Y^1, Z^1), (Y^2, Z^2), \dots, (Y^l, Z^l)$, $Y \in R^m, Z \in R^m$, where m represents the number of inputs and outputs.

The multi-output linear regression function is in the form of $Z_i = f_i(Y) = v_i Y + b_i$, and It satisfies the constraint conditions:

$$\begin{cases} Z_i^j - v_i^T Y^j - b_i \leq \xi_i^j + \varepsilon_i \\ v_i^T Y^j + b_i - Z_i^j \leq \xi_i^j + \varepsilon_i \end{cases} \quad i=1,2,m; j=1,2,\dots,l \quad (16)$$

The relaxation factor $\xi_i^j, \xi_i^{j*} \geq 0$ is introduced in consideration of the allowable fitting error, and the objective function is solved to obtain the minimum value.

$$\min \Phi(v_i, \xi_i^j, \xi_i^{j*}) = \frac{1}{2} \sum_{i=1}^m \|v_i\|^2 + C \sum_{i=1}^m \sum_{j=1}^l (\xi_i^j + \xi_i^{j*}) \quad (17)$$

where A is C constant greater than 0. This is an optimization problem under inequality constraints. The solution to this problem is the same as that of single output support vector machine regression. Introduce Lagrange function:

$$\begin{aligned} L(v_i, b_i, \alpha_i^j, \alpha_i^{j*}) = & \frac{1}{2} \sum_{i=1}^m \|v_i\|^2 + C \sum_{i=1}^m \sum_{j=1}^l (\xi_i^j + \xi_i^{j*}) - \sum_{i=1}^m \sum_{j=1}^l \alpha_i^j (\varepsilon_i + \xi_i^j + Z_i^j - v_i^T Y^j - b_i) - \\ & \sum_{i=1}^m \sum_{j=1}^l \alpha_i^{j*} (\varepsilon_i + \xi_i^{j*} - Z_i^j + v_i^T Y^j + b_i) - \sum_{i=1}^m \sum_{j=1}^l (\eta_i^j \xi_i^j + \eta_i^{j*} \xi_i^{j*}) \end{aligned} \quad (18)$$

Where $\alpha_i^j, \alpha_i^{j*} \geq 0$ is a Lagrange multiplier and the extreme value of function L should satisfy the following conditions:

$$\begin{cases} \frac{\partial L}{\partial v_i} = 0 \rightarrow v_i = \sum_{j=1}^l (\alpha_i^j - \alpha_i^{j*}) Y^j \\ \frac{\partial L}{\partial b_i} = 0 \rightarrow \sum_{j=1}^l (\alpha_i^j - \alpha_i^{j*}) = 0 \\ \frac{\partial L}{\partial \xi_i^j} = C - \alpha_i^j - \eta_i^j = 0 \\ \frac{\partial L}{\partial \xi_i^{j*}} = C - \alpha_i^{j*} - \eta_i^{j*} = 0 \end{cases} \quad (19)$$

The conversion to Lagrange dual problem is:

$$\begin{aligned} \max_{\alpha_i^j, \alpha_i^{j*}} L(\alpha_i^j, \alpha_i^{j*}) = & -\frac{1}{2} \sum_{i=1}^m \sum_{j,k=1}^l (\alpha_i^j - \alpha_i^{j*}) (\alpha_i^k - \alpha_i^{k*}) (Y^j \cdot Y^k) + \sum_{i=1}^m \sum_{j=1}^l (\alpha_i^j - \alpha_i^{j*}) Z_i^j - \sum_{i=1}^m \sum_{j=1}^l (\alpha_i^j - \alpha_i^{j*}) \varepsilon_i \\ \text{st} \quad & \sum_{j=1}^l (\alpha_i^j - \alpha_i^{j*}) = 0, 0 \leq \alpha_i^j, \alpha_i^{j*} \leq C, j=1,2,\dots,l \end{aligned} \quad (20)$$

The expression of multiple output linear regression function can be obtained after finding the optimal solution $\alpha_i^j, \alpha_i^{j^*}$. The function is $Z_i = f_i(Y) = v_i Y + b_i$. Where $v_i = \sum_{j=1}^l (\alpha_i^j - \alpha_i^{j^*}) Y^j$.

According to Karush—Kuhn—Tucker (KKT) conditions, the following conditions are satisfied at the optimal solution:

$$\begin{cases} \alpha_i^{j^*} (\varepsilon_i + \xi_i^{j^*} - Z_i^j + v_i^T Y^j + b_i) = 0 \\ \alpha_i^j (\varepsilon_i + \xi_i^j + Z_i^j - v_i^T Y^j - b_i) = 0 \\ i = 1, 2, \dots, m; j = 1, 2, \dots, l \end{cases} \quad (21)$$

$$\begin{cases} \eta_i^j \xi_i^j = 0 \\ \eta_i^{j^*} \xi_i^{j^*} \\ i = 1, 2, \dots, m; j = 1, 2, \dots, l \end{cases} \quad (22)$$

The threshold variable b can be obtained:

$$\begin{cases} b_i = Z_i^j - \sum_{j=1}^l (\alpha_i^j - \alpha_i^{j^*}) Y^j - \varepsilon_i, \alpha_i^j \in (0, C) \\ b_i = Z_i^j - \sum_{j=1}^l (\alpha_i^j - \alpha_i^{j^*}) Y^j + \varepsilon_i, \alpha_i^{j^*} \in (0, C) \end{cases} \quad (23)$$

The threshold variable can be obtained by using the obtained optimal weight vector and any one of the support vectors.

The multi-output nonlinear regression function obtained by using kernel function $K(Y^j, Y^k) = \psi^T(Y^j) \psi^T(Y^k)$ is expressed as:

$$Z_i = f_i(Y) = \sum_{j=1}^l (\alpha_i^j - \alpha_i^{j^*}) K(Y^j, Y) + b_i \quad (24)$$

The threshold variable b can also be found.

$$\begin{cases} b_i = Z_i^j - \sum_{j=1}^l (\alpha_i^j - \alpha_i^{j^*}) K(Y^j, Y) - \varepsilon_i, \alpha_i^j \in (0, C) \\ b_i = Z_i^j - \sum_{j=1}^l (\alpha_i^j - \alpha_i^{j^*}) K(Y^j, Y) + \varepsilon_i, \alpha_i^{j^*} \in (0, C) \end{cases} \quad (25)$$

The detailed derivation of multivariate support vector machine model can be found in reference (Wang, Jin & Cao, 2007).

TDOA / AOA LOCATION ALGORITHM BASED ON BP AND SVM FUSION

When BP neural network regression and multivariable SVM regression mitigate NLOS errors of TDOA and AOA in different scenario and time ranges, the accuracy of the two algorithms is different. Therefore, according to the characteristics that the location of tourists will change with time indoors, the mitigation results of the two methods are weighted and fused. In this way, not only can the positioning accuracy be improved, but also the stability of the positioning error can be guaranteed. Therefore, this paper proposes a multi-model fusion location algorithm based on BP and SVM, thus giving full play to the respective advantages of the two methods.

The Steps Of Multi-Model Fusion Algorithm

The multi-model fusion algorithm is a method to mitigate NLOS errors based on the method of data fusion. This algorithm has two main steps in the application process:

- (1) Basic method mitigation: TDOA and AOA data collected by four base stations at time $T+1$ are used as input of BP neural network and SVM. Then the correction values of the TDOA and AOA are obtained respectively.
- (2) Fusion correction results: For the current time $T+1$, the correction results of the two methods are weighted according to the minimum square sum of error of l groups of data before time $T+1$ by the basic method, and the new correction values obtained is the result of multi-model fusion correction. The calculation formula is as follows:

$$\hat{Z}_{T+1} = \omega_{BP} \hat{Z}_{T+1}^{BP} + \omega_{SVM} \hat{Z}_{T+1}^{SVM} \quad (26)$$

In the formula, $\omega_{BP}, \omega_{SVM}$ respectively correspond to the weights corresponding to BP neural network and SVM error correction values. The flow chart of multi-model fusion positioning algorithm is shown in figure 3.

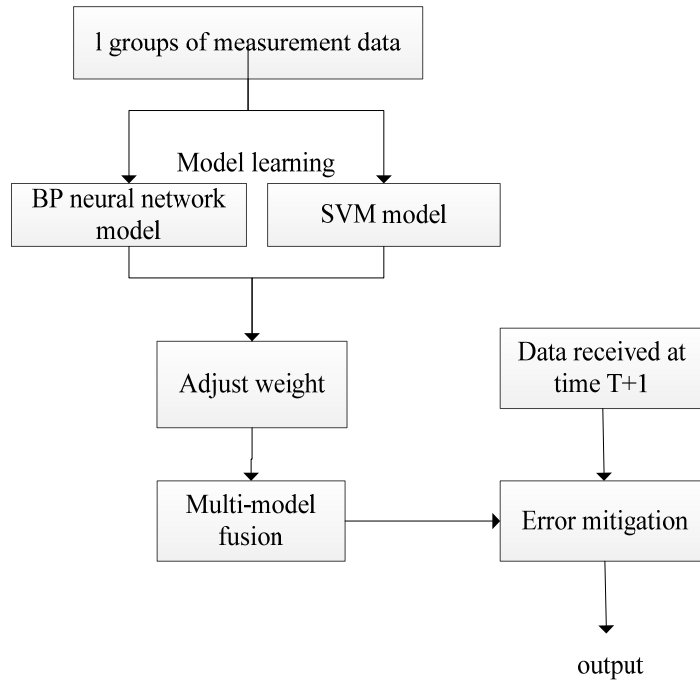


Figure 3: Flow chart of multi-model fusion positioning algorithm

Weight Determination Of Multi - Model Fusion

Fusion model is a model constructed by combining two or more single models according to a certain weight. Because individual models often have their own shortcomings, the error correction values are not all good when they are used in different scenario, so various information of a single model can be combined by using multi-model fusion, so that problems can be comprehensively handled, and the obtained results are higher in correction accuracy and more stable in error than those of a single model.

The linear fusion model selected in this paper takes the minimum square sum of error as the objective function. Define the minimum error sum of squares function as:

$$\min f = \min \sum_{T=1}^I \left[Z^T - \omega_{BP} \hat{Z}_{BP}^T - \omega_{SVM} \hat{Z}_{SVM}^T \right]^2 \quad (27)$$

$$s.t. \begin{cases} \omega_{BP} + \omega_{SVM} = 1 \\ \omega_{BP} \geq 0, \omega_{SVM} \geq 0 \end{cases}$$

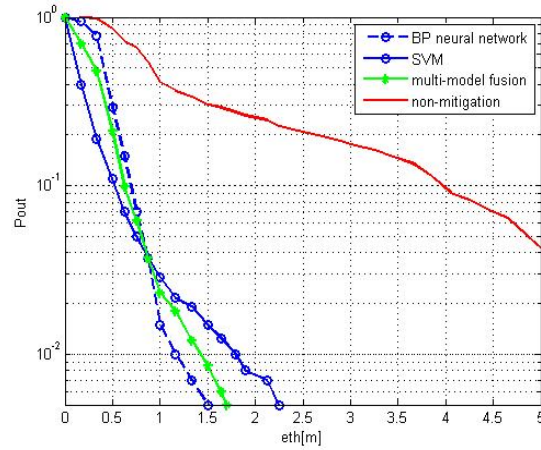
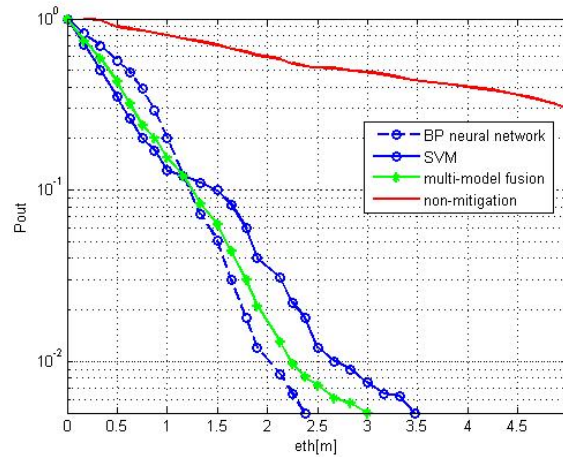
The solution of the above problem belongs to the extreme optimization problem. Lingo can be used to solve the problem. After the weight is calculated, the error correction value of the fusion algorithm can be obtained.

TDOA / AOA Hybrid Location Based On Multi-Model Fusion Algorithm

In order to verify the effectiveness of the proposed multi-model fusion location algorithm, we designed a comparative experiment on the platform of MATLAB 2013 based on the received signal waveform data set. The data set used in the experiment is 1024 measurements (including 512 NLOS measurements and 512 LOS measurements) and their actual values from the MIT measurement competition. We will evaluate the localization performance for a fixed number of anchors $N_b = 4$ and a varying probability of NLOS condition $0 \leq P_{NLOS} \leq 1$. In order to ensure the reliability of the experimental results, we used 10-fold cross validation. In the simulation experiment, we use the calculation result of the following formula as the evaluation index of the algorithm proposed in this paper.

$$P_{out} = \text{Prob} \left\{ \|P - \hat{P}\|_2 > e_{th} \right\} \quad (28)$$

Where P_{out} represents the probability that the 2 norm of the deviation between the actual position and the estimated position is greater than e_{th} . The simulation result is shown in figure 4 and figure 5.

Figure 4: Position Error Probability of Three Algorithms with $P_{NLOS}=0.25$ Figure 5: Position Error Probability of Three Algorithms with $P_{NLOS}=0.5$

CONCLUSION

This paper proposes a multi-model fusion positioning algorithm based on the combination of BP neural network and SVM algorithm, which is mainly used to realize the integrated positioning and navigation inside and outside intelligent tourism. Due to BP neural network and SVM algorithm have different accuracy for error mitigation in different scenarios in different time periods, a multi-model fusion method is proposed to improve positioning accuracy and ensure error stability. Simulation result shows that this method can effectively solve the problem of NLOS error in IR-UWB indoor positioning, and the algorithm has good performance, can adapt to various scenarios, and has a certain application prospect.

ACKNOWLEDGMENT

The authors would like to thank Wymeersch H for providing the dataset of UWB waveforms. This work is supported by the Department of Military Logistics, Army Logistics University of PLA

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Research on Innovation and Strategic Risk Management in Manufacturing Firms (Full Paper)

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ABSTRACT

Chinese manufacturing companies in Bangladesh are committed to achieving optimal investment policy for investors in different industries. The purpose of this research is the strategic risk assessment; where the research approach involves collecting qualitative data through questionnaire survey and compute variables with programmed Rough Set Theory. Researchers have identified a set of key internal and external strategic uncertainties and also accessed the most important attributes from strategic risks. Here, Sector regulation, changing the tax law and organizational governance as the most degree of risk factors in strategic risk analysis. Overall, the focus of our research is to identify strategic risk attributes and proposed a risk assessment framework by demonstrating empirical study analysis of specific industries in Bangladesh those are directly invested by Chinese investors.

Keywords: Risk Assessment, Strategic Risks, Rough Set Theory, Manufacturing Companies.

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INTRODUCTION

Risk analysis involves risk identification, estimation, analysis, evaluation, and control. Assessing risks is an ongoing process; it typically involves an organization engaging in a rigorous analytical process to identify risks and, where possible, to quantify them and the board of directors or senior management to determine the risk tolerance, based on an assessment of the losses of the organization. Subsequent to risk identification, an assessment of the risks concerning their probability of occurrence and the extent of the adverse effect on the entire business ought to be carried out (Khan & Zsidisin, 2011). In conceptualizing different risk management approaches and their associated limitations, we have identified some important factors that need to be given special emphasis while developing a generic risk management framework. Here, in this research paper, our main focus is to identify strategic risk factors with RST mathematical theory. Primarily, we have collected the factors decision by questionnaire survey from selected companies which are invested by Chinese investors in Bangladesh.

In essence, the rough set theory design study is going to be employed to empirically ascertain the extent of such vague attributes. Rough set theory (RST), which is based on knowledge acquisition and discovery, would have a brilliant application prospect in the research topic. In many practical systems, there are various degrees of uncertainty, especially in the data collection process which often contains inaccurate and missing data. RST is a suitable mathematical tool to deal with vagueness and uncertainty (Pawlak, 1995). Considering that the research approach involves collecting qualitative data through questionnaire survey and compute variables with programmed RST theory in this study.

The research process is divided into three stages. Stage 1 involves secondary research in which literature review has been conducted to understand the state of the existing scholarly work related to the topic of interest. The deliverable of the first stage is a tentative list of indicators for strategic risk assessment. The second stage is primary research with the main objective to verify the proposed indicators and data collection. Semi-structured interviews were carried out in recent years to gather opinion and information from the industry. Altogether, 107 usable responses out of around 180 questionnaires from the Chinese company's management personnel were returned and have been analyzed and presented in this paper. In this connection, the user response rate of 62.75% from companies was considered satisfactory and representative of Chinese companies in Bangladesh. The interviewees have given information and opinion on the indicators strategic risk analysis. Then Stage 3 involves modeling by the rough set approach. Through a numerical example, RST is applied for obtaining the importance degree of each indicator in quantitative characterization, that is, to obtain the weight vector of each indicator. Finally, based on the output of the evaluation model, result in interpretation and judgment on risk mitigation as well as validations are demonstrated. The study will explore relevant strategies needed in managing national manufacturing industry growth and strategic risk assessment.

Background of the Study

An organization needs to develop an effective risk culture along with a specific risk identification and management program. Otherwise, the success of any risk management framework would be incomplete. It is found that numerous research studies

have been carried out on risk analysis and risk management. Most of them, however, have focused on particular industries such as nuclear plants, aviation, space exploration, chemical process plants and other areas where the consequence of system breakdown is considered severe or catastrophic for human beings or the environment or where the potential financial loss is significant (Seastroma *et al.*, 2004; Sadgrove, 2005). The utilization of standard risk assessment methodology in the manufacturing industry, in general, is usually limited to food and chemical process sectors. Government regulations, public demand and self-regulatory requirements associated with these industries, basically encourage and in some cases oblige them to implement certain risk management methodologies.

In contrast, lower priority has been noticed in the management of risk in the other manufacturing sectors where the risks are considered to be less than catastrophic and most studies have concentrated solely on the risks associated with safety and occupational health and hazards. These sectors are found to be less focused in their practice for risk management as a part of a self-regulatory system. Both the scarcity in the organizations is found to lack appropriate tools and techniques needed to deal with operational disturbances and their associated risks. In addition, they did not appear to have any systematic approach for self-assessment which would enable them to identify the risk determinants for their businesses academic research literature and practitioner concern supports this claim.

For the past decade, Bangladesh is struggling to achieve optimal investment policy for investors in different industries even though the country's industries are dominated by different risk factors. In order to reduce industry risks and encourages more manufacturing companies to set up and run into an efficient way, must ensure to practices of risk assessment models and way to identify the factors. Various industries or companies will set different risk coefficients or use different evaluation models because of the different tolerances of risk and the different risk attitudes. In the banking industry, for example, the variability of bank stock returns reflects the risks associated with all aspects of bank holding company activities culture to manage and control risks.

Instead of the above scenario, Chinese companies need to emphasize risk management issues to keep up stable growth; also to survive in a foreign country by controlling existing and upcoming risk. In the organization, risk management is an integral part of the decision making and control process that takes into considerations to social, political and engineering factors with relevant risk assessments (Jeynes, 2002; Neuberger, 1991) indicated that because of the different tolerances of risk and the different risk attitudes, various industries or companies will have to set different risk coefficients or use different evaluation models. Although much research has demonstrated the theory of risk management and its positive effects on business performance, there is still a lack of empirical evidence as to how the theory will be applied effectively in manufacturing organizations in the studied sectors, and how the effects occur in practice. So, a gap is prevalent between strategy formulation and strategy implementation. The research also identifies that there are substantial weaknesses in the organizations, in terms of developing a healthy risk management profile.

We attempt to fill this gap and provide empirical evidence of the means by which conceptual limitations in risk management leads to the ineffective application of traditional risk management methodologies. The fact is that significant hazards and operational disturbances are present in every manufacturing organization and an integrated approach which considers operations, employees, assets and the management approach, is necessary to discover the risks and to develop methodologies for managing them.

The Aim and Significance of Research

Investor's motivations for investing in emerging markets and determinants of investment location differ among and across the economic sectors as the importance of a sound investment climate and flow of investment in promoting economic growth in emerging countries (Sun *et al.* 2002). The climate for investment is determined by the interplay of many factors-economic, social, political, and technological -which have a bearing on the operations of a business. Risk management is a pro-active approach to identify, analyze, and manage all potential risks faced by a company. To sustain a business in today's environment, it is necessary to assess the risks faced by the organization and develop contingency plans to mitigate consequences and assure the continuation of critical processes (Pai *et al.*, 2003). Therefore the research titled is well aimed and has significance regarding Bangladesh climate index and risk management for selected companies.

The aim of the paper is to identify the risk factors and the determinants of international investment of emerging country like Bangladesh to make the investment decisions and investigate the relationship among decision factors. After that, to minimize the risk and sustainable growth of Chinese companies, we would like to formulate a risk management model. On the basis of the investigation result, it is expected to draw a model on the basis of the mathematical analytical hierarchical model. From the investors' viewpoint, the study will reveal the rationale of risk management and how best to mitigate risks in their investment. The ultimate object of risk management is to be able to mitigate risk before it occurs. However, risk can't be avoided but can only be reduced to acceptable levels. As different ownership business entity is going to investigate in this thesis paper, it is expected that the findings will be unique regarding the international research also.

Research Organization and Methodology

Consisting of the significance of the study, research organizations have been selected. The target organization is the manufacturing sector of China and Bangladesh. We have selected emerging industrial sector which is invested by Chinese

investors in Bangladesh like Fuel & Energy, Food, Textile & Spinning, Pharmaceuticals industry with collaboration from Bangladesh investors.

The study has followed the same classification as used by BoI (Board of Investment) to avoid any controversy. The total number of Chinese invested listed company at present is more than 450 in BoI. Nature of business of Banks, NBFIs, investment companies, and insurance companies are different from firms of other industries. These industries are also regulated by separate regulatory bodies and laws. Companies are randomly included in Power & Fuel, Food, Pharmaceuticals, Textile & Spinning industries are found to have wide varieties of product offerings that made them unrealistic to be included in a single industry. As to keep the risks categories in similar industries, we have also selected within the same industries when we have compared with few Bangladeshi invested in other industry's companies. We have followed the case study methods to find out more relevant risks for Chinese investors and to justify the business analysis factors.

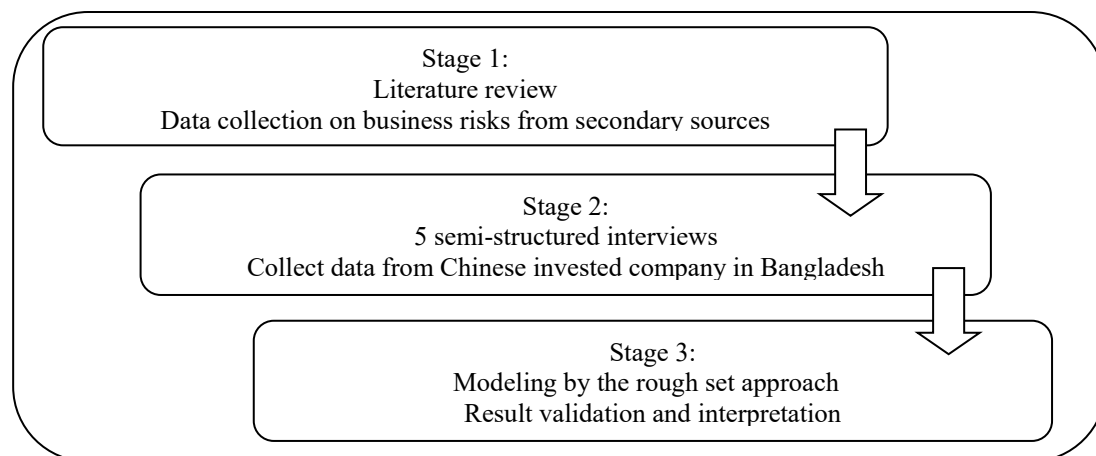
Research Methodology refers to the method and procedure follow in conducting a given research. It clearly entails the steps taken to source data and reveals the techniques employed to arrive at research findings. In order to achieve the desired objectives of the study, the following methodology will be used.

Research Approach and Strategy

Deep diagnoses, analysis and providing a clear presentation of the analysis on the basis of data are mainly required to achieve the proposed objective of the study. To do the required task, the deduction approach will be more meaningful, as it is proven in discovering and uncovering the facts along consistent with the Phenomenology philosophy. Moreover, it is possible to ensure more flexibility to the researcher in determining research emphasis as the research progress by this approach. The data analysis process involves several steps to transform the gathered data into a more convenient and interpretable form. As the thesis is going to deal with qualitative research, collected data and information will be analyzed through the qualitative approach.

This study is absolutely descriptive in nature. The core purpose is to examine the business risk analysis factors and also indicate the economic variables. In essence, the rough set theory design study is going to be employed to empirically ascertain the extent of such vague attributes. Rough set theory (RST), which is based on knowledge acquisition and discovery, would have a brilliant application prospect in the research topic. In many practical systems, there are various degrees of uncertainty, especially in the data collection process which often contains inaccurate and missing data. RST is a suitable mathematical tool to deal with vagueness and uncertainty (Pawlak, 1995). Considering that the research approach involves collecting qualitative data through questionnaire survey and compute variables with programmed RST theory; also with statistical models specified in this study.

The research process is divided into three stages as shown in figure 1. Stage 1 involves secondary research in which literature review has been conducted to understand the state of the existing scholarly work related to the topic of interest.



Source: Authors' Calculation

Figure 1: Research Process

Also, various sources such as company annual reports, trade journals, databases, and the internet were consulted for collecting data and information especially on the company's business risk and risk management. The deliverable of the first stage is a tentative list of indicators for business risk assessment. The second stage is primary research with the main objective to verify the proposed indicators and data collection. Five semi-structured interviews were carried out in recent years to gather opinion and information from the industry. The interviews were targeted at the management personnel of various BoI (board of investment of Bangladesh) listed Chinese invested companies in Bangladesh and some targeted experts from this risk management fields which are the most relevant for the study topic. Companies represent a natural choice since they are investing and doing business in Bangladesh and are in charge of the business. The companies have domain knowledge in business management including the handling of the associated business risks. As for other research and rating companies, they

are professional organizations in managing risks by underwriting risks policies, thus being able to provide relevant information and opinion on the subject matter. Though the interviews were performed in Bangladesh, the organizations involved are all international entities serving a wide coverage of the global market. The organizations are among the largest investment in Bangladesh in their respective industry sector. The interviewees have given information and opinion on the indicators business risk analysis. A minor adjustment was made to the list of indicators according to the interview outcome of Stage 2. Then Stage 3 involves modeling by the rough set approach. Through a numerical example, RST is applied for obtaining the importance degree of each indicator in quantitative characterization, that is, to obtain the weight vector of each indicator. Finally, based on the output of the evaluation model, result in interpretation and judgment on risk mitigation as well as validation is demonstrated. Details of the rough set approach will be presented in later in the section.

Research Data Collection

Data can be described as facts, observations or information in isolation and relating to the subject of the study. Generally, there are two types of data, primary and secondary data. Significance portion of this study will rely heavily on secondary data which are normally published for the consumption of various users. Where it deems necessary and compelling, the primary data which is to be sourced directly by the researcher will be used to complement the quantitative findings. The two main types of data are hereby explained below. The primary data refers to the data the researcher sourced by himself. It is normally acquired through various means of instruments and is often regarded as a raw data which is not manipulated by any other person. The secondary data is the data that has been sourced, recorded and published by someone else or by an agency or institution which is legally authorized to document such information. The more authentic the custodian of the data is the more the reliability of the data. The advantage of secondary data is that most at times it is subjected to through verification, editing, and authentication by authority concern before finally published, this makes the data reliability strong and acceptable. In this study, the bulk of the data to be used is going to be sourced from the several issues of the Central Bank of Bangladesh Statistical bulletin. Other secondary data sources include the National Bureau of Statistics, (NBS), World Bank report, United Nation Trade, and Development Conference (UNTACD) and so on.

Sampling Methodology, Instrumentation, and Procedures

On a broader perspective, the study of risk analysis on Chinese invested companies in Bangladesh could either be based on a micro or macro level. Some studies use industries aggregate data to assess the relative impact of risk on company performance, while some studies focus on one country investment and some are the focus on the factors relative to specific sector-wise investment. However, most of the studies of risk analysis pass-through were conducted in advanced countries where data are very much available both at country or industry level. In the case of this study, the researcher intends to use the primary data that relates to the company risk variables and economic to country factors specified above for statistical computation and analysis. Bangladesh as a small open-economy lacks sufficient industrial and others data that will permit research into specific industries as done in advance risk analysis and management. Therefore, in terms of the mathematical computation company, specific risk factors are to be included as a whole. In other words, the researcher intends to use the primary questionnaire of the estimated values of the variables under investigation rather than taking the sample of other previously collected data related to countries or specific industries.

However, for the primary source of which comprises the use of interviews or questionnaire, where possible, judgmental sampling technique will be employed to select the appropriate number of respondents. Since the findings of this study are strictly going to be based on quantitative data, the small sample size of the respondents will be used to ensure adequate representation of all the selected industrial participants of the Chinese invested company's personnel in Bangladesh. The process of gathering the primary data is summarized as follows:

The needs for data in this study are intensive that warrants the necessity for the field trip. The researcher intends to embark on the trip back to Bangladesh to source relevant data that would not be obtainable on the internet. Most data relating to the risk variables under study can only be accessible to contact directly with company officials. Similarly, during the field trip, I will visit four major commercial cities of Bangladesh where have EPZ with Chinese investment to interact with the major participants of the foreign exchange market in the country.

The technique of focus groups will enable the researcher to define and target relevant participants of the foreign investment in Bangladesh and also company top managers to systematically have faced -to- face brainstorming with them. The rationale is to generate ideas that would not be readily available in published sources. How they have faced some specific risks and some sensitive risks that will not be disclosed? Then, what attributes of risk more important for some industries? How they face, especially for Chinese management to work with local experts? After that can be arranged a focus group discussion with industry experts to get the opinions. All these are some of the fundamental issues which can only be clarified through formal discussions with people concerns to articulate the relevant information relating to the actual effects of exchange rate volatility.

Where applicable the questionnaire may be used by the researcher to acquire relevant information which might be difficult to obtain during the face-to-face discussion, in such a situation a structured questionnaire format will be constructed using 5 point likert-scale to sample the opinions of the respondents more conveniently.

Data Analysis and Interpretation

The data analysis process involves several steps to transform the gathered data into a more convenient and interpretable form. As the thesis is going to deal with quantitative research, collected data and information will be analyzed through a quantitative approach. Most researches in qualitative and quantitative finance involve collection and computation of numerical data that can be subjected for empirical analysis. This study aims at utilizing quantitative data to draw inferences. The researcher intends to use the following software statistical packages for the computation.

In this research calculation, the researcher has made a customized programming to risk analysis with RST theory. That software will work as other statistical software, but it is programmed only for risk management analysis by using this research method. It deducts the attributes and dissemination table. Furthermore, it will help to calculate risk assign value and predict the analysis result.

The SPSS package will also be used to augment the RST approach. SPSS will be used in the empirical presentation of data, plotting charts, and frequency table. The package is very essential in data tabulation and computation of mean and standard deviation. In the situation where questionnaires are used, the SPSS will be used to conduct the reliability test and compute the qualitative responses in a form that will suit the analysis and enable draw authentic inferences. In order to accurately document the references refer in this study, endnote software is used which provide easier means of recording references, and APA style referencing is used throughout the study.

LITERATURE REVIEW

The term risk can be defined and explained in many different ways depending on the aim and perspective of a discussion. Kaplan & Garrick (1981) stated that a risk is an uncertainty combined with damage or a loss. They mean that something that is uncertain does not have to incur a risk; however, if an event is considered as both uncertain and a loss is included, it can be defined as a risk. The research on the international investment decisions in emerging countries and risk management is getting concentration again because of the current stage of the world economy is a tremendous force that greatly affects the activities of multinational firms in general (Bartlett & Ghoshal, 2000; Dunning, 2005) go further and stress that firms from developing countries may seize the opportunity to move overseas even if they do not necessarily have any specific advantage based on superior technology or competitive products. Most of the studies on international investment decision location using micro-level data focus on variables such as Research and Development (R&D), factor cost differences, advertising expenditures, wages, trade cost, market size, and taxation (Carr, Markusen, & Maskus, 2001; Disdier & Mayer, 2004; Hanson, Mataloni, & Slaughter, 2001).

Some of the studies have concentrated on the regulatory framework and government influence on the growth and patterns of geographical and sector-wise distribution, as well as the investment motives of Chinese companies (Hong and Sun, 2004; Taylor, 2002; Wang, 2001; Wong and Chan, 2003; Zhan, 1995). Other studies have applied an international management perspective, focusing on the internationalization strategies of Chinese companies (Buckley *et al.*, 2007; Child and Rodrigues, 2005; Deng, 2008). Dollar, Hallward-Driemeier and Mengistae (2006) analyze the importance of the investment climate on export and international investment probability for eight Latin American and Asian countries using firm-level data. On the other side, many uncertainties are affecting the business operating environment of an organization. Many of them are unpredictable and would occur suddenly, they include financial crisis, terrorist attacks, and natural disasters. These risks can have the significant impact on both the short- and long-term performances of a business organization (Tang, 2006) and organizations are likely to suffer loss if they do not actively manage these risks.

Johanson and Vahlne (1977) are among the first to discuss the internationalization process and state that understanding the marketplace or having market knowledge is essential for making new market commitments. It is also indicated that the globalization of financial markets and the complexity of financial products have increased investor uncertainty and risks. They demonstrated investment projects under uncertainty and risk using break-even analysis, sensitivity analysis, and game theory. Orbett (2004) applied multi-criteria decision models and used multi-group hierarchical discrimination to classify countries into four groups and obtained similar classification results. By considering alternative scenarios generated by a risk management process, an organization can judge their respective merits, select solution and undertake the implementation.

Risk Management using RST theory

The concept of rough sets was introduced by Pawlak (Pawlak, 1991; Pawlak & Skowron, 2007) as an extension of the set theory, which allows defining an approximate classification of the given set of data objects (data universe) in presence of data vagueness. The basic assumption is that every object present in the considered data universe can be described using only the available associated information. For example, information associated with a portfolio of financial assets forms a data universe, where each individual transaction represents an object described by properties of the used financial instrument and associated characteristics, transaction size, value, trade date, etc. The rough set approach was criticized for its requirement to discrete data (Grzymala-Busse and Ziarko, 2000), strict definition of lower and upper approximations (no fuzziness) and sole reliance on the available data to induce knowledge about the real world. Consequently, the rough set theory has been studied intensively since their introduction and numerous extensions have been proposed, which alleviate many of the above-mentioned limitations and allow the use of rough sets beyond the pure supervised learning-based data classification domain (Pawlak and Skowron, 2007); Shen and Jensen, 2007).

The risk management understood as the way to discover and predict the possibility of financial losses, business failures, and financial crises, has an obvious and prominent importance for economic ecosystems. Among many types of risk, the valuation of a solvency risk or the assessment of the business risk likelihood is of great interest to the financial sector in particular and the public in general. The ability to correctly classify a transaction counterparty or security issuer (be it a commercial company or a sovereign) according to its bankruptcy likelihood (credit scoring) allows one to correctly price it into the transaction or reject it altogether if the risk is deemed to be too large. The plausible assessment of financial health is also crucial in the heavily regulated financial services sector, where mere rumors about solvency problems may cause a deep financial stress to the affected financial institution, market panic, and liquidity squeeze, resulting in the country- or worldwide financial crises.

It is even important to develop alternative methods for credit assessment as well as propose ways to verify the given credit rating and explain the rationale behind it, without knowing the actual methodology employed by the rating agencies. Consequently, these problem areas attracted a lot of research attention – an early survey of Dimitras *et al.* (1999) showed the usage of methods ranging from the discriminant analysis and logit/probit models to recursive partitioning (tree) algorithms and expert systems. A more recent discussion of empirical research on financial crises and business failures in the banking sector and the artificial intelligence methods proposed for their prediction was given by Demyanyk and Hasan (2010).

An early work of Slowinski and Zapounidis (1994) applied the rough set theory classification approach to the problem of credit scoring for a sample of 39 companies described by a set of 12 conditional attributes, being a mixture of selected financial ratios (quantitative attributes) and descriptive variables (qualitative attributes). Each company in the learning set was assigned a credit score (decision attribute) by a domain expert. The numerical (quantitative) attributes were discretized into qualitative ranges using the experts' opinion (i.e. using the best practice with regards to the interpretation of financial ratios). Based on the decision system, the significant set of conditional attributes (reduces) and resulting if-then rules were generated. The authors pointed out the importance of qualitative input variables in the induced decision rules (e.g. management experience), which were not considered by traditional quantitative risk models.

Slowinski, Zapounidis and Dimitras (1997) continued to research the application of classical rough sets in the business domain by applying it to the problem of predicting a company acquisition, based on a sample of Greek companies. The rough set based prediction delivered a classification accuracy of 100%, 75% and 66.7% for 1, 2 and 3 years before the acquisition, respectively. Objects not matching any of the generated rules have been assigned the 'closest' rules – a distance measure based on the valued closeness relation (Mienko *et al.* 1995) has been introduced for this purpose. The other advantages of the rough set approach were also presented, like the ability to deliver a minimal subset of significant attributes (reducts) or the possibility to generate human-readable if-then rules. Furthermore, an empirical evidence of advantages of rough sets vs. discriminant analysis, especially their explanatory power, was shown.

Dimitras *et al.* (1999) compared the effectiveness of the rough set model with that of discriminant analysis and logit models, applied to the case of Greek companies. In comparison to Slowinski *et al.* (1997) and Slowinski and Zapounidis (1994) a relatively larger learning and test samples of firms (80 and 36, respectively) across several industrial sectors were created and similarly, an expert judgment used to identify conditional attributes (12 out of 28 financial ratios) and discretize the entry dataset. Similarly to Ruggiero (1994), authors reported a better predictability using rules generated with the rough set approach against the results of a discriminant analysis, whereas the effectiveness of rough sets and a logit model were comparable. The effectiveness of the valued closeness relation (VCR) approach to classifying objects not exactly matching the generated rules was also confirmed (VCR helped to correctly classify 60% of previously not classified objects). The availability of the minimal set of most significant attributes (the selected reduct had 5 variables) and resulting compact decision rules was quoted as additional advantages of the rough set approach. The authors admitted, however, that the induced rules were most relevant to the bank and the expert user, who delivered the data sample and selected decision rules.

Another empirical confirmation of rough set theory suitability for the business failure prediction was delivered by McKee (1995). The author used the rough set methodology to construct a company failure prediction model generated and tested using financial report data for years 1986 – 1988 of a sample of 200 US companies, whereas 100 companies constructed the learning sample and another 100 the testing sample. The information table had 8 conditional variables, being financial ratios selected arbitrarily based on prior research and the author's experience. The author used decision class rule strength and valued closeness relation based classification for objects having no exact match to the generated rules. The model accuracy was given as 93% for the learning sample and 88% for the testing sample. The model accuracy was much better than that of the recursive partitioning method developed previously using the ID3 method (McKee 1995), which when applied to the same data sample had an accuracy of 65%. A related work and findings were published by Liu and Zhu (2006), who applied the rough set theory to the analysis of construction industry in China, using a sample of 16 financial ratios for 296 Chinese construction contracting companies.

Similarly to Bose (2006), the authors used the ROSETTA software and noted the better performance of the rough set model in classifying negative samples (unhealthy companies) than the positive ones. They have also noted a large number of reducts and redundant rules. The constructed rough set model had 5% to 10% worse classification rate than the other methods tested (decision tree, logistic regression, and neural network). Sanchis *et al.* (2007) provided a discussion of financial crisis and insurance company insolvency phenomena and proposed explanatory models for both the macro- and microeconomic problem

based on the rough set theory. The authors mentioned the dominance relation rough sets, introduced by Greco, Matarazzo and Slowinski (1998), but decided to use the classical rough set theory based on the observation that the considered financial ratios exhibit complex correlations which prevent the applicability of the dominance relation.

Greco, Matarazzo and Slowinski (1998) showed the usability of the rough set model to the generation of decision rules, which describe the rating process, based on the data set containing the rating information. The authors applied the rough set model to the data sample describing the investment risk ranking of 52 countries as compiled by the Wall Street Journal using 27 indicator variables. An extension of the rough set model able to cope with incomplete information was also described and used to generate the decision table, as 9.5% of data were missing. Bioch and Popova (2003) introduced a related method of rough set-based analysis based on the concept of the monotone discernibility matrix and monotone reduct. The authors showed the applicability of the proposed model to the case of the bankruptcy risk analysis and compared the effectiveness of the proposed approach with this of the dominance based rough sets.

Shuai and Li (2005) used a combination of rough sets and worst practice data envelopment analysis to construct a business failure predicting model for Taiwanese companies. The model used 9 quantitative and 4 qualitative input variables derived from annual reports for years 2003-2004 of 396 firms (352 going concern and 44 failed). The DEA model was used to classify the input sample based on quantitative variables. Rough sets were used to generate classification rules based on qualitative variables only. The authors reported a 100% accuracy of the analysis.

Trends in Chinese investments in Bangladesh

The emerging trends in Chinese investments in Bangladesh need to be analyzed in the context of Chinese foreign direct investment (FDI) as a whole. China began to make investments abroad with the onset of the economic reforms in the late 1970s. Initially, the amount of capital was limited and outward investment was dominated by the state-owned enterprises (SOEs). By the late 1980s, China not only opened up its economy welcoming foreign capital, technology, and expertise but also encouraged its own enterprises to invest abroad. Subsequently, overseas investment became one of the major elements in [China's] economic development strategies (Wu and Chen 2001: 1236-37). Since 1991, more and more Chinese corporations started to invest overseas to develop new markets, increase exports, exploit advantageous local conditions and obtain resources

Although starting from near zero in the early 1970s and early 1980s, by the end of 2010, more than 13,000 Chinese companies/corporations had established about 16,000 overseas enterprises, spread over 178 countries, with accumulated outward FDI standing at US\$317.21 billion. In the case of Bangladesh, the volume of Chinese investments is not particularly noteworthy; until 2010, Bangladesh did not get much priority. Between 1977 and 2010, China invested only US\$250 million; however, in 2011 alone, it invested some US\$200 million (Imam 2012). (In this paper the terms outward FDI and overseas direct investment are used interchangeably).

Chinese Investments in Bangladesh

FDI has played a key role in the development of the Bangladesh economy. FDI volume increased in Bangladesh from an inflow of US\$666 million in 2007 to US\$1.136 billion as of 2011 (Board of Investment, Bangladesh 2011). There is also an increase in Chinese investment in Bangladesh (Tables 1 and 2) It is also notable that China was the third-largest investor in Bangladesh after Saudi Arabia and South Korea in the year 2009-2010 recording 12 projects amounting US\$21 million (Table 3) (Board of Investment, Bangladesh 2011).

Most Chinese projects in Bangladesh fall in either the infrastructure or service sectors. China has built six bridges in Bangladesh – the important 4.8 km-long Mukhterpur Bridge over the river Dhaleswari, built by China Road and Bridge Corporation, was inaugurated on February 2008. The agreement to build the 7th China-Bangladesh Friendship Bridge at Kajirtek in Madaripur was signed in January 2012 and the consultations are ongoing with regard to the 8th China-Bangladesh Friendship Bridge (*Financial Express* 2012). Furthermore, China is also interested in investing in the Padma Bridge2 and some Chinese firms have come up with specific offers in this regard. Poly Technologies, a state-owned construction company in China, for instance, has proposed an investment of US\$2.4 billion in the project, which will be financed by the Exim Bank of China (*Daily Star* 2013, *Prothom Alo* 2013a). In July 2012, another Chinese company Spare Energy Creations Australia Pty Ltd (SECA) also submitted a proposal for building the bridge with the Chinese government proposing to bear 70 percent of the cost (Imam 2012).

Bangladesh merited more attention from China as an investment destination. During the visit of the then Chinese vice-president Xi Jinping to Bangladesh in 2010, China agreed to provide RMB40 million (approximately US\$6.5 million) as the grant under an economic cooperation agreement and two agreements were concluded, one for a fertilizer factory and another for a telecommunication project.

The competitive low wage is one of the major reasons for increased Chinese interest in investing and relocating some of its companies to Bangladesh. Alongside, strategic location, regional connectivity and worldwide access, growing local market and growth, proven export competitiveness, advantageous trading agreements, attractive business and investment climate, competitive cost base, fiscal and non-fiscal incentives and export processing zones" are important factors that attract Chinese

investments to Bangladesh (Board of Investment, Bangladesh 2011). Another significant point is that Bangladeshi environmental laws are much more flexible than those of China.

Challenges and Opportunities in Bangladesh

There are a number of challenges regarding Chinese investments in Bangladesh such as poor infrastructure and political instability. Shortage of electricity and gas is the main hindrance for foreign investments in Bangladesh. According to the World Bank's *Doing Business 2012* report, in 2005, foreigners needed 185 days to get the permission for construction in Bangladesh and it worsened to 201 days in 2011; similarly, the days required for getting electricity connection in industries in 2011 was more than a year (372 days).

Table 1: The position of Bangladesh of ease of doing business

	Bangladesh	China	India	Pakistan
Starting Business	19	38	29	21
Construction permit	201	311	227	222
Registering property	245	29	44	50
Getting electricity	372	145	67	206
Overall Rank	122	91	132	105

Source: World Bank, 2012.

Another important determinant for FDI is the political risk factor. The home country wishes to make sure that host countries are politically stable in order to avoid production disruption, damage to property, threats to personnel and so on. According to the *Global Investment Report 2012*, countries in the South Asian region rank high in the country risk guides of political-risk assessment services and this has deterred FDI inflows. Bangladesh, for example, sees frequent *hartals* or strikes and political violence. Another challenge is regional geopolitics and the internal political dynamics of Bangladesh. Like India, China is also often used as a trump card in Bangladeshi politics for political gains.

Although there are challenges for Chinese investments in Bangladesh, there are also several opportunities. Since Bangladesh has enough cheap labor, particularly in the RMG sector, China should utilize it but in order to be a win-win situation, Chinese companies should also ensure the minimum wage for laborers. It needs to be noted that while in the first half of 2012, FDI inflows declined by 11 percent in developing Asia and 40 percent in South Asia, strong interest by foreign investors in manufacturing, especially in garments, helped keep FDI inflows to Bangladesh at a relatively high level, at about US\$430 million in the first two quarters in 2012. The energy sector can be another area for Chinese investments since the energy demand of China is growing and Bangladesh is rich in energy resources. According to Energy Information Administration, Bangladesh has proven reserves of 5 trillion cubic feet (tcf) of natural gas and the potential to meet the rising demand for energy in Asia. Needless to say, this huge volume of energy reserves can be an opportunity for further Chinese investments.

MODELING THROUGH ROUGH SET THEORY

This paper studies strategic risk in Bangladesh for Chinese manufacturing company which faces high uncertainty and dynamism in a multi-facet environment. After a comprehensive literature review, we propose the Rough Set approach firstly introduced by Pawlak, (1982) as a new solution tool for risk factor identification, which has successful applications in data mining, prediction, control, pattern recognition and classification, mechanism learning, and decision analysis. The concept of rough sets was introduced by Pawlak (Pawlak, 1991; Pawlak and Skowron, 2007) as an extension of the set theory, which allows defining an approximate classification of the given set of data objects (data universe) in presence of data vagueness. The method classifies the study objects into similarity classes containing objects that are indiscernible. The condition of company uncertainties and risk management is usually dynamic and hard to predict, which leads to difficulty in finding pre-requisite knowledge. RST does not require any preliminary or additional information about the data, unlike requiring the grade of membership or the value of possibility in fuzzy set theory used in previous risk studies. (Grzymala-Busse, 2014; Kusiak, 2001).

Set Information Table

$U = \{1, 2, 3, 4, 5, 6, \dots\}$ represents the study objects, i.e. a set of company managers evaluation value about strategic risk factor, represents the all risks evaluation indicators as explained in uncertainties assumption section. Based on interview data, from the evaluation value by the company, regarding the probability of occurrence of an event, it is advisable to compare several points of view. They are also assessed on a scale of 0 to 5, where 0 is the lowest and 5 is the highest probability. Assessments based on the worst impact and probabilities are not representative and cannot be used. In addition, the outcome of the investment is represented by $D = \{\text{outcome}\}$. 'Y' stands for 'loss', and 'N' means no 'loss'.

Table 2: Initialized Information 'S (Sample of Strategic risk attributes)

	SR1					SR2		SR3		SR4		SR5	
U	SR 11	SR 12	SR 13	SR 14	SR 15	SR 21	SR 22	SR 31	SR 32	SR 41	SR 42	SR 51	SR 52
1	5	4	3	2	2	2	*	5	3	2	4	1	3

$$\text{Assessment value of risk} = W_{ij} \times \frac{\sum_{i=0}^n C_{ij}}{n} \quad [8]$$

The comprehensive value of risk factor can be calculated as;

$$W_j(j) = \frac{\sum_{k=1}^r W_k \cdot x_j^k}{\sum_{k=1}^r W_k} \quad [9]$$

Index $j(j=1, 2, \dots, n)$ given by k 'th expert ($k=1, 2, \dots, r$) and W_k is the weight of expert k

STRATEGIC RISK ANALYSIS USING RST

Strategic Risks attributes' literature suggests the core business environment, regulatory environment, brand and communication, Strategic information and behavior of any organization. Particularly it has suggested that firms should create proactive management practices that improve strategic risk-taking by preparing for the inherent uncertainty of strategic. Based on the literature, we have listed all types of risks and coding for our calculation with RST methodology.

Descriptive Statistics for Risk Assessment

Investor's motivations in international investment for investing in emerging markets and determinants of investment location differ among and across the economic sectors. However, certain general factors consistently determine which markets attract the most international investment. A sector-wise analysis of international investment reveals that China investors have so far made a major shift in their investments in Bangladesh from the Textile sector to another sector. Sector-wise analysis of international investment inflow shows a shift of international investment that has been made towards power and energy, manufacturing (especially in RMG) and agricultural industry and trade and commerce whereas, telecommunications, Food, Cement, Computer Software and IT Chemicals and Pharmaceuticals, NBFI sectors have been neglected from some year.

Table 4. Characteristics of the participating companies

Classification	Criteria	Number of organizations	Percentage Organizations (%)
Business category	Textile and wearing sector:	61	35.67%
	Chemical sector	47	27.49%
	Engineering sector:	38	22.22%
	Others	25	14.62%
Types of entry	Green Field	53	30.99%
	Joint Venture	118	69.01%
Amount of Investment	Over 0.1 (Mn. US\$))	11	6.43%
	Less than 0.1 (Mn. US\$))	160	93.57%
Location	Dhaka	137	80.12%
	Chittagong & others	34	19.88%

Source: Authors' Calculation

The list of invested companies selected for the mail survey and case studies was compiled from a variety of business databases from Bangladesh and as well as China also; these were randomly chosen to represent a range of manufacturing groups. These groups covered the four sectors of (1) metal-based product and equipment manufacturers, (2) wood and wood-based product manufacturers, (3) paper- and plastic-based product manufacturers, and (4) textile and garment manufacturers. These groups were selected because of the investment nature and their economic importance to Bangladesh. The characteristics of the participating companies in the mail survey are presented in Table 4.

In our mail survey, we could contact with almost 171 firms and get the acceptable survey results are nearly over from 100 companies. From Table 6.1 we can characteristics the selected companies in our survey. Among the companies, the Textile and wearing sector are the leading in almost 35.76% and then Chemical sector 27.49% and the rest of the others. Textile and wearing sector would be the representative in this survey because of the huge investment from Chinese investors and besides this is the leading industry in Bangladesh. Beside this, investors are interested to invest in another sector also. From our survey replay, we can find the more location choice in the capital of Dhaka and the business capital in Chittagong of Bangladesh. Most of the companies from Chinese investment are in the joint venture, it's almost 69.01% of our survey and invested more companies in less than (Mn. US\$). Comparatively, Greenfield companies are also increasing the number of investment in Bangladesh. Finally, we have used our RST methodology to find out the risk attributes and risk analysis based on our survey companies.

Strategic Risk Analysis Results through Rough Set Theory

Rough set theory (RST), which is based on knowledge acquisition and discovery, would have a brilliant application prospect in the research topic. In many practical systems, there are various degrees of uncertainty, especially in the data collection process which often contains inaccurate and missing data. RST is a suitable mathematical tool to deal with vagueness and uncertainty (Pawlak, 1995). The study uses Rough Set method to classify and judge the risk attributes related to company risk analysis in

Bangladesh. This is very crucial for any risk analysis since the reliability of research outcomes significantly depend on the attributes' weight (Belton and Stewart, 2002). The focal point of this paper is to quantify the importance degree of each factor and to build a mathematical model that comprehensively evaluates the risk exposure of Chinese invested companies in Bangladesh and demonstrate a framework for risk assessment also to risk management. It is also an original attempt to use the rough set approach for Business risk problems. The novelty of this study is to address the concern of objective and precise weight of the factors in the framework of RST.

Here in this study, we have set up a risk attributes table for categorizing risk type; Strategic risk based on the literature review and company case study. After that, we have calculated the degree of importance of each risk attributes through this equation. Then the importance degree of each indicator can be calculated by using *Equation 5* and find the risk of attributes and ranked by *Equation 6*.

Strategic Risks attributes' literature suggests the core business environment, regulatory environment, brand and communication, Strategic information and behavior of any organization. If any business can identify and manage it effectively that would be the overall competitive advantages of any firm management.

Table 5: Risk Attributes for Strategic Risks

Code	Kinds of Risks	Types of Risks
SR11	Country Risk	Business environment SR1
SR12	Monetary Reforms	
SR13	Economic environment	
SR14	Investment capital	
SR15	Investment and lenders	
SR16	shareholders	
SR17	Business partner	
SR18	Competition	
SR19	Industry moves	
SR21	Sector regulations for competitors	Regulatory environment SR2
SR22	Business and tariffs	
SR23	Environment regulations and trade	
SR24	Changing law tax	
SR25	Government Regulation	
SR31	Reputation	Brand and communication SR3
SR32	opinion and trend	
SR33	License	
SR34	New products	
SR35	Marketing education	
SR41	General strategy	Strategic information SR4
SR42	Strategy analysis	
SR43	Investment environment and acquisition	
SR44	Substitution of products	
SR45	Entry-Exit strategy	
SR51	Organizational design	Organization behavior design SR5
SR52	Governance	
SR53	Employee Retention	

Source: Authors.

Particularly it has suggested that firms should create proactive management practices that improve strategic risk-taking by preparing for the inherent uncertainty of strategic decisions (Chatterjee *et al.*, 2003).

Based on the literature, we have listed all types of risks and coding for our calculation with RST methodology (Table 5). In the types of Business environment (SR1), it includes the country risk assuming the political and others indicators inside of those factors, and then also considers the Economic environment, Investment capital, Industry moves, Competition. In the risk types of Regulatory environment (SR2) includes the tax, business law, Government Regulation and industry sector regulation which indicates the easiness of doing business in any country. Brand and communication (SR3) are other important risk factors for companies, especially for international business. It upholds the uncertainty attributes like reputation, license, opinions, and

trends of that host country and also the marketing education of the business participants and country. It is very important to upgraded with information and achieve the capacity to use that information strategically. So, companies should concern about those information uncertainties, Entry-Exit strategy, Strategy analysis Investment environment and acquisition Substitution of products to identify those related risks and management for international companies. Governance, Organizational design are attributes of Organization behavior design (SR5) risks in the category of strategic risk management analysis.

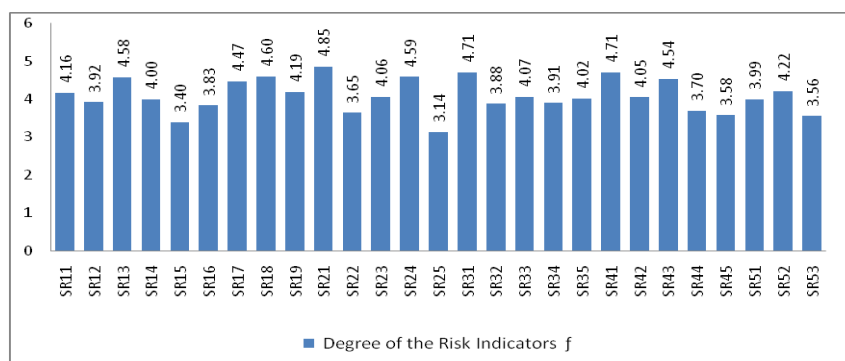
Calculate the Importance Degree of the Risk Indicators

After identifying the uncertainties and categorizing in major risk types, we set the data table and put in RST software coding to Initialized Information (Table 3). To find out the significant risk attributes, the weighted average function is used (Equation 5) to calculate the most significant risk evaluation indicators. Thereafter, the importance degree can be normalized for easier comparison. The importance degree of the Risk Indicators is shown in initial value f in Figure 1. We have also calculated the normalized value of all risk attributes of strategic factors for easier comparison. In another word, these factors are the risk indicators from getting the survey result from company managers and calculated with RST methodology. It may give the results of from the company's viewpoints and depends on the industry environment.

To illustrate the degree of risk importance from the above table, we can find the most important attributes from each risk types. In the risk types of business environment (SR1), the competitive environment is the most degree of importance and the economic environment is the second most important factors for business in Bangladesh for Chinese companies which indicates the normalized risk value of SR18=0.042) and SR13=0.042) respectively. Chinese companies emphasize on the business partner (SR17) and industry moves SR19) in doing business outside which calculated risk value is 0.041 and 0.038. In the Business environment (SR1) risk types, the important factor is the country risk and monetary reforms. But in the case of survey result, it gets the less risk value for assessment.

Regulatory environment (SR2) represents the sector's regulations for competitors (SR21=4.84) and changing the tax law (SR24= 4.58) as the most degree of risk factors in that segment. Business tariffs in less degree of impotent because of having the tax free zone in Bangladesh for foreign investors. Finally, environmental regulation is the last important factors among the regularity environment risk types.

The category of risk type, Brand and communication (SR3) has got the highest value for Reputation (SR31= 0.043) License (SR33=0.037) as the most important degree of risk indicators. Then, the others risk factors are not most significant. In SR4, Strategic information management achieves the highest points for the general strategy and investment environment and acquisition, which deserves the most important factors for investment outside of the country. The last types of risk in strategic risk attributes are organizational behavior (SR5). Here, organizational governance (SR52= 0.038) and design of the company management (SR51=0.036) shows the highest degree of importance in that category and getting the less important degree of risk as employee management.



Source: Authors' Calculation

Figure 2: Importance Degree of the Risk Indicators

To illustrate the degree of risk importance from the above table, we can find the most important attributes from each risk types. As an example, in the risk types of business environment (SR1), the competitive environment is the most degree of importance and the economic environment is the second most important factors for business in Bangladesh for Chinese companies which indicates the normalized risk value of SR18=0.042) and SR13=0.042) respectively.

Risk Analysis and Comparative Risk Ranking Analysis

As illustrated in Table 3, the relative significance of risk factors can be revealed and quantified. Further risk factors can be valued by calculating $Q_{ij} = W_{ij} \times V_{ij}$ and also with the equation from previous parts which derives the expert opinions can be used to calculate and evaluate the risk exposure of Strategic. Like those normalized values obtained from the table of the degree of risk indicators which is given by the experts and averaged from informational decision table, that's given as per values of risk uncertainties from lower to higher given risk. Thus the finally risk knowledge expert(s) illustrates a risk importance and compare with risk ranking, that's values having the highest Q value represents the greatest risk in that sectors.

From table 6, we can find the degree importance of risk value which is calculated by normalized risk value and the multiplication of expert opinion or the average information table value. For simplicity, we are using one by one to indicate the risk factors. Same as the first category of risk types, Business environment (SR1; the country risk (SR11= 0.1556) is the highest degree value of risk indicators after multiplying with expert opinion's value. This method is also justified our methodology and more validity of risk factors by comparing with experts value and with risk degree importance. This country risk factor was the less degree importance in degree indicator table, but here experts give them more important in the basis of the recent country situation in Bangladesh. It was more political unrest in recent times. Then, in the risk analysis, we can find out the next highest value of the economic environment (SR13=0.154), which indicates the same ranking value as the degree of importance (ω). Among the risk factors in the business environment risk types, the competition (SR=0.148), industry movement (SR=0.1249) are getting the significant value from experts opinions. The other factors like investment capital, monetary reforms, and business partners have less risk significant in the business of doing in Bangladesh for Chinese manufacturing companies.

Regulatory environment (SR2) shows the changing tax law and sector regulations for doing business are the main risk factors for companies which indicates the value as SR24=0.148 and SR21=0.138 respectively. If we find risk rank in table 6, we can find the same risk rank as the risk of degree importance of risk table. So we can assume that experts' opinion and the company managers' survey answers come into the same decision.

License (SR33=0.126), reputation (SR31= .10) are the most significant risk factors for brand and communication risk types segment. The others factors of this segment are the less significant in term of risk assessment. Even, if we look through the risk comparison table, it's slightly different with each attribute in this risk ranking but numerically very significant difference among the attributes.

Next, the strategic information risk analysis is very important in recent business and the main strategic key to success or competes with other companies. In that sense, investment environment is the most risk factors in the expert's eyes and the company strategy analysis for taking the right decision, so if companies miss the taking right decision in right time, they may face a risk in their host country. Exit-entry and the substation products having less significant in risk analysis, (SR45=0.07) and SR44= 0.06) respectively. Finally, the last risk types of strategic risk analysis, Governance (SR53= .07) is the highest risk analysis values. After that, the rest of the two factors also remains the same as previous risk indicators. All the risk factors are important based on their company characteristics and the company mission and vision.

Even though, if look through the attributes ranking table for strategic risk analysis, we can find the most of the risk is the same rank with risk degree of importance table. And it is very common to find the different risk assumptions between the expert's knowledge and company opinion interns of company or industry situation. And we can conclude here with assuming the validity of risk analysis results. In the graphical illustration in figure 2, all the risk attributes are shown for comparison with the degree of risk indicator (ω) and the risk analysis with experts' opinion. We can easily compare all the risk factors in that risk mapping figure. In that figure 2, all the attributes are visible as the based on the kinds of risk risks not as the categorized as risk types. So, it is also grouping comparison with each risk attributes.

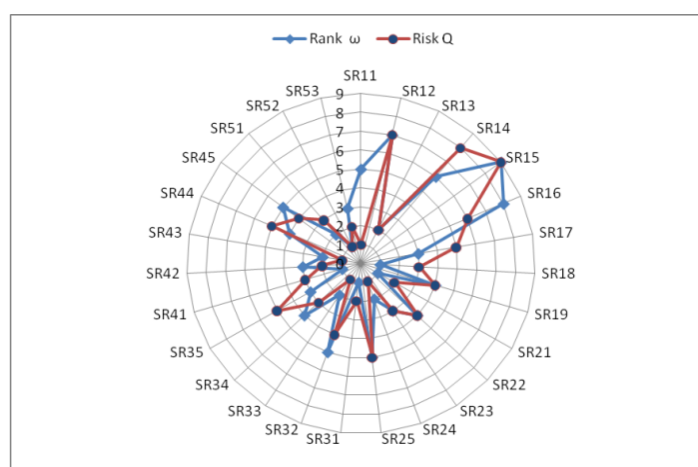
Table 6. Risk Attributes Risk & Analysis Results for Strategic Risks

Table: Risk Attributes for Strategic Risks			Risk Analysis of SR		
Code	Kinds of Risks	Types of Risks	ω	V	Q
SR11	Country Risk	Business environment SR1	0.038	4.095	0.156
SR12	Monetary Reforms		0.036	2.810	0.101
SR136	Economic environment		0.042	3.667	0.154
SR14	Investment capital		0.036	2.810	0.101
SR15	Investment and lenders		0.031	2.762	0.016
SR16	shareholders		0.035	2.952	0.002
SR17	Business partner		0.041	2.857	0.117
SR18	Competition		0.042	3.524	0.148
SR19	Industry moves		0.038	3.286	0.125
SR21	Sector regulations for competitors	Regulatory environment SR2	0.044	3.143	0.138
SR22	Business and tariffs		0.033	3.333	0.110
SR23	Environment regulations and trade		0.037	3.524	0.130
SR24	Changing law tax		0.042	3.524	0.148
SR25	Government Regulation		0.029	3.143	0.091
SR31	Reputation	Brand and communication SR3	0.043	2.333	0.100
SR32	opinion and trend		0.035	2.476	0.087
SR33	License		0.037	3.429	0.127

SR34	New products	Strategic information SR4	0.036	2.714	0.098
SR35	Marketing education		0.037	2.190	0.081
SR41	General strategy		0.043	2.333	0.100
SR42	Strategy analysis		0.037	3.048	0.113
SR43	Investment environment and acquisition		0.041	2.762	0.113
SR44	Substitution of products	Organization behavior design SR5	0.034	1.762	0.060
SR45	Entry-Exit strategy		0.033	2.048	0.068
SR51	Organizational design		0.036	1.762	0.063
SR52	Governance		0.038	2.524	0.096
SR53	Employee Retention		0.032	2.095	0.067

Source: Authors' Calculation

It is very important to find the different risk assumptions between the expert's knowledge and company opinion interns of company or industry situation. And we can conclude here with assuming the validity of risk analysis results. In the graphical illustration in figure 3, all the risk attributes are shown for comparison with the degree of risk indicator (ω) and the risk analysis with experts' opinion. We can easily compare all the risk factors in that risk mapping figure. In that figure 3, all the attributes are visible as the based on the kinds of risk risks not as the categorized as risk types.



Source: Authors'

Figure 3: Comparative images between the Risk indicators and Risk analysis ranking

CONCLUSIONS

In the dynamic and highly competitive business environment, manufacturing industries are under tremendous pressure due to the free market economy, rapid technological development, and continuous changes in customer demands (Islam 2008). To cope with the current business trends, the demands on modern manufacturing systems have required increased flexibility, higher quality standards, and higher innovative capacities (Monica 1999). The focus of our research was to identify the typical risk determinants of Chinese invested companies especially textile and engineering in Bangladesh that need to be considered in developing an integrated risk management approach.

The merits of RST to handle incomplete and uncertain information and its capability of minimizing subjective analysis have been exploited in this study. After identifying the uncertainties and categorizing in major risk types, we set the data table and put in RST software coding to Initialized Information. Then, to find out the similarity relation and set up a discernibility function for information table and discernibility matrix table. To find out the significant risk attributes, the weighted average function is used to calculate the most significant risk evaluation indicators. Thereafter, the importance degree can be normalized for easier comparison. We can find the most important attributes from each risk types. Such as in the risk types of business environment (SR1), the competitive environment is the most degree of importance and the economic environment is the second most important factors for business in Bangladesh for Chinese companies which indicates the normalized risk value of SR18=0.042) and SR13=0.042) respectively. Chinese companies emphasize on the business partner (SR17) and industry moves SR19) respectively.

This study provides in-depth analysis of how assessing the risk for Chinese manufacturing companies in Bangladesh. Nowadays globally, managing risk is the most prominent area of research in the field of international finance and risk management. Reference to the findings of this study the following could be creative areas of the research;

- (1) The application of RST theory is coded as a methodology of assessing and analyzing of risks in Bangladesh for Chinese companies especially the attributes determination from a big quantitative and also qualitative data. This RST

mathematical theory along with fuzzy logic provides new innovative statistical framework or breakthroughs upon which simpler and more robust determination of risk analysis of attributes for any industry or in international business from its vague huge level of data set that could be computed with a high degree of accuracy.

- (2) Through the same risk analysis assessment RST theory mentioned in (1) above, for the first time in literature to analyze risk in Bangladesh for Chinese invested companies, the researcher is able to contribute in risk analysis for Bangladesh and assessment framework for big data attributes. The risk attributes which is found in this research that is also justified with case studies as almost the results.
- (3) The application of risk attributes ranking and weighted method coded is a technique as a tool provides the innovative methodology of evaluating risk among with different industry or country that attributes determinants based on specific country's macroeconomic and microeconomic data. Inferentially, the result obtained via this method shows that apart from the constructive role play by BOI, different investment authority, companies, especially for Chinese investors. Finally, this research conducting with RST theory opens new theoretical aspects in management science for risk analysis with vast attributes that will contribute in more investment in Bangladesh and besides these more important to run their business for Chinese investors.

Conducting research in any of the above areas would probably provide empirical evidence that would support theories and serve as an important basis for risk attributes assessment for the business environment.

Research and Practical Implications

The study has contributed to research and practice in various ways. First, the study has provided a novel method for analyzing risk for business risk or in the big data area. In a broader sense, it is an original attempt to use the rough set approach for business risk problems in a big data or where to have more uncertain attributes. The novelty of this study is to address the concern of objective and precise weight of the factors in the framework of RST. This concern has not been tackled by the business risk assessment for Chinese invested companies in Bangladesh and risk studies reviewed previously, and virtually majority of the studies applying RST. This is very crucial for any risk analysis since the reliability of research outcomes significantly depend on the attributes' weight (Belton and Stewart, 2002). As illustrated by the study of the overseas company, we are able to calculate the significance of each risk factor based on the original data without assigning the weight subjectively. In fact, the main theme of RST is to measure the "ambiguity" inherent in the data and to reveal hidden patterns. Second, the method is capable of handling missing data. Unlike statistical analysis, it is not necessary to discard samples with incomplete data. More samples can be retained when the rough set method is used which reduces the limitation of data problems. Quality solutions can still be obtained without the hassle to collect extra samples, if at all possible. The method's advantage makes a valuable advancement to the risk management field. Furthermore, the quantitative importance degree of the risk evaluation indicators reveals the major root of uncertainties or risk attributes. Managerial implications can be drawn and appropriate actions can be taken accordingly.

Future Research Perspective

Same as other studies, the paper contains research limitation. A rather low number of uncertainties are used for illustration. Future research can be devoted to examining more samples. However, we should note that the number of companies and overseas countries in a particular industry may not be very high in practice. Also, a low number of samples do not pose any problems in the rough set algorithm. As a whole, the numerical example has clearly demonstrated the analysis and research outcomes and has fulfilled the objectives of the research. Regarding more future research, the research process and model developed to provide a lot of potential that study can be undertaken on other types risk analysis, such as specific company risk attributes or sampling in different countries uncertainties, as well as other risk management topics.

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Research on Overseas Development Status of Digital Product Enterprises

(Full Paper)

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ABSTRACT

With the rapid development of the Internet and the policy support of "Belt and Road", cross-border e-commerce has become an important driving force for the growth of China's foreign trade. In the digital economy, the trading of digital products has expanded to include international trade. Different from the traditional goods and service products, the convenience of the transaction of digital products and globalization lead to different trade development strategies. Based on the mobile Internet, this paper analyzes the sea-going history of content-based digital products companies and summarizes the laws of the sea to help companies in western China understand the status quo of digital products trade and better determine the development strategy of digital products trade.

Keywords: Digital products; international trade; companies put out to sea

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DEVELOPMENT STATUS OF DIGITAL PRODUCTS

Related concepts

The digital product is defined as the digital product in the US tax act, which refers to any other goods that are transferred or delivered by any software or electronic means (Li, Zhou & Tian, 2014), including the audio, pictures, data, facts or combinations that exist in the digital format. The impact of digital products on global value chain is disruptive. Digital products lead to the redistribution of international trade interests, and the international trade rules centering on the transaction of digital products will become the main trade rules in the 21st century (Shen & Jin, 2017). Overall, China's digital products trade has seen mixed growth in digital content, social media, search engines, other digital products and services. Comparatively speaking, the digital publishing industry, on the one part of digital content, has reached a new high in output value with the rapid development of the world.

According to the classification of the purpose and existence form of digital products, there are two kinds of common classification methods:

- (1) According to the use and nature of digital products, digital products are divided into three types: content products, exchange tools, digital processes and services: Content products refers to the expression of certain content of digital products. This kind of product mainly has the news, the publication, the movie and the music three forms of expression. Exchange tools refer to digital products that represent a contract, such as digital tickets, digital reservation, etc. Digital process and service mainly refers to digital interactive behavior. Such as distance education, online games, interactive entertainment.
- (2) On the premise that digital products are all bitstreams and eliminate the physical boundaries between production and use, son-yong Choi divided digital products into three categories: Information and entertainment products, such as paper information products, product information, image graphics, audio products and video products. Symbols and concepts, such as flights, concerts, stadium booking process, checks, electronic currency, credit CARDS and other financial tools. Processes and services, such as government services, letter and fax e-consumption, distance education and interactive services, cafes and interactive entertainment, etc.
- (3) The author understands digital products as electronic commodities in a narrow sense, excluding physical disks. It can be divided into the following four categories: Digital service products, which refer to websites providing online services for consumers, such as e-government, distance education and online medical treatment; Tools and practical products that can help users complete specific tasks, such as online games, software and mobile apps. Content digital products, whose value lies in the content they carry, such as information products, e-books, online entertainment products. Symbols and concepts. The digital products are only symbols and symbols of traditional commodities, such as virtual currency and electronic tickets.

China's digital products enterprises are developing rapidly at sea

Due to the explosive development of modern information science and technology, and the policy support of "the Belt and Road", Cross-border e-commerce has greatly promoted the growth of China's foreign economic and trade, what followed is the transaction of digital products has expanded into international trade.

According to the 2016-2017 China Digital Publishing Industry Annual Report, the total revenue of China's digital publishing industry in 2016 was 572.85 billion yuan, what is 29.9% higher than 2015. In the publishing industry, e-book revenue is 5.2 billion

yuan, Internet journal revenue is 1.75 billion yuan, digital newspaper revenue is 900 million yuan, and blog application revenue is about 4.5 billion yuan. Among them, Internet advertising revenue is the highest, about 290.2 billion yuan, followed by mobile publishing revenue of 139.9 billion yuan, online game revenue of 82.7 billion yuan, online education sustainable development with revenue of 25.1 billion yuan, online animation of 15.5 billion yuan, and online music of 6.1 billion yuan.

From the area of China's offshore enterprises to analyze, most of the 6254 enterprises out of the sea, according to the Research Institute of Baijing, are the first-tier cities, such as Beijing, Shanghai, Guangzhou, Shenzhen. Among them, Beijing's enterprises account for 26.8%, which is the largest city for mobile Internet enterprises in overseas. And the emerging Internet cities such as Xiamen, Hangzhou and level, whose mobile sea business have grown rapidly. In western China, only Chengdu entered the Top10, ranking fifth, and 327 overseas enterprises, accounting for 5.2% of the total.

According to the analysis of the international trade area of digital products, developed countries mainly include the United States, Canada, Germany, Portugal, and developing countries mainly include Mexico, Indonesia and India.

From the time dimension of international trade of digital products, the international trade of digital products is mainly the trade of tool products from 2012 to 2015. Since 2015, game and content products have gradually opened up new business models for trade. Since 2016, the development of international trade in content digital products has been gradually moving towards scale. Among them, digital culture, news information, social live products and business have been expanding rapidly overseas, as shown in table 1.

Table 1: List of major content products in China

Name	Time	Enterprise	Financing conditions	Overseas target market	Overseas development status
News republic	2012.3	Cheetah Mobile	Bought by Headline	US	Overseas revenue accounted for more than 60%, Chinese companies ranked No.9 in the sea
Uc news	2016.5	Alibaba	Listed	India,Indonesia	International retail revenue for the first quarter was 2.638 billion yuan, compared with the same period last year growth of 136%
BACA	2016.1	BACA	B round \$20 million	Indonesia, Brazil	More than one million active users per day in Indonesia, global downloads reached 490 million as of June 2017
ByteDance	2015.12	ByteDance	2017 8.1 E-round \$2 billion	Japan, India, Southeast Asia, Brazil, and North America	ByteDance variety of products occupy the top three overseas local App Store/Google Play listings for a long time.
Musical.ly	2014.4	Shanghai WeShare Technology	Bought by Headline	USA	Global active daily users exceed 20 million, of which more than 6 million active users in North America
BIGO LIVE	2016.3	Huadoo Networks	C-round \$100 million	India, Middle East and other Southeast Asian regions	In April 2017, the number of registered users of the live broadcasting application has exceeded 100 million.
Live.me	2016.4	Cheetah Mobile	US listed	USA, Germany	Over 50 countries and regions in the world with more than 15 million downloads
Readtext Group	2017.5	Readtext Group	Listed	Southeast Asia and Europe and America	Joint Third Party Platform to Create Internationalization Route
Wuxiaworld	2014.12	Wuxiaworld Co., Ltd.	Unfinanced	United States, etc.	Worldwide Alexa ranking 954 (April 2017), Daily average number of independent visitors reached 979,200, average daily page views reached 14,492,200
iReader Technology		iReader Technology	Listed	Korea, United States, Thailand	By the end of 2017, Palm has more than 100 works authorized to overseas

Main obstacles for digital content products to go to sea

The development of content digital product enterprises in overseas markets will be subject to local regulatory and policy restrictions, which can be analyzed in four areas: market access and investment restrictions; Data protection and network security; Tax issues; Intellectual property rights, content review, etc.

First, whether the target market allows foreign investment and product entry will impose certain restrictions. Some countries for digital products enterprises to improve the barriers to entry, first consideration should be given to the region market access principle in overseas markets, including local enterprises accounted for more than requirements, local demands, import substitution, etc. For example, Indian digital products enterprises must establish joint ventures with local enterprises to enter the market.

Second, restrictions on network security and data protection. As digital trade expands, there are more and more cross-border data flows. However, some countries require data localization to ensure privacy and information security. In addition, many countries, such as the UK, Brazil and India, have added restrictions to protect cyber security, making it harder to get in. The following are some national policies and measures on protection of data and cybersecurity.

Table 2: Data Protection and Network Security Related Policies in Major Regions

Country	Policy	Content
United States	"Digital Trade Article 24"	Emphasizes network openness and security, builds adaptive frameworks for digital trade (to protect innovative digital products and services), requires parties to allow free flow of data across borders, and prohibits data storage localization, ICT Product tax exemption
	"Digital Trade and U.S. Trade Policy"	Stresses that U.S. Congress should play a key role in shaping global digital trade policies and respond to growing trade challenges.
EU	"European Union Electronic Commerce Directive"	The EU adopts laws to strictly protect data privacy and data flow in digital trade.
	"General Data Protection Regulations"	Improve cross-border data flow mechanism and strictly protect data
	"Privacy and Electronic Communications Regulations"	Stipulates that its privacy protection rules will apply equally to emerging electronic communication service providers and further strengthen the protection of electronic communication data.
Japan	"Personal Information Protection Amendment Act"	Added new information such as the addition of anonymous information, the establishment of personal information protection committees, and cross-border transfer of data to the current development of the technology industry. New restrictions on sensitive information, including the prohibition of Acquire and provide sensitive information with the consent of the data subject.
India	"National Cyber Security Strategy"	Emphasizing the Development of Local Information Technology Products and Reducing the Potential Threat of Imported High-tech Products to National Security

Third, restrictions on tariffs. Different from traditional commodity trade, the emergence of digital product trade brings certain challenges to taxation. At present, relevant tariff regulations are not perfect enough. The US, for instance, advocates of tax exemption, while the European Union advocates VAT on digital products. In addition, some developing countries advocate tariffs on digital products to protect their companies.

Fourth, Restrictions on intellectual property rights, and strictly scrutinize content. National intellectual property laws and regulations block the entry of content-type digital companies, such as Germany and Spain have some provisions on the content, for example if the network platform to news publishers to pay a certain fee, only allows the press to provide platform for users. In addition, the increased national review of product content will also hinder the development of many digital content providers.

Bilateral and multilateral trade rules

Due to the explosion of trade in digital goods, countries and governments are actively exploring relevant trade rules. However, there are some differences among countries on digital trade. First of all, the United States, as a strong digital economy, supports the largest liberalization of international digital trade, and actively promote the establishment of digital trade in all kinds of agreement rules. Second, EU is very strict about data protection and has some differences with the US. China and other developing countries are also actively participating in the promotion of new international trade rules for digital products.

The current major multilateral trade rules are as follows:

Table 3: The current major multilateral trade rules

Time	Relevant agreements	The main content
1996	The information Technology Agreement (ITA)	Liberalization measures were proposed for trade activities in the IT sector, and 53 of the members expanded the agreement in 2015, eliminating tariffs on 201 additional products
2013	Trade in Service Agreement (TiSA)	Twenty-three WTO members are participating to further open up global trade in services, including e-commerce, telecommunications and financial services
2002	Trans-Pacific Partnership Agreement (TPP)	We will prohibit data localization requirements, eliminate tariffs on electronic transmission and digital products, and require greater cooperation from participants. The us joined in 2009 and quit in 2017
2018	Comprehensive Progressive Trans-Pacific Partnership (CPTPP)	The exit after the TPP by 11 asia-pacific countries to participate, retain the original over 95% of the TPP agreement, in market access, trade facilitation, electronic commerce and trade in services and so on are no difference, the difference lies in the intellectual property rights.

CASE ANALYSIS OF CONTENT DIGITAL PRODUCT ENTERPRISES

According to the use and nature of digital products, digital products can be divided into three types: the first type is content products, such as news information, e-books, music, video, etc. The second is the exchange of tools, including digital tickets, digital reservation, etc. The third is digital processes and services such as remote education, online games and so on. (Du , Xue & Gao, 2005).

The author thinks that content digital products based on mobile Internet can be classified into three categories: first, digital content, including electronic newspapers, digital periodicals, etc. Second, information products, such as databases, news reports, etc. Third, online entertainment products, including digital music, film video, etc. Next, we will analyze each kind of typical overseas enterprises in detail.

Digital content --iReader Technology

The encouragement of national policies of "the Belt and Road" provides the policy convenience of digital product trade and investment. Meanwhile, demand for e-books from overseas readers is growing. On the basis of the report from iResearch, digital readers accounted for 29.8% in Europe, 27.7% in North America and 27% in Asia in 2017, which means economically developed regions accounted for a relatively high proportion. As for the specific country, America has the most number of online readers, accounting for 20.9% of the total overseas users, followed by Brazil, India, Canada, etc. That has prompted many digital-publishing companies to step up their pace at sea. Among them, iReader Technology takes advantage of the opportunity of "the Belt and Road" to expand its business to countries along the belt and road and conduct overseas layout.

iReader Technology is an excellent mobile reading brand in China, with the vision of "being the most professional reading platform in the world". With "product and technology" as the starting point. iReader Technology pay attention to the quality of digital content and smooth reading experience, build the reading platform, and the whole industrial chain. In 2015, iReader Technology entered into a cooperation agreement with South Korean and Malaysian companies. In 2016, its mobile app iReader has topped the bestseller list in reading categories in more than 60 countries and regions, providing overseas users with 300,000 volumes of Chinese content, 50,000 volumes of English content and tens of thousands of volumes of Korean and Russian content. In 2017, it reviewed and entered Southeast Asia, and reached a partnership with Thailand's Hongshan Publishing Group. At the same time, iReader Technology mainly developed Southeast Asia, Russia and circumjacent area. In addition, the overseas business division of iReader Technology has developed a "three-step strategy for going out" to speed up China's content products to sea.

The main profit of iReader Technology is digital reading revenue, while the revenue of copyright, advertising, hardware and other businesses is also rising. In the past, iReader Technology has been regarded as a conservative company, with 8 internal financing and only one external financing in the nine years since its establishment. The a-round financing was completed at the end of 2015, and the investor was invested by Sinochem and Aofei animation, with a valuation of nearly \$1 billion. In July 2017, the IPO round was completed, and the IPO was successfully listed on the main board of Shanghai stock exchange in September.

Table 4: Financing process of iReader Technology

Time	2015	2016	2017
Round	A round	A round	IPO
Leading Investment	Aofei animation,	National capital investment	Unknown
Capital	about \$100 million	about \$100 million	Unknow

The author believes that the main strategies of his company's overseas operations are as follows: First, the iReader Technology and the mainstream publishers in various countries establish cooperative relationships, and they can sell digital content publications directly to the sea, or translate the product into the local language for sale. Second, iReader Technology actively participates in international book fairs and showcases Chinese culture to all countries. Finally, iReader Technology established a content translation and distribution platform in various countries. Through combining local cultural backgrounds, Chinese publications were translated and reprocessed and disseminated.

News and Information – ByteDance

The main areas of development for news and digital products are Brazil, India and the US. Among them, ByteDance has a special maritime history, which can be divided into two phases: early exploration phase (2015-2016):Through the development of digital products on the international market and the export of large amounts of capital, it would entered the developing countries such as India and ease out to the sea. The radical expansion phase (2017 - present):It mainly used investment and acquisitions to shift the target from developing countries to developed countries such as the United States. In addition, ByteDance's business model had gradually shifted from the graphic field to video.

One of the main strategies of globalization is "investment + acquisition." On the one hand, ByteDance had entered a bottleneck in domestic development, hopes to improve its business by developing business in other countries. On the other hand, there were many restrictions on the process of ByteDance out to sea, such as insufficient experience in localized overseas operation, insufficient user accumulation, and unresolved copyright issues. But ByteDance's direct investment in established overseas brands can easily solve these problems, thus focusing on its own technological advantages and accelerating growth.

Table 5: Acquisition process of ByteDance

Time	The event
August 2015	ByteDance launches overseas edition TopBuzz
September 2016	TopBuzz Video online
October 2016	Invest in Dailyhunt, India's largest news aggregator
December 2016	Controlling stake in Indonesian news recommendation platform "BABE"
February 2017	The wholly-owned acquisition of the well-known short video community Flipagram in North America
July 2017	Online volcanic small video overseas version of Hypstar
August 2017	Online music short video software hi-fi foreign edition TikTok
November 2017	Participated in the financing round of live.me B, a subsidiary of cheetah mobile, and wholly purchased News Republic, an overseas mobile News information product of cheetah mobile
November 2017	Wholly-owned acquisition of music video sharing and interactive social app musical.ly

Today, ByteDance focuses on the personalized needs of users and delivers accurate content and service business traffic realization mode based on recommendation engines and related technologies, mainly from advertising precision system revenue. ByteDance today 2012 Susquehanna Asia millions of dollars to A round of funding, in 2013 attains the DST/Yun Miner tens of millions of dollars to B round, Sequoia capital and Sina Microblog funds 2014 C \$100 million round of funding. At the end of 2016, ByteDance actively sought for overseas expansion and obtained \$1 billion of international financing from Sequoia Capital, valued at about \$11 billion; After the e-round in August, the valuation of ByteDance has surpassed \$22 billion.

Table 6: ByteDance financing process

Time	2012	2013	2014	2016	2017
Round	A round	B round	C round	D round	E round
Leading Investment	Hainer Asia	DST/Yun Miner	Sequoia Capital, Sina Weibo Fund	Sequoia Capital, Forgan International	Unknown

Capital	millions of dollars	tens millions of dollars	100 million US dollars	1 Billion Dollars	Unknown
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Video and social - Musical. Ly

Different from the investment and purchase of overseas products by large enterprises, Shanghai Audiology Network rapidly went to sea depending on the uniqueness and attraction of its products, such as the popular Musical. ly and Live. ly in North America. Musical. ly was officially launched in July, 2014. Its main theme is the social app of short video and music. Users can upload music small-video with a 15-second duality to the platform.

Musical.ly has A tortuous financing history, and more than 20 investors rejected them in the A round. And cheetah in the internationalization of timing, in April 15, the investment of 5 million yuan A round of financing. Since then, round B has been invested by SIG, GGV (source capital) and Greylock Partners. C round is invested by qiming, guangxin, junlian, morningstar, DCMVentures, Goodwater. In November 2017, Bytedance made a wholly-owned acquisition of it, after all the investors who had been to C round of financing withdrew from the company. The profit model of musical.ly is still unclear, but it is still working on user growth and traffic accumulation, because traffic can be monetized through advertising at any time in the US.

The author thinks that its overseas success under the reasons: First, the goal is clear. Musical. ly focused on the US market, and abandoning the domestic market, directly to the target group for American teenagers. It seized the customer demand, lowered the threshold of the user content production. Second, in order to eliminate cultural barriers, they build local teams and done a good localization operation. The operation team timely analyzed the American pop culture in the start-up process, and as early as the beginning of 2015 Musical. ly set up a north American team to connect with local customers, which was conducive to localized operation. Third, gradually expand product functions and maintain user stickiness. As the users of Music.ly grew, it not only developed video features, but also gradually established entertainment communities to maintain the stickiness and increase the activity of user.

The successful of Music.ly in oversea markets shows that China's content digital products enterprises can expand overseas without relying on the overseas enterprises or the acquisition of overseas enterprises with a large amount of capital. Enterprises should grasp the internal demand of overseas users, strengthen innovation according to the needs of users, and export content products depending on the attraction of products.

SUGGESTIONS FOR ENTERPRISES WITH DIGITAL PRODUCTS IN FOREIGN COUNTRIES

Establish target market according to product orientation

Digital product enterprises should first understand the differences between different regions and the acceptance degree of products according to their product positioning, and establish the target market for going to sea. The author analyzes and summarizes the strengths and weaknesses of digital products exported from major regions as follows:

Table 7: Advantages and disadvantages of going to the sea in major regions

Region	Advantages	Disadvantages	Suggestions
United States, Britain and other developed countries	High level of mobile Internet development, user spending power and strong sense of pay	Internet products are mature and difficult to enter	Develop unique digital products, seize the key points of regional users cut into the market
Europe	Mobile Internet development is slightly lower than China	Cultural barriers are higher, population is dispersed and geopolitical differences are large	Content-based digital product companies can use Europe as an alternative market
South East Asia	The development of the Internet is low, and the cost of obtaining customers is low.	There are no cultural barriers. Awareness of copyright protection is strong, and the cost of copyright of information products is higher	Consider exporting social video digital products to the region
Middle East, Africa and other regions	Low level of Internet development, strong content and social needs	High barriers to culture due to language and historical reasons, localization is challenging	Content-based, social-oriented products, local conditions Precision marketing

Therefore, it is suggested that digital content products should focus on the Middle East and Africa. Live and social network digital products can be exported to southeast Asia, and news aggregation digital products can be focused on Indonesia and other regions. And distinctive digital products can try to enter the United States and the US and other countries.

In-depth understanding of relevant rules and conditions of digital trade

After establishing the target market, digital product enterprises should understand the differences between the two parties' laws before going to sea, be familiar with the access scope and relevant laws of the target market. Firstly, digital product enterprises should improve their ability to adapt to the rules of international trade market, and turn passive acceptance into active use of trade rules. Secondly, they should master and analyze the laws of the target market, and conduct a lot of research in this area in advance, take effective measures to prevent various risks and safeguard the rights of enterprises. Specifically, enterprises can strengthen the training of relevant legal personnel or cooperate with experienced law firms.

Build a localized operation mode

Good local operation is crucial to the growth of overseas users. Compared with instrumental digital products, the content type of the digital products need more depth of understanding of the local language, culture, rules, and religious practices, design aesthetic differences, not only to localization, content and commerce but also political culture localization.

Digital content products can make localization operation from three aspects: first, the enterprise can partner with local ones to gain access, such as the palm reading before science and technology through the mainstream press with other countries to establish relations of cooperation, make digital content product localization. Second, invest in acquiring local companies for expansion. Today, Japanese headlines directly acquire overseas brands to solve copyright and local operation problems. Third, the enterprise can establish a target market of the overseas team, and even set up a local team, through their own Internet talent cooperation with local talent market, development based on local conditions, avoid to use the Chinese model.

Digital content products should ensure the quality of content, develop around high-quality IP, adhere to the spirit of craftsmanship, and create products suitable for local reading, so as to achieve user growth. At the same time, we will strengthen the construction of new media marketing capabilities and make full use of the growth modes of social media, web celebrity or star marketing to obtain user resources.

ACKNOWLEDGMENT

This work is supported by grant 16ZDA036 of the National major social science fund, China.

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Research on Regional Imbalance of Cross-Border E-Commerce --Take Fujian Free Trade Zone as an Example

(Full Paper)

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ABSTRACT

This article takes the information data era, world trade, and the deep integration of the "Belt and Road" policy as the background. Using questionnaires and compare to analyze the cross-border e-commerce regional issues in Fujian Free Trade Area, based on the analysis of cross-border e-commerce differences between Fujian, Shanghai and Zhengzhou and the comparative analysis of cross-border e-commerce platforms, it establishes a cross-border e-commerce service quality gap model to further identify problems. This article points out the current development trend of cross-border e-commerce zone in Fujian Free Trade Area, and the problems and the development shortcomings. Utilizing the advantages of cross-border e-commerce and its platform in Shanghai and Zhengzhou Free Trade Area to improve the imbalance of cross-border e-commerce in the Fujian Free Trade Zone, It has come up with actions and recommendations for building a multi-level network, an open credit platform, and a service quality evaluation system.

Keywords: Cross-border e-commerce, free-trade area, Fujian, The Gaps Model of Service Quality, Recommendations.

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As world trade has become more frequent, the establishment of free trade zones has become an inevitable trend. In 2015, the three pilot free trade zones in Guangdong, Tianjin and Fujian were approved by the central committee. China's free trade zone 1.0 era of Daigou was officially launched. It experienced the 2.0 overseas online shopping era and has developed into the 3.0 era of cross-border import. Cross-border e-commerce has become a new window for a new power of domestic economy , new business mode and reform.

Fujian was one of the first open cities along the southeast coast Across the strait from Taiwan. With the funding and the support of overseas Chinese and Taiwan compatriots, the local industry has been effectively promoted. As an important means to promote global economic and trade integration, cross-border e-commerce has obvious strategic significance. Fujian free trade zone is divided into Fuzhou area, Xiamen area and Pingtan area. At present, the development of the three regions still faces many difficulties, especially the increasingly obvious regional problems. Through in-depth exploration of the advantages and disadvantages of cross-border e-commerce in three regions, this paper knows the development imbalance among them. Comparing and contrasting Shanghai, Zhengzhou and cross-border platforms, the paper improves the short board of cross-border e-commerce regional development of Fujian free trade zone, and provide Suggestions on actions and policies for follow-up development.

OVERVIEW OF DOMESTIC AND FOREIGN RESEARCH

The United Nations Conference on Trade and Development gave the definition of a free trade zone for the first time in 1984. It means that goods are not required to pass through the customs for an area within the territory of a country. In the "World Economics Dictionary", the free trade zone is defined as the free trade zone to implement trade, customs, investment, service and other liberalization measures in the country or customs territory, and reduce the administrative intervention area (Li, 2000). Western classical scientists Adam Smith and David Ricardo believe that the purpose of the free trade zone is to promote free trade by removing barriers and thereby improving welfare, and this view is also the original source of the free trade zone (Cui, 2016). Rodriguez (2014) focused on the establishment and development of the free trade zone, and clarified that in these processes, and the free trade zone plays a leading role in the surrounding areas. Gomez-Herrera, Martens & Turlea (2014) analyzed the cross-border e-commerce in the EU, and thought that cross-border e-commerce consumers in these countries or regions often do not influence their decision to purchase goods because of the distance, and now more consumption participate in cross-border shopping.

The first point of similar view for cross-border e-commerce in China is the "E-International Trade" proposed by Yao Zhonghua in the "International Trade E-Commerce Raiders". Fang Luo (2017) proposed the reform and opening-up strategy of the domestic free trade zone under the background of "the Belt and Road", which not only improved the level of domestic opening up, but also

promoted the economic development of the central and western regions. Dayu Wei (2017) analyzed the causes and problems of the domestic cross-border e-commerce industry chain, and studied it from the aspects of policy, foundation, industrial chain and industrial competitive advantage. Xu & Chen (2016) discussed the mode of coordinated development of cross-border e-commerce in Fujian and Taiwan basing on the national strategy of peaceful reunification on both sides of the straits. Xu & Hong (2017) started with the basic characteristics of the three zones of Fujian free trade zone, in order to promote the reasonable division of labor among the three zones, discussing the development rules of the free trade zone of Fujian, and make active planning of the three zones of Fujian by referring to the planning experience of other free trade zones. Wang, Cai & Chen, (2015) deeply analyzed the current situation of cross-border e-commerce development in Fujian Free Trade Zone, and used the excellent experience of Shanghai and other places to put forward suggestions for improvement.

In summary, domestic and foreign research literature on free trade and cross-border e-commerce is a major driving force for this paper.

AREA ANALYSIS OF CROSS-BORDER E-COMMERCE IN FUJIAN FREE TRADE ZONE

The Fujian Free Trade Zone is divided into Fuzhou District and Xiamen District and Pingtan Area. The following is an analysis of the current situation of the three districts.

As the provincial capital of Fujian Province, Fuzhou is the most important responsibility to promote cross-strait common development. Relying on the geographical environment of Fuzhou, It provides important overseas Chinese and Taiwan compatriots for cross-border e-commerce. Through maritime trade, the market is extended to Southeast Asia and Europe. It uses talents to expand local enterprises and uses Mawei Port to develop domestic and international logistics and cross-strait transportation. The E-Commerce Research Center showed that the cross-border platform import business has reached 640,000 votes, the sales amount was 210.41 million yuan, and the value of imported goods was 187.19 million yuan, Increased by 98.34% year-on-year in 2017.

As one of the special economic zones, Xiamen is a central city in the southeast coast. Utilizing its natural geographical advantages, port trade experience, and its position as a financial center in Fujian Province and a vast overseas market, it attracts foreign investment to develop cross-border e-commerce. According to the statistics of Xiamen Municipal Bureau of Commerce, the import of Xiamen Free Trade Zone was about 1.08 million cross-border and the value of goods is 180 million yuan in the first half of 2017.

The Pingtan area is mainly to build cross-strait homes and international tourist islands. Although it is still in a slow phase, its environmental value and economic potential are enormous because of the island closest to Taiwan in Fujian Province. Since the establishment of Pingtan, cross-border e-commerce has supplemented the short-board, coordinated and promoted cooperation. Whether it is the "human" type railway, the direct cross-strait "three links" or the Pingtan Port, it is constantly being established. The most important thing is that Fujian's first cross-border e-commerce comprehensive public service platform is Pingtan's cross-border e-commerce public service platform. Business Bureau statistics display that The value of cross-border e-commerce in the Pingtan Free Trade Zone is 216.29 million yuan, The value of goods in the area was 17,410,000 yuan, the total number of express documents was 395,838, and the value of goods was about 75.386 million yuan. The cross-border e-commerce and shipping business all showed a large-scale growth trend in 2017.

Ten pilot cities for cross-border e-commerce have been set up in China, and Fujian has two: Fuzhou and Pingtan. there is a qualification for bonded and stocking with the pilot. Overseas public warehousing on both sides of Pingtan, Taiwan is the first overseas warehouse established by the two sides of the strait. It has opened up a new channel for cross-strait cross-border e-commerce. Fuzhou District encourages enterprises to set up overseas warehouses. Lijia E-commerce has bonded warehouses and overseas warehouses in many places in Fujian. The rookie logistics landed in the Pingtan area, and the customs clearance, declaration, verification and release were completed in 58 seconds. The package was completed and sent out within 2 minutes, and a series of work was completed quickly and conveniently. Although the Fuzhou area holds the logistics advantages of the mainland's only water and land mail general contracting exchange bureau and Fuzhou to Taipei and then Fuzhou Post and Air, but the rookie logistics is also indispensable. The Xiamen area does not have the qualification to be bonded and stocked, many policies cannot be implemented, or the implementation of the policy is lagging behind. But there are many practitioners in Xiamen, and it has the scale effect and clusters are better; In terms of logistics, direct mail is also the main source. Direct mail is generally carried by air. The timeliness is high, and it is also in line with the way of modern consumer fragmentation shopping. The risk of purchasing goods is also small, and the inventory risk is also reduced. The fidelity is also better because of direct shipment from abroad. But the costs incurred in returning, after-sales, maintenance, long logistics time, and customs and other complex issues, among others, have caused poor consumer experience, so it is necessary to change the direct mail model.

The Xiamen area truck flight was opened to deliver the goods from abroad to the consumers in the fastest time. It also realized the air-land transportation of Australia, Germany, the Netherlands to Guangzhou and then to Xiamen, with a new channel for more efficient and convenient logistics. The Pingtan area first opened the passenger and cargo routes and the "mini three links" route, and then opened the cargo route between Fujian and Taiwan (Taipei Fast Wheel) to provide a stable and fast green channel for

Fujian-Taiwan trade. The Fuzhou area will focus on creating four cross-border e-commerce supervision centers, achieving full coverage of "sea, land and air" cross-border transportation, and implementing transaction volume to expand the flow of goods. As a financial development center, Xiamen Area is far ahead of Fuzhou and Pingtan in attracting investment. According to statistics, there are now more than 5,000 large families joining the cross-border e-commerce in Xiamen. As the provincial capital of Fujian, the Fuzhou area has only more than 100, and Pingtan has fewer than 90. It can only be said that the strength is insufficient and the regulatory system is different in the face of such a situation. The Fuzhou area has formed a complete cross-border trinity logistics system through the construction of a customs supervision center and related supporting storage facilities. At the same time, the Fuzhou area's cross-border e-commerce convenience measures take the "one outstanding, two lists, three sets, four guarantees" work mode. The Xiamen area plans to build a cross-border e-commerce single-window customs clearance platform, focusing on expanding overseas warehouse operations and strengthening the construction of "one district and multiple parks". The Pingtan area is also actively promoting the establishment of a cross-strait system.

In summary, it can be seen that the development of the three districts is independent and less connected. In order to discover and analyze the problem better, this paper conducted a questionnaire survey on the cross-border regional issues of the Fujian Free Trade Zone using classmates, friends, family members and companies to fill in real-time. The questionnaires were real and effective. A total of 356 questionnaires were issued, 340 were returned, and 320 questionnaires were valid. Through research, it is found that although the development of the three districts is relatively good, the development is uneven. Xiamen is 2.14 at the top of the list and its development is very good; Followed by Fuzhou, it is 2.03, and the development is centered, finally Pingtan is 1.67. The current status of this region is mostly due to the economy of 62.25%, the industrial chain concentration of 47.61%, the environment of 44.23% and the talent of 41.41%, Coupled with other factors such as logistics and payment. The most important is that the national and even provincial policies are the cause of the regional imbalance problem.

COMPARATIVE ANALYSIS OF CROSS-BORDER E-COMMERCE AND PLATFORMS IN FUJIAN, SHANGHAI AND ZHENGZHOU

After adding the parameters and the data from Tables 2 and 3 into the system dynamics flow diagram, we optionally chose a variable to open the editing window of that variable. Then we checked the model. If the result was, "the model has no problem," we presumed that the model is correct.

Differences of Cross-Border E-Commerce in Fujian, Shanghai and Zhengzhou

The advantage over Taiwan is the highlight of cross-border e-commerce in Fujian free trade zone. Large Taiwan compatriots and overseas Chinese provide good capital, talents and resources for cross-border e-commerce in Fujian free trade zone. As a leading city in China, Shanghai's GDP is also far ahead in China. It is a famous financial center, playing a leading role in the development of cross-border e-commerce in free trade zones. As the capital of Henan Province, Zhengzhou is located in the central region. Although there is no sea transportation, it has a powerful comprehensive transportation hub irreplaceably in other regions. The most important one is the domestic commodity distribution center. The details are shown in Table 1.

Table 1: Comparison of basic situation of cross-border e-commerce in Fujian, Shanghai and Zhengzhou Free Trade Zone.

	Strategic Positioning	Geographic location	Transportation logistics	Cultural heritage	Industry chain
Fujian	Focusing on the strategic requirements of basing on the two sides of the strait, serving the country and facing the world, the three-pointer will strengthen its core position and help the economic integration of the Taiwan Strait.	It is located on the southeast coast of China, adjacent to Zhejiang Province in the northeast, bordering Jiangxi Province in the northwest, Guangdong Province in the southwest, and Taiwan across the Taiwan Strait.	Fujian has formed a three-dimensional integrated transportation system for seaports, highways, railways and modern airports. It is one of the five largest port groups in China.	The large group of Taiwan compatriots who are connected with each other by water, look at each other on the ground, have the same language, are similar to each other and provide good capital, talent and resource reserve for cross-border e-commerce in	International trade, sea transport, air transport, logistics, finance, tourism and other services and manufacturing industries form a new industrial chain, gathering development platform and offshore economy to form a new form of business.

				fujian free trade zone.	
Shanghai	We will build an open and innovative comprehensive reform pilot zone, an economic risk stress test zone, and a government-led zone to drive the market.	It is located at the mouth of the Yangtze river, opposite Japan's kyushu island in the east China sea, close to hangzhou bay in the south, and connected with jiangsu and zhejiang provinces in the west.	Air transport, sea transport and land transport have a relatively complete rail transport pattern, airport port is more mature.	It is the first open coastal cities, the world's famous financial center, one of the world's largest metropolitan areas with the largest population and area, the first free trade zone in China.	Guided by five major industries of international trade, finance, shipping, professionalism and manufacturing, we will increase the proportion of tertiary industry in the region and accelerate the transformation and upgrading of traditional industries.
Zhengzhou	Zhengzhou is an international modernized comprehensive transportation hub, an important advanced manufacturing industry and a modern service industry base in the country, giving full play to the overlapping advantages of Zhengzhou's multiple national strategies, leading the development of the Central Plains urban agglomeration and supporting the rise of the central region.	As an inland city, Zhengzhou is an important central city in central China. It borders the Yellow River in the north, the Lushan Mountain in the west, and the vast Huanghuai Plain in the southeast.	Zhengzhou is a comprehensive transportation hub with roads, railways and aviation. Zheng Ou Ban Li is also the shortest time, the most cargo, and the most outbound ports.	Zhengzhou is a national historical and cultural city. It relies on the Silk Road Economic Belt and focuses on opening to Central and Western Asia and Europe. It is based on modern agriculture and coordinated development of the three industries.	It is a special feature of zhengzhou to realize the transformation from traditional agriculture as the economic subject to the new industrial economy with rich topography and unique climate promoting the agricultural development.

Only by introducing more major favorable policies, cross-border e-commerce in the free trade zone can produce satisfactory transcripts. Zhengzhou built a “three-in-one” platform, which is a platform built by the three centers of sea, business and property. The realization of “second pass” greatly improved the efficiency of customs clearance and saved unnecessary troubles. Zhengzhou builds a “smart national inspection” platform, initiates quality and safety traceability, and builds a multimodal transport service system and a credit visa; Shanghai implements “double random, one open” post-event supervision, “one-stop acceptance, online push, parallel approval, unified certification” efficient service model, which provides a good learning model for Fujian. Shanghai's strong economic foundation and preferential policies are a strong foundation for attracting foreign investment. Zhengzhou pre-investment attracts investment, absorbs leading enterprises, and cultivates e-commerce enterprises to enhance their comprehensive

strength. Fujian is not willing to show weakness in actively absorbing learning. As the country's first cross-border trade e-commerce model, Zhengzhou actively promotes the government and social capital cooperation model in the areas of infrastructure and public utilities, namely the PPP (Public-Private-Partnership) model. this PPP model can deal with the lack of government investment skills, management capabilities, and inefficiency, then social capital is dispatched to participate in the supply of public goods and public services through the government to purchase services. Shanghai is also actively implementing the PPP model to accelerate the implementation of a new cross-border model.

Comparative Analysis of Cross-Border E-Commerce Platforms in Fujian, Shanghai and Zhengzhou

As shown in Figure 1, As a pioneer in cross-border e-commerce in China, Shanghai has a leading role and its trading scale is second to none. (Fujian cross-border e-commerce platform is Lijia e-commerce, Shanghai is Cross-border links, Zhengzhou is E-trade)

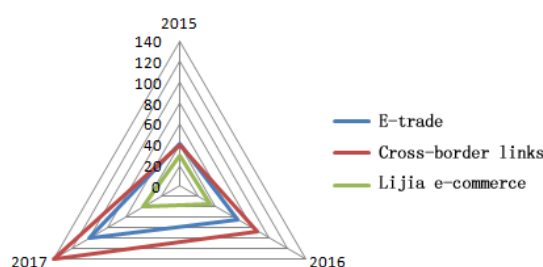


Figure 1: Comparison of three platforms (Source: author finishing).

The establishment of cross-border communication in 2013 upgraded the mode of direct mail, bonded stock and front store and back warehouse in the industry. It forms the full chain operation of bonded, duty-paid and duty-free, to create the integration of information, capital and logistics, and to monitor in real time. All data and information can be found, including data controllability, visualization and traceability in the transaction process. E-trade of Zhengzhou is as the cross-border e-commerce platform in central China, It has the first 1210 supervision mode, the supervision mode of customs clearance of e-commerce plus postal supervision plus bonded center, new second clearance mode and the establishment of O2O experience store. All set an excellent example for the e-commerce business of Fujian Lijia. The products of Shanghai cross-border communication all have QR codes, which can quickly go through the green channel in shopping. The same is true for Zhengzhou E-trade, where goods have QR codes, and shopping only needs id verification, scanning QR codes, ordering, payment, customs clearance and logistics distribution through mobile phones. The Fujian Lijia e-commerce is just an offline experience, online shopping, the platform can learn the QR code to change the shopping model. The most important cross-border e-commerce platform is service and security. With the transaction guarantee service, the consumers' after-sales rights and interests are guaranteed. In addition, it actively builds cross-border warehousing and provides a strong foundation and resources for the platform. The three platforms exchanged learning and absorbed the advantages applied to the study of imbalances in Fujian. The details are shown in Table 2.

Table 2: Comparison of Lijia e-commerce, Cross-border communication and E-trade.

	Business model	Warehousing	shopping	After sales service	Consumer protection
Lijia e-commerce	B2B distribution system, B2C mall, and O2O platform combined transport, establish the "Internet + inspection and certification" mode of customs clearance and inspection.	Fuzhou, pingtan, ningbo, chongqing, guangzhou, shenzhen are equipped with cross-border e-commerce bonded warehouses.	Offline experience, online purchase, selection of goods, bonded area, inspection and clearance, forwarding and express delivery.	The professional after-sales service team currently sells more than 5,000 merchants with 300 million docks online and offline.	Triple verification, genuine protection.

Cross-border communication	The B2B model implements online direct purchase import, online purchase bonded import and general export mode, forming a direct mail China and free trade earning model.	Pudong Airport Comprehensive Bonded Zone.	After verifying the unique 2D barcode on the "Cross-Border" products, it will arrange for a fast green channel.	Provide online transaction protection services to ensure payment security. The after-sales return service is provided domestically to protect the after-sales rights of consumers.	Overseas direct sales, original authentic, enterprises, merchants are all filed by the customs to avoid the risk of buying fake goods, and there is a service guarantee mechanism for the goods sold.
E-trade	1210 supervision mode, O2O retail sales model; innovative "e-commerce + postal supervision + bonded center" supervision mode; second clearance mode.	There are bonded warehouses in Russia, Belgium, the United States, Hungary, Australia, Germany, and Henan Bonded Logistics Center.	The product has a QR code, and the consumer carries the ID card to scan the QR code, pay for the mobile phone, check the customs clearance, and deliver the goods to the home.	Real-time updates to protect consumer rights in real time.	Strict review system, genuine guarantee service.

ANALYSIS BASED ON SERVICE QUALITY MODEL (5GAP)

In the mid-20th century, American scholar parasuraman *et al.* proposed Service Quality Model (5GAP). This model can lead managers to find service quality problems, find differences between managers and consumers in service concept, and use strategies to narrow gaps, ensure the consistency between expectations and reality, and improve consumers' satisfaction.

Through questionnaire survey on cross-border regional issues of Fujian free trade zone and analysis of the above tables, it is found that there are gaps in the cognition, understanding and service of consumers. In order to further analyze regional problems and make services better and more efficient, the service quality model of cross-border e-commerce is established as shown in figure 2.

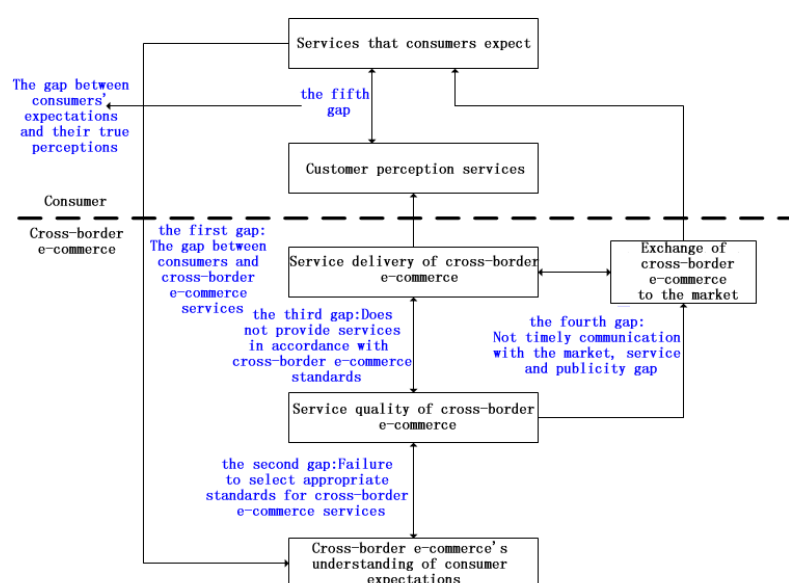


Figure 2: Cross-border e-commerce service quality model (Source: author collation).

In order to bridge the gap between consumer expectations of cross-border e-commerce and the gap between service delivery and external promotion, according to the questionnaire survey as shown in Figure 3, under the premise of understanding consumer expectations, 45.35% persons think that cross-border e-commerce describing the realism of goods is average, 29.58% think it is not true, 24.23% is true. So only one quarter of consumers think it is true, That is to say, cross-border e-commerce products are inconsistent with real goods. Cross-border e-commerce does not have a good understanding of consumers' expectations or a good interpretation of commodities. Therefore, social investigation, Internet investigation and telephone investigation should be stepped up to listen to consumers' wishes and remedy their expectations through field investigation; It must reduce the false description of goods, face the vast number of consumers with the true appearance, and improve the quality of cross-border e-commerce services.

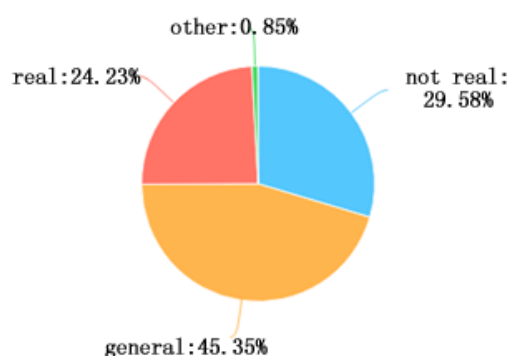


Figure 3: Cross-border e-commerce description of product realism (Source: Questionnaire).

In order to bridge the gap between consumers' choice of quality of cross-border e-commerce services and the gap between services provided by standards, the results of the questionnaire are shown in Figure 4. Consumers evaluate the quality of cross-border e-commerce services, tending to half of consumers. In general, 32.11% of consumers believe that service is enthusiasm, and 15.77% of consumers feel that service attitude needs to be improved. For this, From the perspective of consumers, we must actively understand cross-border e-commerce services, formulate cross-border service standards, standardize cross-border standard service actions, and then implement service evaluation, and collect a large number of consumer feedback information for consumers. We must work hard to bring a pleasant environment to consumers.

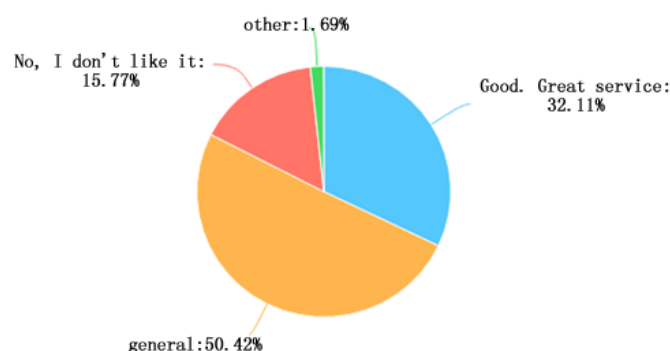


Figure 4: Cross-border e-commerce service quality evaluation (Source: Questionnaire).

In order to bridge the gap between consumers' expectations and consumers' actual feelings, as shown in Figure 5, consumers' satisfaction with cross-border e-commerce is 44.51%, and half of them are within the acceptance range, and 9.3% are far beyond cross-border e-commerce. Expectations, extremely satisfied, and a small number of dissatisfaction and inconsistency with their own imagination. All illustrate the distance between the consumer's expectations and the actual feelings of the consumer. In order to reduce this gap, we should seek truth from facts to understand the specific expectations and actual feelings of consumers, create communication channels, and improve satisfaction.

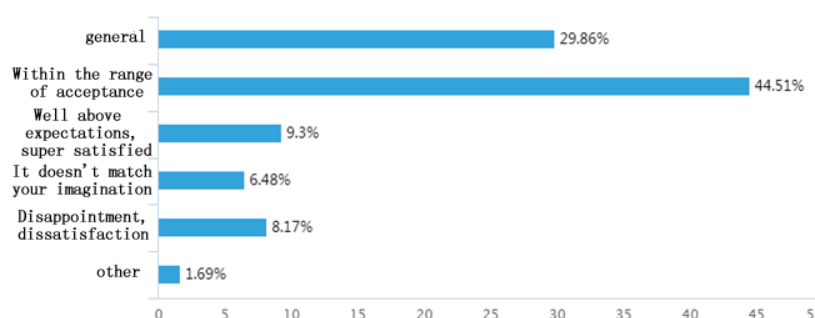


Figure 5: Cross-border e-commerce satisfaction (Source: Questionnaire).

As shown in Figure 6 for the overall evaluation of cross-border e-commerce services, 45.92% of consumers are basically satisfied, which means that most consumers are still acceptable for cross-border e-commerce services. Consumer satisfaction is the driving force behind the progress of cross-border e-commerce.

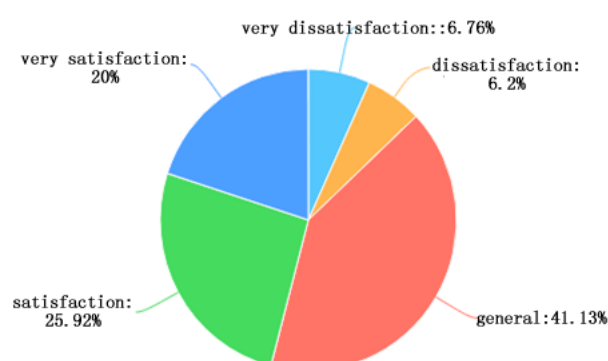


Figure 6: Cross-border e-commerce service evaluation (Source: Questionnaire).

COUNTERMEASURES FOR REGIONAL DEVELOPMENT IMBALANCE OF CROSS-BORDER E-COMMERCE IN FUJIAN FREE TRADE ZONE

Advantage Analysis from Shanghai and Zhengzhou

In the study of cross-border e-commerce in Shanghai and Zhengzhou Free Trade Zone, Fuzhou District promoted and copied Shanghai's five major reform pilots in the fields of finance, investment, trade and services, as well as after-the-fact supervision; The Xiamen area promoted and cloned 35 pilot experiences in Shanghai; The Pingtan area promoted the replication of 51 pilot projects in Shanghai. It can be said that Fujian is a continuation of Shanghai. Among them, Fujian Free Trade Zone cross-border e-commerce is also actively learning many excellent policies related to Zhengzhou, Shanghai, including the Shanghai government's 12 tasks, supporting cross-border service platforms, talents and cross-border Corporate preferential policies, etc. In addition, Shanghai has established a high-speed customs clearance mechanism on customs clearance. The maximum length will not exceed one day, that is, it will be passed within 24 hours, and the low-risk goods can also achieve second release. Zhengzhou actively builds a "smart country inspection" platform, launches the "Internet +" safety quality and traces its roots, and implements a one-stop, integrated customs clearance service, which is also known as "second pass customs", from the original 2 to 3 times per second, until now 100 per second, also applied a credit visa to reduce credit risk. In terms of capital operation, Zhengzhou Shanghai is actively applying the PPP model, especially Zhengzhou, which is the first to complete. Its PPP model optimizes the organic combination of central enterprises, state-owned enterprises and private capital, and has become an excellent sample of PPP operations nationwide.

The cross-border e-commerce enterprise platform of Fujian Free Trade Zone learn the Shanghai cross-border pre-store and post-library model, monitor the platform transaction information in real time, and ensure the transaction process is transparent and traceable. They learn from Zhengzhou E-trade for unified procurement, warehouse and distribution. In shopping, Shanghai and Zhengzhou commodity transactions have two-dimensional codes, which can be used to learn the two-dimensional code conveniently and quickly, and establish an online and offline O2O joint mode. In the face of consumers, they can use the service quality gap model to learn to bridge the five gaps, improve services, and improve efficiency. The three regions and the three regions are all parallel. So they can exchange and learn from each other, and apply the advantages to the imbalance of cross-border e-commerce in the Fujian Free Trade Zone.

Recommendations for Regional Development Imbalance of Cross-Border E-Commerce in Fujian Free Trade Zone

Suggestions based on the development of free trade zones

(1) Depending on local conditions, make the best use of it. The three major regions of cross-border e-commerce in Fuzhou Free Trade Zone are independent, and the three districts should be promoted to use their respective advantages to cooperate to avoid homogenization competition. For example, Pingtan is closer to Taiwan, and has established overseas public warehousing in Taiwan, which can share resources. Xiamen's economic background attracts powerful enterprises to recommend to Fuzhou and Pingtan. In addition, Fuzhou and Pingtan are cross-border e-commerce pilots. The current strategic policies are all paving the way for Xiamen. We also actively build regional brands and local specialty products to promote the manufacturing of the three districts and even Fujian. The three major areas should narrow the gap, improve the imbalance, remove impurities, retain the essence, and coordinate development.

(2) Establish a multi-level network and pay attention to cross-border dynamics. It can create a multi-level network that covers the global cross-border e-commerce area and implement a "hierarchical layout" network. The first level is the cross-border e-commerce collection network in Fuzhou, Xiamen and Pingtan. The second level is the cross-border e-commerce alliance network in the Fujian Free Trade Zone. The third level is a nationwide cross-border e-commerce customs clearance service network. The fourth level is the world cross-border e-commerce data sharing network.

(3) The port of the three districts is united and docked to Taiwan. The three ports of Fuzhou, Xiamen and Pingtan jumped together to connect Taiwan and help Fujian and Taiwan to cooperate. The three districts are complementary to each other, regardless of input or output, promoting cross-border e-commerce in the Fujian Free Trade Zone to emerge from the characteristic road.

(4) Promote the application of artificial intelligence. In the process of cross-border e-commerce operation of the free trade zone, regular operations such as goods inventory, security clearance in the park, matching of warehouses, and personnel audit records were conducted. For these, we can increase investment in artificial intelligence, such as robots, drones, AR and VR glasses, can reduce costs, shorten time, improve efficiency and optimize resources in the three regions.

Policy recommendations based on government

(1) Improve customs clearance efficiency and establish a new model. We should learn to imitate Zhengzhou "second pass" mode, 100 singles per second. We must improve customs clearance efficiency, build a smart national inspection, and expand overseas warehousing. Study Zhengzhou Shanghai, actively establish a PPP model, and achieve an organic combination of government and social capital.

(2) Establish a three-zone management organization. The three-zone management organization can make One-on-one supervision of cross-border undertakings, face-to-face control, and division of labor in the three districts to complete traces afterwards. As the supervisor of Fujian free trade zone, the government should pay close attention to the coordination of the departments in the three regions, and properly handle the relations between countries and regions. The government should change the cross-border strategic approach according to the cross-border situation, and achieve the goal of consistent development. The establishment of the management organization of the three districts will add to the cross-border e-commerce in the Fujian free trade zone.

(3) Deepen investment promotion and strengthen the investment team. It should learn the gathering effect of Shanghai and Zhengzhou, and actively introduce strong enterprises, use policy rewards and mechanisms to track and track the company's work in real time. The government has strengthened the construction of the investment promotion team, strengthened the training of investment promotion personnel, and built an efficient team.

(4) Introduce, select and cultivate professional talents to help cross-border development. It should cooperate with the government and major universities to actively select and train cross-border professionals. Cross-border e-commerce training centers should be established in three districts of Fuzhou, Xiamen and Pingtan to provide professional professionals with cross-border services. Cross-border e-commerce meetings and cross-border e-commerce exchanges can be organized regularly to enhance cross-border knowledge. Assistance in technology, services, etc. It should establish a talent guarantee system, protect the team and backbone, and introduce senior talents and teams from around the world to learn from the world's advanced technology and management. In addition, we must strengthen the cultivation of innovative talents, focus on improving the employment and entrepreneurial environment, create a good atmosphere conducive to retaining talents, and implement preferential policy subsidies for innovative talents (Wang & Ding, 2016).

Recommendations based on cross-border e-commerce platform

(1) Open credit platform, updated in real time. In order to better regulate the operation of cross-border enterprises and make consumers more secure, Fujian Free Trade Zone cross-border e-commerce enterprises register credit files, issue credit visas, and conduct strict management. The state and the government can evaluate it and strengthen the credit rating of the enterprise based on the analysis of the evaluation data. The higher the credit, the higher the cooperation guarantee. The three districts regularly update

and revise cross-border enterprises to ensure that consumers understand the situation at the first time, establish a black and white list, conduct cross-border enterprise spot checks from time to time, and improve the sense of integrity of cross-border enterprises.

(2) Support local enterprises and build leading e-commerce. It should develop local enterprises, create a new model for the development of three-region tourism + cross-border e-commerce enterprises, and create a cooperative approach of e-commerce, network operators, logistics providers and service providers. We must actively promote the establishment of the O2O online and offline experience hall, learn cross-border communication, and conduct E-trade to implement green channel scan code shopping; We must increase the intensity of activities and promote the visibility of cross-border enterprises. We must play the leading role of the leading Lijia e-commerce in Fujian, the first-level multi-level and multi-level development.

(3) Listening to the voices of cross-strait cross-border enterprises and promoting cross-strait development. The country's guiding trend is to cooperate with Fujian and Taiwan to deepen the cross-strait sentiments and listen to the voices of Taiwan's cross-border enterprises. Cross-strait enterprises exchanged in depth, exchanged opinions, seized the opportunity, and supported the opening of trade in the free trade zone to Taiwanese capital, which had a ripple effect on Taiwan and boosted the development of cross-border enterprises in Taiwan, thus inspiring the cross-border enterprises in the three districts and Taiwan to flourish.

(4) Cross-border basic guarantee of enterprises. Cross-border transactions are becoming more frequent today, and there are often false cross-border trades that use domestic products as overseas products. Fujian cross-border enterprises should guarantee the supply of goods, 100% foreign original authentic, 100% foreign merchants, domestic and international authentic identification; They should guarantee transaction security, ensure that information is not exposed, after-sales service optimization, fast return and exchange of rights.

Advice based on consumer

(1) Create a service quality evaluation system to improve satisfaction. Focusing on the needs of consumers' needs, we will build a cross-border e-commerce service quality evaluation system for Fujian Free Trade Zone, establish cross-border service evaluation standards, and evaluate one-stage and one-time assessments to achieve fairness and openness. We will conduct regular research to implement consumer cross-border expectations into each area, and widely accept consumers' cross-border evaluations, complaints, complaints and many other issues. We must actively solve problems, reduce complaints, shorten gaps, and improve satisfaction.

(2) Establish an exchange platform. Cross-border services are professional and diversified, and consumer expectations are also personalized and diversified. Establishing a three-region exchange platform in Fujian, consumers and cross-border e-commerce can talk freely on the above, and then collect and summarize the three districts. Achieve consumer demand expectations and improve service quality.

(3) Cross-border entity visits. Because the main body of cross-border e-commerce comes from different countries in different regions, the culture, language, and habits are different, and the needs of categories are also different. Organizing cross-border entity visits can enable consumers to understand each other's cross-border e-commerce in the Fujian Free Trade Zone, feel cross-border realism, reduce the gap with consumers, and reduce the gap between the three regions and promote balanced development.

ACKNOWLEDGMENT

This work was supported by the humanities and Social Sciences project of the Ministry of Education [NO. 17YJC630097], China.

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Research on Sales Forecast of Fresh Produce Considering Weather Factors

(Full Paper)

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ABSTRACT

In order to ensure the freshness of agricultural products and reduce the cost of loss due to product decay, weather factors such as weather conditions, wind level and air quality index are incorporated into the fresh agricultural product sales forecasting model. Then, based on the historical sales data of agricultural products, three machine learning methods of Ridge Regression, Random Forest and Support Vector Machine are used to perform regression prediction. The prediction results show that the fresh agricultural product sales forecasting model considering weather factors can significantly improve the prediction accuracy. The relative reduction rate of the Root Mean Square Error achieved by the three algorithms is 68.90%, 23.66% and 59.52%. And relative reduction rate of the Mean Absolute Percentage Error is 66.2%, 34.99% and 61.13%, respectively.

Keywords: sales forecast, weather factors, machine learning algorithm, fresh produce.

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INTRODUCTION

Fresh agricultural products mainly refer to vegetables, fruits, eggs, aquatic products, meat, dairy products and other necessities. Due to the large population, the production and consumption of fresh agricultural products in China is very large. According to the National Bureau of Statistics (China), the output of fresh agricultural products in China has ranked first in the world for many years. In 2016, the total retail sales of fresh products in China were 324 million tons, and the total retail sales was 4.57 trillion yuan, a year-on-year increase of 9.30%. In 2016, the total retail sales of consumer goods in China amounted to 3.323 billion yuan, and the proportion of fresh retail sales was as high as 13.8%. Besides, the proportion of offline fresh supermarkets has steadily increased in fresh agricultural products retail channels, which makes offline purchase as the main channel for consumers.

However, different from other products, the fresh is perishable and deteriorated, which make it more time-sensitive. In order to ensure the freshness of the products sold in supermarkets, it is required to keep the quantity of purchases and sales as equal as possible. Demand underestimation or overestimation negatively affects the revenues of the retailer. Stock-outs have an undesired impact on consumers while unsold items need to be discarded at the end of the day. Therefore, how to forecast the future sales accurately and quickly has become a key issue in the whole supply chain of fresh agricultural products. In practice, accurate sales forecast results can provide decision support for suppliers in scheduling material, as well as reduce cost due to deteriorated goods. In theory, how to incorporate various proper and significant factors into the fresh agricultural product sales forecasting framework? How to apply advanced and solid model to verify the value of the factors? Our research tries to make some explorations about expanding the application area of feature engineering and machine learning.

At present, scholars at home and abroad have made meaningful explorations on sales forecasts, but most of them focus on the fields of clothing (e.g., Huang *et al.* 2017, Thomassey 2010, Cui *et al.* 2015), cosmetics (e.g., Vahdani *et al.* 2016, Chern *et al.* 2009, Kim *et al.* 2018), electronic products (e.g., Chen and Lu 2017, Lu 2014), vehicles (e.g., Fantazzini 2015) and others, the sales forecast in fresh produce field was less studied. Huber *et al.* (2017) applied multivariate ARIMA models to predict the daily demand for perishable goods. In order to forecast the sales of dairy products, Doganis *et al.* (2006) presented a nonlinear time series sales forecasting model which is a combination of the radial basis function (RBF) neural network architecture and genetic algorithm (GA). Chen *et al.* (2010) proposed the "ordinary day and holiday moving average method" and "back-propagation neural network" to predict the sales of fresh food. Dellino *et al.* (2017) provided a decision support system (DSS) for the supply chain of packaged fresh and highly perishable products. The DSS used ARIMA model and ARIMA-X model that take the price factors of sales forecast into account. In summary, most scholars focused on algorithm integration or method innovation for better forecast accuracy, but fewer pay enough attention to the factors affecting the sales of fresh products.

As an important factor affecting consumers' shopping plans, the weather is bound to have an important impact on the sales of fresh produce, especially offline fresh supermarkets. To our knowledge limited, researches about the effect of weather on production and operations management is relatively scarce. Belasco *et al.* (2015) examined the economic losses to cattle feeding associated with extreme weather. Albers *et al.* (2017) disentangled the relative impacts of inputs and weather on

regional yield volatility, and proved that models with only weather variables deliver biased but reasonable approximations for climate impact research. Besides, Craig *et al.* (2018) analyzed the impact of climatic factors and weather conditions on outdoor tourism. Lee (2010) verified the economic value of weather forecasts for decision-making problems in the profit/loss situation.

Due to perishability and vulnerability of fresh agricultural products, it is of great practical significance to accurately predict the sales of such products. However, there is no rigorous evidence regarding the effect of incorporating weather factors within the forecasting sales about agricultural fresh goods. This paper constructs two prediction models: baseline prediction model and weather prediction model. Among them, the features of the baseline prediction model are conventional factors that do not include weather factors while the weather prediction model adds weather factors in contrast with the baseline model. As for predictive model, we use three different types of machine learning algorithms, Ridge Regression (RR), Random Forest (RF) and Support Vector Machine (SVM), to perform regression prediction. The value of weather factors for fresh produce sales forecast is verified via different horizons by comparing the results of the predictions of the two models under three algorithms.

NOVEL DATA SOURCES

Sales Data

We select a 64-day sales data from a fresh supermarket in Hangzhou from May 9, 2016 to July 11, 2016 as experimental data, in which we use the sales data from May 9 to July 4 as a training set, and the 7-day data from July 5th to July 11th is used as a test set to verify the accuracy of the sales forecast results. We draw the daily sales data of the fresh produce of the supermarket into a line chart, as shown in Figure 1.

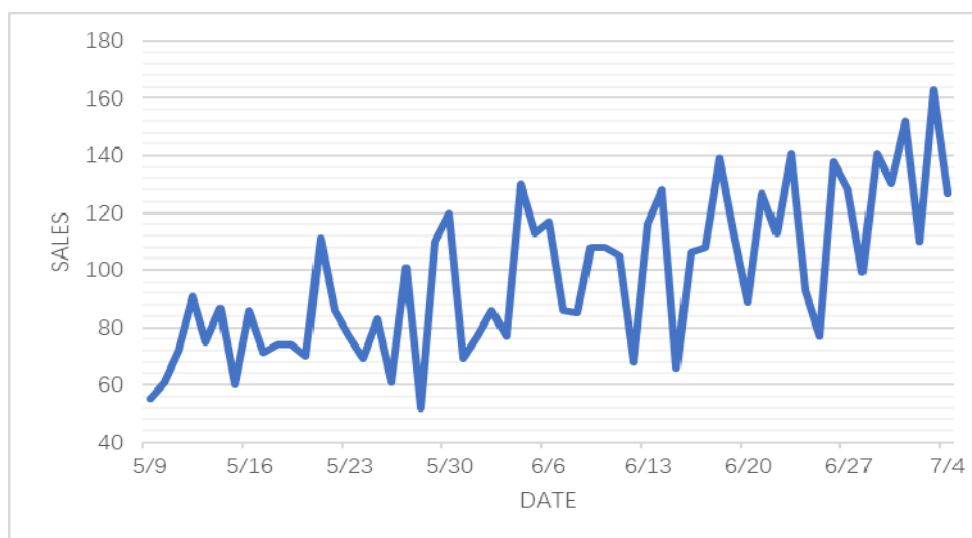


Figure 1: Daily Sales Data of the Fresh Supermarket

Weather Data

This paper selects three weather factors: weather conditions, wind level and air quality index (AQI). Daily weather conditions and wind level information can be obtained from the website: <https://www.15tianqi.cn/>, and air quality index information can be gained from the following website: <https://www.aqistudy.cn/historydata/>. All the weather data needed for this article is crawled by Python, and all data is true.

SALES FORECASTING FRAMEWORK AND MACHINE LEARNING ALGORITHMS

Sales Forecast Framework

To prove the value of weather factors in the sales forecast of fresh produce, we construct two prediction models: baseline prediction model and weather prediction model. Among them, the characteristic variables of the baseline prediction model are conventional factors, such as sales, workday or weekends and holidays, without weather factors. The weather prediction model is obtained by adding weather factors (weather conditions, wind level, air quality index) based on the baseline prediction model. Concentrated on historical sales data from fresh supermarkets, we use three different types of machine learning algorithms, Ridge Regression (RR), Random Forest (RF) and Support Vector Machine (SVM), to perform regression prediction for the two predictive models. The value of weather factors for fresh produce sales forecast is verified via different horizons by comparing the results of the predictions of the two models under three algorithms. Figure 2 shows the forecasting framework for fresh agricultural products sales.

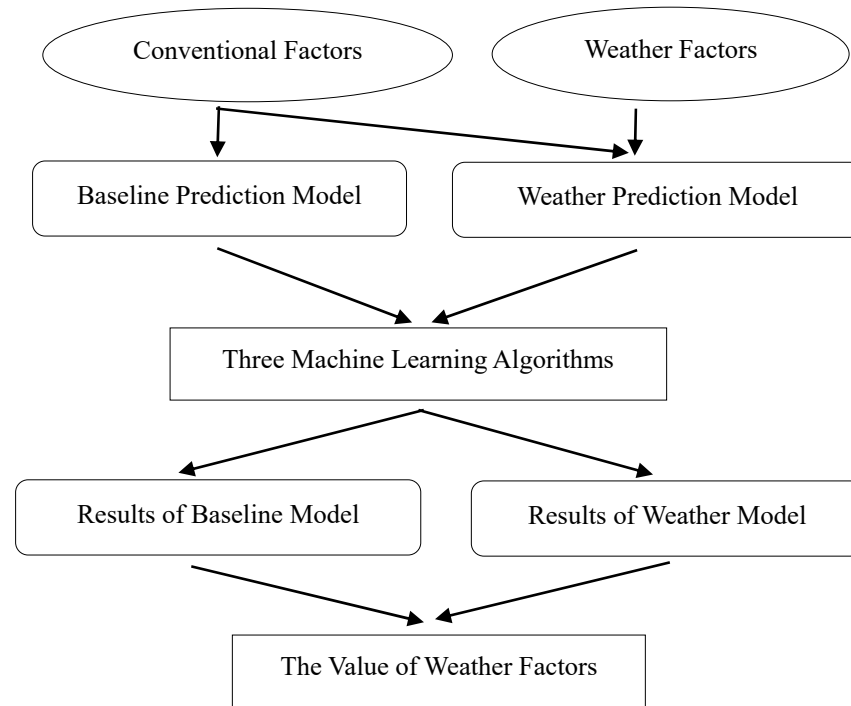


Figure 2: Forecasting Framework

Baseline Prediction Model:

In the baseline prediction model, we assume that the sales on day t is a function of sales in the past week (i.e., past seven days) and the characteristics associated with that t days.

$$S_t = F_1(S_{t-1}, S_{t-2}, S_{t-3}, S_{t-7}, W_t, W_{t-1}, H_t)$$

Where S_t is the output value (predicted value) indicating the sales on the t day. $F_1(S_{t-1}, S_{t-2}, S_{t-3}, S_{t-7}, W_t, W_{t-1}, H_t)$ represents the baseline prediction model function and related features.

The features are explained in Table 1:

Table 1: Features and Explanation of Baseline Prediction Model

Features	Explanation
S_{t-1}	Sales of day $t-1$ (yesterday)
S_{t-2}	Sales of day $t-2$ (the day before yesterday)
S_{t-3}	Sales of day $t-3$ (big day before yesterday)
S_{t-7}	Sales of day $t-7$ (last week)
W_t	A dummy variable equal to 1 if day t is weekend
W_{t-1}	A dummy variable equal to 1 if day $t-1$ is weekend
H_t	A dummy variable equal to 1 if day t is National statutory holiday

Weather Prediction Model:

In the weather prediction model, we assume that it has the similar structure as the baseline prediction model, the only difference being that the weather factors are added to the model. This facilitates comparisons to show the impact of weather factors on sales forecasts.

$$S_t = F_2(S_{t-1}, S_{t-2}, S_{t-3}, S_{t-7}, W_t, W_{t-1}, H_t, A_t, C_t, P_t)$$

Where $F_2(S_{t-1}, S_{t-2}, S_{t-3}, S_{t-7}, W_t, W_{t-1}, H_t, A_t, C_t, P_t)$ represents the weather prediction model function and related features. The unique factors of the weather forecasting model and the corresponding meanings are illustrated in Table 2. Other features and their meanings are the same as those of the baseline prediction model.

Table 2: Features and Explanation of Weather Prediction Model

Features	Explanation
A_t	Category of weather conditions in day t
C_t	Category of wind level in day t
P_t	Category of air quality index in day t

Machine Learning Model for Sales Forecast of Fresh Agricultural Products

In order to eliminate the influence of accidental random factors and to verify the value of weather factors on the sales forecast more reasonably and effectively, we select three different types of representative algorithms in a variety of machine learning algorithms to predict the sales of fresh produce. These three algorithms are Ridge Regression(RR) based on Linear Regression、Random Forest(RF) based on Tree Model、Support Vector Machines(SVM) based on the Kernel Method.

Ridge Regression

Ridge Regression is a biased estimation regression method dedicated to collinear data analysis. It is essentially an improved Least Squares Estimation Method. Ridge Regression gives up the unbiasedness of the Least Squares Method, and obtains a more realistic and reliable regression coefficient at the cost of losing part of the information and reducing the accuracy. When dealing with ill-conditioned data, the fitting effect of Ridge Regression is much stronger than the Least Squares Method.

Ridge Regression shrinks the coefficient by increasing the penalty of the regular term based on the squared error. The algorithm minimizes the expression as follows:

$$w^{ridge} = \operatorname{argmin}_w \sum_{i=1}^n (y_i - w_0 - \sum_{j=1}^p w_j x_{ij})^2 + \alpha \sum_{j=1}^p w_j^2 \quad (1)$$

As α increases, the variance of the model decreases and the deviation increases. By determining the value of α , a balance can be achieved between the variance and the deviation. Find the partial derivative for w and let the expression be zero to get the w value:

$$w^{ridge} = (X^T X + \alpha I)^{-1} X^T Y \quad (2)$$

Random Forest

Random forest is built on regression trees. Regression trees use a tree-like structure to map observations of an item in order to reach conclusions about the item's target value. The random forest model first uses cross-validation to determine the best number of variables, m , to include in a tree. It then draws bootstrap subsamples from the training dataset and grows a regression tree on each of those bootstraps. This is done by bootstrapping variables at each split—randomly selecting m variables at each node and picking the best one as a split-point, which generates a diverse set of trees. In this way, we grow a vast number of trees and average those trees in order to yield a prediction. The biggest advantage of a Random Forest is that it produces highly accurate results, making it one of the most popular statistical learning methods in practice.

Support Vector Machines

Support vector machine is a classical machine learning method based on statistical learning theory which can handle classification and regression. Compared with other machine learning methods, SVM successfully solves the problems of high dimension and local minima. The basic idea of SVM is to design a linear classifier with maximal classification margin, while minimizing the training error. Maximizing the margin plays the role of capacity control so that the learning machine will not only have small empirical risk but also hold good generalization ability. The key to SVM is the kernel function. Low-dimensional space vector sets are often difficult to partition, and the solution is to map them to high-dimensional space. But the difficulty with this approach is the increase in computational complexity, and the kernel function solves this problem subtly. That is, by selecting the appropriate kernel function, the classification function of the high-dimensional space can be obtained. In SVM theory, using different kernel functions will result in different SVM algorithms.

THE VALUE OF WEATHER FACTORES IN THE SALES FOREACST OF FRESH AGRICULTURAL PRODUCTS

Parameter Estimation

In order to make the results of sales forecasting more accurate and compare the performance between the baseline forecasting model and the weather forecasting model, it is necessary to estimate the hyperparameters of the three different algorithms respectively.

To be more specific, we use the 10-fold cross-validation to choose the hyperparameters of our models. The original data set is divided into a training set and a test set, the training set is used for training the model, and the test set is used to verify the accuracy of the results. For the sake of making full use of the training set to select algorithm parameters, the training set is randomly partitioned into 10 equal-size subsets. Of the 10 subsets, a single subset is retained as the validation data for testing

the model's performance and the remaining 9 subsets are used as training data. This process is repeated 10 times (the folds), with each of the 10 subsets used exactly once as the validation data. After averaging the performance of model in each of 10 subsets, we have a measure of the performance for each potential value of the hyperparameter. Finally, the value of the hyperparameter that gives the best performance is chosen. Once we set the best value for the hyperparameter, we use the entire training set to estimate the parameters of the model and the features we retain. The cross-validation is shown in Figure 3.

Comparison of Forecasting Results between Baseline Prediction Model and Weather Prediction Model

In this paper, two commonly used indicators, Root Mean Square Error (RMSE) and Mean Absolute Percentage Error (MAPE), are applied to measure the error between the predicted sales and actual sales of different models. The two error formulas are as follows.

$$RMSE = \sqrt{\frac{1}{N} \sum_{i=1}^N (\text{real}_i - \text{predicted}_i)^2} \quad (3)$$

$$MAPE = \frac{1}{N} \sum_{i=1}^N \left| \frac{\text{real}_i - \text{predicted}_i}{\text{real}_i} \right| \times 100\% \quad (4)$$

In addition, the relative reduction rate of the Root Mean Square Error ($\Delta RMSE$) and the relative reduction rate of Mean Absolute Percentage Error ($\Delta MAPE$) are introduced in this paper to more significantly depict the accuracy of the weather prediction model compared to the baseline prediction model. Formulas are as follows.

$$\Delta RMSE = \frac{RMSE_{base} - RMSE_{wea}}{RMSE_{base}} \times 100\% \quad (5)$$

$$\Delta MAPE = \frac{MAPE_{base} - MAPE_{wea}}{MAPE_{base}} \times 100\% \quad (6)$$

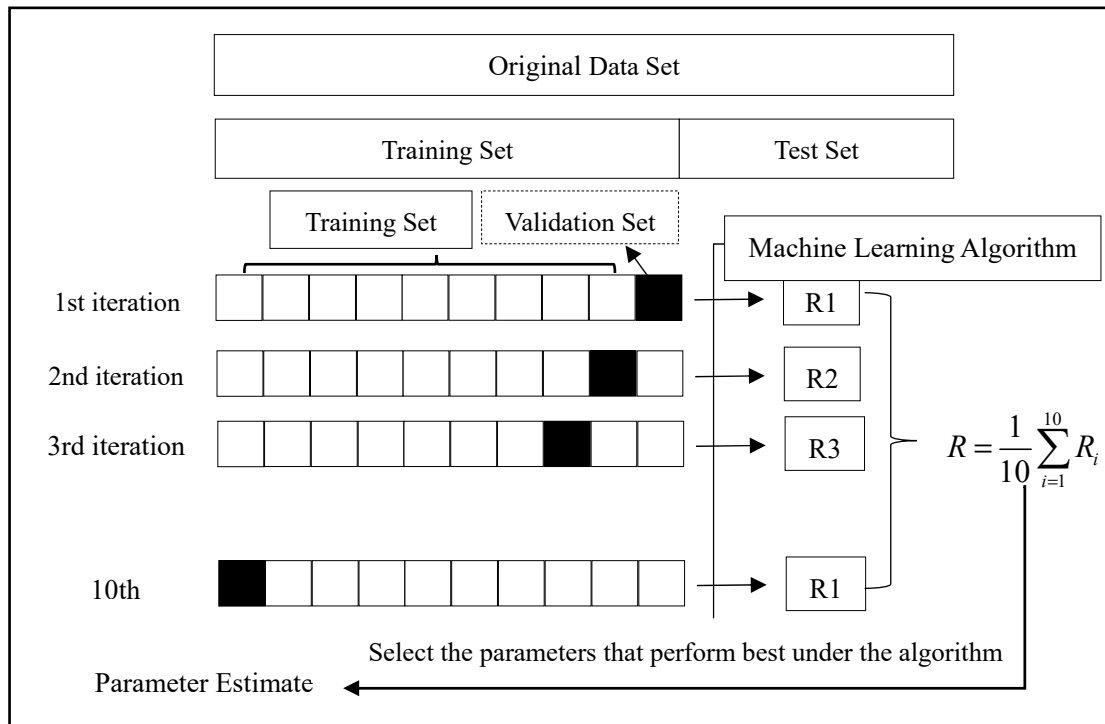


Figure 3: Select Parameters by Cross-validation

According to the historical sales data of a fresh supermarket, three kinds of machine learning methods are used to predict the sales via the baseline prediction model and the weather prediction model respectively. The error statistics between the forecasting sales and the actual sales are shown in Table 3 and Table 4.

Table 3 Comparison of RMSE between Baseline Model and Weather Model

	RMSE _{baseline}	RMSE _{weather}	Δ RMSE (%)
Ridge Regression	9.69	3.01	68.90
Random Forest	11.21	8.55	23.66
Support Vector Machines	13.75	5.56	59.52

Table 4 Comparison of MAPE between Baseline Model and Weather Model

	MAPE _{baseline} (%)	MAPE _{weather} (%)	Δ MAPE (%)
Ridge Regression	6.01	2.03	66.20
Random Forest	7.46	4.85	34.99
Support Vector Machines	9.33	3.63	61.13

As can be seen from Table 3 and Table 4, the RMSE and MAPE of the weather prediction model under the three algorithms have a significant reduction compared to the baseline prediction model. The relative reduction rate of the Root Mean Square Error achieved by the three algorithms is 68.90%, 23.66%, 59.52%, and relative reduction rate of the Mean Absolute Percentage Error is respectively 66.2%, 34.99%, 61.13%. The performance of the fresh agricultural product sales forecasting model considering weather factors is more prominent, which can greatly reduce the forecasting error. So, the value of weather factors in the sales forecast of fresh agricultural products is verified. Weather factors can greatly reduce the error in the forecast of sales of fresh agricultural products.

ACKNOWLEDGMENT

This research is supported by National Natural Science Foundation of China (Nos.71471025, 71531002) and the Fundamental Research Funds for the Central Universities (Nos. DUT17RW214).

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Research on the Third-party Payment Risk in the Background of Nets Union Clearing Platform: The Case of Alipay

(Full Paper)

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ABSTRACT

Third-party payment has become an important part of the current payment method in China. However, there are many risks associated with the development of the third-party payment network. The establishment of the Nets Union in 2017 had a significant impact on the standardization of the entire third-party payment market. By further researching the third-party payment risk under the background of Nets Union Clearing Platform, combining with the empirical analysis for the case of Alipay, this paper constructs the third-party payment risk model by AHP and fuzzy comprehensive evaluation, then making some recommendations for Third-party payment risk control management.

Keywords: The third-party payment, China Nets Union Clearing Corporation, Alipay, risk control.

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INTRODUCTION

From the first intermediary platform serving online transactions had been introduced at the end of the last century in China, the third-party payment and e-commerce had grown together. After decades of development, they have achieved impressive results in both user usage and transaction scale. However, the third-party payment still exposes a lot of risks during the development stage. Although the third-party payment in China has gone from the earliest regulatory omission to various laws and regulations, the supervision of China is far behind the rapid development demand even if the Nets Union was established to support the liquidation for online payment of non-bank payment agencies in 2017.

As for the risk of third-party payment, a great deal of useful research has been done by predecessors. However, the focus of this paper is the development of the market and industry under the rapidly changing conditions, especially with the newly established Nets Union over the past year, and to discuss the risk management and risk analysis of third-party payment under this background. This paper select the case of Alipay as an example to perform the risk analysis through theoretical and empirical way, in order to better identify and manage those risks and prepare to take preventive measures.

LITERATURE REVIEW

For the foreign literature, the research of e-commerce and third-party payment in developed countries have started in earlier time than China. Those researches involved payment model, third-party payment security index, and risk measurement evaluation, which possessed values of reference to the depth and breadth.

For domestic literature, Chinese scholars have done a lot of research on the risks of third-party payment as well. Che (2015) claimed that the risk of third-party mobile payments mainly consisted of external and internal aspects. External risks included industry-related administrative laws, regulations, policies and the creditworthiness. Internal risks were mainly determined by the safety of funds and the compliance of technologies and operations. Wang and Guo (2011) classified the third-party payment risk into four major components: the third-party payment platform itself, the security of the system network and the internet, and the precipitation and virtual currency risks closely related to the transaction. Xie (2010) suggested that promoting and supporting third-party payment agencies to access inter-bank payment and settlement systems could facilitate the supervision and management of the entire industry. Zhang (2011) took Alipay as an example to discuss the problems of ownership for deposit interest of third party payment platform. Wu, Yu and Wang (2010) pointed out that it is necessary to supervise online transactions, establish an online trading database to record transaction information, and analyze the data information to effectively reduce the risk impact on the anti-money laundering system. Since the Nets Union was firstly established in China in 2017, there are only a few related research information in domestic and abroad.

To sum up, most of those researches only qualitatively analyzed the third-party payment risk, and did not conduct quantitative and comprehensive evaluation on the third-party payment risk in the new situation. This paper comprehensively review the research results both at home and abroad, summarizing the possible risk factors of the third-party payment in the context of the

Internet. Then it design and construct the model using analytic hierarchy process, fuzzy comprehensive analysis, and take Alipay as an example to come with quantitative analysis results under the background of third party payment risk empirical research.

THIRD PARTY PAYMENT RISK FACTORS UNDER NETS UNION

Network Alliance Clearing Limited, or "Nets Union", was formally incorporated in 2017. The principal business scope of Nets Union includes the construction and operation of a unified national clearing system to provide liquidation of online payment transactions for non-bank payment institutions. Before the establishment of Nets Union, every third-party payment agency set up a network system themselves that directly connected with the bank, which was considered to circumvent the supervision of the national central bank. Due to the founding of Nets Union, the cleaning system will be processed on the network platform of Nets Union, which allows the financial data becoming more transparent and is able to be effectively regulate by the national regulatory authorities. Therefore, it can be said that the establishment of Nets Union have great impact on the standardization of third-party payment.

Based on the background of the establishment of Nets Union, the previous research theories, and the Basel Accord, combining with the specific features of third-party payment, this article will analyze the five dimensions consist of financial risk, market risk, credit risk, policy regulatory risk, and security technology risk, to discuss the risk of third-party payment.

Financial Risk

Financial risks mainly include five dimensions considering to be the risks of depositing capital, cash, money laundering, liquidity and virtual currency. First of all, the third-party payment agencies have a great incentive to divert funds from settling deposits and the deposits during the custody of securities market, which poses a security risk. Secondly, third-party payments may use the virtual nature of the internet for fraudulent transactions that create a cash-for-cash risk. Thirdly, due to the network environment, third-party payment coupled with the opaque nature of data and information, provide a space for criminals to use the platform to launder money with the opaque nature of data and information under internet environment. Fourthly, the liquidity risk mainly lies in the reserve for bank deposits. Finally, there are a number of "virtual currencies" in the payment process, and the easiness of payment by third parties results in more frequent transactions which increase the velocity of the currency. This may increase the base currency and break the original stable financial order, resulting in a virtual currency risk.

Market Risk

Market risks mainly include the risks of loss of customers, rejection of cooperation by banks, potential entrants, industry competitors and industry replacement. Firstly, businesses and users, as the third-party payment customers, have the characteristics of large cardinality with low loyalty, and the diversification of platforms leads to more cruel competition and contributing to the loss of customers. Secondly, the business of third-party payment is carried out with the bank docking service port. Those business will be difficult to carry out once the bank refuses to cooperate. Thirdly, as the e-commerce platform, mobile operators, and banks get into the third-party payment field, market competition trends to be fiercer. Moreover, at the end of 2016, 255 non-bank payment agencies in China had obtained payment licenses. Those numerous industry participants led to brutal competition. Finally, with the advances of technology, new connotations and methods will emerge in the future, which means similar and better product or services will emerge, bring a tremendous risk to third-party payments market.

Credit Risk

This paper discusses the credit risk from the four aspects of the defaults of buyers, sellers, banks and third-party platforms. First of all, the inability of buyers to pay in full will lead to an increase in the credit cost of the service provider, as well as the bad user rate. Secondly, as the seller cannot provide or not promptly provide the products or services requested by the buyer, the transaction revocation occurs and the seller's credit value is lowered, resulting in bad industry influence. Moreover, due to delayed settlement of the bank led to the funds cannot be credited in time, affecting the user experience and platform reputation. Finally, due to third-party payment of poor management, lacking of risk control and other reasons caused by the failure to perform, misappropriation of funds and other circumstances also result in the loss of users.

Policy and Regulation Risks

This paper discusses policy and regulatory risks from aspects of policies, laws and regulations. On the one hand, At present, China holds the attitude of support and encouragement for the innovation and development of the third-party payment industry, so the policy risk is relatively small. However, with the continuous change of policies, the possibility of policy risks will also change. On the other hand, compared to the alarming rate for development of third-party payment, the existing laws and regulations are far behind to effectively monitor the user's legitimate rights. Right of interests cannot be really protected, which will become a stumbling block for further development of the industry.

Security and Technology Risk

Security technology risks mainly include the aspects of system security, technology, and operation. On the one hand, third-party payment relies on the development of internet technology, and the normal operation of the security system possess a great importance at any stage of its development. Once a technology loophole is exploited by hackers or other criminals, it will trigger a chain reaction of information security and endanger citizen's personal property safety and national security. On the other hand, users and staffs of third-party payment platforms are exposed to instantaneous risks due to mistakes in technical operations during payment.

THE CASE OF ALIPAY

Alipay is the industry leader of third-party payment in China depending on its popularity, influence, and the proportion of the scale in the market. Therefore, this paper choose Alipay as a representative in the context of the Nets Union to study the third party payment risk assessment system.

For the risk assessment of third-party payment, interviews and surveys were used to take this study. 40 scholars and veteran practitioners in the financial industry as experts were invited to take the example of Alipay in the form of a questionnaire to give feedback on the risk rating of third-party payment in the context of the Nets Union. Through the analytic hierarchy process and the fuzzy comprehensive method, the conclusion of overall evaluation for third-party payment risk under the reality of Nets Union would be finally drawn.

The Third Party Payment Risk Evaluation Index System under Nets Union

Based on the above analysis of the third-party payment risk in the context of Nets Union, the evaluation index system of Alipay is designed as Table 1.

Table 1: The Third Party Payment Risk Evaluation Index System under Nets Union

No.	Target level	Primary Indicator	Secondary Indicator
1	X Risk of third-party payment under Nets Union	X1Financial Risk	X11Precipitation funds risk
2			X12Cash out risk
3			X13Money laundering risk
4			X14Liquidity risk
5			X15Virtual currency risk
6			X21Customer loss risk
7			X22Bank cooperation risk
8			X23Potential entrants risk
9		X2Market Risk	X24Industry competition risk
10			X25Alternative risk
11			X31Buyer risk
12		X3Credit Risk	X32Seller risk
13			X33Bank risk
14			X34Payer default risk
15		X4Policy and Regulation Risk	X41Policy risk
16			X42Laws and regulations risk
17		X5Security and Technology Risk	X51System security risk
18			X52Technical and operational risk

Evaluation Process

Build A Judgment Matrix.

Analytic Hierarchy Process (AHP) compares the importance of each two evaluated objects individually, and assigns importance to the two objects according to 1-9 scale. Based on the matrix of importance of judgment matrix, a judgment matrix is constructed respectively for the secondary indicator relative to the primary indicator and the primary indicator relative to the target level.

Calculate The Weighted Vector.

This paper use column and inversion method to calculate the weighted vector: If a_{ij} is the importance scale of the judgment matrix, that is, the importance scale of the j^{th} indicator relative to the i^{th} indicator, the calculation steps are as follows:

Firstly, set m order judgment matrix as:

$$A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1m} \\ a_{21} & a_{22} & \cdots & a_{2m} \\ \vdots & \vdots & \cdots & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{mm} \end{bmatrix} \quad (1)$$

Secondly, calculate the weight of each element in the column($i=1,2,\dots,m$):

$$b_{ij} = \frac{a_{ij}}{\sum_{j=1}^m a_{ij}} \quad (2)$$

Thirdly, Normalize $\sum_{i=1}^m b_{ij} = b_j$, that is, to obtain the weight of each indicator

$$u_k^{(j)} = \frac{b_j}{\sum_{k=1}^m b_k} \quad (3)$$

$u_k^{(j)} = (u_1^{(j)}, u_2^{(j)}, \dots, u_n^{(j)})^T$ is the weight vector of the indicator under the j^{th} indicator layer, $u^{(j)} = (u^{(1)}, u^{(2)}, \dots, u^{(m)})^T$ is the index layer relative to the target layer of the weight vector, the same can be calculated under the other indicators of the index weight $u_k^{(j)}$.

Check the Consistency of Judgment Matrix.

Check the consistency of judgment matrix based on the step (3) to get the step (4), that is :

$$CR = \frac{\lambda - n}{(n - 1)RI} \quad (4)$$

To determine the maximum eigenvalue of the matrix, n is the number of objects to be evaluated, and RI is the average random consistency indicator. In general, if the consistency ratio $CR \leq 0.1$, the judgment matrix is considered to be passed the consistency check; otherwise, the judgment matrix needs to be reconstructed.

Results of Weight Calculation.

Based on the step (1), (2), (3), the weight of primary indicator is:

$$u_k^{(0)} = (0.45, 0.09, 0.13, 0.05, 0.28)^T$$

Similarly, calculate the weight vector of the secondary indicators under the other primary indicators, listed in the ninth column of Table 2.

Table 2: Indicator judgment matrix and weight

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	X	X	X1	X2	X3	X4	X5	Weight $u^{(i)}$	
2		X1	1	5	3	7	3	0.45	$\lambda_{\max}=5.23$
3		X2	1/5	1	1/2	3	1/5	0.09	RI=1.1185
4		X3	1/3	2	1	3	1/3	0.13	CR=0.05
5		X4	1/7	1/3	1/3	1	1/5	0.05	
6		X5	1/3	5	3	5	1	0.28	
7	X1	X1	X11	X12	X13	X14	X15	Weight $u_k^{(i)}$	
8		X11	1	3	3	2	5	0.40	$\lambda_{\max}=5.13$
9		X12	1/3	1	1	1/2	3	0.14	RI=1.1185
10		X13	1/3	1	1	1/3	3	0.14	CR=0.03
11		X14	1/2	2	3	1	3	0.26	
12		X15	1/5	1/3	1/3	1/3	1	0.06	
13	X2	X2	X21	X22	X23	X24	X25	Weight $u_k^{(i)}$	
14		X21	1	6	5	3	2	0.42	$\lambda_{\max}=5.17$
15		X22	1/5	1	1/2	1/3	1/4	0.06	RI=1.1185
16		X23	1/5	2	1	1/3	1/5	0.08	CR=0.04
17		X24	1/3	3	3	1	1/2	0.16	
18		X25	1/2	4	5	2	1	0.27	
19	X3	X3	X31	X32	X33	X34		Weight $u_k^{(i)}$	
20		X31	1	1/2	1/5	1/3		0.08	$\lambda_{\max}=4.16$
21		X32	2	1	1/4	1/3		0.12	RI=0.8931

22		X33	5	5	1	3	0.55	CR=0.06
23		X34	3	3	1/3	1	0.25	
24	X4	X4	X41	X42			Weight $u_k^{(i)}$	$\lambda_{\max}=2.00$
25		X41	1	1/3			0.25	RI=0
26		X42	3	1			0.75	CR=0.00
27	X5	X5	X51	X52			Weight $u_k^{(i)}$	$\lambda_{\max}=2.00$
28		X51	1	5			0.83	RI=0
29		X52	1/5	1			0.17	CR=0.00

Consistency Check.

According to step (4), the judgment matrix is checked for consistency, and the results are listed in the tenth column of Table 2, showing $CR \leq 0.1$ which means those all pass the consistency test.

Determine the Evaluation Factor Set.

According to Table 1, the fuzzy comprehensive evaluation factor set is:

$X = \{X_1, X_2, X_3, X_4, X_5\}; X_1 = \{X_{11}, X_{12}, X_{13}, X_{14}, X_{15}\}; X_2 = \{X_{21}, X_{22}, X_{23}, X_{24}, X_{25}\}; X_3 = \{X_{31}, X_{32}, X_{33}, X_{34}\}; X_4 = \{X_{41}, X_{42}\}; X_5 = \{X_{51}, X_{52}\}.$

Determine the Remark Set.

Remark set $V = \{V_1, V_2, \dots, V_5\}$, represent the rating level from high to low five levels, which are: low risk, relatively low risk, medium risk, relatively high risk, high risk.

Determine the Set of Evaluation Indicators Weight.

According to AHP to determine the weight vector $U = [0.45, 0.09, 0.13, 0.05, 0.28]$, $U^{(1)} = [0.40, 0.14, 0.14, 0.26, 0.06]$, $U^{(2)} = [0.42, 0.06, 0.08, 0.16, 0.27]$, $U^{(3)} = [0.08, 0.12, 0.55, 0.25]$, $U^{(4)} = [0.25, 0.75]$, $U^{(5)} = [0.83, 0.17]$ see the details in Table 2.

Determine the Evaluation Matrix R and Ri.

Combined with matrix construction and judgment to determine the evaluation matrix.

Conduct Fuzzy Comprehensive Evaluation.

The fuzzy vector of the evaluation index and the evaluation matrix constituted by step (4) are synthetically transformed. The comprehensive evaluation results are as follows:

$$B = U \times R \quad (5)$$

Fuzzy evaluation set $B_i = \{B_{i1}, B_{i2}, \dots, B_{in}\}$, B_{in} is the B_i membership of the i^{th} indicator comment set V_i to the fuzzy comprehensive evaluation set. According to the principle of maximum degree of membership, the corresponding fuzzy comprehensive evaluation results are obtained:

$$M_i = \max(B_{i1}, B_{i2}, \dots, B_{in}) \quad (6)$$

By the same token, the fuzzy comprehensive evaluation results of each criterion layer can be calculated.

Questionnaire Results and Statistical Analysis.

Firstly, we make the construction of single evaluation fuzzy matrix.

Based on the results obtained through questionnaire survey, the statistical results of each index in each evaluation center are determined to calculate the weight. According to step (5) and the weight vector $U^{(i)}$ of the index under each criterion layer in AHP, the fuzzy evaluation set B_i of the criterion layer can be obtained, that is,:

$$\begin{aligned}
 B_1 &= U^{(1)} \times R_1 = [0.40, 0.14, 0.14, 0.26, 0.06] \begin{bmatrix} 0.00 & 0.10 & 0.60 & 0.30 & 0.00 \\ 0.00 & 0.15 & 0.85 & 0.00 & 0.00 \\ 0.00 & 0.00 & 0.70 & 0.30 & 0.00 \\ 0.00 & 0.10 & 0.20 & 0.55 & 0.15 \\ 0.00 & 0.20 & 0.30 & 0.50 & 0.00 \end{bmatrix} \\
 &= [0.000, 0.099, 0.527, 0.335, 0.039]
 \end{aligned}$$

According to the principle of maximum membership degree, it is calculated by step (6):

$$M_1 = \max(0.000, 0.099, 0.527, 0.335, 0.039) = 0.527$$

The "medium risk" level of membership has the largest membership degree.

$$B_2 = U^{(2)} \times R_2 = [0.42, 0.06, 0.08, 0.16, 0.27] \begin{bmatrix} 0.00 & 0.30 & 0.55 & 0.15 & 0.00 \\ 0.00 & 0.30 & 0.70 & 0.00 & 0.00 \\ 0.00 & 0.85 & 0.15 & 0.00 & 0.00 \\ 0.30 & 0.55 & 0.15 & 0.00 & 0.00 \\ 0.15 & 0.50 & 0.25 & 0.10 & 0.00 \end{bmatrix} = [0.089, 0.435, 0.377, 0.090, 0.000]$$

According to the principle of maximum membership degree, it is calculated by step(6):

$$M_2 = \max(0.089, 0.435, 0.377, 0.090, 0.000) = 0.435$$

The "relatively low risk" level of membership has the largest membership degree.

$$B_3 = U^{(3)} \times R_3 = [0.08, 0.12, 0.55, 0.25] \begin{bmatrix} 0.90 & 0.10 & 0.00 & 0.00 & 0.00 \\ 0.90 & 0.10 & 0.00 & 0.00 & 0.00 \\ 0.05 & 0.35 & 0.60 & 0.00 & 0.00 \\ 0.00 & 0.25 & 0.75 & 0.00 & 0.00 \end{bmatrix} = [0.208, 0.275, 0.518, 0.000, 0.000]$$

According to the principle of maximum membership degree, it is calculated by step(6):

$$M_3 = \max(0.208, 0.275, 0.518, 0.000, 0.000) = 0.518$$

The "medium risk" level of membership has the largest membership degree.

$$B_4 = U^{(4)} \times R_4 = [0.25, 0.75] \begin{bmatrix} 0.00 & 0.20 & 0.60 & 0.20 & 0.00 \\ 0.00 & 0.00 & 0.60 & 0.40 & 0.00 \end{bmatrix} = [0.000, 0.050, 0.600, 0.350, 0.000]$$

According to the principle of maximum membership degree, it is calculated by step(6):

$$M_4 = \max(0.000, 0.050, 0.600, 0.350, 0.000) = 0.600$$

The "medium risk" level of membership has the largest membership degree

$$B_5 = U^{(5)} \times R_5 = [0.83, 0.17] \begin{bmatrix} 0.00 & 0.00 & 0.05 & 0.80 & 0.15 \\ 0.00 & 0.00 & 0.55 & 0.45 & 0.00 \end{bmatrix} = [0.000, 0.000, 0.135, 0.741, 0.125]$$

According to the principle of maximum membership degree, it is calculated by step(6):

$$M_5 = \max(0.000, 0.000, 0.135, 0.741, 0.125) = 0.741$$

The "relatively high risk" level of membership has the largest membership degree.

Secondly, we make the analysis of comprehensive evaluation results.

Based on the individual evaluation result of each level indicator layer obtained from the single evaluation, after combining the five primary indicator's membership vector, the fuzzy comprehensive evaluation matrix R is obtained as follows:

$$R = \begin{bmatrix} B_1 \\ B_2 \\ B_3 \\ B_4 \\ B_5 \end{bmatrix} = \begin{bmatrix} 0.000 & 0.099 & 0.527 & 0.335 & 0.039 \\ 0.089 & 0.435 & 0.377 & 0.090 & 0.000 \\ 0.208 & 0.275 & 0.518 & 0.000 & 0.000 \\ 0.000 & 0.050 & 0.600 & 0.350 & 0.000 \\ 0.000 & 0.000 & 0.135 & 0.741 & 0.125 \end{bmatrix}$$

At the same time, according to AHP calculated the weight of each level indicators $U = [0.45, 0.09, 0.13, 0.05, 0.28]$, and the evaluation model $B = U \times R$, to get the Fuzzy comprehensive evaluation set B, that is :

$$B = U \times R = [0.45, 0.09, 0.13, 0.05, 0.28] \begin{bmatrix} 0.000 & 0.099 & 0.527 & 0.335 & 0.039 \\ 0.089 & 0.435 & 0.377 & 0.090 & 0.000 \\ 0.208 & 0.275 & 0.518 & 0.000 & 0.000 \\ 0.000 & 0.050 & 0.600 & 0.350 & 0.000 \\ 0.000 & 0.000 & 0.135 & 0.741 & 0.125 \end{bmatrix} = [0.035, 0.122, 0.406, 0.384, 0.052]$$

According to the principle of maximum membership degree, it is calculated by step(6):

$$M = \max(0.035, 0.122, 0.406, 0.384, 0.052) = 0.406$$

He "medium risk" level of membership has the largest membership degree.

CONCLUSION

According to the result of empirical analysis and the principle of maximum subordination, the security and technology risk is considered to be "relatively high risk" level, and market risk belongs to "relatively low risk" level among the primary risk indicators. The rest of financial risk, credit risk and policy & regulation risk are considered to be "medium risk" level. Overall, the results of this research which takes Alipay as an example is considered to be "medium risk" level under the background of establishment of Nets Union. The results also highlight that the security and technology risk should be focused, especially for the platform of Nets Union which has demand for higher requirement of technology.

At the same time, related agencies should also strengthen the management of medium risks such as financial risk, credit risk and policy and regulatory risk, with particular attention to the secondary indicators: capital inflow under financial risk, buyer risk under credit risk and risk of laws and regulations under the risk of policies and regulations. Of course, the relatively low risks such as market risk, should not be relaxed vigilance. In conclusion, although the overall management of the third-party payment risks may have some beneficial effects due to the establishment of the Nets Union, there is still some space for improvement in risk prevention and security in the context of overall medium risk.

SUGGESTION

Based on the above empirical results, this paper puts forward the following suggestions on the third party payment risk control.

Strengthen The Management of Sedimentary Funds

Through the implementation of the provisions from the national central bank, opening a dedicated way of payment of equipment can be separated from the settlement funds and the basic account. For banks, it can take a variety of measures to prevent third party payment agencies from diverting funds for settling funds, such as setting up detailed ledgers for users, strengthening the disclosure mechanism, and increasing the frequency of issuance of deposited funds.

Implement Anti-Money Laundering and Anti-Cashing Work

After the establishment of the Nets Union, with a clearer financial flow, more comprehensive screening and management of anti-money laundering and anti-cash-out efforts can be achieved. At the same time, it is necessary to strengthen the examination of customers and businesses. For example, they can verify and identify users, and strengthen online trading review and supervision through internet technology.

Enhance Security Supervision and Measures

At present, most third-party payment platforms use the SSL protocol for data encryption and transmission. However, advanced technologies may also have vulnerabilities or risk of being outdated and hacked. Therefore, continuous improvement in the hardware and software of payment platforms cannot be ignored.

Strengthen The Supervision and Management of Credit Risk

The implementation of credit rating agencies and individuals' evaluation measures allow related agencies to strengthen the supervision and management of credit risk. This also can ensure that all aspects of online payment can participate in mutual supervision and improve the awareness of integrity.

Improve Laws and Regulations and Strengthen Enforcement

In China, there is no legal law to determine the ownership of the interest accruing from the sedimentary capital formed by the payment of the third party, and the data and disposal of deposited funds in the third party payment account has never been disclosed to the public. Therefore, it is urgent and necessary to formulate and improved the regulation of relevant reserve management system.

ACKNOWLEDGMENT

This work is partially sponsored by grant 14BGL186 of National Planning Office of Philosophy and Social Science, grant SC13A007 of Sichuan Philosophy and Social Science Planning Key Projects of China and grant XZX18011 of Project of Basic Scientific Research Operation of Central University of Southwestern University of Finance and Economics.

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Research on User Information Behavior and Hotspot Prediction of WeChat Official Accounts Based on Sootoo Network

(Full Paper)

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ABSTRACT

With the rapid development of mobile Internet, more and more attention has been paid to the new form of online social media represented by WeChat official accounts. However, these operators do not have clear ideas for enhancing WeChat heat, and clear and effective guidance on how to positively influence users' information behavior. Therefore, this paper combines the psychology neutral Stimulus-Response theory with the user information behavior research to construct a second-order user information behavior model. Then, through the official accounts data provided by the Sootoo Network, we collected a total of more than 10,000 push data of nine accounts from January to December, 2017. Based on the empirical research, we find the main influencing factors of user information behavior are identified, and construct a push hotspot prediction model. Also, this paper provides account operator with practical guidance significance in enhancing user information behavior.

Keywords: WeChat official account, user information behavior, hotspot prediction.

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INTRODUCTION

WeChat is an instant messaging software based on the mobile Internet launched by Tencent in January 2011. According to the 2017 Ecological Research Report on WeChat users, by the end of 2016, there were more than 10 million official accounts emerging in WeChat (Fang& Shi& Zhang, 2013). Everyone can be a communicator of WeChat we-media platform, but the huge differences in operational capabilities have led to a gradual disintegration of communication power among the communicators.

The general process of users' activities on WeChat official accounts is as follows: firstly, the user receives the push message directly or indirectly. Direct acceptance means that the user receives push messages from the message list. And indirect acceptance means that user receives push messages from other channels such as moments and other users. Secondly, when the user receives the push stimulus, the user can choose to click to read or not to click to read. Then, when the user chooses to read, he receives the stimuli from push text. After that, the user will perform likes, comments, collections, and shares. Finally, after the overall push stimuli, the user will choose follow this account or not (Fang& Lu, 2016).

This paper focuses on the impact of the WeChat official account push on user information behavior, including the reading rate, sharing rate, and new fans. As for the data collection, this paper chose 9 official accounts from which had a huge number of fans accounts data provided by the Sootoo Network, and collected a total of 10,507 push data of nine accounts from January to December, 2017.

The content of this paper includes the following aspects:

- (1) Build the user information behavior model based on the Stimulation-Reaction theory in the official account, and summarizes the different influencing factors of each behavioral stage.
- (2) Data preprocess: Export the relevant data from the database of official accounts, and then clean, label, normalize, and merge the data. Combining the theoretical model of this paper, define the relevant independent variables and dependent variables.
- (3) Data analyze: Use SPSS software to analyze the data and compare the influence of different account types, different push dates, and whether or not to push index on user information behavior.
- (4) Build the hotspot prediction model: The hotspots are divided into multiple dimensions: reading rate, sharing rate, comment/collection volume, the number of fans. For different prediction dimensions, build the prediction model based on BP Neural Network and Random Forest.

LITERATURE REVIEW

2.1 User Information Behavior

Davenport (1997) first proposed the concept of information behavior in 1997. He believed that information behavior is an individual behavior to obtain and process information, including information retrieval, correction, utilization, sharing, storage, and neglect. Wilson (2000) complemented this concept in 2000 and proposed that information behavior includes actively information seeking and utilization, as well as passive information reception. Bai Haiyan (2002) found that user information behavior is a response to the external environment under the control of cognitive thinking. It was based on the information needs and ideological motivations. It went through a process of searching, selecting, and collecting information. Deng Xiaoyong & Li Xiaohong (2008) defined the information behavior of network users as the users in the network environment using network tools to do some activities such as the information retrieval, selecting, exchange, and release under the control of their information needs. Koh J & Kim Y.G (2004) found that the information sharing behavior of virtual community users can drive information sharing of other users, thereby achieving a virtuous circle.

According to the definition of user information behavior, this paper use the user information behavior in the operation of WeChat official accounts as the user's behaviors such as reading, sharing, collection and like for the push from the new media official account (Park J H& Gu B& Leng, 2014).

2.2 Stimulation-Reaction Model

The Stimulation-Reaction Model was first established by John Watson who was the founder of behavioral psychology in the early 20th century. S-R theory pointed out that human's complex behavior could be divided into two parts: stimulus and reaction. Based on John Watson's S-R theory, Howard & Sheth (1969) proposed the consumer's stimulus-body-reaction model. This model believed that the stimuli from the corporate social environment could affect the user's perception and learning, so that the user had a certain degree of emotion and cognition, thus affecting the purchase behavior of consumers. Ergolu (2003) completed the model above through the empirical research, and obtained a new conceptual model. He pointed out that the website atmosphere influenced consumer's pleasure, arousal and attitude, and then influenced consumer satisfaction and approach or avoidance behavior.

In the process of a push from WeChat official account, we define the official account and the push as stimulus. The stimulus mainly comes from the account itself, time attribute, push title attribute, etc before the user accepts information (Wang Ye, 2015). After the user receives the information, the stimulus mainly comes from the text of the push.

2.3 Content Sharing and Communication on Online Social Platforms

Wu Zhongtang (2015) studied the influence of keyword and title on information dissemination through empirical analysis. Fang Xingdong (2013) studied the impact of push frequency, push time, word count of the title, topic on information dissemination and the push's life cycle through empirical analysis. Yan Yinwen (2017) used BP Neural Network to evaluate the effect of information communication in governmental WeChat official account. Wang Xiudan (2015) studied the influence mechanism of the company's WeChat official account on users' willingness to share, and believed that information quality, information volume, information content, frequency of push, and information innovation indirectly affect users' willingness to share. Yang.J & Counts.S (2010) found that the information content and the reference rate of related users are the key factors affecting the information dissemination.

2.4 Innovation

As for the research variables, this paper broadened the data sources to a certain extent. We obtained the second-hand data of WeChat official account through cooperation with enterpris, which made up for the fact that the variables in previous research were difficult to obtain. Due to data limited, previous researches related to the WeChat official account are currently focused on WeChat marketing strategies, consumer purchase intentions, customer relationship management and so on, but there are few studies on information dissemination and user information behavior. And often use qualitative methods such as questionnaires. This paper uses quantitative empirical analysis to study the influencing factors of user information behavior.

Second, about the theoretical model, based on the theory of user information behavior, this paper combines the Stimulation-Reaction model and the environmental characteristics of WeChat official account. Defines the two-level research concept of push stimuli-user information behavior, and conducts specific dimensionality of user information behavior in this environment. At the same time, find out the main factors affecting user information behavior.

DATA COLLECTION AND PREPROCESSING

3.1 Data Collection

The data in this paper is derived from several official accounts operated by Sootoo Netwok. This paper selects three types of representative official accounts categories: "emotional psychology", "video entertainment" and "science & technology finance". Each category selects 3 accounts with lots of fans to research. This paper has obtained all the push data of these 9 accounts from

January 1 to December 31, 2017, with a total of 10,524 pushes amount, a total of 250 million reading amount, a total of 4,905,000 sharing amount, and a total of 1,829,000 fans growth. The amount of data is shown in Table 1.

Table 1: Data overview

Name	Push amount	Fans amount	New fans amount	Reading amount	Sharing amount	Likes amount
Short Novel	1,133	518,352	93,391	16,752,141	286,425	198,059
Psychological Test	1,164	1,273,403	164,800	44,224,103	847,806	128,685
Mood Signature	1,291	1,036,347	371,340	37,743,509	784,482	263,176
Creative Agency	1,410	1,246,621	250,982	53,010,159	1,447,299	346,485
Movie Heaven	1,112	1,401,068	598,824	26,508,795	236,465	128,611
Miao is coming	2,056	504,679	233,561	43,380,478	907,937	1,381,942
Electric Business News	527	255,097	10,074	5,212,894	58,055	11,202
Internet New Things	1,037	404,068	78,002	14,876,471	202,129	44,278
Financial Reference	794	234,827	27,836	9,942,651	134,625	35,677
TOTAL	10,524	6,874,462	1,828,810	251,651,201	4,905,223	2,538,115

After an in-depth analysis of the model and the variables, the first-order stimulation selected in this paper include the attributes of the account and the attributes of the title. The second- order stimulation selected the attributes of the content, and extract relevant data dimensions from the original data, including the name of WeChat, the number of successful pushes, total number of fans, whether is copyright, number of likes, total readings, number of reprints, title, number of pictures, whether is push index, location, number of characters, date of push, graphic page, number of viewers of the graphic page, number of shares, number of collectors, total number of graphic readers, total number of graphic readings, number of public session readers, number of public session readers, history Message page readers, historical message page readers, moments readers, friends share readers, other scene readers, public number of conversations forwarded friends, public Number of sessions, number of friends forwarded by friends, number of friends forwarded through friends, number of friends forwarded through friends, number of friends forwarded through other scenes, and number of times friends forwarded by other scenes (Wang Xiaoli, 2015). Each field is standardized into an Excel to prepare for subsequent data analysis.

3.2 Variable Definitions

Table 2: Variable definition details

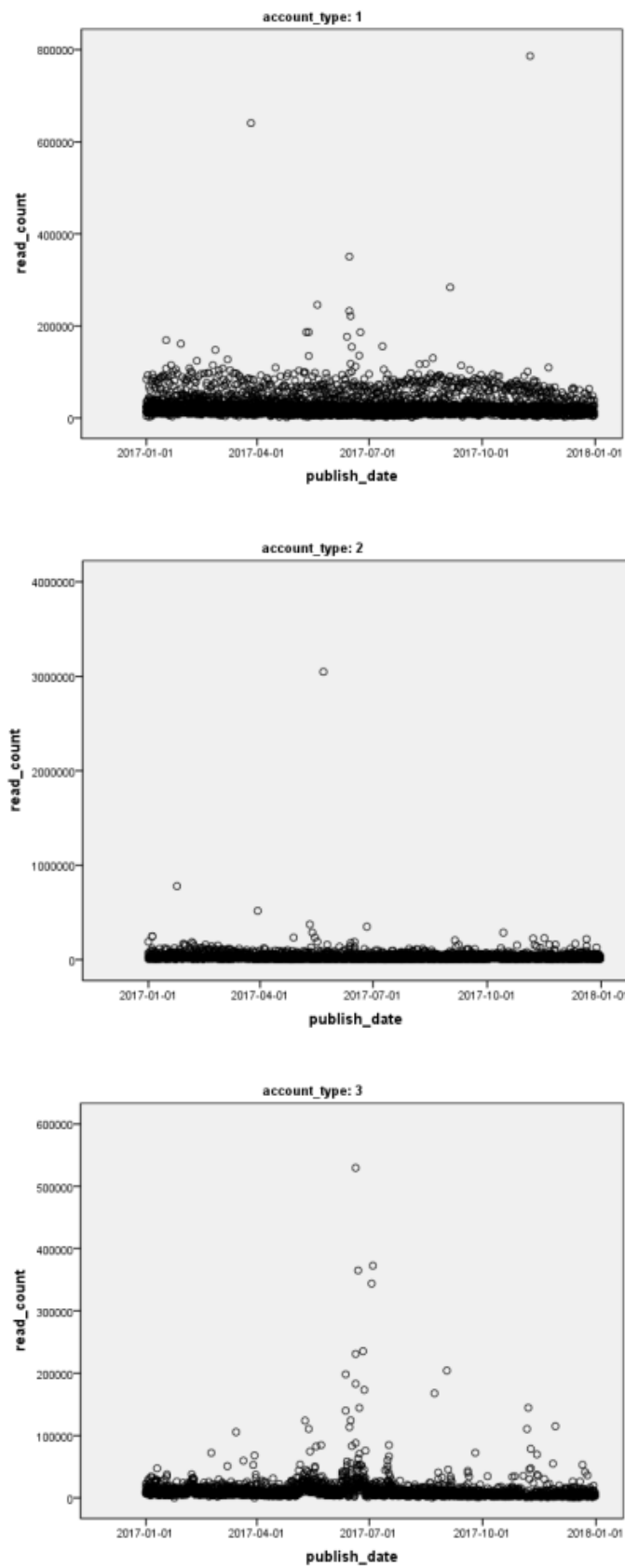
Independent variable	The name of the variable	Meaning	Type
the attributes of the account	wx_officalaccount_name	The name of WeChat	String
	account_type	The type of the official account	Value (N)
	fans	Total of fans	Value (N)
	is_weekend	Whether is weekend	0-1
the attributes of the title	is_question	Whether is a question	0-1
	is_exclamation	Whether is an exclamation	0-1
	is_doublehead	Whether is a doublehead	0-1

the attributes of the content	have_number	Whether has numbers	0-1
	is_first	Whether is the first	0-1
	idx	The position of the push	Value (N)
	title_num	The number of the title	Value (N)
	img_num	The number of the image	Value (N)
	copyright_type	Whether is copyright	0-1
	article_word	The word of the article	Value (N)
Dependent variable	The name of the variable	Meaning	Type
New fans	new_fans	The number of the new fans	Value (N)
	new_fans_rate	The rate of the new fans	Value (N)
Reading	read_count	The number of reading	Value (N)
	read_count_rate	The rate of reading	Value (N)
	int_page_from_session_read_count	Reading times in account	Value (N)
	1stread_count_rate	The rate of reading one time	Value (N)
	int_page_from_feed_read_count	Reading times in moments	Value (N)
	int_page_from_friends_read_count	Reading times in sharing	Value (N)
Sharing	share_count	The number of sharing	Value (N)
	share_count_rate	The rate of sharing	Value (N)
	int_page_read_user	The reading users in graphic page	Value (N)
	int_page_read_count	The reading times in graphic page	Value (N)
	share_user	The sharing users	Value (N)
	feed_share_from_session_count	The number of sharing from account	Value (N)
	1stshare_count_rate	The rate of sharing one time	Value (N)
	feed_share_from_feed_cnt	The number of sharing from moments	Value (N)
Collect Likes	add_to_fav_count	The number of collecting	Value (N)
	like_num	The number of likes	Value (N)

3.3 Outlier Removal

There may be abnormal data in the data collected in this paper, such as “bursting text” which has a high rate of reading and sharing. Its occurrence has great contingency and external reasons. Therefore, in the study of this paper, abnormal data should be removed to find the universal law (Jansen B J, 2000).

The scatter plots of the three types of the official accounts are shown in the figure:



After removing the outliers:

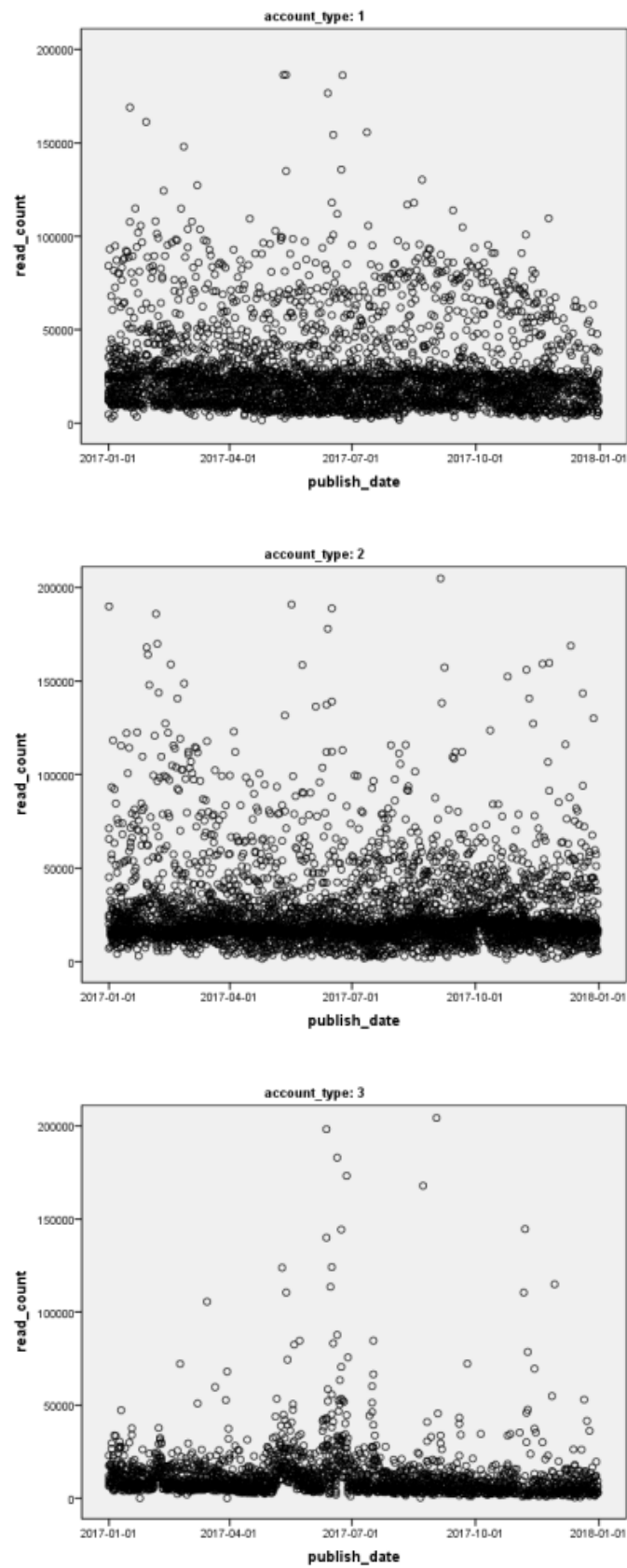
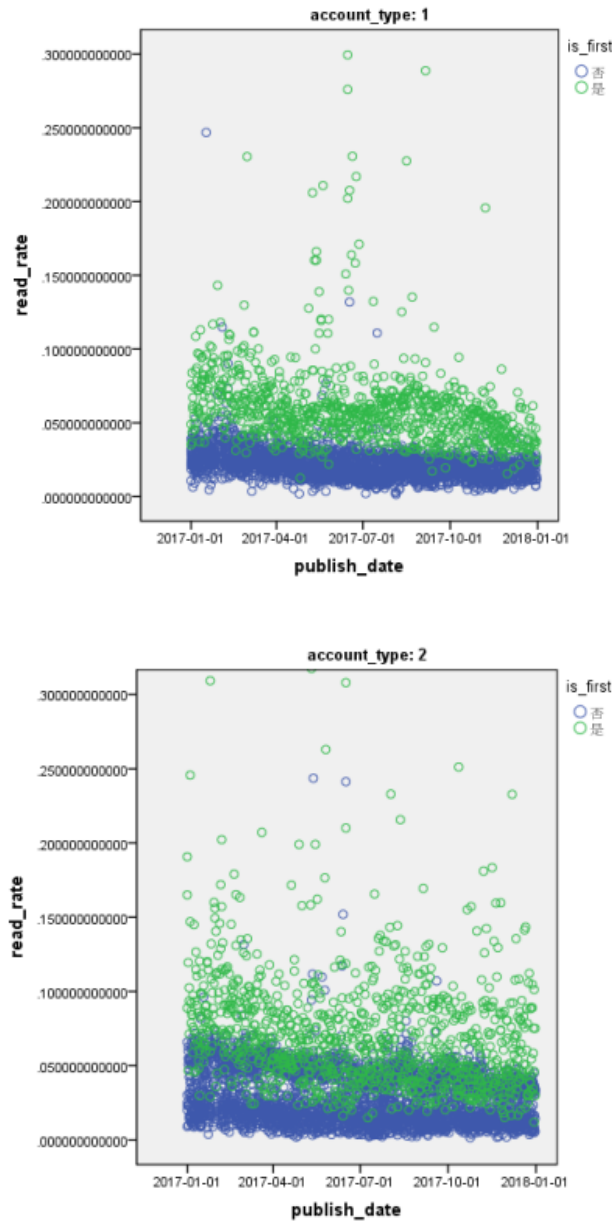


Figure 1: Three types of official account reading date scatter plot

CONSTRUCTION AND APPLICATION OF PUSH HOTSPOT PREDICTION MODEL

4.1 Statistical Analysis of Data

Firstly, we analyze the impact of variables on user information behavior, mainly using statistical analysis, one-way ANOVA, correlation analysis and so on. As a result of many and similar variables, we take the effect of the push index on the reading rate as an example. The horizontal axis of the scatter plot is time, the longitudinal axis is the reading rate, the green point is the top push, the blue is not the top push, we can see the obvious difference. As shown in Figure 2.



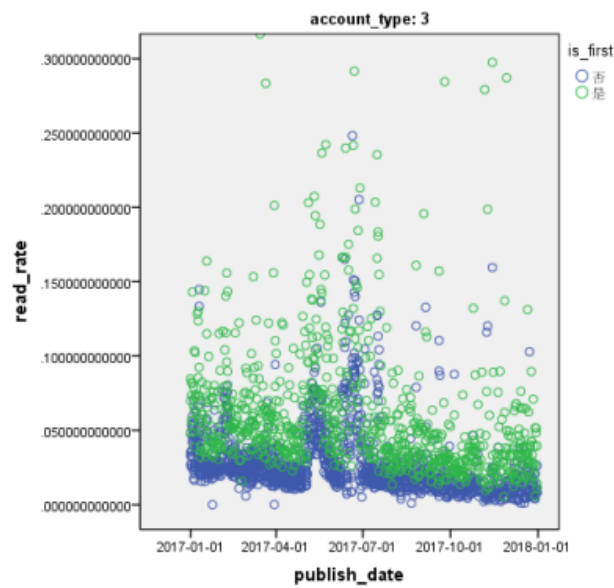
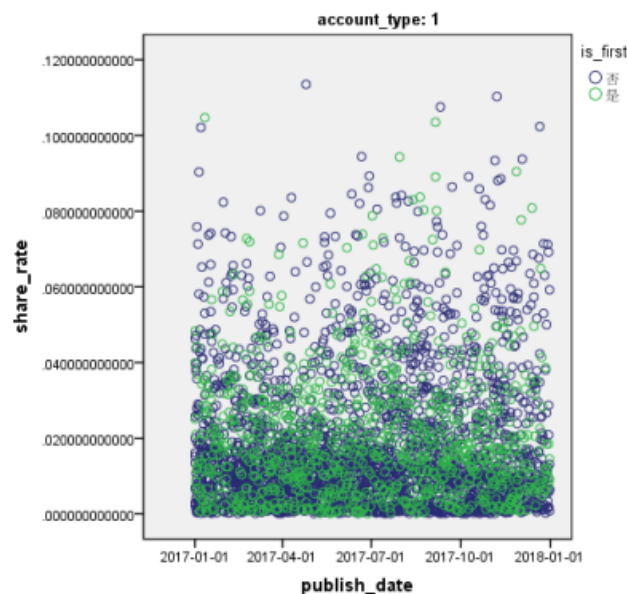


Figure 2: Three type of official accounts reading rate scatter plot

In order to further study whether the push index has a significant impact on the reading rate, we randomly selected 500 samples in the top pushes and non top pushes of each official account to carry out a single factor analysis of variance. The F values of the three groups were 2470,716,172 and the sig values were less than 0.05, reaching a significant level, indicating whether the top pushes had a significant impact on the reading rate under the three types of official accounts.

The sharing is similar, the push index is the first order stimulation, and the effect on the second order reaction sharing is not obvious. It is found that the sig values were less than 0.05 by nonparametric test, so it is significant. The scatter diagram of the influence of the push index on the sharing rate is shown in Figure 3.



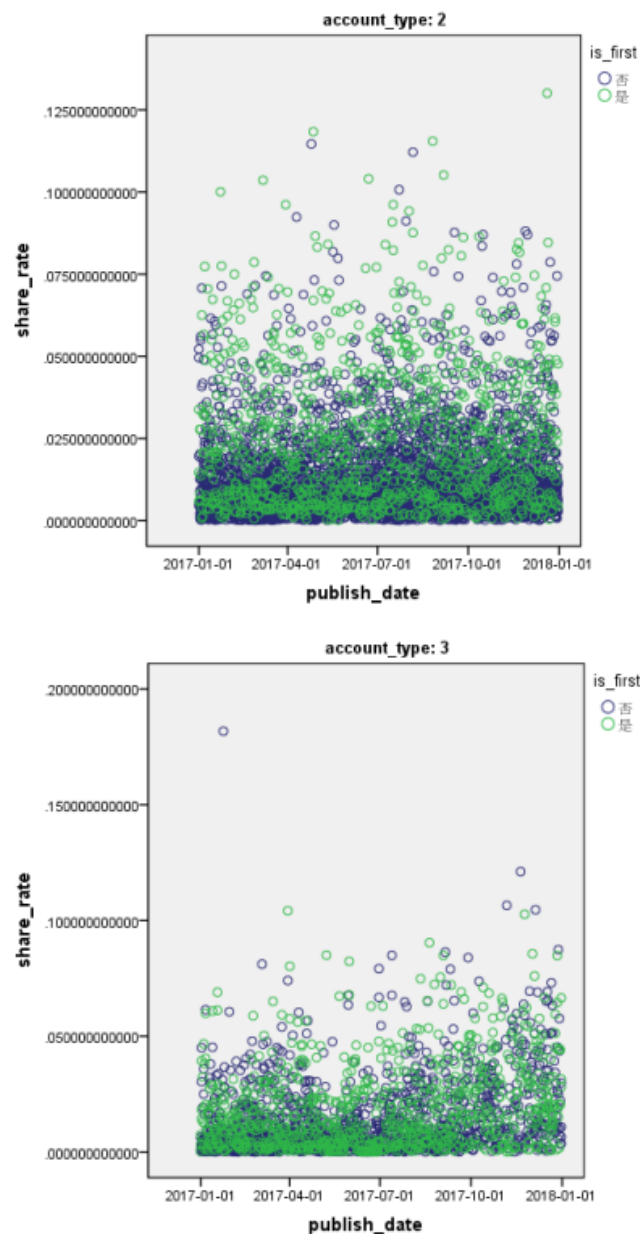


Figure 3: Three type of official accounts sharing rate date scatter plot

After the analysis of the variables, the following conclusions can be obtained as shown in Table 3.

In order to build the prediction model of push hotspots, we define the prediction variable of pushing "hot spots". In this paper, the reading rate and sharing rate in the first 10% intervals of the account is defined as hot push, and then 0-1 categorical variable is constructed. The total variables and the standardized variables related to the reading rate and sharing rate were used as the two set of feature variables. Neural network algorithm and random forest algorithm are used to construct the model respectively. After data processing, the push for prediction model construction is shown in Table 4.

Table 3: Results of analysis

First order stimulus-first order reaction and second order reaction	Second order stimulus-second order reaction
The weekend has a positive impact on the reading rate of “emotional psychology” and “video entertainment”, a negative impact on “science & technology finance”, and has a positive effect on the sharing rate of all the accounts.	There is a moderate positive correlation between copyright and sharing/ collecting/ likes
In terms of titles’ emotion, interrogative sentences and exclamations have a positive influence on the reading rate of “emotional psychology” and “video entertainment”, and have a negative impact on “science & technology finance”, and has a positive effect on the sharing rate of all the accounts.	There is a moderate positive correlation between the number of pictures and the sharing rate.
Double titles has a negative impact on reading and sharing rate, and has a positive effect on increasing the number of fans.	The number of words of the push is moderately positively related to the sharing rate and the amount of collection, and has a negative impact on the growth of fans.
Push index obviously have a strong positive impact on reading rate, and have a moderate positive correlation with the second order reaction (sharing, collecting, and like).	Copyright and push index had no significant impact on the growth of fans, but their interaction had a significant impact on the number of fans.

Table 4: The push for prediction model construction

Variable	Value
Total push number	10507
Hot push number	242

4.2 Experimental Design

The experiment uses 3-fold crossValidation , the data is predicted for three times, and two copies of the three equal data set are taken as the training set, one is used as the test set and the average value is used as the prediction result. We use BP neural network (Li Huanning& Wang Shuning, 2000) and random forest (Zhang Junliang, 2013) two algorithms, each group algorithm uses all variables E1 and correlation variable E2 two groups of variables combination. The two set of feature variables is detailed as follows:

All variables set E1: whether weekends, whether interrogative sentences, whether exclamatory sentences, whether double title , whether including numbers, push index, push positions, copyright, title numbers, number of pictures, the number of words of the push.

Related variables set E2: whether exclamatory sentences, whether double title, push index, copyright, number of pictures, the number of words of the push.

4.3 Modeling Process

Firstly, we model the BP neural network. After a number of experiments, all variables and related variables were selected. The two sets of parameters were used to construct the parameters of the model respectively. The results are shown in the following table 5:

Table 5: Network structure comparison table

	the number of hidden nodes	Training function
all variables	5	Trainlm
related variables	4	Traingd

Then, using random forest modeling (Quinln, 1986), from the original training sample set N, n samples are repeatedly extracted randomly to generate a new training sample set for training decision trees. Then, according to the above steps, m decision trees are generated to form random forests. The classification results of new data are determined according to the scores formed by voting of classification trees.

The code is as follows:

```

results = []
# The parameter value of the minimum leaf node
sample_leaf_options = list(range(1, 500, 3))
# Number parameter value of decision tree
n_estimators_options = list(range(1, 1000, 5))
groud_truth = train_data['Survived'][601:]

for leaf_size in sample_leaf_options:
    for n_estimators_size in n_estimators_options:
        alg = RandomForestClassifier(min_samples_leaf=leaf_size, n_estimators=n_estimators_size, random_state=50)
        alg.fit(train_data[predictors][:600], train_data['Survived'][:600])
        predict = alg.predict(train_data[predictors][601:])
        results.append((leaf_size, n_estimators_size, (groud_truth == predict).mean()))
print((groud_truth == predict).mean())
print(max(results, key=lambda x: x[2]))

```

4.4 Evaluation Index and Experimental results

We use four statistics in the confusion matrix as the evaluation index of classification algorithm.

Confusion matrix		Prediction outcome	
		N	P
Actual value	N	True negative(TN)	False positive(FP)
	P	False negative(FN)	True positive(TP)

The calculation formulas are as follows:

$$Accuracy = (TP + TN) / (TP + FP + FN + TN) \times 100\%$$

$$Precision = TP / (FP + TP) \times 100\%$$

$$recall = TP / (TP + FN) \times 100\%$$

$$F1 - score = 2 \times precision \times recall / (precision + recall) \times 100\%$$

$$TPR = TP / (TP + FN)$$

$$FNR = FN / (TP + FN)$$

$$FPR = FP / (FP + TN)$$

$$TNR = TN / (TN + FP)$$

The transverse coordinate of the ROC curve is FPR and the longitudinal coordinate is TPR. The curve reflects the sensitivity and specificity of the prediction results as the threshold changes. The larger the area under the ROC curve, the better the performance of the model.

AUC is the graphic area between the ROC curve and the abscissa.

Respectively using the BP neural network algorithm and the random forest algorithm, and characteristic variable groups E1 and E2 were used for comparative experiments. The results of the experimental evaluation are shown in Table 6 as follows.

Table 6: Comparison of experimental results

Model	Variable	Accuracy	Precision	Recall	F1-score	AUC
BP	E1	0.845	0.811	0.293	0.430	0.811
	E2	0.873	0.768	0.467	0.581	0.867
RF	E1	0.845	0.649	0.551	0.596	0.851
	E2	0.861	0.651	0.548	0.595	0.865

By comparing several evaluation indexes, in most cases, the prediction performance of the E2 feature set is better than that of the E1 set. BPNN achieved better accuracy and precision, while RF achieved better recall, F1 score and AUC value, but the superior model of each evaluation index did not gain an overwhelming advantage. However, this paper still chooses BPNN as the better prediction model. The reason is that, when selecting E2 as the feature set, although the F1 score of BPNN and the AUC value are

less than RF, the difference is very small. Two is the obvious advantage of BPNN in precision so that it can identify more potential hot spots, which is of more practical significance in the case that hot push is relatively small.

SUMMARY AND PROSPECT

5.1 Summary

This paper based on the stimulus response model in psychological theory, constructs the user information behavior impact model based on the WeChat official accounts, and complements the blank field of WeChat research.

Through a comprehensive analysis, the following conclusions are reached.

1. First order stimulus -- first order reaction and second order reaction

(1) In terms of the date of push, the weekend has a positive impact on the reading rate of "emotional psychology" and "video entertainment". For "science & technology finance", the weekend has a negative impact on the reading rate. The weekend has a positive effect on the sharing rate for all the accounts. This may be due to the nature of accounts. Users will reduce professional reading on non-working days.

(2) In terms of emotion, the appropriate use of interrogative sentences and exclamations can have a positive effect on reading rate of "emotional psychology" and "video entertainment", and exclamations can more positively promote user information behavior than interrogative sentences. This proves the effectiveness of the "title party" to some extent. However, for "science & technology finance", the behavior of the "title party" will have a negative impact on reading, sharing and fans. For more professional push, users prefer rational and objective description.

(3) Whether double title have a weak negative impact on reading and sharing, and have a weak positive impact on increasing the number of fans.

(4) There is a strong positive correlation between top push and reading rate.

2. Second order stimulation -- second order reaction

(1) There is a moderate positive correlation between push index and second order responses (sharing, collecting, and like).

(2) There is a moderate positive correlation between the number of pictures and the sharing rate, which is not related to the first order response.

(3) Word count of the push is positively related to the rate of sharing and collecting, and is negatively related to the number of fans. The lengthy push may make the reader feel boring, and unrelated to the first order reaction.

(4) Copyright and push index had no significant impact on the growth of fans, but their interaction had a significant impact on the number of fans.

In addition, this paper uses two algorithms and two variables to build a prediction model of user information behavior, and analyzes the effects of different prediction models. It is hoped that the public operators can use more scientific methods and more comprehensive indicators to identify potential push heat.

5.2 Suggestion and Prospect

After integrating data analysis conclusions and forecasting models, this study proposes the following suggestions for WeChat official accounts.

Firstly, reasonable set up the title of the push: strong emotional titles for leisure accounts, professional accounts should be as objective as possible; use a series of content to attract new fans, keep old fans. Secondly, make full use of the top push exposure advantage, place high quality original article, make full use of the interaction between top push and original, so as to get higher sharing rate and number of fans. Then content quality is still the most important factor in communication. Although the "title party" can improve the reading rate to a certain extent, its influence on the second order reaction is usually very small, only by winning the text content can effectively improve the user's second order information behavior.

The shortcomings and expectations of this study are as follows:

The data dimension is limited. In this paper, 3 types of accounts are selected for analysis, it is impossible to compare horizontally between different accounts. Moreover, the push time of the same account is basically fixed, so it is difficult to study the impact of push time.

The text content was not included in the stimulus variable. The two order stimulus of this study only considered the macro variables of each push, and did not divide the important content of text analysis more carefully.

It is difficult to measure the number of fans in user information behavior. Since the background data can only be extracted to each account daily, and cannot refine the new number of fans to each push, so this study does not consider the difference between the fans of the same account in one day.

In the stimulus response model, the body's arousal is actually a part of it, but because this study can't be analyzed by the body arose qualitatively and quantitatively, it is not considered. In the follow-up study, we can consider the introduction of questionnaires and interviews for analysis.

ACKNOWLEDGMENT

Financial support from the Science and Technology Plan Project of Beijing (No. Z171100000117009) and NSFC (No. 91546125) is acknowledged.

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Retrieval Method of Electronic Medical Records Based on Rules and Knowledge Graph

(Full paper)

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ABSTRACT

Every day, the hospital has accumulated a large number of electronic medical records, which record the doctor's description of various patients' conditions, including a large number of medical knowledge related to the patient's health status. So intelligent retrieval research of EMR is an important extension of the medical field. Its accurate retrieval plays an important guiding role in research in the medical field. In this paper, we come up with the combination of rules and knowledge graph, and experimental results demonstrate that the electronic medical record retrieval method based on rules and knowledge map technology can significantly improve the retrieval effect.

Keywords: EMR, information retrieval, knowledge graph.

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INTRODUCTION

With the informatization of the medical system, the hospital has accumulated a large number of electronic medical records. These electronic medical records are good learning materials for doctors when they conduct medical research or encounter incurable diseases (Yang *et al.*, 2014). Therefore, accurate retrieval of electronic medical records has important guiding significance for inexperienced doctors. At the same time, it is also of great significance to the development of the entire medical research. However, when doctors describe the condition on an electronic medical record, they are not accustomed to this way of filling in the blanks, but describe them according to their own writing habits. Although this method can accurately record the patient's condition, but different doctors write differently, the terms are different, so it brings a lot of trouble to the medical record retrieval. The current electronic medical record management system has certain defects in retrieval, which are embodied in the following aspects: (1) Focus on patient needs and ignore the needs of doctors. Patients or their families have a clear purpose in querying medical records. Usually, they only need one person's medical record and do not care about other people's medical records. Of course, they do not have the right to inquire. For medical or scientific purposes, doctors need to check the medical records of multiple patients. At present, most electronic medical record management systems only support the direct search of a patient's medical record by name and other information, ignoring the needs of doctors. (2) Ignore the connection between keywords. Only through the most basic keyword matching, although it is possible to search for these subjective items with strong description of the condition, if the contact of the keyword in the sentence is neglected, it will find that the precision has certain limitations. Medical descriptions are relatively small, but the combination is complex, and different combinations may represent different meanings. The complexity of electronic medical record content poses great difficulties for accurate retrieval. Therefore, how to improve the retrieval effect of electronic medical records has become a hot issue in the field of information retrieval.

The retrieval task of the electronic medical record is to filter out the electronic medical record set that meets the requirements according to the query statement. The keywords in these queries usually include descriptions of the organs and symptoms of the disease, such as: left lung lobe, nodules, thyroid, and swelling. These keyword groups represent query intents and there is a clear logical relationship between these keywords. Therefore, this paper proposes a query method based on rules and knowledge graphs. Under the premise that doctors use punctuation correctly, we use the punctuation to semantically segment these texts, and use dependency parsing analysis to judge the logical relationship between keyword groups. Experiments show that this method can significantly improve the retrieval effect of electronic medical records. Finally, using knowledge graph to achieve query reconstruction, the results of the eight groups of experiments show that the knowledge graph can further improve the retrieval effect.

PREVIOUS WORK

In this section, we briefly review the related work. The retrieval effect of text depends on the semantic analysis of the text and the validity of the representation method. One idea of text representation technology is to build semantic models based on knowledge of statistics and probability. In the late 1980s, Deerwester and others (Deerwester *et al.*, 2010) proposed Latent Semantic Analysis (LSA), which extracts the meaning of vocabulary in context from the corpus through statistical methods. Its core idea is statistics. The frequency of occurrence of words, thereby forming a representation matrix of the corpus, and then using the corresponding algorithm to convert the matrix into the weight of the words for the document itself. Later, Hoffman (Hoffman *et al.*, 1999)

proposed Probability Latent Semantic Indexing (pLSI) *et al.*, which solved the problem of synonym and polysemy to some extent. Compared to the LSA, it considers the document to be a mixture of topics based on certain weights, and the words are generated according to probability under each topic. Blei *et al.* (2003) proposed a potential Dirichlet distribution in 2003 for the large computational complexity of pLSI and the uncertainty of the probability calculation of new documents. The basic idea is still based on the corpus-based probability generation model. Potential topics are described, and documents can be represented as a random mix of potential topics. On the basis of LDA, another person conducted a research question and answer in the medical health questionnaire (Seelig *et al.*, 2015), and also used it to test the similarity degree of disease types (Frick *et al.*, 2015), and later appeared many variants, such as Dynamic topic Model (Blei *et al.*, 2006), Approximate distributed-LDA (Ihler *et al.*, 2012) and some studies of simplified probability models (Griffiths *et al.*, 2004; Wallach., 2006) and topic models combined with metadata (Chang *et al.*, 2009; Boydgraber *et al.*, 2010; Wang *et al.*, 2009; Newman *et al.*, 2006). In order to improve the accuracy of the search, some people try to use structured electronic medical records. Although this brings convenience to retrieval, the structured electronic medical records lack flexibility, it is difficult to adapt to complex and variable diseases, and the structured electronic medical records rely on human experiences. It is difficult to fully consider the various expressions of the disease record. In order to avoid this situation, and to improve the search results, there are two method, namely expanding query keywords (Weekamp *et al.*, 2012; Xu *et al.*, 1996; Gao *et al.*, 2013) and keyword weight adjustment (Chang *et al.*, 2006). The keywords are extracted from the medical dictionary and added to the original query to form a new query (Zhu *et al.*, 2011), which can improve the effect of the electronic medical records retrieval. However, such a query can improve the retrieval effect to some extent, but it is easy to bring about the problem of query drift, and the retrieval effect cannot be further improved. Therefore, some people propose a query reconstruction method based on word weight adjustment (Dinh *et al.*, 2011). They adds medical information to the weight adjustment algorithm, and take into account the weight adjustment of medical terms in the query statement (Wang *et al.*, 2016). Experimental results demonstrate that there are improvements in the three indicators of map, bpref and p10. In addition to query reconstruction, some people try to use the machine learning algorithm to calculate the similarity between texts through text presentation. However, most of text presentation methods are based on the statistical characteristics of words such as whether they appear (Rudin *et al.*, 2012; Rudin *et al.*, 2010) or the number of appearance (Qiu *et al.*, 2016; Xie *et al.*, 2016), and do not consider the relationship between words and words, so there are certain defects. Therefore, Word2vec is proposed. The word vector originated from the paper proposed by Hinton in 1986 (Hinton *et al.*, 1989). Later, Bengio summarized a set of neural network language model (NNLM), and formally proposed Word vector (Bengio, 2008a, 2012b; Bengio *et al.*, 2009a, 2011b). Later, more and more researchers have invested in the study of neural network learning. They hope to replace the word frequency statistics and complex feature extraction work with artificial neural network models, and get a digital representation corresponding to each word. Previously, both Bengio's paper and "deep Neural Networks with Multitask Learning" (Collobert & Weston, 2008) published in ICML in 2008, word vectors were a by-product of training, and later in Google's open source Word2vec (Mikolov *et al.*, 2013a, 2013b). There is an efficient way to train word vectors. In 2014, Stanford's Richard published "GloVe: Global Vectors for Word Representation" on EMNLP (Richard *et al.*, 2015). It combines the concept of LSA and the training method of Word2Vec, and proposes a global vocabulary information to make greater use. The contextual semantic information of text data has achieved better results in some practical applications. Finally, the emergence of knowledge graph provides us with a new way of thinking. The ontology-based electronic medical records retrieval method (Zhao *et al.*, 2010) can realize the semantic expansion of the concept, and has improve the precision and recall. However, ontology research is a complex project. Therefore, this paper attempts to use the dependency syntax to analyze the logical relationship between words and words based on the grammatical features of texts; and building a small-scale knowledge graph to further improve the search results.

RETRIEVAL FRAMENWORK BASED ON RULES AND KNOWLEDAGE GRAPH

Retrieval Framework

According to the characteristics of electronic medical records from Shengjing Hospital, this paper proposes an electronic medical record retrieval framework combining rules and knowledge graph. The rules are mainly based on the grammatical features of EMRs, such as punctuation and dependency syntax analysis. The entire search framework is shown in the following figure.

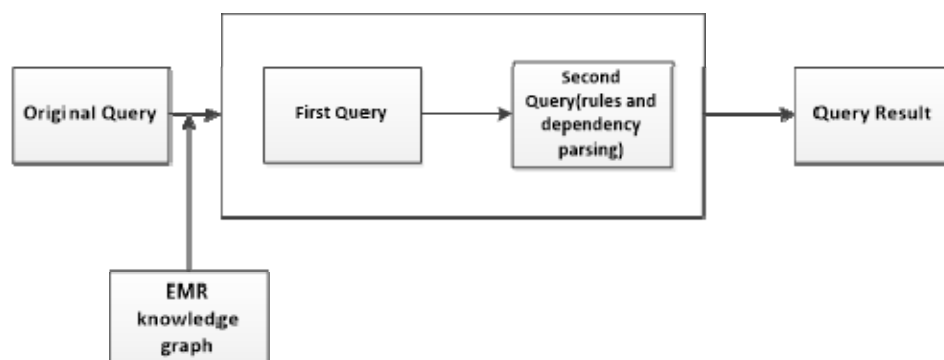


Figure 1. Framework of EMRs retrieval

- Step 1: Reconstructing the original query using knowledge graph.
 Step 2: Perform the first search in the original data set and get the result1.
 Step 3: Perform a second search on result 1, using rules and dependency parsing.
 Step 4: Get the query result.

Dependency Parsing Analysis

There are relatively few keywords for a single disease, but the combination is complicated. Sometimes even if we can retrieve the field in a record, it may not be what we want actually. For example, the high-density blurred patch of the upper lobe of the left lung and the high-density nodules of the basal segment of the right lower lobe. When we use keywords to retrieval such as "left lung nodule", we can find a record like that, but that isn't what we want. Keywords mismatch apparently happened here. So the key is to identify the collocation of the keywords "left lung" and "nodule" in the record.

This paper mainly identifies the keyword collocation problem by dependency parsing analysis, and uses punctuation to divide complex sentences into multiple independent simple sentences, thus improving the effect of dependency parsing. The basic steps are as follows:

- Step 1: Use the punctuation to divide the long sentence into a sequence of clauses.
 Step 2: Determine whether the query keyword is in the same clause, if not, output no; if yes, proceed to step 3.
 Step 3: Perform a dependency syntax analysis on the clause to obtain a dependency tree with the highest probability.
 Step 4: Determine whether the keyword group has a collocation relationship according to the dependency parsing result. If yes, the output is; otherwise, the output is no.

For example, there are blurred patch on the upper part of the left lower lobe. The dependency parsing result is shown below:

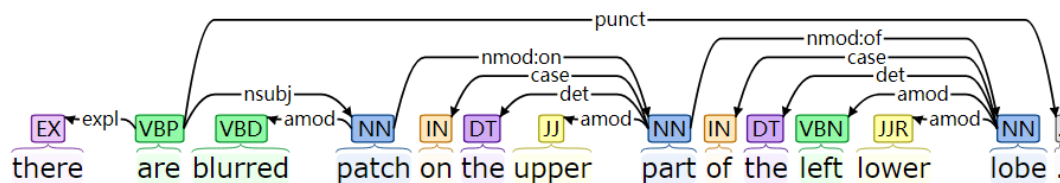


Figure 2. Result of dependency parsing

It can be seen from the figure that there is a dependency between the left lower lobe and the patch, so this record is what we want.

Building EMR Knowledge Graph

Knowledge graph are generally divided into open domain knowledge graph and closed domain knowledge graph. The former involves a wide range and complex relationships, so the current application depth is limited. The latter refers to the knowledge graph applied to a specific domain, and its scope is relatively narrow. It is relatively simple and the application is deeper. In this paper, the knowledge graph constructed is applied to the electronic medical record text.

When describing a patient's condition, it is usually the form of the diseased part and symptoms, such as left lung and nodules, etc. According to the characteristics of its text, the steps of building EMR knowledge graph are as follows:

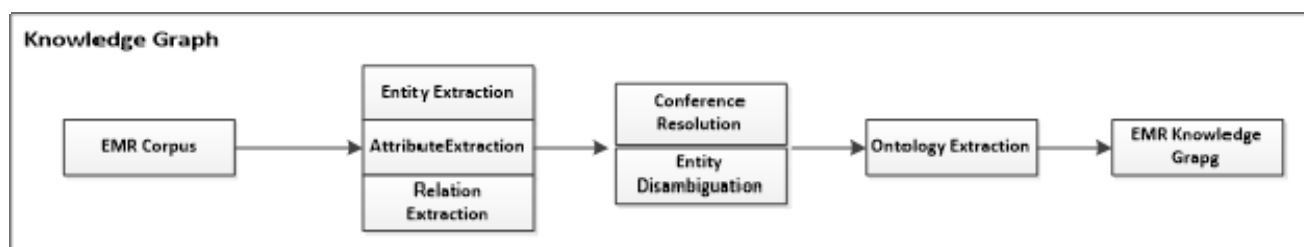


Figure 3.Steps of building EMRs knowledge graph

Entity Extraction

Entity extraction, also called named entity identification, mainly extracts words representing entities in the electronic medical record description. The main steps are word segmentation and part-of-speech tagging.

1. Word segmentation. Firstly, we segment the text of the patients' condition description of the electronic medical records by jieba. At the same time, enhancing the effect of word segmentation through a custom dictionary. For some high-frequency phrases like "left lobe", this article classifies it as a word phrase. In order to identify more such high frequency phrases, it is mainly achieved by the following formula:

$$p(A, B) = \frac{\text{count}(A, B) - \theta}{\text{count}(A) + \text{count}(B) - \text{count}(A, B)} \quad (1)$$

For a example, A=left, B=lobe. if left and lobe are often used together, the value of $p(A, B)$ is relatively big, so AB can be seen as a high-frequency phrase. And these two words can be seen one word when segmentation, which could improve the effect of word segmentation. The θ is mainly to prevent the problem that $\text{count}(A, B)$ is too small and $p(A, B)$ is too large. For an AB phrase that appears only once, if there is no θ , $p(A, B)=1$, but this is not a high frequency phrase.

2. Part-of-speech tagging. This paper mainly uses the LTP cloud platform of Harbin Institute of Technology to mark the words in the electronic medical record text. The words are mainly divided into verbs, nouns, conjunctions, adverbs, and punctuation. For example, "high-density patchy shadows in the medial segment of the right lung are essentially absorbed" can be marked as:

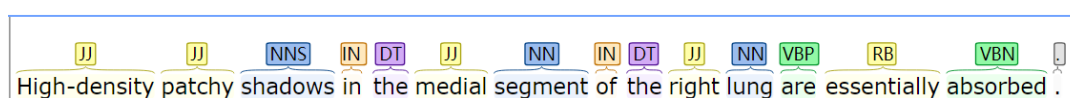


Figure 4. Result of POS tagging

According to the medical dictionary, the words are mainly divided into three categories. 1. words describing the parts of body, such as the left lung, thyroid and so on. 2. words describing the disease, such as nodules, patchy shadows and so on. 3. Adverbs describing the extent of the condition. For an instance, that record can be divided as follows:

Table 1. Example of categories

Categories	Words
Describing the parts of body	The medial segment of right lung
Describing the disease	Patchy shadows
Describing the extent of the condition	High-density, essentially

Relation Extraction

After extracting entities from the text corpus, we obtain the entities. The main purpose of relation extraction is to find the relation between the entities, and connect these individual entities to make it a knowledge network. There are three main relations between entity A and entity B: A contains B, B contains A or has no relationship. Because the research object of this paper is the electronic medical record of the CT scan results of the lungs, the number of entities involved is small, and the relationship between entities mainly depends on manual judgment. For example, "double lungs" include "left lung", "left lung" contains "left lung upper lobe", "left lung" has no relationship with "right lung", etc.

Attribute Extraction

Attributes are inseparable from entities and are a kind of information supplement to entities. Therefore, attribute extraction can be regarded as the relationship extraction between entities and attributes. Here, the attributes of the entity mainly refer to the symptoms, such as "nodule", "plaque shadow" and so on.

Conference Resolution

The main task of conference resolution is to find synonyms that represent entities or attributes. This paper mainly uses word2vec to train the corpus to get the word vector, then put the words together according to the part of speech, and finally select the similar words according to the cosine similarity. In order to ensure the accuracy of the conference resolution, the finally selected synonyms must be manually reviewed.

Entity Disambiguation

The corpus used in this paper is the electronic medical record related to the lungs, and the medical terms are relatively standardized. Therefore, the problem of entity ambiguity does not exist, and the steps of entity disambiguation are omitted.

EXPERIMENTS

In order to test the experimental results of the retrieval method based on rules and knowledge graph, this paper takes about 30000 EMRs related to lungs in Shengjing Hospital as an example. At the same time, the traditional string matching result is used as the benchmark result, and the result of the retrieval is recorded as QF; then the second retrieval result of using the rule and the

dependency syntax analysis is recorded as QS; finally, adding the knowledge graph. the retrieval result is recorded as QT. And eight different sets of queries are set in this paper to compare the retrieval effects of these three methods.

Evaluation Standard

The evaluation indicators used to measure the retrieval results mainly include mean average precision (MAP), binary preference (bpref), and precision. This paper uses precision as the main evaluation indicator.

$$\text{precision} = \frac{\text{the number of related documents in the result}}{\text{the number of documents in the result}} \quad (2)$$

It should be noted that for each retrieval result, the first 100 samples are taken as statistical samples, that is, the precision here is equivalent to the Top-100 precision

Experimental Results and Analysis

In this paper, eight different queries are selected for experiment, and getting QF, QS, and QT in turn. Among them, QF is regarded as baseline. The results of the experiment are shown in the following figure:



Figure 5. Precision of eight queries result

As can be seen from the above figure, in the eight examples of this experiment, the retrieval effect $QS > QF$, which indicates that the doctor mostly follows the Chinese grammar rules when describing the condition, so that the method can improve the retrieval effect; $QT > QS$ explains that query reconstruction through knowledge graph can effectively improve the retrieval effect. Specifically, in each of the examples, the retrieval effect is not same. Maybe after the query reconstruction, it may not optimize the query, but add noise, so that the precision improvement is not obvious. See the table below for details.

Table 2. Comparison of eight queries

	QF (baseline)	QS	QT
Query1	0.76	0.83 (+9.21%)	0.85 (+2.41%)
Query2	0.68	0.74 (+8.82)	0.86 (+16.22%)
Query3	0.77	0.89 (+15.58%)	0.85 (-4.49%)
Query4	0.69	0.85 (+23.19%)	0.90 (+5.88%)
Query5	0.73	0.79 (+8.22%)	0.83 (+5.06%)
Query6	0.64	0.81 (26.56%)	0.92 (+13.58%)
Query7	0.56	0.75 (+33.93)	0.80 (+6.67%)
Query8	0.48	0.62 (29.17%)	0.89 (+43.55%)

For example, in Query 3, the retrieval effect $QT > QS$. This may be because after the query reconstruction, it may not function as a query optimization, but instead add noise, so that the precision improvement is not obvious. Overall, QS's performance improvement is higher than QT, but query8 is the exception. The reason is that query8 is relatively complicated, which indicates that the more complicated the query conditions are, the more important the role of the knowledge graph is. At the same time, the more complex the query, the worse the effect of QF, indicating that the traditional method is not suitable for complex queries. In order to compare the effects of QF, QS and QT intuitively, this paper introduces the concept of APFQ.

$$APFQ = \frac{1}{n} \sum_{i=1}^n p_i \quad (3)$$

P_i represents the precision of each retrieval

Table 3. Compare of APFQ

method	APFQ
QT(overall)	0.87
QS	0.78
QF(baseline)	0.66



Figure 6. compare of APFQ

As can be seen that the retrieval effect of the combination of knowledge graph and rules is better than the effect based on syntax and rules, better than baseline. All in all, retrieval framework based on rules and knowledge graph can effectively improve the retrieval effect of electronic medical records

CONCLUSION

In the electronic medical record retrieval, this paper proposes a retrieval method combining rules and knowledge graph, which partially solves the problem of synonym and the matching between keyword groups, which makes the results of the query more accurate. It is also proved by experiments that the retrieval effect of this method is better than that of the rule retrieval alone, which makes the electronic medical record play an important role in medical assistant decision-making, providing more learning and guidance for medical staff with poor experience.

LIMITATIONS AND FUTURE WORK

However, the experimental data used in this experiment is relatively simple, and whether it is valid on large-scale data remains to be verified. Moreover, when performing query reconstruction, it is possible to produce noise due to the expansion of semantics, thereby decreasing the accuracy of the query. How to reduce noise when expanding semantics is also the direction that needs to be

continued in the future. Finally, the small-scale knowledge graph constructed in this paper is not suitable for other kinds of diseases, but the idea of this construction can be used for reference. Therefore, building a large-scale knowledge graph that can be applied to more diseases is also the focus and direction of the next step.

ACKNOWLEDGEMENT

This work is supported by National Social Science Fund Project, China (No. 16BTQ065).

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Social Capital Dimensions in Virtual World Platforms

(Full Paper)

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ABSTRACT

This study investigates the three dimensions (cognitive, relational, and structural) of social capital within social, gaming, and mixed virtual world platforms. Utilising ANOVA in examining data collected from three different virtual worlds' users (Second Life, World of Warcraft, and Entropia Universe). Finding supports no significant differences between cognitive (shared values and language) and relational (trust) social capital between the different virtual world platform. However, there are significant differences in structural social capital (network ties) between the different types of virtual world platforms. The study findings help virtual world operators, developers, and business in understanding the social capital dimensions needed to build stronger social capital, and trust, between the virtual world community participants, developers, and business.

Keywords: Social capital dimensions, virtual world platforms, cognitive, structural, and relational social capital.

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INTRODUCTION

Virtual communities including Social Network Sites (SNS), are under massively increasing growth phases. Their growth leads to the innovative, and different types of virtual platforms such as Virtual Worlds (VWs), Virtual Realities (VR), and Augmented Reality (AR). These platforms are supported of leading technology companies such as Google, Apple, and Microsoft (Apple Inc., 2018; Ron Amadeo, 2018). A variety of communication tools allow more immersive communication channels within such virtual platforms. Here, VR glasses, Voice-to-Text chats, voice and video chats, and even VR full body suites such as the TeslaSuit (Javelosa, 2016; Teslasuit, n.d.) are now operational within these platforms.

These newly developed communications and interaction tools create new opportunities, and support interactive social communications. These personal experiences include workplace communities - especially those with remote interaction and collaboration approaches that work and communicate virtually in such a distributed environment (Wang *et al.*, 2014).

A wide variety of technologies across virtual platforms - including Massively Multi-player Online Games (MMOGs), allows the unique shared experience between thousands of virtual platform participants. This not only develops a personal level of relationship, but it facilitates a form of feeling and touching between participants (Gallace and Spence, 2010; Lehdonvirta, 2009; Nazir *et al.*, 2016; Nazir and Lui, 2016; Williams *et al.*, 2009).

The developed tools in the virtual platforms also indirectly affect the economic systems within these virtual worlds (VWs) (Nazir *et al.*, 2016; Virtual Sense, 2014). The expectation of the increasing popularity of the VWs can lead to more business transactions in such virtual platform (Guo and Gong, 2011; Nazir *et al.*, 2016; Salomon and Soudoplatoff, 2009). The economic system in VWs can include both transactions within the borders of the virtual platforms, or a trade between the real world and the VW. Here, in-game virtual currencies can exchange for real-world currencies, or vice versa. This creates an economic and mechanistic academic research interest as to how virtual and real monies can be exchanged securely (Hallett-Hook, 2008; Heeks, 2009; Hunter, 2006; Lehdonvirta, 2005; Nazir and Lui, 2017, 2015).

The exchange rate on the virtual platforms can be different from one VW to another. For example, Second Life (SL), has a free exchange rate market for its Linden Dollar (L\$) based on supply and demand on the currency, whilst Entropia Universe (EU) has a fixed exchange rate of 1 US\$ to 10 EDP (EU currency) (Nazir *et al.*, 2016). Platform development remains a key element to the success of Real Money Trading (RMT) in the virtual worlds.

As a result of the platform development, a lot of improvement reached SNS, VW, VR, and AR. In the last few years, Apple, Microsoft, and Google have developed their mobile, tablet, laptop, and desktop computer systems by incorporating powerful graphics cards and processors - specially designed to run virtual and augmented reality systems smoothly (Apple Inc., 2018; Ron Amadeo, 2018).

Previous studies investigate the influence of virtual platforms and SNSs on developing social capital, and on investigating the influence of social capital dimensions (cognitive, relational, and structural social capital) (Alqithami and Hexmoor, 2012; Chen *et*

et al., 2017; Hau and Kang, 2016; Lee, 2014; Liu *et al.*, 2016). Some studies find relational social capital (trust) strongly interlinks with cognitive social capital (shared language) and structural (network ties) social capital (Alqithami and Hexmoor, 2012; Nazir, 2017). Other studies find stronger network ties and developing a shared language can strengthen the relational social capital within virtual teams and communities (Alqithami and Hexmoor, 2012; Chen *et al.*, 2017; Nazir, 2017).

Chen *et al.* (2017) investigate the quality of the virtual platform (website quality), social capital dimension, and customer loyalty (loyalty to seller). They conclude cognitive and structural social capital positively and directly influences relational social capital, but it also positively influences customer loyalty (both directly and indirectly) through relational social capital.

Although some past studies investigate social capital dimensions in VWs (e.g. Alqithami and Hexmoor, 2012; Chen *et al.*, 2017; Hau and Kang, 2016; Lee, 2014; Liu *et al.*, 2016), each only investigates one type of VW platform, or one particular VW. For example, Chen *et al.* (2017) investigate Second Life (SL) as the main VW platform in their study, whilst (Hau and Kang, 2016) studied Aion Game Chosun (Korean VW game) as their main VW platform.

In summary, previous studies research social capital dimensions in the virtual communities either as one VW platform, or as a specific Massively Multiplayer Online Role-Playing Game (MMORPG) (Chang and Chuang, 2011; Lefebvre *et al.*, 2016; Lu and Yang, 2011; Nov *et al.*, 2012; Striukova and Rayna, 2008; van den Hooff and de Winter, 2011; Wang and Chiang, 2009).

This study investigates the strength and the development of social capital dimensions, and compares them across different virtual platforms. Particularly, whether cognitive social capital (shared language), relational social capital (network ties), and structural social capital differ considerably on social capital dimensions, and engage the different virtual platforms – Gaming VWs (GVWs), Social VWs (SVWs), and Mixed VWs (MVWs).

This study contributes to the research area by examine and comparing social capital dimensions (cognitive, relational, and structural social capital) on three different virtual platforms – World of Warcraft (WOW) representing GVWs, Second Life (SL) representing SVWs, and Entropia Universe (EU) representing MVWs.

LITERATURE REVIEW

Virtual Reality & Virtual Worlds

Social capital is the ability of community, team, and group to utilise set of resources (embedded in the ongoing social relationship amongst people) towards achieving a desired goal or outcome (Adler and Kwon, 2002; Coleman, 1988; Nahapiet and Ghoshal, 1998; Portes, 1998). Social capital is an essential factor for stronger social communities, and researchers such as Fornoni *et al.* (2012) and Stam *et al.* (2014) also argue social capital between a team and/or staff is essential for entrepreneurial success (Smith *et al.*, 2017).

Social capital is considered a key element for the success of both communities and entrepreneurs (Huvila *et al.*, 2010; Murphy, 2011). Social capital also enhances communities and entrepreneurs in different ways - such as; identifying market opportunities (Uzzi, 1997), collecting information and influence (Adler and Kwon, 2002), providing support and improving outcome through hardship times (Rogers, 2016), avoiding failure (Westhead, 1995), strengthening the community, and enhancing competitiveness (Özcan, 1995; Smith *et al.*, 2017).

Social Capital Theory

Social capital theory (SCT) provides a theoretical perspective for investigating benefits directly obtained by organisations and/or communities through their social network and relationship. SCT supports community relationship characteristics by focusing on the flow of shared resources - which also enables the investigation of performance differentials both with, and between communities (Carey *et al.*, 2011; Koka and Prescott, 2002).

Some researchers question whether social capital exists in e-commerce and virtual platforms. They suggest social capital developed as a result of cooperative behavior among the users and participants of the social network - which is characterised by frequency interaction, and close structures associated with shared backgrounds (Wasko and Faraj, 2005). At the same time, the new virtual platforms can now provide richer communication media, and can replace the traditional face-to-face interactions. There is now accumulated evidence that consistently supports social capital as existing in online/virtual contexts (Huang, 2016; Steinfield *et al.*, 2008).

Previous studies investigate the effect of social capital on individuals' behavior in the virtual online platforms, including community engagement (Ganley and Lampe, 2009), knowledge sharing (Hau and Kang, 2016; Wasko and Faraj, 2005), and virtual connectivities (Nazir, 2017). However, to the best of our knowledge, no studies have yet focused on the effect of virtual worlds on social capital dimensions and especially through a comparison between different types of VW platforms.

In this study, we focus on the relationship between the different VWs platforms/types (GVWs, SVWs, and MVWs) and social capital dimensions (Cognitive, relational, and structure social capital).

Social Capital Dimensions

Previous studies (Chen *et al.*, 2016; Lin, 2011; Nahapiet and Ghoshal, 1998; Wang *et al.*, 2016) suggest three main social capital dimensions (cognitive, relational, and structure) exist. Local communities in New South Wales (Australia) studied by Onyx and Bullen in 2000 applied six social capital constructs under the theme “participation in networks”, “reciprocity”, “trust”, “social norms”, “the commons”, and “proactivity” (Law and Chang, 2008). Hau and Kang (2016), Striukova and Rayna (2008), and Wagner *et al.* (2014) use “trust” to measure relational social capital, “ties” for structural social capital, and “shared goals” for cognitive social capital.

As the studies investigated in this literature review show, social capital dimensions may be framed under three constructs (cognitive, relational, and structural). This study uses these as first-level social capital constructs. Table 1 indicates shared language (cognitive), trust (relational), and network ties (structural) are widely applied social capital constructs in past studies (Hau *et al.*, 2013; Nahapiet and Ghoshal, 1998; Wang *et al.*, 2016)

Table.1: Grouping Social Capital Studies

Social Capital Constructs	Cognitive			Relational				Structural	
	Shared goals	Shared language	Shared vision	Identification	Norms	Obligation	Trust	Network configuration	Ties/social interaction
Social Capital Components									
Social Capital Studies									
Lefebvre <i>et al.</i> , 2016		✓	✓				✓		✓
Wang <i>et al.</i> , 2016		✓					✓		✓
Chen <i>et al.</i> , 2017		✓					✓		✓
Lee, 2014					✓		✓		
Hau <i>et al.</i> , 2013	✓						✓		✓
Carey <i>et al.</i> , 2011				✓		✓	✓		✓
Hau and Kim, 2011	✓						✓		✓
(Lin, 2011)		✓		✓	✓	✓	✓	✓	✓
van den Hooff and de Winter, 2011		✓			✓	✓	✓		✓
Chow and Chan, 2008	✓						✓	✓	
Pearson <i>et al.</i> , 2008		✓	✓	✓	✓	✓	✓		✓
Tsai and Ghoshal, 1998			✓				✓		✓

Social capital dimensions include cognitive, relational, and structural social capital (Hau *et al.*, 2013; Nahapiet and Ghoshal, 1998). The cognitive dimension in social capital is measured through “shared language” (Chen *et al.*, 2016; Wang *et al.*, 2016). Shared language can help community members to understand their common goals and behave properly within their community (Tsai & Ghoshal, 1998), as shared language provides a common understanding by developing common/shared paradigms, values, stories and terms (Nahapiet & Ghoshal, 1998). Cognitive capital, hence measure the level of common terms, language and understanding of the end-users within the community (Nahapiet & Ghoshal, 1998; Tsai & Ghoshal, 1998).

The relational dimension in social capital is measured through “trust” (Chen *et al.*, 2016; Wang *et al.*, 2016). Trust has been articulated as an essential element of relationship. Nahapiet and Ghoshal (1998) referred to the relational dimension as “the kind of personal relationships people have developed with each other through a history of interaction” (Nahapiet & Ghoshal, 1998, p. 1035). Relational capital, hence measure the level of trust and confidence between end- users within the community (Nahapiet & Ghoshal, 1998; Tsai & Ghoshal, 1998).

The structural dimension in social capital is measured using “network ties” (Chen *et al.*, 2017; Wang *et al.*, 2016). Network ties is the essential factor for structural capital, which includes network characteristics such as social interaction ties, tie strength and centrality. The structural capital, hence measure the strength of the relationship between end-users within the community (Nahapiet & Ghoshal, 1998).

METHODOLOGY

Instrument Development

This study investigates whether the build of cognitive, relational, and structural social capital dimensions does differ among the different types of VW platforms. Target participants are active users of SL (SVWs), WOW (GVWs), and EU (MVWs). Hence, an online questionnaire is a suitable research design as it allows the researcher to reach a global population within each of specifically targeted VW.

The online questionnaire is shared globally through the Survey Monkey platform. The online questionnaire is based on 5-Point Likert Scale - 1 (strongly disagree) to 5 (strongly agree). It takes around 10 – 15 minutes to complete. It remained alive online for three months. Its shared distribution is through direct URL addressing into SL, WOW, and EU related communities' platforms - such as: Facebook groups, forums, and Instant Messages (IM) with the VWs platforms.

The piloted and validated questionnaire measurement items (developed from instruments used in previous studies) did deliver the target constructs. Specifically, cognitive social capital measurement items are adapted from (Chang and Chuang, 2011; Chen *et al.*, 2017; Chiu *et al.*, 2006; Wang *et al.*, 2016), relational social capital measurement items are adapted from (Chang and Chuang, 2011; Chiu *et al.*, 2006), and structural social capital measurement items are adapted from (Chang and Chuang, 2011; Chiu *et al.*, 2006).

Data Collection

The online questionnaire delivered a total of 613 responses. After eliminating duplications, incomplete responses, and inconsistencies, the final usable sample size for this study was 274 responses. Factor reduction engaged SPSS 22. Constructs developed were validated for dimensional and construct reliability. All variables exceeded recommended Cronbach Alpha empirical research acceptance levels of > 0.60 (Hair *et al.*, 2010).

Table 1 summarises the final outcome of this survey validation process. The final 274 surveys are reserved in the database (acceptance rate is 74.8%) to be examined, and for testing normality and outliers.

Table 1: Total Number of Responses (N = 365)

Filter No.	Filter Name (Description)	Total Invalids	Remaining Responses
1	Declined to take the survey	9	356
2	Not completed / missing data	22	334
3	Survey duration (less than 10 min)	29	305
4	Comment field was not in English	14	291
5	Duplicated IP address	17	274
Total number of valid responses after five filters = 274			

RESULTS

Table 2 summarises the study's demographics (n = 274) across the different VWs types (SL, WOW, and EU). Overall, the male population (57%) outweighs the female (43%) population across investigated VWs platforms. About 79 per cent of those participating in the VW is under 45 years old.

Table 2: Respondent Demographics (profile)

Demographic Measure	Percentage (%)
Gender	
Female	43.1%
Male	56.9%
Age	
18 to 24	23.7%
25 to 34	30.7%
35 to 44	24.8%
45 to 54	14.6%
55 or older	6.2%

Table 3 summarises the survey global respondents collected from each virtual world community.

Table 3: Total Valid Responses from Different VWs

VW	No. of Responses
SL	85
EU	75
WOW	114
TOTAL	274

ANOVA Results

The research hypotheses applies ANOVA with post-hoc analysis. Table 4's cognitive, relational, and structural social capital dimensions in the different VW platforms (SL, EU, WOW) indicates no significant differences between cognitive and relational social capital across the different VW platforms. However, considering structural social capital dimensions, there is a significant ($p < 0.05$) difference between EU and both SL and WOW.

Table 4: ANOVA with Tukey HSD Test for Social Capital (Cognitive, Relational, and Structural)

Construct	Main VW	Compared VW	Mean Differences	Std. Error	Sig.
Cognitive					
Cognitive	SL	EU	.014	.109	0.99
		WOW	-.140	.099	0.33
	EU	SL	-.014	.109	0.99
		WOW	-.154	.103	0.29
	WOW	SL	.140	.099	0.33
		EU	.154	.103	0.29
Relational					
Relational	SL	EU	.015	.123	0.99
		WOW	.097	.111	0.65
	EU	SL	-.015	.123	0.99
		WOW	.082	.115	0.75
	WOW	SL	-.097	.111	0.65
		EU	-.082	.115	0.75
Structural					
Structural	SL	EU	.670*	.1402	0.00
		WOW	.233	.126	0.15
	EU	SL	-.670*	.140	0.00
		WOW	-.436*	.131	0.00
	WOW	SL	-.233	.126	0.15
		EU	.436*	.131	0.00

* The mean difference is significant at the 0.05 level

This significant difference in structural social capital between EU and both SL and WOW can be because EU, as a platform, is a mixture of socialising and gaming activities - where EU participants in such platforms develop specific social capital activities suites. The mixed nature of the EU VW also makes it a very different VW environment to game-oriented only (WoW) platforms and social oriented (SL) only platforms.

CONCLUSION

The study of cognitive, relational, and structural social capital dimensions in a specific VW platform has been studied before (Reer and Krämer, 2014; Yoon, 2014; Zhong, 2011). However, whether cognitive, relational, and structural social capital differs across different VW platforms, has before this study, remained unpredictable.

It remains useful to investigate the influence of different VWs types and their individual effects on cognitive, relational, and structural social capital dimensions. A better understanding of such influences provides developers and business with a better way of offering customised products and services. This allows developers to consider the build of higher levels of trust, and the build of

a stronger social capital relationship among VWs platforms participants. This may, in-turn, build high levels of customer trust and ongoing loyalty.

This study also addresses the gap that differences in social capital dimensions do exist between gaming, social, and mixed VW platform participants and their behaviour(s). Overall this study shows *significant differences in structural social capital dimensions* do exist across different types of VWs (EU versus WoW of SL). In contrast, this study shows no significant differences between cognitive and relational social capital dimensions. Thus, cognitive and relational social capital can be treated identically by platform developers, but structural social capital needs to be treated specifically for the VW involved.

LIMITATIONS & FUTURE RESEARCH

This study chooses only SL to represent SVWs, only EU to represent MVWs, and only WOW to represent GVWs. This study also did not consider the demographics or the background differences of the respondents. Further segmentation of respondents, and a larger study, may together provide further insights. Future extension studies can include additional VW platforms. This can provide further understanding and generalisation and also provide further validation.

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Strategic Alignment and Performance for Service-oriented Smart Government in Taiwan: A Comparison between Government Officials and Private Sector Managers

(Full Paper)

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ABSTRACT

Transformation to service-oriented smart government is one of the most important issues for governments across the world, and has been promoted by academia and practitioners in the recent years. This study conducted quantitative research to evaluate the effect of the two different types of stakeholders – government officials and private sector managers – on the relationship between the strategic alignment and performance of service-oriented smart government in Taiwan. The findings of the study indicated that the government officials and the private sector managers focused on using different strategic alignments to enhance the government performance. These findings are able to serve as a guide to developing and transforming a government into a service-oriented smart government.

Keywords: Service-oriented smart government, strategic alignment, government performance and stakeholder.

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INTRODUCTION

Service-oriented smart government in this study refers to that the role of the government is transformed from a decision maker to a service provider, emphasizing citizens placed at the center of the governance system with the concept of new public service theory (Denhardt & Denhardt, 2011). Meanwhile, the application of information technology and intelligent computing to the process, which enables e-Government to transform into Smart e-Government/Smart government, is regarded as digital government transformation (Gartner, 2017). In recent years, the e-Governments of developed countries have been striving to transform into the service-oriented smart government. Therefore, these countries have published new digital policies, such as the Australian Government Digital Transformation Agenda, the UK Government Digital Strategy, the American Digital Government Strategy, Singapore's Smart Nation 2025, and Taiwan's Service-oriented Smart Government Promotion Project - the 5th phase e-Government Program of Taiwan 2017-2020. As a result, the relatively new topic of service-oriented smart government has drawn great attention from other countries' governments as well as industries and academia (Peever *et al.*, 2015; Alghazi *et al.*, 2017; Ghildyal & Chang, 2017).

As service-oriented smart government relies on the assistance of information technology, such as cloud computing, open data and data analysis, mobile and social network (Gartner, 2017), the information technology plays an important role in helping service-oriented smart government to put new public service into practice so as to develop digital business strategies of the government as well as a key factor influencing the government performance. The concept of strategic alignment is necessary for the service-oriented smart government in creating the value of information technology to improve the performance. The strategic alignment is defined as the interrelationships between the information technology and business (Papp, 2001). This means that the implementation of the information technology is able to fully support organizations to achieve their goals, and the internal organizational management and information system stakeholders are willing and committed to support it (Winkler, 2013). The government has paid attention to the issue of the strategic alignment (Gerow *et al.*, 2014; Wu *et al.*, 2015; Alghazi *et al.*, 2017). The reason for this is that, compared with the private sector, the government is more concerned with the return of investment in information technology projects, and the government performance widely impacts every citizen of the country than that of enterprises.

Past studies have explored the relationship between organizational strategic alignment and performance (Sabherwal & Chan, 2001; Chan *et al.*, 2006; Leonard & Seddon, 2012; Reynolds & Yetton, 2015; Kappelman *et al.*, 2016). These studies showed the positive impact of strategic alignment on organizational performance, and pointed out that organizations that achieved strategic alignment performed better than those that failed. Most of these studies focused on exploring the relationship between the strategic alignment and performance in the context of the private sector rather than that of the government sector. Although only few studies explored the impact of strategic alignment on government performance, the findings of these studies have greatly contributed to government sectors (Winkler, 2013; Vander Elst & De Rynck, 2014; Walser *et al.*, 2016; Rusu & Jonathan, 2017; Hung & Lin, 2018). According to the published literature of Hung & Lin (2018), the authors adopted the Strategic Alignment Model (SAM) to examine the relationship between the strategic alignment and performance of Taiwan's service-oriented smart government from the perspective of the government transformation strategy, governance and public

service delivery. This study has revealed that there is a significant positive relationship between the strategic alignment and Taiwan's service-oriented smart government performance.

Obviously, compared with private sectors, it is more necessary for serviced-oriented smart government to enhance its performance through the use of strategic alignment. The reason for this is that service-oriented smart government stakeholders are complex and various stakeholders with different interests that need to be taken into account (Greger *et al.*, 2014). Empirical studies have shown that the satisfaction of government employee and citizens is associated with strategic alignment and government performance as well (Walser *et al.*, 2016). Therefore, in order to improve the performance, service-oriented smart government must understand stakeholders' concerns, interests and requirements. In addition, the government needs to keep its strategy formulation aligned with the information technology strategy and the business strategy as well. However, transforming into a service-oriented government is a new topic. There are still less studies exploring on the relationship among the strategic alignment, performance and stakeholders in the context of service-oriented smart government.

In order to bridge the gap among the academy, the industry and the government, this study aimed to examine the effect of different types of stakeholders on the relationship between the strategic alignment and performance of service-oriented smart government. The stakeholders in the study are divided into two types, i.e. government officials and private sector managers. The former represents the service provider and the latter represents the service recipient. The contribution of this study is the discovery of the effect of different types of stakeholders on the relationship between the strategic alignment and performance of service-oriented smart government. The findings of the study based on the analysis of the differences between the service provider and the service recipient are able to serve as a guide to developing and transforming a government into a service-oriented smart government.

Since the study focuses on analyzing the effect of the two types of stakeholders on the relationship between the strategic alignment and performance of service-oriented smart government, it develops the conceptual model to define constructs, and statistically evaluates operational measures of different types of strategic alignment and the performance of service-oriented smart government.

THEORETICAL BACKGROUND

Strategic Alignment and the Strategic Alignment Model

The strategic alignment is defined as the interrelationships between the information technology and business (Papp, 2001). This means that the implementation of the information technology is able to fully support organizations to achieve their goals, and the internal organizational management and information system stakeholders are willing to commit and support it (Winkler, 2013).

The models, used to measure strategic alignment, are diverse and slightly different from their concepts and frameworks. The reason for this is that the development of strategic alignment is almost four decades old (Papp & Coleman, 2006). However, the concept of strategic alignment remains valuable to organizations to looking to achieve alignment of their business and information technology strategies (Papp & Coleman, 2006). In spite of the various development of models measuring strategic alignment, it is agreed that the strategic alignment can boost performance. The perspectives on the model mainly discussed the extent of interrelationships between organizational business strategy and the information technology, e.g. the Strategic Alignment Model (SAM), or the critical success factors for influencing strategic alignment, e.g. the Critical Success Factors Model (CSF).

Among various models to measure strategic alignment, the Strategic Alignment Model (SAM) was adopted in the study to explore the interrelationships between the alignment of business and the information technology. SAM proposed by Henderson and Venkatraman in 1993 conceptualizes and directs two distinct areas, business and information technology, each of which has two quadrants defining that part of the business (Henderson & Venkatraman, 1993; Henderson *et al.*, 1996). SAM consists of four quadrants or domains, including business strategy, information technology strategy, organizational infrastructure, and information technology infrastructure. The four domains can be used to determine the extent and type of alignment with organizations. The domains of business strategy and information technology strategy considered to be external factors, while the other two domains, organizational infrastructure, and information technology infrastructure, are considered to be internal factors. The interrelationships between the four domains reflect the linkages between the four domains, forming eight different types of alignment, i.e. "business strategy → organizational infrastructure", "organizational infrastructure → business strategy", "information technology strategy → information technology infrastructure", "information technology infrastructure → information technology strategy", "business strategy → information technology strategy", "information technology strategy → business strategy", "organizational infrastructure → information technology infrastructure", "information technology infrastructure → organizational infrastructure". The arrow represents the direction-driven, for example, the "business strategy → organizational infrastructure" means that the business strategy drives the organization infrastructure. These eight types of alignment are divided into two types of linkages, namely strategic fit and functional integration. The four former strategic alignments are classified into strategic fit that is the vertical linkage in the model and refers to the interrelationships between the strategy and the infrastructure. The four latter strategic alignments are classified into functional integration that is the horizontal linkage in the model and directly relates to information technology and the alignment of business.

This study focused on the application of the SAM to measure and evaluate how different types of alignment affect government performance. The three primary reasons for this are given as follows. Firstly, the four domains of the SAM are still widely adopted by corporations in order to build their strength to win competition. Meanwhile, the SAM has been empirically studied in many different industries (Luftman *et al.*, 1993; Papp, 2001). Secondly, the eight types of alignment, composed of the four domains in the model, are almost applicable to a business/information system in the context of organizations and have a positive impact on the performance (Papp, 2001). Thirdly, the SAM is the basis for many recent models today (Al-Hatmi & Hales, 2010). In addition, the SAM is one of the top business and information technology tools that is commonly adopted by experts and scholar to apply to the process of alignment (Renaud *et al.*, 2016).

Government Performance and the Balanced Scorecard

Currently, governments across the world are striving to transform into service-oriented smart government. Therefore, a set of performance measures for evaluating government service quality have been proposed, and related studies on e-Government performance indicators have been emerged as well. According to publishers, the existing performance evaluation frameworks are derived from the two entities, i.e. government organizations and third-party institutions. The former includes the Government of Canada (Treasury Board of Canada Secretariat, 2002), the U.S. government (FEAPMO, 2003) and the United Nations (2003), etc. The latter fall into universities and research institutions, such as Brown University (2004) and private consultancies, such as Gartner (2003) and Accenture (2004), etc. These evaluation studies and reports have different frameworks from different perspectives. However, they showed that the performance evaluation of service-oriented smart government is one of the primary issues that governments must take into account. The use of the performance evaluation enables service-oriented smart government to improve government efficiency and management process, enhance the public service quality and promote better execution of government departments.

There are many mechanisms to measure organizational performance. This study adopted the balanced scorecard to measure the performance of service-oriented smart government. The balanced scorecard proposed by Kaplan and Norton in 1992 has four balanced perspectives: the financial perspective, the customer perspective, the internal business processes, and learning and growth (Kaplan & Norton, 1992). The two primary reasons for the study to choose the Balanced Scorecard as the measurement tool are given as follows. Firstly, the balanced scorecard is applicable to the government entity. The Balanced Scorecard Institute indicates that the balanced scorecard has been widely used in business and industry, government and non-profit organizations as well as a strategic planning and management system to align the organizational infrastructures to the vision and strategy of organizations, in order to enhance the internal and external communications and monitor organizational performance (BSI, 2011). Secondly, the concept of the Balanced Scorecard is similar to that of the Strategic Alignment Model (SAM), as their measurement framework are established on the basis of internal and external environmental factors that affecting organizations (Al-Hatmi & Hales, 2010).

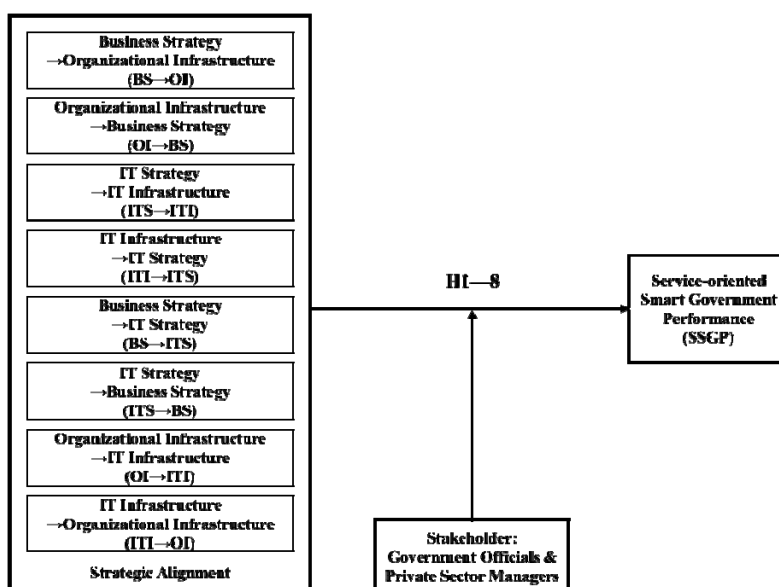
The Stakeholder Model

The definition of a stakeholder can be seen as any group or individual in an organization who is able to affect or is affected by the achievement of the organization's objective (Freeman, 1984). There is general agreement that service-oriented smart government is complex and involves a variety of stakeholders (Chircu, 2008). The alignment of service-oriented smart government objectives with stakeholder interests is central to effective e-governance.

There are various types of stakeholder model used in the context of e-Government. According to Greger *et al.* (2014), the stakeholder models can be divided into eight types on the basis of three attributes, i.e. categorization, interaction and scope (Greger *et al.*, 2014). The attribute *categorization* refers to the composition of entities in the model. The interrelationships between stakeholders are defined as the attribute *interaction*. The attribute *scope* refers to a type of project, such as a particular project or a generic project. This study adopts the De's model that identifies two categories based the direction of their interactions, i.e. a demand side and a supply side (De', 2005). The demand side, defined as the service receipt, refers to the private sector managers. The supply side, regarded as the service provider, refers to the government officials in the service-oriented smart government in this study.

RESEARCH MODEL AND HYPOTHESES

Figure 1 presents the research model of the SAM and the performance of service-oriented smart government tested in the study. According to the model, eight measures of strategic alignment, "BS → OI", "OI → BS", "ITS → ITI", "ITI → ITS", "BS → ITS", "ITS → BS", "OI → ITI" and "ITI → OI", are related to the performance of service-oriented smart government. One variable, the stakeholder, is drawn from the literature and used to examine its effects on the relationship between the strategic alignment and performance of service-oriented smart government.



Source: This study.

Figure 1: Research model.

The use of strategic alignment enables service-oriented smart government to boost its performance. Therefore, the study examined the differences between the Taiwanese government officials (service provider) and the Taiwanese private sector managers (service recipient) on the relationship between the strategic alignment and performance of service-oriented smart government, which are able to serve as a guide to developing and transforming a government into a service-oriented smart government. The performance of service-oriented smart government is improved through the application of information technology, which collects the wisdom of crowds and creates IoT ecosystem (Denhardt & Denhardt, 2011; Gartner, 2017). This ITC-enabled reform leads to more efficient and cost-effective government, more government accountability to citizens, and convenient government service. In order to ensure the return of investment in information technology projects, the strategic alignment is necessary (Al-Hatmi & Hales, 2010; Walser *et al.*, 2016; Alghazi *et al.*, 2017; Rusu & Jonathan, 2017). This enables service-oriented smart government to create value for its stakeholders, e.g. the service provider and recipient. The above discussion leads to the following hypotheses:

H1: The variable, stakeholder, influences the relationship between the alignment of business strategy → organizational infrastructure and the performance of service-oriented smart government.

H2: The variable, stakeholder, influences the relationship between the alignment of organizational infrastructure → business strategy and the performance of service-oriented smart government.

H3: The variable, stakeholder, influences the relationship between the alignment of information technology strategy → information technology infrastructure and the performance of service-oriented smart government.

H4: The variable, stakeholder, influences the relationship between the alignment of information technology infrastructure → information technology strategy and the performance of service-oriented smart government.

H5: The variable, stakeholder, influences the relationship between the alignment of business strategy → information technology strategy and the performance of service-oriented smart government.

H6: The variable, stakeholder, influences the relationship between the alignment of information technology strategy → business strategy and the performance of service-oriented smart government.

H7: The variable, stakeholder, influences the relationship between the alignment of “organizational infrastructure → information technology infrastructure” and the performance of service-oriented smart government.

H8: The variable, stakeholder, influences the relationship between the alignment of information technology infrastructure → organizational infrastructure and the performance of service-oriented smart government.

METHODOLOGY

The study divided the stakeholders into two sample groups, i.e. the Taiwanese government officials (service provider) and the Taiwanese private sector managers (service recipient). The issues of strategic alignment and government performance are too professional to be understood by general public. Therefore, the two selected types of stakeholders for the samples are

government officials and private sector managers, who have ever attended information technology development conferences and business strategy development conferences. Then, the study conducted multiple regression analysis to test the effect of the two types of stakeholders on the relationship between the strategic alignment and performance of Service-oriented smart government. The research model and hypotheses were tested using SPSS Statistics.

Questionnaire Design

The issues in relation with the strategic alignment and performance of service-oriented smart government are so professional; therefore, it is difficult to collect the data. In order to tackle this problem, A questionnaire was designed for testing the proposed research model and hypotheses, and a Likert seven-point scale was employed for the responses. The study collected data through E-mail and communication software in order to ensure the data reliable and valid. In addition, seven experienced senior supervisors and experts in the field of industry, government and academia helped revisions of the questionnaire through the focus group interview methodology, specifically for correcting semantic errors and checking completeness of the questions, to ensure the overall design was valid and clear and the questions were appropriate and representative.

On the basis of the research model in this study, the questionnaire design included three parts, i.e. strategic alignment, Smart-oriented smart government performance and personal information. The questions in the part one was a set of prototype that Papp adapted from the Strategic Alignment Model (SAM) to assess the eight different strategic alignments (Papp, 2001). The Likert seven-point scale was employed for the responses (1 = “strongly disagree” to 7 = “strongly agree”). In the second part, the questions, based on the Kaplan and Norton’s concept of the balanced scorecard, were designed to measure the performance of Taiwan’s service-oriented smart government. The two criteria in relation to the concept of new public service and the application of information technology were used to determine the level of government performance. The definition of high performance in the study is that the government provides the public service through the application of information technology, and constantly adjusts its business and information technology strategy to changing public demands with development. The Likert seven-point scale was employed for the responses (1 = “strongly disagree” to 7 = “strongly agree”). In the third part, subjects are required to fill in their personal information, such as company and job title, etc.

Data Collection

The study divided the stakeholders into two sample groups, i.e. the Taiwanese government officials (service provider) and the Taiwanese private sector managers (service recipient). The questionnaires in relation with the strategic alignment and performance of service-oriented smart government are too professional and challenging to general public to answer. The study set the three criteria to build a representative sample. Firstly, subjects are either the officials of government entities or private sector manager. Secondly, subjects must have the experience of business supervisors or information technology supervisor. In addition, they must have ever attended information technology development conferences and business strategy development conferences. Ideally, the CEO (or highest ranking business management) and CIO (or highest ranking information technology management) are the most suitable to use the SAM to evaluate the organization strategic alignment (Papp, 2001). Thirdly, subjects have received higher education that is helpful in understanding the survey questions. Therefore, subjects in our studies were required to graduate from college and universities, including bachelor’s degrees, master’s degrees and doctor’s degree.

Analyses

This study conducted comparative analysis and quantitative research to evaluate the effect of the two different types of stakeholder – the government officials (service provider) and the private sector managers (service recipient) - on the relationship between the strategic alignment and performance of service-oriented smart government. Due to the only two sample groups, the study conducted multiple regression analysis to test the effect of the two types of stakeholders on the relationship between the strategic alignment and performance of service-oriented smart government. Standardized regression coefficients (β values) and P-values were used to determine the stakeholder’s effect. The research model and hypotheses were tested using SPSS Statistics to perform descriptive analysis, factor analysis, reliability and validity test, and model verification.

RESULTS AND DISCUSSIONS

Participants

The final-version of the completed questionnaire was distributed through E-mails. A sample of 2136 selected the Taiwanese government official and private sector managers. The distribution period was six weeks. A reminder messages from E-mail and communication software was sent two weeks after the initial distribution.

A total of 326 surveys were returned (a 15.3 percent response rate). After eliminating invalid questionnaires based on the three criteria for selecting subjects, the final sample consisted of 236 respondents, including government officials (42%) and private sector managers (52%). The demographic breakdown of the respondents was as follows: 35 percent were high-level management position, such as chairman, general manager and deputy general manager; and 65 percent were mid-level/senior management position. 61 percent were supervisors of the information technology department and 45 percent were supervisors of the business strategy department. 96 percent and 94 percent have attended the information technology development conferences and business strategy development conferences, respectively. 68 percent had a master's degree as their highest degree attained, 28 percent had a bachelor’s degree, and 5 percent had a Ph.D. Compared with the general public, the respondents in this study had better understanding of the questions in relation to the strategic alignment and performance of Service-oriented smart government. As a result, their data were reliable and valid.

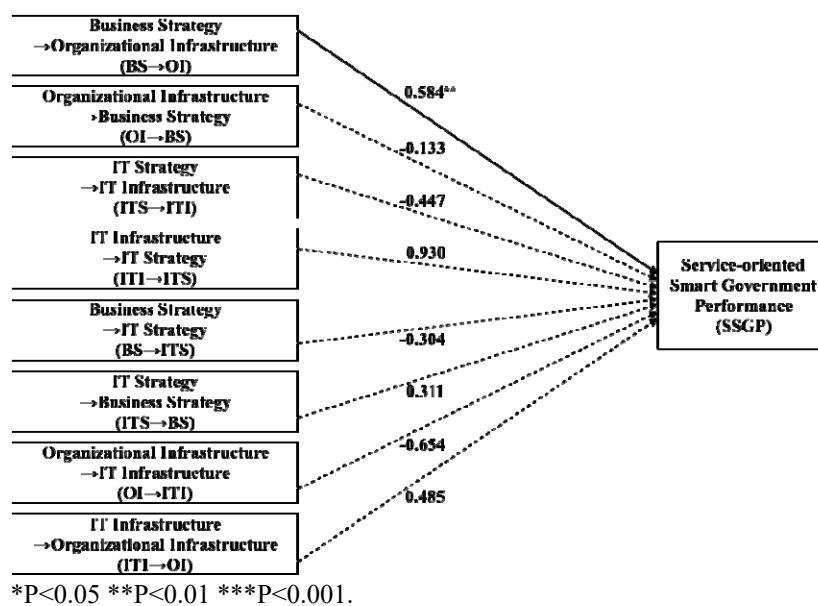
Reliability and Validity Testing

In order to ensure the reliability and validity of the data, pretest was conducted through different methods. Firstly, seven experienced senior supervisors and experts in the field of industry, government and academia helped revisions of the questionnaire through the focus group interview methodology. The reason for the study to adopt this methodology is that since this study focused on dealing with the issue of government performance, the focus group interview proposed by Grbich in 1999 is widely used in collecting feedback related to policy and performance issues (Grbich, 1999). Finally, the study conducted a pretest and distributed to 105 supervisors of business or information technology department from the government and the private sector. A total of 105 completed questionnaires were collected through E-mails. In order to ensure the internal consistency, the Cronbach α was calculated. The Cronbach α of the strategic alignment construct and the performance of service-oriented smart government was 0.92 and 0.96 respectively, which were both over 0.7 (Nunnally, 1978). This indicated that each variable in the model reached an acceptable level of reliability.

Exploratory factor analysis was performed and factorability was assessed with both the Kaiser-Meyer-Olkin Index (KMO) test and Bartlett's test of sphericity. The KMO of sampling adequacy value was 0.932, and Bartlett's test of sphericity was significant ($p < .001$). The factor analysis result showed that all items converged in the corresponding constructs, and that each construct was significantly different from the others. Therefore, the study adopted Principal Component Analysis to test construct validity, and measured the factor loadings to determine if the questionnaire achieved both discriminant and convergent validities. According to Hair *et al.* (2010), when the number of samples surpasses 150, a factor loading over 0.45 achieves construct validity. This study used the Varimax and Equamax of the orthogonal rotation method to perform adjustments in the factor analysis. The factor loadings values obtained were all greater than 0.5, which cumulatively explained 75.32% of the variance. The Cronbach α of each construct was greater than 0.7 (between 0.93 to 0.98), which indicates that the reliability of the questionnaire in the study was satisfactory and was sufficient for reliability to be assumed.

Path Analysis Results

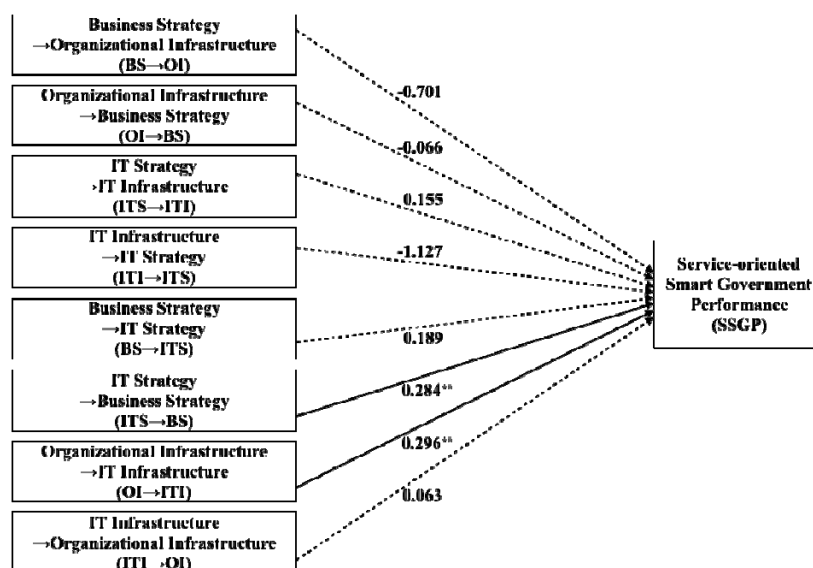
Figure 2 presents the path analysis results of the participants who are government officials. For these participants, this study found that one (BS→IO) out of eight independent variables have significant and predictive power on SSGP. This one and the dependent variable (i.e., SSGP) share 0.631 for the multiple correlation coefficient, 0.488 for the determination coefficient, and 4.448 ($p = 0.000$; < 0.05) for the F value of the model's overall testing.



Source: This study.

Figure 2: Path analysis of government officials.

Figure 3 offers the path analysis results of the participants who are private sector managers. For this type of participants, this study found that two (ITS→BS, OI→ITI) out of eight independent variables have significant predictive power on SSGP. These two predictors and the dependent variable (i.e., SSGP) share 0.731 for the multiple correlation coefficient, 0.451 for the determination coefficient, and 20.302 ($p = 0.000$; < 0.05) for the F value of the model's overall testing.



*P<0.05 **P<0.01 ***P<0.001.

Source: This study.

Figure 3: Path analysis of private sector managers.

In a summary, the results for testing the direct effects as hypothesized are given in Table 1. If the result of the path is significant, it is denoted with bolded “Yes”. In the model of the government officials, stakeholder has an effect on the relationship between the alignment of “business strategy → organizational infrastructure” and performance of service-oriented smart government. However, in the model of the private sector model, stakeholder has effects on the relationship between the alignment of “information technology strategy → business strategy”, “organizational infrastructure → information technology infrastructure” and performance of service-oriented smart government.

Table 1: Results of hypotheses testing.

Hypotheses	Path	Government Officials (Service Provider) Significant?	Private Sector Managers (Service Recipient) Significant?
H1	“BS→OI” → SSGP	Yes	No
H2	“OI→BS” → SSGP	No	No
H3	“ITS→ITI” → SSGP	No	No
H4	“ITI→ITS” → SSGP	No	No
H5	“BS→ITS” → SSGP	No	No
H6	“ITS→BS” → SSGP	No	Yes
H7	“OI→ITI” → SSGP	No	Yes
H8	“ITI→OI” → SSGP	No	No

CONCLUSIONS

The Taiwanese government is now moving forward to the fifth phase of e-Government – service-oriented smart government. Comparing with the first four phases of e-Government, transforming into a service-oriented smart government is more challenging. It is due to the fact that a service-oriented smart government must implement strategic alignment in order to achieve higher performance, and a good strategic alignment shall integrate the four key domains: business strategy, organizational infrastructure, information technology strategy, and information technology infrastructure. This study examined the differences between the Taiwanese government officials (service provider) and the private sector managers (service recipient) on the relationship between the strategic alignment and performance of service-oriented smart government. The findings of the study based on the analysis of the differences between the service provider and the service recipient are able to serve as a guide to developing and transforming a government into a service-oriented smart government.

Comparing the impacts of strategic alignment on performance of service-oriented smart government between the Taiwanese government officials and the private sector managers, the great differences lie in whether “business strategy → organizational infrastructure”, “information technology strategy → business strategy”, and “organizational infrastructure → information technology infrastructure” contribute significant influence on performance of service-oriented smart government. In terms of “business strategy → organizational infrastructure”, this linkage is classified into strategic fit (Papp, 2001). The government officials think that the use of “business strategy → organizational infrastructure” enhances performance of service-oriented smart government. However, the private sector managers think that the use of “information technology strategy → business strategy” and “organizational infrastructure → information technology infrastructure”, classified into functional integration (Papp, 2001), enhance performance of service-oriented smart government rather than the use of “business strategy → organizational infrastructure”. Both of them think that the rest of the linkages have no significant impacts on performance of

service-oriented smart government, i.e. “organizational infrastructure → business strategy”, “information technology strategy → information technology infrastructure”, “information technology infrastructure → information technology strategy”, “business strategy → information technology strategy” and “information technology infrastructure → organizational infrastructure”. In other words, the relationships between these five strategic alignments and performance of service-oriented smart government do not vary according to different stakeholders, i.e. the government officials and the private sector managers.

Management Implications

The results of the study showed that perspectives between the Taiwanese government officials and the private sector managers on the effect of strategic alignments on performance of service-oriented smart government are not exactly the same. In other words, the different types of a strategic alignment, which the service provider and the service recipients focused on, will directly impact the performance. The primary reason for this is that the government officials tend to use strategic fit to develop and transform a government into a service-oriented smart government. According to the strategic alignment model (Henderson & Venkatraman, 1990; Papp, 2001), this is regarded as the strategy execution perspective. Business strategy has been widely used to drive and improve organizational infrastructure; however, the application and the integration of information technology to development of a service-oriented smart government has been ignored. In this case, it is unlikely to satisfy service recipients' demand and achieve high performance (Winkler, 2013; Walser *et al.*, 2016).

In contrast, the private sector managers, who are service recipients as well, think functional integration is more important. According to the strategic alignment model (Henderson & Venkatraman, 1990; Papp, 2001), the private sector managers think that both the competitive potential perspective and the organizational information technology infrastructure perspective must be taken into account in order to achieve high performance of a service-oriented smart government. In this case, in order to enhance performance, information technology strategy is used to drive business strategy; meanwhile, a business process of a service-oriented smart government must be analyzed, and then results in the improvement of information technology infrastructure. Obviously, these three different strategic alignment perspectives from both the government officials and the private sector managers must be taken into account for the government transformation into the service-based smart government, especially the alignments of “information technology strategy → business strategy” and “organizational infrastructure → information technology infrastructure”, which the service recipient concerns for. In addition, the government must begin to take the rest of the alignments into account, although both the government officials and the private sector managers think those alignments have no significant effects on performance of a service-oriented smart government. Otherwise, when a service-oriented smart government has a poor performance, the government or society will blame for strategic misalignments.

Limitations and Directions for Future Research

This study has several limitations and foresees future directions for research. The study mainly focused on the study upon managers of government as well as private enterprises towards strategic alignment and service-oriented smart government, but not populace yet. Thus, in the future study, we can collect more ideas from the populace, and further understand the demand gap between the government (service provider) and the populace (service recipients).

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Strengths of Chinese Rural Areas to Develop E-commerce Projects

(Full paper)

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ABSTRACT

It is important to use appropriate ways to develop e-commerce in rural areas. Despite numerous studies which have addressed barriers that rural areas in developing countries are facing, few studies can be found that were focused on strengths that rural areas could consider about when developing e-commerce. In this paper, we analyzed typical cases (as known as patterns) in Chinese rural areas where e-commerce have been developed in a quick, innovative and successful way. We analyzed these cases and proposed four strengths (i.e., Industry Strength, Resource Strength, Position Strength and Marketing Strength) that rural areas could use when developing e-commerce. Started from the strength, a framework named SASS (Strength, Aim, Subjects, and Solutions) which characterizes key elements to develop e-commerce in rural areas was identified. According to a review on ten such cases, we found that the four strengths and the SASS framework could help us understand such cases in a unified and organized way. Accordingly, reference can be obtained in a more efficient way for top-level design of e-commerce development in similar areas.

Keywords: E-commerce, developing countries, rural areas, strength.

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INTRODUCTION

During the past several years, e-commerce has been developed in a rapid way in Chinese rural areas. However, in many counties or villages, e-commerce infrastructure has been built and e-services have been applied in a similar way. This brought waste of resources due to unbalanced supplies and demands. Experts proposed that top-level design of e-commerce should be carried out based on specific characteristics of local area. Both barriers and strengths should be considered. Despite many research focusing on barriers and challenges that developed areas should pay attention to when develop e-commerce (Kshetri, 2008) (Lawrence and Tar, 2013) (Guo and Gao, 2017), there is few studies addressing which strengths such areas need to be considered when developing e-commerce. It is also unclear which important elements should be considered about when designing top-level e-commerce development route based on its strengths.

Researchers and practitioners summarized some successful cases in which e-commerce have been applied quickly and successfully in some Chinese rural counties (Taobao University, 2016). Such cases are well-known and called as “e-commerce patterns in counties” (Qiu, 2017) such as Yiwu pattern (Chen, 2014), Beishan pattern (Zhu, 2016). These cases are quite typical for three reasons. First, some counties have got high ranking in the development of e-commerce. Second, some counties have achieved dramatic economic growth after applying e-commerce even if they were quite poor and possessed little resources previously. Third, some counties have developed e-commerce in an innovative way.

There are some other researches focusing on such e-commerce patterns also. For instance, in (Zhou, 2015), the authors summarized core factors for each pattern. However, such factors were not abstracted from one single perspective. This makes it difficult for persons to communicate about them in a unified way, or refer to them in order to improve practical results elsewhere. In (Zeng *et al.*, 2016), three e-commerce development models in counties have been classified from the perspective of government support: Suichang pattern (building up industry associations and distribution platform), Chengxian pattern (micro marketing and resource integration), and Tongyu pattern (marketing operation and branding strategy). Despite innovative and concise insights in this article, government support can be thought as one kind of solution from the government perspective in order to develop e-commerce. It is something about the ‘result’, not the ‘reason’. Therefore, there are limitations to obtain references from it elsewhere.

To address this issue, in this paper, we analyzed such cases, and proposed four primary strengths of counties that could be considered about when developing e-commerce. Further, we identified key elements for counties when designing the route of e-commerce development (Strength, Aim, Subjects and Solutions). The rest of this article is structured as below. In Section 2, ten patterns of e-commerce development in Chinese counties are introduced. In Section 3, we discuss several related work, and in Section 4, the four strengths and the SASS route framework are introduced. Ten well-known e-commerce patterns in Chinese counties are reviewed in Section 5. Then in Section 6, we discuss about how SASS elements and industry strengths can be used for

understanding and designing e-commerce development in similar areas. Lastly, we discuss limitations and future work, and conclude this paper in Section 7.

BACKGROUND

Since the government's "Internet +" strategy was introduced in 2015, e-commerce has been developing vigorously in Chinese counties. This section introduces ten well known cases of e-commerce development in Chinese counties that appeared in earlier stage: Yiwu pattern, Haining pattern, Qinghe pattern, Chengxian pattern, Suichang pattern, Tongyu pattern, Tonglu pattern, Wugong pattern, Beishan pattern, and Shaji pattern.

Yiwu Pattern

Yiwu is a miracle of China's economy (Ali, 2013a). In July 2013, Forbes Chinese Network announced that Yiwu has become the richest county-level city in China with a per capita disposable income of more than 40,000 yuan. In 2005, Yiwu was the largest wholesale market of small commodities in the world according to authoritative agencies such as the United Nations. As a new productive force, e-commerce has been continuously integrated into the traditional business economy of Yiwu, promoting the upgrading of Yiwu professional market, and further promoting the development of county e-commerce economy. The development of Yiwu small commodity economy has gone through five stages: marketization, industrialization, urbanization, internationalization and e-commerce. The e-commerce mileage of Yiwu traditional wholesale market has gone through four stages of development: B2B e-commerce opens up a new channel for international trade, Taobao villages open up a new channel for online retail, traditional merchants and commercial cities collectively embrace e-commerce, and a new ecology of multi-channel e-commerce co-existence. The main characteristics of Yiwu pattern is the rapid rise of online merchants and electricity, leading e-commerce trade volume in the country, rising e-commerce service industry, diversified e-commerce ecology, and e-commerce speeded up by traditional wholesale market.

Haining Pattern

Haining is a well-known fur city in China, and has been following the pace of the internet to promote the development of e-commerce. By the end of 2012, Haining's network merchants (B2C/C2C) had been more than 10,000, with more than 40,000 new job positions created, and the annual online sales exceeded 10 billion yuan. The characteristics of the Haining pattern are similar to those of Yiwu, as the e-commerce is also driven by electricity providers for transformation and upgrading. Specifically speaking, one is to introduce talents; the other is to create the platform and develop e-commerce in both domestic and cross-border way; the third is to strengthen supervision and brand protection; the fourth is to build industrial parks and strengthen services; the fifth is to upgrade management and upgrade enterprises.

Qinghe Pattern

Qinghe is the largest online sales base of cashmere products in China. It has more than 80% cashmere processing capacity in China and 50% in the world. It has the title of "Capital of Cashmere in China". Qinghe has a very strong industrial foundation. Relying on this professional and traditional market, Qinghe's e-commerce has been developed rapidly. The main development idea of Qinghe pattern is developing online and offline commerce at the same time, so that the tangible market and the invisible market can complement each other. Key features include: 1, similar to Yiwu E-commerce, the e-commerce development is supported by strong traditional industries or professional markets. Therefore, its electricity supplier supply chain has high efficiency, low commodity prices and strong industry competitiveness; 2, after seeing the leader's demonstration, the traditional merchants and enterprises with deep industrial accumulation have rapidly transformed e-commerce, and the online merchants group and the scale of transactions have rapidly expanded; 3, the electricity supplier ecology created by the government has played a strong role in promoting the development of local e-commerce.

ChengXian Pattern

Chengxian is a county with beautiful mountains and rivers. The industrial economy is poor here, but there are many mountains and rich agricultural and forestry products. There are about 500 thousand acres of walnut forest. Since 2013, Li Xiang, secretary of Party committee in Chengxian, has taken the lead to popularize walnuts through Weibo and WeChat. The key features of Chengxian pattern include: 1, explosive product line. Walnuts are used to promote the popularity first, and then garlic, honey, pork, hand-made noodles and other agricultural products became popular; 2, government marketing. The secretary of the county Party committee took the lead. Four groups and village cadres joined forces to carry out marketing by means of Weibo and WeChat.

Suichang Pattern

Suichang is a typical mountainous county. Its industrial economy is not quite advanced, but agricultural and forestry products are abundant. The so-called "Suichang pattern" (Ali, 2013b) is a sustainable mechanism of agricultural e-commerce centered on the association of online stores, under the guidance and support of the local government, cooperating with service providers and online merchants. Its core subjects are the association of online stores, online merchants, service providers and governments. The core business of the association consists of three parts: integration of saleable sources, organization of network distributors (mainly local merchants), unified warehousing and delivery services.

Before 2014, the Suichang pattern was in the first generation stage, and it was called the "Suichang 1.0 mode". With the development of e-commerce towards the direction of O2O and mobility, Suichang mode has been upgraded into 2.0 mode (Yu and Zhao, 2016), and has been improved in two aspects: first, the establishment of "street-driving company" and the establishment of rural information service stations, which formed the rudiment of agricultural product supply mechanism for small farmers and improved agriculture; second, the marketing channels are multi-platform, cross-platform and mobile, thus realizing the diversity of marketing channels.

Suichang, as the only "strong counties in rural e-commerce" identified by the Chinese Ministry of Commerce, is the first county in China. Suichang pattern enlightens the direction of solving the front-end predicament of fresh e-commerce supply chain. It is to build a county-level integrated service system of agricultural e-commerce, with county-level integrated service providers of agricultural e-commerce, town-level hub and village-level. The service station is the core body. According to the scale of agricultural production, the dual-track agricultural product supply mechanism and traceability system of agricultural product quality and safety are established, and modern agricultural production methods such as order agriculture are promoted.

Tongyu Pattern

Tongyu is a typical northeastern agricultural county and a state-level poverty-stricken county. It is the famous "land of miscellaneous grains and miscellaneous beans" in China. The output of mung beans, sunflower and other agricultural products ranks first in China. However, it is located in a remote area with inconvenient transportation and weak foundation of e-commerce. Agricultural products are sold through traditional ways (wholesale and retail channels). Key features of Tongyu pattern include: 1, online direct selling is the main channel, and a small number of foreign network distributors are subsidiary; 2, a unified brand "three thousand Wo" is registered to unify the packaging, sale and service of all agricultural products; 3, the county government has drawn up the "Tongyu County Electronic Commerce Development Center" from various departments to fully cooperate with the work of the e-commerce company.

Tonglu Pattern

Tonglu is the most powerful county in the west of Zhejiang Province. It is only 80 kilometers away from Hangzhou City and it is also a well-known logistics and pen-making town in China. The unique location advantages provide a good support for Tonglu's e-commerce development, especially in terms of logistics. In less than three years, e-commerce has developed from scratch and merged into various industries of Tonglu. The e-commerce development in Tonglu has been approved by the industry and won many honors. The process of Tonglu's e-commerce development is: grassroots innovation goes first, followed by the masses, and promptly promoted by the government after e-commerce forms a certain scale. This is what experts call a "smooth sailing" model. The model has four main characteristics: 1, government-led. The government takes the initiative to think ahead of enterprises, take a series of measures to promote the development of e-commerce, such as changing ideas, promulgating policies, creating an atmosphere, looking for resources, and building platforms; 2, ecological concept. Tonglu firmly grasps the logistics and talent bottlenecks that restrict the development of rural e-commerce, and consider the top-level design issues, focusing on building an ecological system of rural e-commerce, and to achieve open innovation; 3, two projects taken simultaneously, one is the Alibaba Rural Taobao Pilot Project, which is used to open up the logistics channels. Another is to take Tonglu Agricultural Products E-commerce Industrial Park as the center, enhance the resources of rural products and expand the online market.

Wugong Pattern

Wugong is located in the western part of Guanzhong Plain of China. It is an important channel for the east of Xinjiang, Qinghai and Gansu provinces. Wugong County is about 70 kilometers east of the capital city of Xi'an and 50 kilometers away from Xianyang International Airport. It is an important transportation hub and material distribution center in Guanzhong area with its flat and open terrain and superior geographical location. When developing e-commerce in Wugong County, the idea of "basing on Wugong, linking Shaanxi, radiating northwest, facing the Silk Road Economic Belt" was put forward. A new way of county e-commerce development of "buying northwest and selling the whole country" was gradually developed. The business mode of Wugong can be summed up as: distribution center plus e-commerce. Key features of Wugong pattern include: 1, the planning of "distributing center" has brought into full play the advantages of convenient transportation, and the development of warehousing and logistics industry; 2, relying on the complete and perfect electricity supplier park, vigorously attract foreign business operators to register locally; 3, integrating the resources of Northwest China, breaking through the constraints of local products (Wei, 2014).

Beishan Pattern

Beishan has been developing rural e-commerce since 2006, and its rural e-commerce sales have increased geometrically. Beishan has been transformed from a traditional barbecue village and wonton village to a Taobao village. The e-commerce business has nothing to do with the local traditional industries: new industries have been developed on traditional farming land, such as outdoor goods, tents, sleeping bags and backpacks. In 2006, Lu Zhenhong, a native entrepreneur, set up the first online store, attracting more young people to turn to online entrepreneurship. Driven by leading enterprises, the relevant government departments have made every effort to promote the formation of a "leading government to promote youth interaction" Beishan pattern. Beishan

pattern differs from the "Shaji pattern" (as introduced below) in that: 1, the product category is different, mainly used outdoor goods; 2, the brand is single. 95% of the electricity providers in Beishan village do outdoor products, of which 90% are "Beishan wolf" brand distributors.

Shaji Pattern

Shaji is a typical rural area in northern Jiangsu Province of China. Every year, rice and maize are grown in saline-alkali land with less than 1 mu per person, and the income is very low. Young adults mostly rely on migrant workers to increase their income. The whole town has once developed pig farming here, but it failed in the financial crisis in Southeast Asia in 1998. Later, the whole town developed waste plastic recycling industry, but it was destroyed by the global financial crisis in 2008 and increasingly stringent environmental protection policies. Beginning in 2006, the "three swordsmen" headed by sun Han began to make simple furniture business. By the end of 2014, more than 2,000 people were directly engaged in online merchants in Dongfeng Village, Shaji Town alone, opening more than 1,000 online stores, and achieving a transaction scale of more than 2.4 billion yuan. The key features of Shaji pattern include: 1, they choose categories that are totally unrelated to local traditional industries; 2, the category of simple furniture they choose has the characteristics of low technology threshold, low capital demand and low difficulty in industrial resource integration; 3, towards the mode of industrial division of labor: plate suppliers, processing plants, online stores, logistics express delivery, packaging and so on.

RELATED WORK

In (Xin, 2015), the author analysed the characteristics of the five counties which he has participated in and served, including Chengxian County of Gansu Province, Tongyu County of Jilin Province, Mengyin County of Shandong Province, Dawa County of Liaoning Province and Yanji City of Jilin Province. The author believed that the most important thing of e-commerce mode is to provide better entrepreneurship environment for agricultural operators and farmers, sell high-quality agricultural products of origin and with a good price, enrich the people and develop the economy. This paper has well grasped the core power and demand of county e-commerce, but the research has limitations on the research scope, and the case analysis is comparatively rough.

In (Ren, 2015), eight e-commerce patterns in Chinese counties were enumerated, including Suichang pattern, Tongyu pattern, Tongtong world agricultural and commercial industry alliance pattern, Shaji pattern, Qinghe pattern, Wugong pattern, Chengxian pattern and street-rushing pattern. The authors compared these patterns from four aspects: the electricity supplier pattern, the key characteristics, the imitation point and the applicable area. The analysis of this paper is still not detailed enough. Therefore, it is difficult for different regions to make reference and innovative application according to their own specific characteristics.

In (Luo *et al.*, 2016), the author considered that county e-commerce is a complex system engineering, involving diverse aspects such as county brand building, large-scale standard production, e-commerce network channel building, logistics storage infrastructure and increasing income for farmers. It is believed that only by building a sustainable County e-commerce eco-economy can the transformation and upgrading of the county economy be really promoted. This paper proposes three models of e-commerce development in counties, namely "one county one product eco-economic model", "eco-economic model of distribution center" and "eco-economic model of industrial chain". "One County, One Product, Eco-economic Model" such as the Chengxian pattern, is a multi-dimensional and systematic way to create local regional brands online and offline by taking a specific category of county characteristic products or brands as the starting point and county enterprises, governments, social organizations and regional leaders as propaganda carriers. E-commerce has been promoted to the whole country and even the whole world, so as to promote the development of local economy. "Eco-economic model of distribution center" is to develop logistics industry by taking advantage of location and convenient transportation. Through the high cost-effectiveness of logistics delivery, a large number of powerful enterprises will be attracted to gather here to develop e-commerce industry, thus forming "distribution center model" and promoting the rapid development of local e-commerce and regional economy. Tonglu pattern is such an example. "Industrial Eco-economic Model" is based on a category of products as a starting point. All the counties (districts) concerned with the products participate in the formulation of product classification standards, the establishment of traceability system (agricultural products) and service standards (services), and the production is carried out according to a unified standard. Product processing, unified brand publicity, through the product pre-production, production, post-production industrial chain (production/planting, processing, quality inspection, traceability, warehousing, logistics, sales, after-sales, etc.). The key point of the model is to embrace development, establish brand, open up the industrial chain, and promote the development of supporting industries. Examples include Qinghe pattern and Yangling pattern. In this paper, several modes have been abstracted, which have some similarities with present paper, but the scope of the patterns is limited. In addition, the detailed comparison of different patterns is insufficient.

THE FOUR STRENGTHS AND THE SASS FRAMEWORK

By searching with keywords of 'e-commerce', 'counties', and 'patterns' from scientific papers as well as news and reports in Internet, we have collected ten well-known cases of 'e-commerce pattern in Counties'. They are: Yiwu pattern, Haining pattern, Qinghe pattern, Chengxian pattern, Suichang pattern, Tongyu pattern, Tonglu pattern, Wugong pattern, Beishan pattern, and Shaji pattern. In each case, e-commerce has been developed successfully in some ways in one Chinese county. To identify primary strengths of these counties, we took an iterative approach. *First*, we read descriptions of the cases, and found out key words

associated with strengths, merits or advantages. *Second*, we summarized, classified and refined these words. *Third*, we checked whether these refined words applied to other cases. If not, we modify and check again. After several rounds, we finished with four strengths which we thought exist in all cases. During the process, we noticed that in addition to strengths, a similar route of e-commerce development also exists in the cases. In such a route, four important elements are included: Strength, Aim, Subjects, and Solutions. The general route to develop e-commerce in these cases is: some *subjects* set out an *aim* to develop e-commerce according to the primary *strength* of the county, then they put in place proper *solutions* to achieve the aim. Thus we proposed the SASS framework to characterize key elements of the general route to develop e-commerce in a county. Similar to the four strengths, an iterative approach has been taken to refine and hammer the SASS framework elements.

Four strengths have been identified in e-commerce patterns in Chinese counties:

- **Industry Strength (IS):** means that in one county, some traditional industries have been well developed and tested by the (offline) market;
- **Resource Strength (RS):** means some properties or environment resources are rich and of high quality in a county, although corresponding industry may not be developed;
- **Position Strength (PS):** means convenient traffic which means cheap logistics and rich human resources (which are essential for e-commerce development) exists in a county; and
- **Marketing Strength (MS)** means that in a county, an innovative, specific, or emerging marketing positioning has been used.

And the SASS framework is proposed to recognize four key elements of a general e-commerce development route:

- **Strength:** Primary advantages of one county, based on which, e-commerce can be developed;
- **Aim:** The key goal of developing e-commerce;
- **Subjects:** Persons or organizations who drive the e-commerce development, managers of local governments and solution providers for instances;
- **Solutions:** Tasks that should be performed in order to achieve the aim.

REVIEW RESULT

Strength in the Cases

We tried to identify which strengths have been used in each case. The results were listed in Table 1. From the table, we can see that Yiwu, HaiNing, Qinghe have used Industry Strength when developing e-commerce. For Yiwu, before the e-commerce was developed in 2015, the county has been well-known as “the world’s largest small commodity wholesale market” in a global scope. Based on the powerful traditional industry, Yiwu has achieved huge online success comparatively smoothly. In 2016, Yiwu was regarded as No.1 in “Top 100 counties for e-commerce development” which was published by Ali Research (Ali, 2017). Similarly, Haining has been famous for fur industry traditionally. After applying e-commerce, Haining achieved success as well. While in Qinghe, it has been the biggest collecting and distributing center for cashmere sales before e-commerce was applied. For e-commerce development in Qinghe, it started when a local farmer tried selling cashmere online and achieved success. This has led many local farmers follow and achieve success in the whole village and the whole county afterwards. During the process, the government has played an important role by providing training and business opportunities.

Table 1: Strengths for “E-Commerce Patterns in Counties”.

	IS	RS	PS	MS
Typical Patterns	Yiwu(Small commodity), HaiNing(Fur), Qinghe(Cashmere)	Chengxian(Walnut), Suichang(Agricultural products), Tongyu(Agricultural products), Tonglu(Multiple goods)	Wugong(Multiple goods), HaiNing(Fresh Flowers), Tonglu(Multiple goods)	Beishan (Outdoors equipments), Shaji (Furniture)

Chengxian, Suichang, and Tongyu fall into the RS category. This is because although no mature industry or brand is available, rich local resource has been explored and used when developing e-commerce. For Chengxian, it has been very poor and the traffic there is quite inconvenient. Later, one head of the local government advocated local walnuts through his personal social media. This marketing method was quite fashionable at that time. And it brought the outbreak of e-commerce markets then. Later the good sales of walnuts led to the sale of other items. In Suichang, there are rich agricultural produce. But no unified production, packaging, and marketing was available. From 2010, a team was built up and agricultural products were sold with unified brands. “The strategy was to promote Sui Chang as the first unique agricultural product center online. This helped us establish our identity and support further development (Yenni, Pan, and Cui, 2017).” After that, e-commerce was developed gradually. Similarly in Tongyu, thanks for the local fertile soil, many kinds of agricultural products of good quality are available. Tongyu has been well known as “Hometown of sunflowers”, “Hometown of Mung Bean”, and etc.. But there is no competitive brand in Tongyu due to

low level of commercialization. In 2013, a team was built up to build unified brands and package best-selling products. Then e-commerce was developed continuously. Another case in RS is Tonglu. Different with the other three cases in this category, Tonglu is well known not only for agricultural products, but also for wonderful natural environments. Tonglu has been called as “The Most Beautiful County in China”. E-commerce in Tonglu has been applied deeply and successfully in many industries including tourism.

Wugong might be the most typical example in PS category. Wugong is located in a broad and open area with extremely convenient traffic conditions. It has been a very important traffic center and collecting & distributing center in central China. As for the e-commerce in Wugong, the main business model is selling materials from southwest China to other places in China. As said in (Cui, Pan, Newell, & Cui, 2017), “*Given the importance of e-commerce in social innovations in rural villages with limited resources, orchestrating resources has a critical role.*” In Wugong, resources in not only Wugong, but also other counties in southwest China, have been utilized. Haining is also listed in this category. This is because apart from the dominating industry (Fur), the e-commerce has also been developed for a new industry (fresh flower industry) in HaiNing. For this new industry, PS is primarily used. Another example in this category is Tonglu. In Tonglu, there is no industry that is highly developed. And there is no specific property resource that is very rich and of good quality. However, there are many light industries that are medium-developed. Tonglu is also well-known as “The Hometown of Private Express Delivery”. With cheap logistics services and abundant human resources due to the Position Strength, the overall e-commerce has been developed in a satisfying way.

There are two cases in MS category: Beishan and Shaji. These two counties are somewhat similar: they are poor and remote, and there is no advanced industry or rich resource that can be developed or explored there. Under these circumstances, local people has had to find a brand new market, and develop the industry gradually based on limited conditions. In Beishan, one grassroot peasant tried to sell outdoors clothe and achieved some success. Then many local people followed quickly. The industry was developed and became competitive accordingly. While in Shaji, one local people chose to focus on another specific market: assembled furniture. When many local people followed up with the successful commercial models, a new industry gradually grew up. In these two cases, “*rural regeneration that leverages e-commerce requires the emergence of grassroots leaders in order to showcase the viability of rural e-commerce in the early stages* (Leong, Pan, Newell, and Cui, 2016).”

SASS Elements for Different Strength

Based on the SASS framework, the route to develop e-commerce in counties can be recognized in a clear way as shown in Table 2. For *counties with IS*, the aim of applying e-commerce is often to expand the market from offline to online. A typical case is Yiwu. While in *counties with RS*, some barriers exist such as lack of information broadcasting, so the local industry was not developed. However, because of the rich material or environmental resources, big potential exists for corresponding industries to be developed successfully. Thus in such areas, the aim of applying e-commerce is often to make an online “Hot Cake” first, and open the market for other goods afterwards. Because of the need for professional knowledge and skills, e-commerce operators usually undertook the tasks. Chengxian pattern is such a case. For *counties with PS*, two general e-commerce barriers (expensive logistics and lack of human resources) have been alleviated to a large extent. Therefore, it is much smoother to develop e-commerce in such areas than other remote areas. Generally, the aim is to encourage various businesses to develop e-commerce freely by establishing proper atmosphere and providing supporting services. A typical case is Tonglu. While in *counties with MS*, there is almost no advantages at the first glance. Some peasant or private enterprise need to find a differentiated market and achieve online success first. When more local people follow up, gather, divide the labor and cooperate, a new industry might be developed gradually. Shaji pattern (Dong *et al.*, 2016) is a typical case.

DISCUSSION

We have analysed e-commerce patterns in counties and identified four strengths in the previous section. For other counties with limited resources that are underdeveloped, the four strengths and the SASS framework could also be used for a reference model to develop e-commerce projects. First, the primary strength should be identified, such as an existed industry that is developed offline, some specific resources, good ecological environment, or convenient traffic conditions. Or, if no such strength exists, some innovative markets might need to be identified, taking into account other conditions in the county. Second, a clear aim should be set based on the specific strength. And third, a series of solutions need to be designed and performed in order to fulfil the aim. Last, during all the process, actions should be done by proper subjects.

During the process of our analysis, we realized that a pattern was named after the county name. However, the pattern is actually relative to one specific industry instead of all industries in the county. This specific industry was usually dominating in the county at that time. Therefore, one strength is relative to one specific industry as well. Take Haining for instance, when e-commerce was applied to the fur industry, IS has been primarily considered. But when e-commerce was applied to the fresh flower industry, PS was primarily considered. When several industries are similarly developed in one county, we need to identify one primary strength for each industry.

Table 2: A Sample of SASS Elements for Different Strengths

Strength	Aim	Subject	Solution	Typical Pattern
IS	Expanding online market based on offline industry	Companies	Expanding online channels	Yiwu
RS	Achieving online success firstly	E-commerce Operators	Making “hotcakes”	Chengxian
PS	Open development	Government	Creating atmosphere and providing services	Tonglu
MS	Achieving online success firstly	Private Enterprises	Differentiated market	Shaji

For these typical cases, one primary strength have been identified for one county/industry. However, we should be aware that for many other counties, we might not be able to find one dominating strength. Instead, two or more strengths might be almost strong. In that case, it might be helpful to consider the combination of several strengths to give the most value. What is more, it is important not only to consider which strengths exist, but also to consider how big each strength is.

CONCLUSION AND LIMITATIONS

In this article, we have analyzed successful cases of e-commerce in Chinese counties. Four industry strengths have been identified. In addition, we proposed the SASS framework to characterize important elements to develop e-commerce in a county. We have reviewed ten well-known e-commerce patterns to evaluate our proposal, and the results showed that these strengths can be easily found in the patterns. Based on the strength, the corresponding aim, subjects, and solutions can be identified in the cases as well. The SASS framework helped us analyze and understand such cases in a more efficient way. There are some limitations of this research. First, we have only evaluated the four strengths and the SASS framework with ten typical e-commerce cases. The generaliability of the framework to other cases needs to be explored. Second, we performed the evaluation only in our team. Therefore, some future work has been planned. We will analyze more general and complicated cases of e-commerce development in other counties. In addition, we will invite experts or practitioners for user evaluation. We will evaluate whether the SASS framework could cover all the key elements when performing top-level design of e-commerce for one county. We will also evaluate whether enumerated strengths and SASS elements are exhausted and organized in a well-structured way.

ACKNOWLEDGEMENT

This research is supported by Science Foundation of Ministry of Education of China (No.18YJC630082).

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Structural Pattern Recognition of Fraudster Groups in P2P Transaction Websites

(Full Paper)

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ABSTRACT

The advent of online platform economy has increased online fraudsters. To detect them, most research explored to recognize characteristics from behavioral data of online users. In those works, each user was regarded as an individual subject, while relationship between users was underestimated. This paper introduced methodology of social network analysis to mine characteristics of relationship among online fraudsters. Using dataset from a Bitcoin trading website, a weighted signed network is constructed. By removing normal user nodes from the network, relationships between fraudsters are clarified. Then, major structural patterns of the snipped network are uncovered by way of community partitioning method. Based on real data from the Bitcoin trading website, 3 typical structures of fraudster groups are found: star-shaped structure, double-core structure and reticular structure.

Keywords: Platform economy, fraudster detection, structural pattern, weighted signed network

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INTRODUCTION

An Online Platform Economy (OPE) refers to a kind of virtual marketplace that facilitates transactions between buyers and sellers (Farrell & Greig, 2016). It is an emerging form of e-commerce, as business model of eBay, Airbnb and Uber is increasingly popular. The remarkable success of OPE is derived from its peer-to-peer (P2P) transaction model. Compared to the traditional transaction model, the P2P platform facilitates a marketplace allowing individual buyers and sellers to interact with each other directly. In this way, both buyers and sellers would benefit from the decreasing of transaction cost.

However, P2P transactions have increased online fraudsters because the transactions are without participation or intermediation from the platform. Fraudsters may take advantage of the P2P mechanism and extract money from the innocent users. So, users need to take the responsibility themselves to avoid being cheated. To help users to be aware of counterparty risk, the platform usually introduced a credit rating mechanism. For example, eBay presents the total number of positive and negative feedback ratings for transactions for users that ended in the last 12 months. Similar credit rating system in Bitcoin trading platform Bitcoin-OTC is named 'web of trust'. By this way, users can access others' trade history and credit record. Nevertheless, this mechanism cannot overcome the problem of singularity standard as it only pays attention to the total number of ratings and ignored the users' internal relationships, which makes it difficult to recognize fraudster groups. The description above can be verified from disclaimers of Bitcoin-OTC: "...a scammer creates a bunch of bogus accounts who all inter-rate each other."

At present, the credit rating system treats user as an individual person, ignoring inter-relationship between users. So, characteristics of group fraudsters are underestimated for detecting fraudsters. This paper use methodology of social network analysis to represent the relationship between users as a weighted signed network, and analyze internal structures among fraudsters.

The rest of this paper is organized as follows: A brief introduction of related works will be given in section 2. Section 3 is devoted to the basic aspects of the Bitcoin exchange website Bitcoin-OTC and the dataset used in this research. Section 4 first demonstrates the five-step approach that is used in this paper to detect fraudster groups: constructing the weighted signed network from dataset, classifying nodes of the network, filtering nodes, detecting communities and pruning the network. In section 5 of this paper, the structural analysis is performed based on the results above. Finally, the conclusion of the whole paper is discussed in the last section.

RELATED WORKS

Credit Model

With the emerging of online platform economy, the problem of trading risks becomes an important issue. There has been a rising interest in design of credit rating mechanism. These researches mainly focused on building the quantitative model. Marsh (1994) first tried to introduce trust relationship into the Internet environment, who proposed a model based on social properties of trust. The model focuses on the personal experiences and tried to integrate many aspects related to trust. However, the model is too impractical and inaccessible. Later, Abdul-Rahman and Hailes (2000) simplified some obscure concepts proposed by Marsh. Based on Marsh's work, they divided trust into "direct" and "indirect" trusts. The direct trust refers to an agent feeling towards another agent. According to the extent of trust, the direct trust can be classified into 4 levels. As for the indirect trust, Abdul-Rahman and Hailes (2000) believe indirect trust generated from word-of-mouth. After that, Josang and Ismail (2002) proposed Beta model based on Bayesian theory where credit scores are statistically updating beta probability density functions. The Beta method uses probability density function to calculate credit ratings and increase the weights of recent transactions, which accords with characteristics of human memory. Beside researches in literature, the pioneer eBay also practiced a well-known credit rating system. In eBay, buyers and sellers can rate each other after transactions. And the overall credit of a user is computed as the sum of these ratings over the last six months auction site. Buyers and sellers on eBay can open access users' credit. What's more, many other models are proposed from scholars (Beth, Borchering, & Klein, 1994; Zacharia, Moukas, & Maes, 2000; Xiong & Liu, 2004). Although many studies of credit model have been reported and it is effective of using model to detect fraudsters, limited by the research method, little is known about the internal structures of fraudster groups.

Social Network Analysis

The technique we applied is referred to as Social Network Analysis (SNA), which is a method of quantitative research on social relationships based on mathematical tools such as graph theory and matrix (Wasserman & Faust, 1994). Assuming that relationships are important, social network analysis takes actors and their mutual relationships as the research content. It maps formal and informal relations between the actors and analyzes the relationship contained in the network through several indicators. In a social network, the nodes represent individuals, and an edge or arc between nodes indicates a direct relationship between the individuals.

During past decades, there has been an increasing interest in applying SNA to information science (Otte & Rousseau, 2002), innovation system (Cantner & Graf, 2006), biological questions (Croft, James, & Krause, 2008) and other fields. One of the most popular concepts in SNA is the small world whose most famous manifestation is the "six degrees of separation" concept proposed by Travers and Milgram (1967). After that, Boccaletti *et al.* (2006) proposed that our brain networks are small-world networks whether at macro or micro scales. In the case of social media, a research such as that conducted by Li and Du (2014) have proposed a framework to investigate the persuasiveness of opinion leaders in twitter bases on SNA where results show the framework can identify opinion leaders and their opinions effectively. As for the animal ecology field, Farine and Whitehead (2015) conduct an interesting research where SNA is applied to analyze animal social systems and test hypotheses and prove the SNA model could be used to explore how the rules influence group joining and leaving drive social structure.

Despite the numerous contributions of applied SNA, efforts in the direction of applying SNA to online user credit evaluation are very limited. Consequently, this paper is based on SNA to detect communities and explore the internal structures of fraudster groups. Some basic indicators often used in SNA are listed below.

(1) Degree: The degree k_i of a node i is the number of edges incident with the node, and is defined in terms of the adjacency matrix A as:

$$k_i = \sum_{j \in N} a_{ij} \quad (1)$$

If the graph is directed, the degree of the node has two components: the number of outgoing links (or arcs) $k_i^{out} = \sum_j a_{ij}$ (referred to as the out-degree of the node), and the number of ingoing (or arcs) $k_i^{in} = \sum_j a_{ji}$ (referred to as the in-degree of the node). The total degree is then defined as $k_i = k_i^{out} + k_i^{in}$ (Boccaletti *et al.*, 2006).

(2) The diameter characterizes the ability of two nodes to communicate with each other: the smaller the diameter is, the shorter is the expected path between them. Networks with a very large number of nodes can have a rather small diameter.

(3) A measure of the typical separation between two nodes in the graph is given by the average shortest path length, also known as characteristic path length, defined as the mean of geodesic lengths over all couples of nodes (Boccaletti *et al.*, 2006).

$$L = \frac{N}{N(N-1)} \sum_{i,j \in N, i \neq j} d_{ij} \quad (2)$$

(4) Network density refers to the proportion of direct ties in a network relative to the total number possible (Intanagonwiwat *et al.*, 2002). It equals to the ratio between the actual number of edges or arcs in the network and the upper limit of the number of edges

or arcs that can be accommodated. Network density describes the overall level of interaction of network nodes. The density of an undirected network with N nodes and L actual edges is

$$d(G) = \frac{2L}{N(N-1)} \quad (3)$$

(5) Network centralization refers to an index demonstrating the overall centrality of the network graph based on the degree centrality of a node; it measures the connectivity of the whole network and dependence on few actors. Centralization reflects the extent to which interactions are concentrated in a small number of individuals rather than distributed equally among all members. The numerator of network centralization is

$$C = \frac{\sum_{i=1}^n [C_{max} - C_i]}{\max[\sum_{i=1}^n (C_{max} - C_i)]} \quad (4)$$

C_{max} is the maximum point of degree centrality in the graph. C_i is the degree centrality of node i (Freeman, 1978).

THE BITCOIN EXCHANGE WEBSITE AND DATASET

Introduction Of Bitcoin Trading Website

The P2P transaction website researched in this paper is Bitcoin-otc (<https://www.Bitcoin-otc.com>). The dataset used was published by a network analysis project from Stanford University. Like other P2P transaction websites, Bitcoin-otc does not have prescribed membership and strict transaction rules, where users trade through negotiation. Also, according to the site policy, the website does not conduct user qualification examination or take any responsibility for transactions. The individual buyers and the sellers shall take all transaction risks. Therefore, users on the website may be either normal users or fraudsters.

A credit rating mechanism is also set up to reduce transaction risks. Users can rate the trading objects after transactions and ratings can vary from -10 to +10 (integral and cannot be 0). As shown in table 1, the website gives guidelines for users to rate different people.

Table 1: Rating Guidelines from Bitcoin-otc

Rating	Guideline
10	You trust this person as you trust yourself. Reserve this for close friends and associates you know in person.
8	Large number of high-value transactions, long period of association, very trustworthy.
5	You've had a number of good transactions with this person.
1	One or two good transactions with this person
-1	Person strikes you as a bit flaky. Unreasonable/unexpected delays in payment, etc.
-10	Person failed to hold up his end of the bargain, took payment and ran, fraudster.

To summary, the credit rating mechanism is mainly based on the following rules:

- (1) The higher ratings are given to the users, the better are their credit, and transaction risk is lower.
- (2) If negative ratings are given to the users, their credit is worse, transactions might be risky.
- (3) If positive and negative ratings are given, their credit is uncertain, and transactions may also be risky.

Therefore, if a user receives high ratings, it can be “initially” considered that the user is trust worthier than other users and the transaction credibility is high.

Risks And Vulnerabilities Of Current Mechanism

It is acknowledged that Bitcoin is a digital currency with no central authority. Bitcoin exchanges do not explicitly distinguish the payer or the payee. Therefore, the exchanges are in a cryptographic way and private keys are needed to authorize a fund transfer in transactions. Because of this form of Bitcoin transaction, there is a lag time between payment and delivering. The lag time causes remarkable risks vulnerabilities, as fraudsters can take the money or the private keys and disappear forever.

The credit rating mechanism is set up to reduce this transaction risks. However, since not all users are honest, there are still risks and vulnerabilities in Bitcoin-otc's credit rating mechanism. For example, several shills can give high ratings to a fraudster account first, thus improving the total rating of the fraudster account. Then, the fraudster account can defraud innocent users of their money. As shown in figure 1, the fraudster account received several positive ratings from 8 shill accounts (whose total ratings are negative) until 13:31 in September 10, 2012. However, several ratings of minus 10 were given to this user after 2 hours. The credit rating mechanism failed in the above-mentioned situation. We tend to consider the shills and fraudsters in the above situations are in close cooperation. In other words, they are in a fraudster group.

id	rater nick	rater total rating	rated nick	created at (UTC)	rating	notes
140889	moonlight123	-14	moonlight123	2012-09-10 12:32:19	6	Good Seller
140893	blackback	-11	blackback	2012-09-10 12:33:15	8	Sold me Btc for paypal
140897	gamma123	-17	gamma123	2012-09-10 12:40:10	1	good seller
140898	cutthroat	-3	cutthroat	2012-09-10 12:48:05	2	loaned me 4.5 bitcoins at 6% int. ty
140899	luciferus	-7	luciferus	2012-09-10 12:51:30	1	bought btc for dwolla
140907	clara123	-19	clara123	2012-09-10 13:27:43	1	bought btc for mp
140909	weebee	-29	weebee	2012-09-10 13:29:40	1	loaned me 2 btc at 8% interest
140913	prakash	-20	prakash	2012-09-10 13:31:57	2	bought btc pp
140917	CloudBox	252	CloudBox	2012-09-10 15:27:36	-10	WARNING: Obvious shill account. Known Scammer AKA: dragonx cecil Bitman dknys dkny tooool ezeikiell ninjaD ninjaA
140918	clashD	109	clashD	2012-09-10 15:28:16	-10	Obvious shill account. Known Scammer AKA: dragonx cecil Bitman dknys dkny tooool ezeikiell ninjaD ninjaA
140923	netDuster	353	netDuster	2012-09-10 16:45:17	-10	WARNING: Obvious shill account. Known Scammer AKA: dragonx cecil Bitman dknys dkny tooool ezeikiell ninjaD ninjaA
140926	shackles	191	shackles	2012-09-10 22:06:09	-10	

Figure 1: A Typical Fraud Group and Victims

COMMUNITY DETECTION

Framework Of Community Detection

Figure 2 illustrates the process of detecting fraudster groups. Step 1 is the preparation stage where a weighted signed network is constructed based on the data collection extracted from Bitcoin-otc. This step allows us to analyze the data by taking advantage of Social Network Analysis in the following steps. After that, we conduct classification according to whether the nodes are rated negatively by other users. In Step 3, the nodes that were not classified as fraudsters were filtered. In this way, the network was snipped to a fraudster network, where nodes were all related with fraudsters. Once the normal user nodes are filtrated from the network, a community detection algorithm was applied to partition the fraudster groups. To discover the core fraudsters in each fraudster group, the snipped fraudster network is handled and optimized through pruning redundant nodes in the last step.

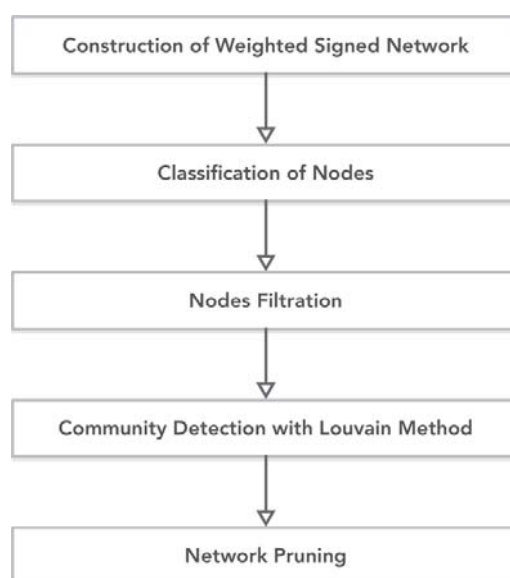


Figure 2: Five-step Approach to Detect Fraudster Groups

Construction Of A Weighted Signed Network

Many complex relationships in the real world can be modeled as social network and community detection algorithm can be used to find the fraudster groups. Firstly, we construct a weighted signed network from the rating dataset. In the network, each node represents a user on Bitcoin-otc platform, and each arc describes a user's rating action toward another user. The weights of arcs are positive or negative ratings received by the ratees. The data collection of Bitcoin-otc gives 35,592 comments, involving 5,881 users. Each data includes four aspects: Source, Target, Rating and Time. To avoid making the analysis more complicated, this paper ignores the evaluation time and only constructs the weighted signed network based on Source, Target, and Rating. Figure 3 shows the final weighted signed we constructed in Kamdam-Kawai layout. It can be observed that there is a lumping tendency within the network.

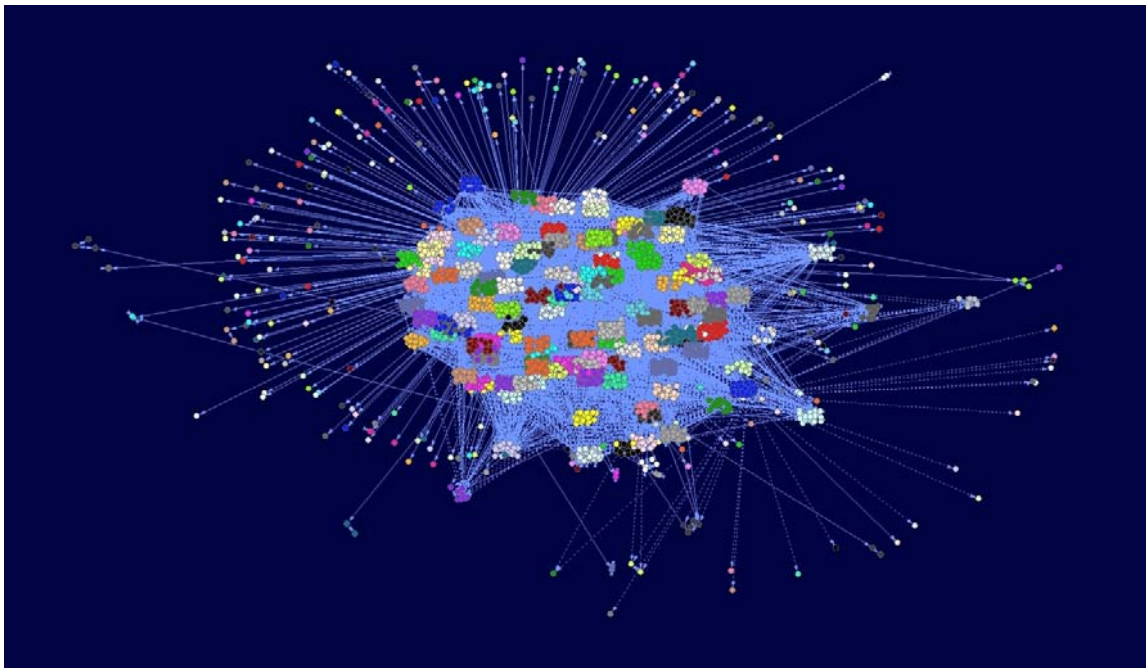


Figure 3: The Initial Weighted Signed Network

Table 2 gives the basic statistical data of the initial weighted signed network whose total number of nodes is 5881 and total number of arcs is 35592. The average degree of this large network is 12.1040, which reflects a relatively high exchanging frequency in the whole network. What's more, an equal relationship between average in-degree and average out-degree can be seen in table 1. At last, close relations between nodes are found in conjunction with the network diameter of 11 and the average path length of 3.7189.

Table 2: Basic Information of the Initial Weighted Signed Network

Indicators	Value
Total number of nodes	5,881
Total number of arcs	35,592
Average degree	12.1040
Average in-degree	6.0520
Average out-degree	6.0520
Network diameter	11
Average path length	3.7189

Classification Of Nodes

According to the website's description, when a user is negatively rated by other users, it indicates that the user is "abnormal" in the transaction. If users choose to trade with such users, the transaction might be risky. Instead, when a user receives positive ratings from other users, it indicates that the user performed "well" in the transaction. If a user chooses to trade with such a user, the transaction risk might be low. Therefore, we divided nodes into 2 classes according to whether the users are negatively rated by other users.

After classification, the number of nodes that have been rated negatively by other users is 1,254 (class-A nodes for short), while the number of nodes that have not been rated negatively by other users is 4,604 (class-B nodes for short). Also, users have not rated 23 nodes, that is, these nodes have ever rated other users, but have never been rated by other users (class-C nodes for short).

Nodes Filtration

Based on the analysis result in 3.2, we know that most "fraudster" users are in close cooperation. They form their fraudster groups and cheat the unwitting users together. Thus the fraudsters fall into 2 categories: core fraudsters and shills. Core fraudsters are main actors to cheat unwitting users while shills are those who are disguising themselves as normal users and assisting the core fraudsters. In fact, core fraudsters are the core nodes of the fraudster groups and other users have rated them negatively. Shills are the marginal nodes of the fraudster groups who are not rated negatively by other users, but give the "core fraudster" users positive ratings. Moreover, in order to extract money from innocent users, the members of the fraudster groups will rate positively to each other within the groups to improve their total ratings.

To filtrate all fraudster nodes, we first need to extract a sub-network composed of both core fraudsters and shills. According to the definition in the last paragraph, that means the end points of arcs in the new sub-network must be class-A nodes. Therefore, the sub-network is an extended A network containing all class-A nodes and some class-B nodes, so we named it “A+ network.”

As the next step, according to the fact that the members of the fraudster groups will rate positively to each other within the groups to improve their total ratings, there is no denying that the weights inside the “A+ network” must be positive. Consequently, we deleted the 607 arcs with negative weights and 370 isolated nodes generated, and finally get a new network containing 15969 arcs and 3492 nodes.

Community Detection In The Network

Louvain Method is an algorithm based on modularity optimization, which is a simple but effective method to extract communities from initial network (Blondel *et al.*, 2008). In this part, Louvain Method is utilized to detect fraudster groups in the A+ network where resolution parameter is set to 50 and the number of random restarts is set to 1. After creating partitions by using Pajek (a free program for large network analysis), 574 communities were extracted. To improve the showing effect, the arcs between different communities are removed (figure 3). Figure 4 demonstrates a complete structure (including both core fraudster nodes and shill nodes) of each fraudster group.

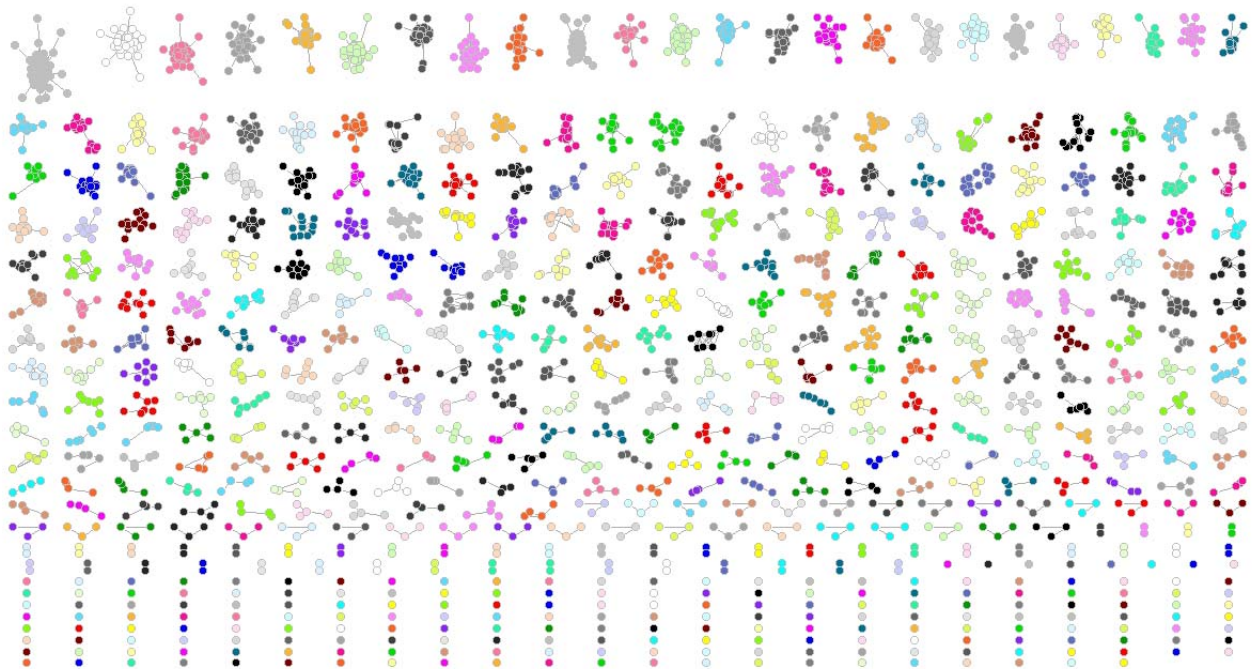


Figure 4: Separate fraudster groups in A+ network

Network Pruning

Next, according to the hypothesis in 4.2 that the fraudsters can be divided into 2 categories, the shill nodes refer to those who do not belong to class-A but give positive ratings to class-A nodes need to be pruned from the “A+ network”. Therefore, to explore the core structure of fraudster network, the new sub-network should only contain the class-A nodes as we consider the class-A nodes as core fraudster nodes. Having known that class-A users are those who have been rated negatively by other nodes, the starting point and ending point of each arc in the new sub-network must be both class-A nodes. Consequently, arcs whose ending points are class-A nodes while the starting points are not class-A nodes are removed in this step.

The Louvain Method (Blondel *et al.*, 2008) is also used to identify communities from the new network. 268 communities were extracted where the resolution parameter is set to 50 and the number of random restarts is set to 1. To improve the showing effect, arcs between different communities are removed. Figure 5 demonstrates the core nodes (core fraudsters) of each fraudster group.

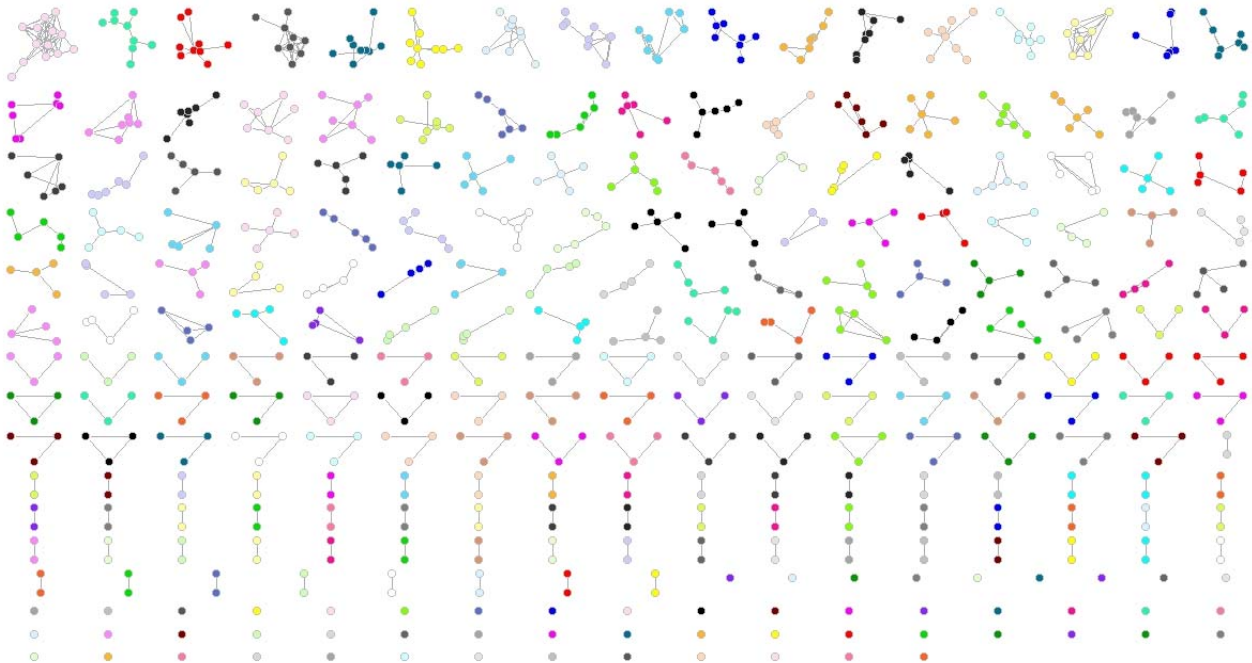


Figure 5: Separate Fraudster Groups in A Network

The basic statistical data of 2 sub-networks (A+ network and A network) are shown in the following table.

Table 3: Basic Information of the 2 Sub-networks

Indicators	A+ network	A network
Total number of clusters	574	268
Total number of nodes	3492	876
Total number of arcs	6920	2013
Average number of nodes	6.08	3.26
Average number of arcs	12.05	4.23
Average degree	1.96	2.58

As shown in table 3, total number of clusters, total number of nodes and total number of arcs all decrease sharply vary from “A+ network” to “A network”. These changes indicate that the core fraudsters are only a small percentage of fraudster groups. As for the change happened in average number of nodes and average number of arcs, it could be known that the core fraudster groups are much smaller in scale. However, the average degree of “A network” is much higher than the “A+ network”, which shows a highly close cooperation relationship and high exchange frequency within the core fraudsters.

An example will be given to explain details further. If we zoom out and focus on the same fraudster group in A and A+ network respectively, a very clear distinction between 2 sub-networks will be found (Figure 6). It can be seen from the figure 5 that all nodes in “A network” actually act as core nodes in “A+ network”. The core nodes are at the center and marginal nodes refer to the skills.

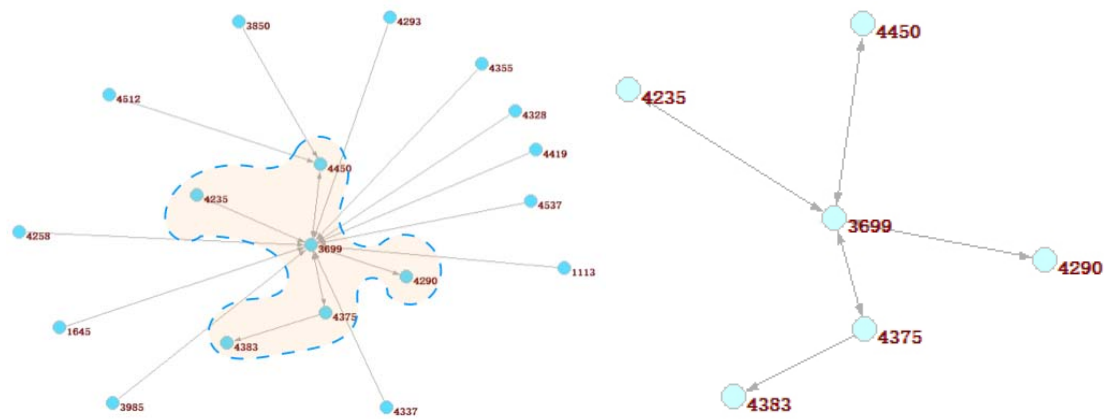


Figure 6: The Same Fraudster Group in A and A+ Network

EXPLORING STRUCTURES

In order to explore the characteristics of the fraudster groups further, we observed their network structure. Our observation shows that there are three typical network structures of fraudster groups: star-shaped, double-core and reticular.

- 1) Star-shaped structure (Figure 7 (a)) refers to the topological structure with one core node at the center of the structure and all other nodes' arcs pointing towards the core node.
- 2) Double-core structure (Figure 7 (b)) refers to the topology structure in which two core nodes are in the center of the structure, and all other nodes have arcs pointing towards two core nodes.
- 3) Reticular structure (Figure 7 (c)) is a kind of topology in which the nodes in the groups are nearly fully connected.

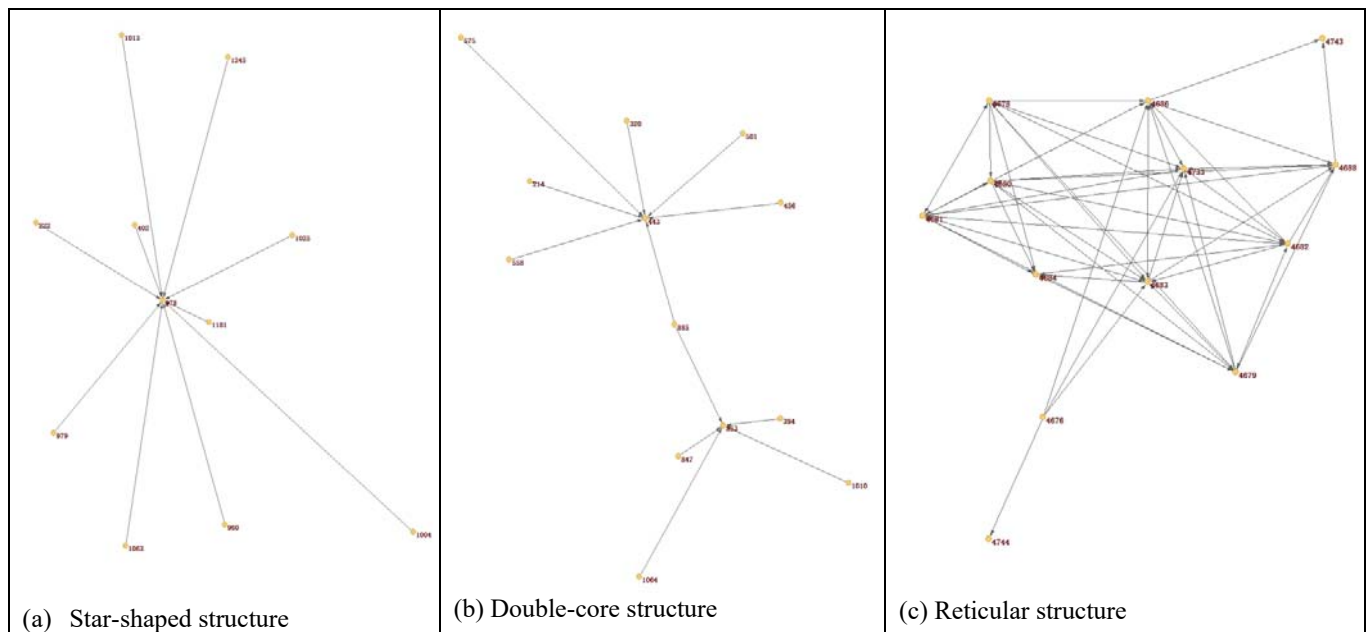


Figure 7: Three Typical Structures of Fraudster Groups

To explore the internal rules of the network structure of fraudster groups further, we try to draw a scatter diagram based on several indexes in SNA.

Table 4: Model Summary and Parameter Estimation

Model Summary						Parameter Estimates		
Equation	R Square	F	df1	df2	Sig.	Constant	b1	b2
Linear	0.436	255.469	1	330	0.000	19.611	-69.276	
Logarithmic	0.757	1028.813	1	330	0.000	-15.004	-11.824	
Inverse	0.953	6618.637	1	330	0.000	-0.063	1.000	
Quadratic	0.682	352.697	2	329	0.000	29.500	-205.206	368.474

Cubic	0.815	480.446	3	328	0.000	42.029	-474.105	1829.215
Compound	0.630	561.253	1	330	0.000	20.485	0.001	
Power	0.829	1604.903	1	330	0.000	0.954	-1.005	
S	0.700	769.349	1	330	0.000	1.372	0.070	
Growth	0.630	561.253	1	330	0.000	3.020	-6.758	
Exponential	0.630	561.253	1	330	0.000	20.485	-6.758	
Logistic	0.630	561.253	1	330	0.000	0.049	860.889	

We find that network density is negatively correlated the number of nodes and carried out analyses using SPSS. We select several fitting methods to deal with the correlation between the number of nodes and network density. Compared with the linear, logarithmic and other fitting method, the inverse matching effect-fitting method is preferable (Table 4) as it has an excellent performance in goodness-of-fit (R^2) and regression test (F) ($R^2 = 0.953$, $F = 6618.637$). Adopting an inverse fitting, equation of the number of nodes and network density is built in (3) where “ y ” represents network density and “ x ” represents the number of nodes.

$$y = -0.063 + 1/x \quad (5)$$

The figure 8 clearly demonstrates the inverse correlation between the number of nodes and network density further. Network density describes the overall level of interaction of network nodes. It is believed that a Star-shaped structure is sparser than a reticular structure. It means there are structure preferences among the fraudster groups: the bigger the scale of fraudster groups, the more likely the fraudsters are to choose star-shaped structure; the smaller the scale of fraudster groups, the more likely the fraudsters are to choose reticular structure.

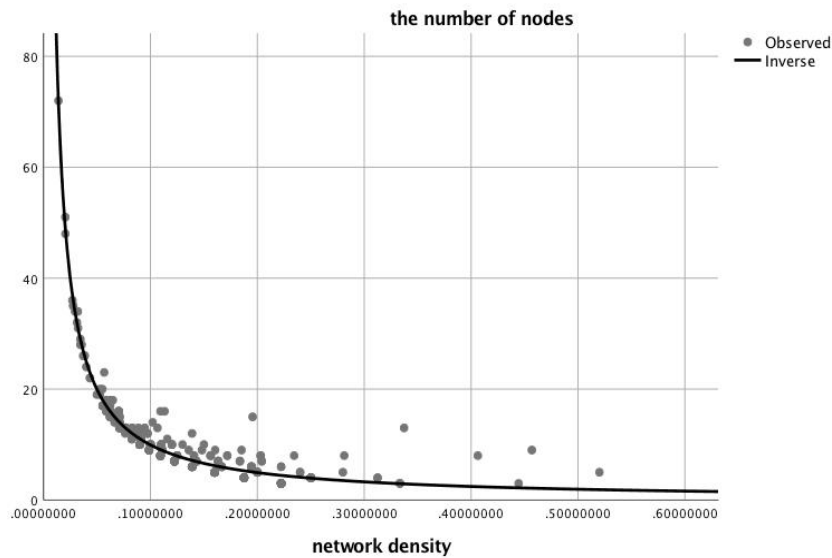


Figure 8: A Scatter Diagram of the Number of Nodes and Network Density

CONCLUSIONS

This paper builds a weighted signed network based on a Bitcoin transaction website. Nodes with different characteristics in the network are classified into 2 classes. According to the results of classification, fraudster groups are detected through community detection algorithm. Next, several typical structures of fraudster groups are found. Then, we find the number of nodes and network density move in opposite directions. At last, a mathematical formula of the number of nodes and network density has been obtained by fitting analysis and structure preferences among the fraudster groups have been found.

ACKNOWLEDGEMENT

This work is partially supported by Education and Teaching Reform Project of the South China University of Technology (Y9161010).

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The Evolution of E-Commerce Service Ecosystem

(Full Paper)

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ABSTRACT

On the basis of defining e-commerce service ecosystem (ECSEM), we elaborated its population constitution and structure, drew on the theory of industrial ecosystem and the development course of e-commerce in China to discuss the evolutionary path and process, and concretely analyze the evolutionary process and characteristics of crucial components included in this ecosystem, such as all kinds of service providers, competitors, industrial rule and standard systems, etc. In the end, a case of Alibaba's ECSEM and its evolution was analyzed to testify our study. This paper aimed to build the basic theory of ECSEM and reveal its evolutionary process and laws, so as to provide reference for the construction and development of ECSEM.

Keywords: E-commerce service, ecosystem, evolution, Alibaba

*Corresponding author.

INTRODUCTION

Since the global financial crisis in 2008, China's e-commerce service industry has been developing as blowout. According to statistics, its market scale increased from 1.3 billion dollars in 2012 to 13.7 billion dollars in 2017, and the CAGR (compound annual average growth rate) reached 61% (China's Industrial Information Network, 2018). E-commerce service has been widely used in all aspects of the economic and social life, deeply integrated with production, circulation, consumption, investment and other fields. It becomes an important growth point and development engine of the national economy, and plays an important role in promoting the development of e-commerce, supporting economic transformation and upgrading, promoting industrial integration, optimizing the allocation of market resources, facilitating entrepreneurship and employment. With the rapid expansion of e-commerce and its service market, the in-depth application of new information technologies such as big data and cloud computing, the gradual improvement of industrial rules and related policy and legal systems, various e-commerce service enterprises and service providers are rapidly approaching different core enterprises to achieve large-scaled ecosystems. The change of competition mode between enterprises becomes more and more obvious. In the future, the competition among enterprises has gradually changed from competition among individuals, competition between supply chains and value chains, competition among business models into the competition among ecosystems based on shared value (Xiao, 2015; Jiang, 2016). Ecological development has become the consensus of leading e-commerce companies.

This paper proceeds as follows: in the next section, research related to e-commerce service ecosystem (ECSEM) is reviewed. This is followed by the definition and structure analysis of the ecosystem, which is the basis and essential factor to analyze its evolution. We then point out the three crucial forces that drive the ecosystem to evolve. Next, we show the evolutionary path and process of this ecosystem, and further analyze the evolutionary process and characteristics of key elements in it in order to further disclose the ecosystem's evolutionary rules. At the end of the paper, a case of Alibaba's ECSEM is clearly described to certify all the viewpoints above.

RELATED WORK

E-commerce Service Industry

AliResearch has studied a lot about e-commerce service industry and its ecological development based on business practice: 1) from the viewpoint of e-commerce ecosystem, studied the types and structure of its related service, analyzed the current development situation and the impact on the economy and society (IDC & Alibaba Research Center, 2012); 2) from the perspective of ecological system, divided the ECSEM into four parts: core layer, expansion layer, correlation layer and social layer (IDC & Alibaba Research Center, 2011); 3) analyzed the four stages of its ecological evolution: gestation, construction, expansion and leadership (Alibaba Research Center, 2011).

Ecological Development Mechanism of Certain Types of E-commerce Service

Wang (2014) studied the connotation and construction process of the Internet enterprise platform ecosystem and financial ecosystem based on the common value theory. The essence of brand ecosphere is the integration platform of brand relations under self-repair mechanism, self-differentiation mechanism and self-adaptation mechanism, and it deals with all kinds of brand relations based on these three mechanism (Xu et al., 2017). Based on the analysis of brand development history of Yunnan Baiyao Group from 1999 to 2015, Xu and his partners thought that the growth process of brand ecosphere is also the evolution of core competence from low to high level and finally gain self-adaptation capability based on the operation mechanism of brand ecosphere. In their view, the purpose of building a brand ecosystem is to form a systematic competitive advantage. With the rapid development and common use of mobile

payment technology, researchers defined and constructed the mobile payment service ecosystem, analyzed its technological innovation, and explored the evolutionary path of different payment modes (Liu, Kauffman & Ma, 2015; Hedman & Henningsson, 2015).

Structure and Evolutionary Path of Specific ECSEM

Zheng (2013) divided ECSEM of Taobao into 4 parts: core layer, tight layer, associated layer and environmental layer according to tightness between business subjects and the members of Alibaba Group. Meanwhile, he divided the ecosystem's development process into four stages: natural growth stage (2003-2004), ecological awareness stage (2005-2007), "big Taobao" strategy stage (2008-2010), "big Ali" strategy stage (after 2010). Based on the development status of e-commerce service industry, Li (2016) divided the developing process of seller service into three stages: germination period, growth period and expansion period. Alibaba Research Center & Business Department (2017) analyzed the development status of Alibaba cloud retailing service ecosystem.

The current research above has studied different aspects of ECSEM in detail, but also shows some limitations: 1) conceptually, it has not yet made a clear analysis of its connotation; 2) As for the research object, only one part of the ECSEM is studied, but global research about it is rare; 3) as for the evolution process, from the viewpoint of e-commerce service industry or e-commerce ecosystem only, partial and brief analyses are carried out on the basis of predicting the future development situation, which lacks comprehensiveness. Therefore, this paper attempts to discuss and analyze the whole ECSEM and its evolution from the perspective of industrial ecology, combined with the idea of species in natural ecosystem and more than ten years of e-commerce service practice.

KNOWING ABOUT ECSEM

The concept of ECSEM is the transplantation and reference of ecosystem in natural ecology. Ecosystem refers to a unified whole with self-coordination ability, which is composed of all living organisms and the surrounding microbial environment in a certain space (Qu, 2012). The members of the system interact and coexist through material circulation and energy flow to maintain dynamic balance. In the e-commerce environment, the service enterprises, application enterprises and their related members interact to form the ECSEM.

The Definition of ECSEM

The concept of ecosystem is first proposed by a British ecologist, A.G. Tansley. He believed that the whole can be regarded as an ecosystem when there exists different species self-growing and interacting with each other to maintain a dynamic balance in structure and function (Tansley, 1935). Industrial ecosystem refers to the unity in which all industries and its existing environment interact and coordinate in a certain region to gain sustainable development capabilities through information sharing, material circulation and energy flow (Zhang, 2012). The relationship between industries lies not only in the recycling of waste and primary products, but also in the sharing of technology and information, the joint participation of commercial subjects and the coordinated development among different industries (Zhang, 2012; Tsvetkova et al., 2015). The core of industrial ecosystem is the three industrial chains of innovation, production and application, which simulate the biological ecosystem by tracking the energy exchange in the system (Li & Liu, 2013; Su, Zheng & Chen, 2018). Its purpose is to maximize the use of resources and energy and minimize waste emissions, in order to actualize a win-win situation between economy and environment (Fan et al., 2017). It's obvious that ECSEM inherits the ideas of natural ecosystem and industrial ecology, and extends according to its own characteristics.

Therefore, this paper holds that the ECSEM is an organic whole which can be understood from the following four keypoints: 1) It's based on e-commerce transaction activities; 2) It involves all kinds of e-commerce service enterprises and application enterprises, consumers, relevant governmental departments and social organizations, and external environment; 3) Its core is value sharing and co-evolution; 4) It's formed throughout resources sharing, advantages complementation and synergistic innovation among all subjects of the system, with the help of e-commerce platform, influenced by the flow of commodities, information and capital.

Population Structure of ECSEM

Population refers to the sum of the same species of organisms in a certain space, and is the basic unit of biological evolution and the main body of the system (Xu, 2016). In the ECSEM, the population can be regarded as the aggregation of individuals or groups with the same service functions in an industrial cluster. Its structure is the basic support of the ecosystem's evolution.

Figure 1 shows some forms of relationship such as member structure, niche, and population in the ECSEM. In terms of member structure, the ecosystem is divided into five layers: core layer, key layer, correlated layer, extended layer and environmental layer; In terms of population structure, the ecological subjects of the system are divided into four types: core population, key population, extended population and associated population, which can be divided into endogenous population and implanted population according to their source. Among them, the core population is generally endogenous population, while the key population, extended population and related population may be endogenous population or implanted population. The different population types correspond to their levels in the ecosystem.

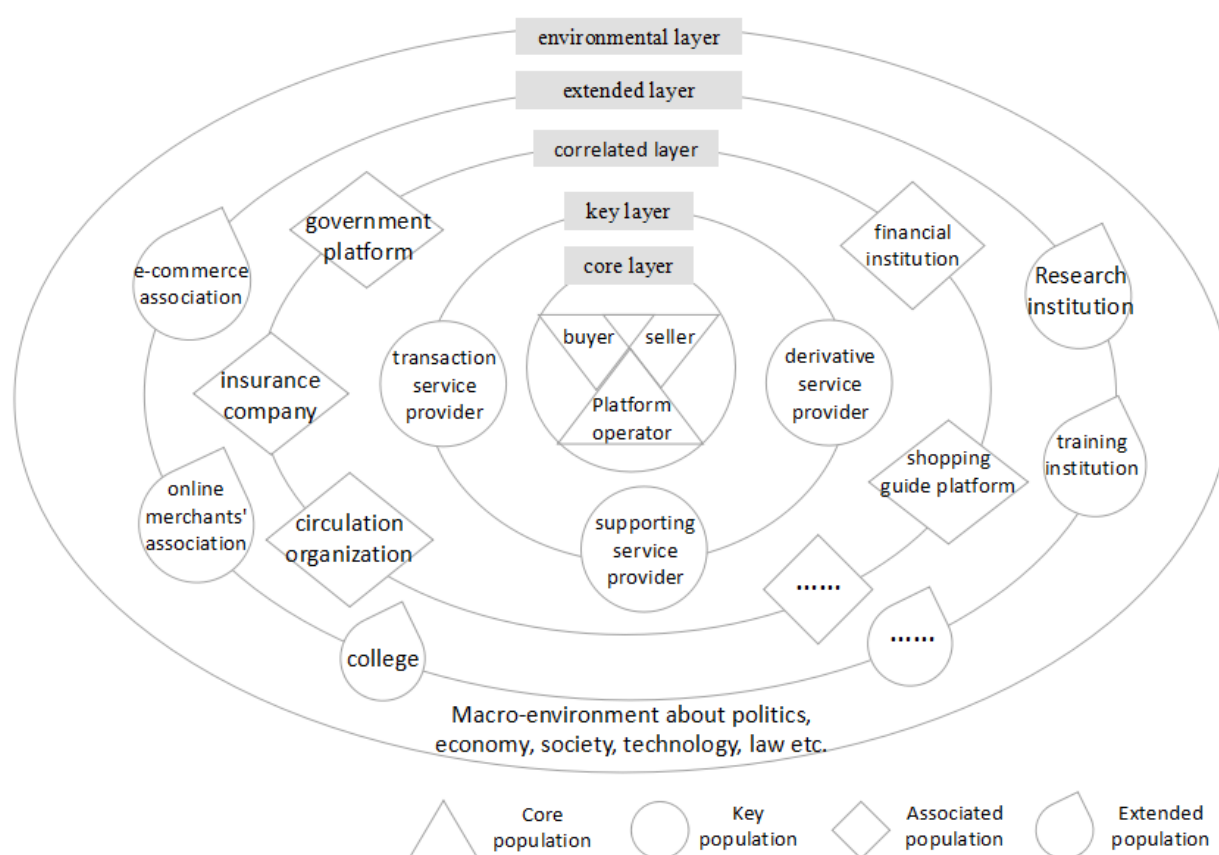


Figure 1: Population Relationship of ECSEM

Core population, including buyers, sellers and e-commerce platform operators, is the core of the entire ECSEM.

Key population, includes all kinds of e-commerce transaction service providers, supporting service providers and derivative service providers such as information service, platform service, payment service, logistic service, IT technology service, generation of operating service, marketing service, customer service, credit service, personnel training service, data service, etc.

Associated population, refers to institutions or organizations who have carried out business cooperation with core populations and key populations and can help improve their service levels and capabilities, for example, financial organizations such as banks, insurance corporations, various media platforms, shopping guide platforms, and various related circulation organizations and government platforms, etc.

Extended population, refers to institutions or organizations that do not directly participate in system's business activities, but can affect the growth, maturity and profitability of the ecosystem's populations indirectly, mainly including various industrial research institutions, scientific research center, industrial associations, online merchants' associations, relevant policy and legal departments responsible to that, industrial regulators that are related to e-commerce service, such as AliResearch, iResearch, China's Network Merchants Alliance, China's Modern Logistic Network Alliance, China's Electronic Commerce Association and so on.

Due to the large scale, wide range and numerous influencing factors of ECSEM, the role of each ecological subject in the system will frequently change with factors such as time, space and scene. What's more, the relationship between subjects is also very complicated. Therefore, the layers to which subjects are attributed and the relationship among populations is elastic and changeable. Different layers and populations are interlaced and dynamic rather than completely separated.

EVOLUTIONARY DYNAMICS OF ECSEM

The evolution of ecosystem is a process in which system's main subjects interacts and functions in multiple angles and patterns in a certain environment, thus achieving coordinated evolution. The evolution of ECSEM refers to the process that, with the deepening of e-commerce application, e-commerce service enterprises are gradually specialized, large-scaled and clustered, market resources are constantly coordinated and redistributed among different ecological entities, relevant industrial rules and

standards, policy and legal systems are gradually improved, jointly promote the continuous expansion, maturity and improvement of ECSEM. The driving forces of ECSEM's evolution are mainly reflected in the fierce market competition among system entities, the ecological symbiosis among system entities and their interaction with the environment, and the collaborative innovation of all members.

Driven by Market Competition

In order to ensure the survival and development, compete for limited market resources and maintain its market position, there will be fierce competition among the core enterprises of different ECSEM and among homogenous or alternative entities in the same ecosystem. Enterprises will continually explore and stimulate market demand, capture changes and enhancements of individualized needs in a timely manner, or absorb new information technologies, imitate successful developing cases, thereby adjusting market strategies and transforming service models to provide innovative service, which will aggravate and upgrade competition. The fierce market competition among different ecosystems and their main entities has caused the dynamic changes of their niche, maintains or even promotes the process of removing enterprises and developing models that cannot adapt to market's development, and retaining enterprises with strong core capabilities and developing models most adaptable so that the ecosystem is constantly updated and optimized to promote the ecosystem's evolution.

Driven by Ecological Symbiosis

The driving forces of ecological symbiosis include the symbiosis among main entities of ECSEM and its surrounded environment. The symbiosis among main entities of the ecosystem includes four types: 1) Mutual industrial symbiosis, that is, enterprises, which don't have direct competition or interest conflicts with each other, establish an alliance to cooperate in the form of goal mutually seeking, resource and interests sharing, and risk sharing based on the principle of equality and mutual benefits, forming a community of interests in which mutual benefits, coexistence and advantages complementing is fulfilled; 2) Parasitic industrial symbiosis, that is, one enterprise exists parasitically on another enterprise, its survival, development and interest distribution depends all on the host enterprise; 3) Interest-deviated industrial symbiosis, that is, a symbiotic relationship which is beneficial to one enterprise but has no direct profit or less profit to another enterprise; 4) Mixed symbiosis, that is, a mixture of the above three symbiotic relationships (Qu, 2012). Different symbiotic modes between enterprises will produce different ways of energy and value flow, and different interest distribution, making the network of members in the ecosystem more diverse and complex, improving the stabilization of its structure, enhancing the vitality of the system and its members. At the same time, the symbiosis between ecological subjects and environment promotes a more coordinated ecosystem, and enhances the system's perception and reaction ability to changes of external environmental factors.

Driven by Collaborative Innovation

Every member of the ECSEM is a node in a symbiotic network in which all nodes are interrelated and interdependent, and changes of any member's niche will cause changes in the entire ecosystem. Therefore, when ecological entities mutually interact by all means such as industrial association, business alliances and so on, and combine their core capabilities to jointly develop and innovate, a complex relationship network of sharing, co-construction and symbiosis will be formed, the reform and perfection of other parts in the system will be driven and urged, then collaborative innovation of the entire ecosystem is accomplished and the comprehensive and profound evolution of the ecosystem will be pushed.

In addition, the application of various new information technologies, the regulation of policies and laws, and the feedback adjustment of consumers and the market are all important driving forces for the ECSEM's evolution. Different drivers interact to construct a synergy to form an orderly driving system with multiple levels, jointly promote the ecosystem's development and evolution (Guan et al, 2013).

EVOLUTIONARY PATH AND PROCESS OF ECSEM

Based on current research results and the developing process of China's ECSEM, this paper draws on the evolution theory of industrial ecosystem, combined with the research about the evolution of e-commerce system (Hu, Lu & Huang, 2009; Guo, 2014; Ji & Li, 2012), and summarizes the evolutionary path of ECSEM into four stages: initial formation - development and expansion - maturity and coordination - innovation and upgrading (see Figure 2).

Since the ECSEM is a brand-new industrial ecosystem, the experience and laws that can be used for reference are scarce. So it is vulnerable to the external environment, and may be transferred directly from the stage of initial formation, stage of development and expansion, or stage of maturity and coordination into the stage of innovation and upgrading (see Figure 3). At this point, if the system can subvert its original mode, a new ecosystem can be formed, and a new round of evolution can be resumed from the stage of initial formation. However, if the innovation fails, it will gradually be replaced by other ecosystems, going to recession and even death.

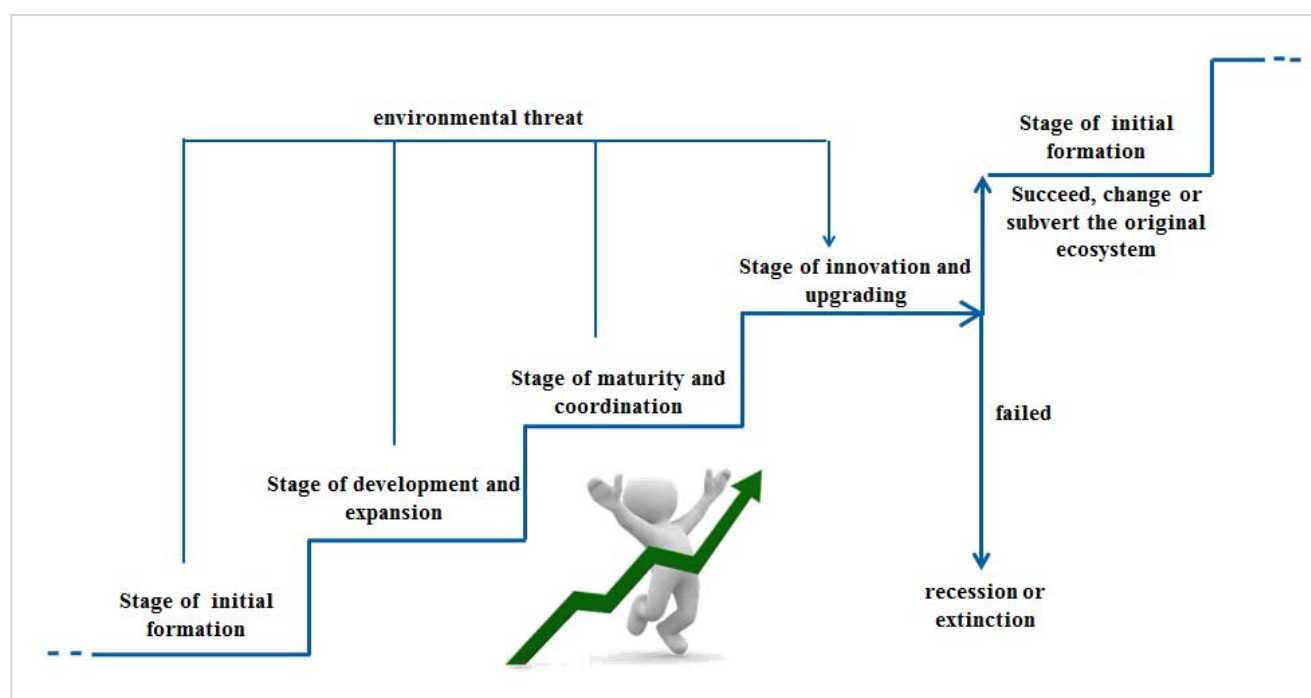


Figure 2: The Evolutionary Path of ECSEM

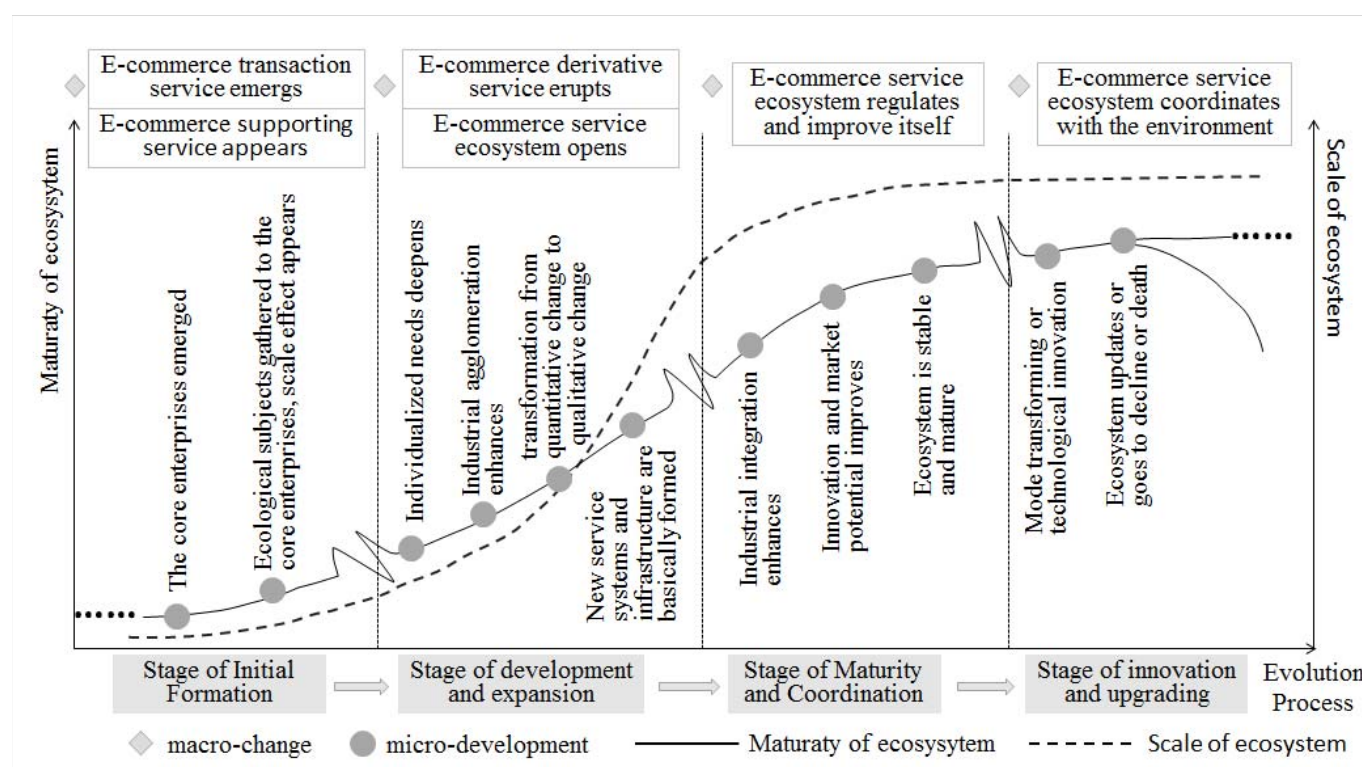


Figure 3: The Evolutionary Process of ECSEM

Stage of initial formation. The core enterprises appear. Various types of e-commerce service enterprises and application enterprises gradually emerge and gather to the core enterprises. The scale effect begins to appear. The ECSEM is initially formed and gradually scaled. At this stage, the types of e-commerce service are relatively simple, the number of members in the ecosystem is small and the growth rate is slow, and the competition among members is not obvious. The main e-commerce service in the stage of initial formation is transaction service, while supporting service is gradually emerging.

Stage of development and expansion. The system's members accelerate to grow and aggregate, significantly enhancing the industrial agglomeration effect and expanding the system's boundaries. Various e-commerce applications accomplished the transformation from quantitative change to qualitative change. E-commerce service enterprises flourish and its market's

specialized subdivision deepens. Traditional industries are beginning to be replaced. At this stage, with the growth of core enterprises and the expansion of system scale, the demand for e-commerce applications is gradually diversified, and the demand for personalization is deepening. Various types of supporting service, innovative service and characteristic service is generated and enters the ecosystem. Types of e-commerce service keep diversifying, and service models are continuously innovating and improving. The successful developing model of a certain enterprise will also be replicated and applied to other enterprises. The competition between the homogenous populations of different leadership cores will continue to escalate, and the market competition pattern will be basically determined. In the stage of development and expansion, the e-commerce service ecology is open. The transaction service is developing at a high speed, supporting service continues to be constructed and extended, and derivative service is erupting. New service systems and infrastructure is basically formed.

Stage of Maturity and Coordination. Members of the ecosystem have already a large scale, the number has broken through the growth threshold and begins to saturate. The relationship between ecological subjects has become increasingly complex and it becomes particularly important to coordinate the development of the system. At this stage, the competition among homogenous ecological entities in the system is particularly fierce, and the complementary ecological entities cooperate or form alliances through various forms. The roles played by the system's ecological subjects are also in the process of continuous transformation. Various fields, such as production, circulation, consumption and investment, are gradually integrated with e-commerce service fields to realize the transformation and upgrading of enterprise's competitive strategies, and the innovation and market potentials are comprehensively improved. At the same time, various certification systems, industrial rule and standard systems, policy and legal systems have been gradually improved, thus coordinating conflicts of interest and value divisions to ensure the sustainable and healthy development of the ecosystem. The ECSEM in the stage of maturity and coordination has strong sustainable profitabilities and self-renewal capabilities, and the ecosystem is mature.

Stage of innovation and upgrading. When the existing ECSEM is impacted by new technologies, new rules and models, or external political, economic, social factors, etc., the system will face a huge threat of recession, substitution or death. At this point, the ecosystem needs to absorb new developing concepts, and change or subvert its original developing models, then carry out mode transforming or technological innovation, and update it.

The above four stages basically summarize the lifecycle of ECSEM's evolution. During this process, the ecosystem's ecological subjects have always been closely connected with various kinds of resources and external environment to form a stable equilibrium. Meanwhile, the ecosystem is also dynamically changing under the regulation of various substances, information and energy, so the ECSEM, at any stage, is developing in a dynamic balance.

EVOLUTIONARY ANALYSIS OF ECSEM'S KEY ELEMENTS

The key elements of an ecosystem refer to the vital factors in the system whose rise, fall and level of development can significantly affect the growth and maturity of other system members. They can produce sustained and far-reaching effects on the maturation and evolution of the entire ecosystem. In a sense, it is the growth, maturity and continuous optimization of key elements of the ecosystem that reflect and promote the evolution of the ecosystem. The evolution process has also gone through stages of initial formation --- development and expansion --- maturity and coordination --- innovation and upgrading.

Composition of Key Elements

Key elements of the ECSEM include various e-commerce service, market competitors, industrial organizations and business alliances, industrial rule and standard systems, and policy and legal systems, etc. Among them, all kinds of e-commerce transaction service, supporting service and derivative service is the main content and soul of the ECSEM, including platform service, payment service, logistic service, marketing service, data service, customer service, etc.; Competitors refer to market competitors of key populations of an ecosystem, which are playing an important role in promoting the growth, maturity, and innovation of system's entities; Industrial organizations and business alliances are mixed-type entities consisting of a wide range of members, including various e-commerce service providers, exerts group effects and joint effects to promote the growth of individual members; The industrial rule and standard systems, policy and legal systems, formulated by the ecosystem's core leaders and government agencies, are the coordinators of the ecosystem. They regulate, constrain and coordinate the behavior of all system members, regulate the development path and posture of the whole ecosystem. It is a kind of underlying constraint and macro-control, which is essential for maintaining the sustainable and healthy development of the ecosystem.

Evolutionary Process of Key Elements

The development and maturity of the ecosystem's key elements is strong evidence and driving forces for the maturity and evolution of the ECSEM. With the development of e-commerce and continual rise of its application requirements and consumer personalized needs, the developing levels and maturity of various key elements of the ECSEM is gradually increasing, and the ecosystem is approaching mature.

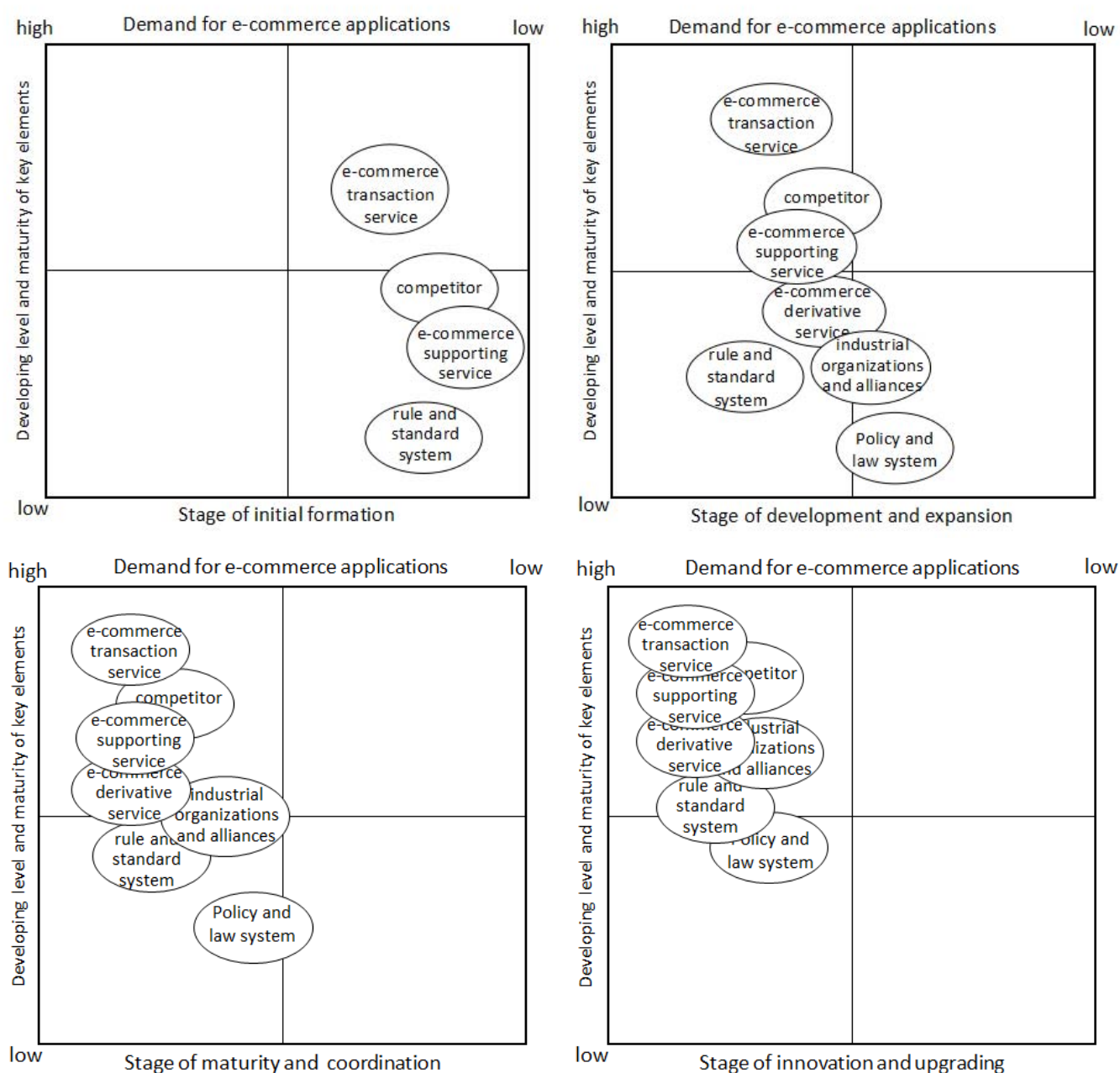


Figure 4: The Evolution of ECSEM's Key Elements

During the evolution of the ECSEM, the evolutionary process of its key elements is mainly reflected in the following aspects:

First, all kinds of e-commerce transaction service and supporting service is continuously developing and becoming more perfect. Its service functions are continuously enriched, service capabilities are unremittingly improved, and service models are frequently innovated. For example, the initial e-commerce platforms only have basic transaction functions, and its payment service is mostly based on online bank transfer. Nowadays, they have collected almost all kinds of functions, such as commodities trading, customer management, marketing, personalized recommendation, community communication, value-added applications, etc. The payment methods have developed to a co-existence of Alipay, WeChat, Huabei, online banking, credit card payment, points and coupon deduction, etc.

Second, competitors have risen rapidly in the stage of initial formation, but their competition is much chaotic at first. With the survival of the fittest in the market, the competition is gradually ordered and its competitive landscape is gradually stable. For example, when Alibaba began to enter the e-commerce market, there were competitors such as Amazon, Ebay, paipai and so on. In today's Chinese market, Alibaba Group, JD, LeEco, and Suning are not only leading in their respective advantageous fields, but also competing with each other in their cross-cutting areas.

Third, derivative service is almost non-existent in the stage of initial formation, and their market demand is also low. However, in the second stage, with the expansion of the market and the intensification of competition, derivative service is rapidly erupting and their application demand is comparatively high. Derivative service's maturity is relatively high and its sustainable development and innovation is continually generating due to the fact that it is application of service industries in other fields to the field of e-commerce. Its service mode goes from some forms of outsourcing service, such as simple product photography, online shop decoration etc., to full-scale service model based on the "people-goods-scene", such as channel planning, brand building, user's portrait creating, live video streaming, etc.

Fourth, various industrial organizations and business alliances gradually emerge and develop rapidly, such as China's Network Merchants Alliance, China's Modern Logistic Network Alliance, the strategic cooperation between Alibaba Group and Suning, strategic alliance of JD and Wal-Mart.

Fifth, the demand for relevant industrial rule and standard systems, policy and legal systems has been relatively high, but its level of development is always lagged behind that of the market. After the market expands to a certain extent, its importance becomes particularly prominent and its maturity degree of development will also rapidly increase. For example, the emergence of "Taobao Declaration", "Research Instructions of New Business Civilization (2010)", and "China's E-commerce Laws" has injected new vitality into ECSEM.

It should be noted that the key elements' evolution map in the stage of innovation and upgrading presented in figure 4 is a state naturally evolved from the stage of maturity and coordination. If it's evolved directly from the stage of initial formation or the stage of development and expansion, its key elements and their location will differ from this diagram.

Characteristics of Key Elements' Evolution

Continuous Enrichment in Variety

The ECSEM only has basic service functions in the stage of initial formation. Most of the derivative service, industrial organizations and business alliances related to e-commerce service, and policy and legal systems gradually appear and grow with the development of ecosystem. Key elements of the ecosystem are gradually increasing during the evolution process and their service contents become more and more abundant. For example, data service is a kind of e-commerce service that serves marketing and individualization. It's generated with the rapid growth of the number of netizens and online merchants in the stage of development and expansion.

Gradual Improvement in Maturity

The growth and maturity of ecosystem's key elements is gradually advanced and improved with the development of the market under the joint action of various internal driving forces and external environmental factors. For example, e-commerce platforms only have basic trading functions in the stage of initial formation. After continuous improvement and innovation, they gradually absorb large quantity of elements, such as customer service centers, business management systems, fans and community marketing ports, various e-commerce applications and individualization recommendation systems, etc., continuously enriching and improving its service functions, and enhancing the service capabilities.

Continuous Increase in Relevance

Key elements of the ecosystem are not isolated, but related to each other. This association is mainly shown as the division of labor and combination of functions in the stage of initial formation. With the evolution of key elements, this association will become more and more manifested as an interrelated and interdependent state, which means the correlation is continuously enhanced. For example, the agency operation service has gradually expanded from simple front-end store operations to many aspects of e-commerce, such as channel planning, site building, customer service, warehousing and logistic service, product shelves, marketing, financial settlement, etc., closely connecting with platform service, information technology service, customer service, logistic service, data service, marketing service, etc.; Data analysis service is based on data collected by e-commerce platforms, and its results are applied to various aspects such as marketing service, product operation, and the design and improvement of personalized recommendation systems.

CASE ANALYSIS --- ALIBABA'S ECSEM

Alibaba Group was founded in 1999 in Hangzhou, China by 18 individuals headed by Jack Ma. Over the years, Alibaba Group has provided the basic Internet infrastructure and marketing platforms for network operators, brands and other enterprises with the mission of "to make it easy to do business anywhere". With the power of the Internet, it promotes the interaction with users and customers, and changes marketing and operating styles, empowering companies from all aspects, and building a future business ecosystem.

As a new product of deep integration of information technologies and business service, the ECSEM has emerged with the booming of e-commerce transactions. Based on a series of platforms such as Taobao, Tmall, AliExpress, etc., Alibaba Group is collaboratively developing with various e-commerce service providers to achieve frequent interaction, communication,

competition and innovation between platforms and service providers, forming a huge commercial service ecosystem, which is based on platforms, customers and service merchants, and is co-constructed, shared and coexisted by many commercial service groups.

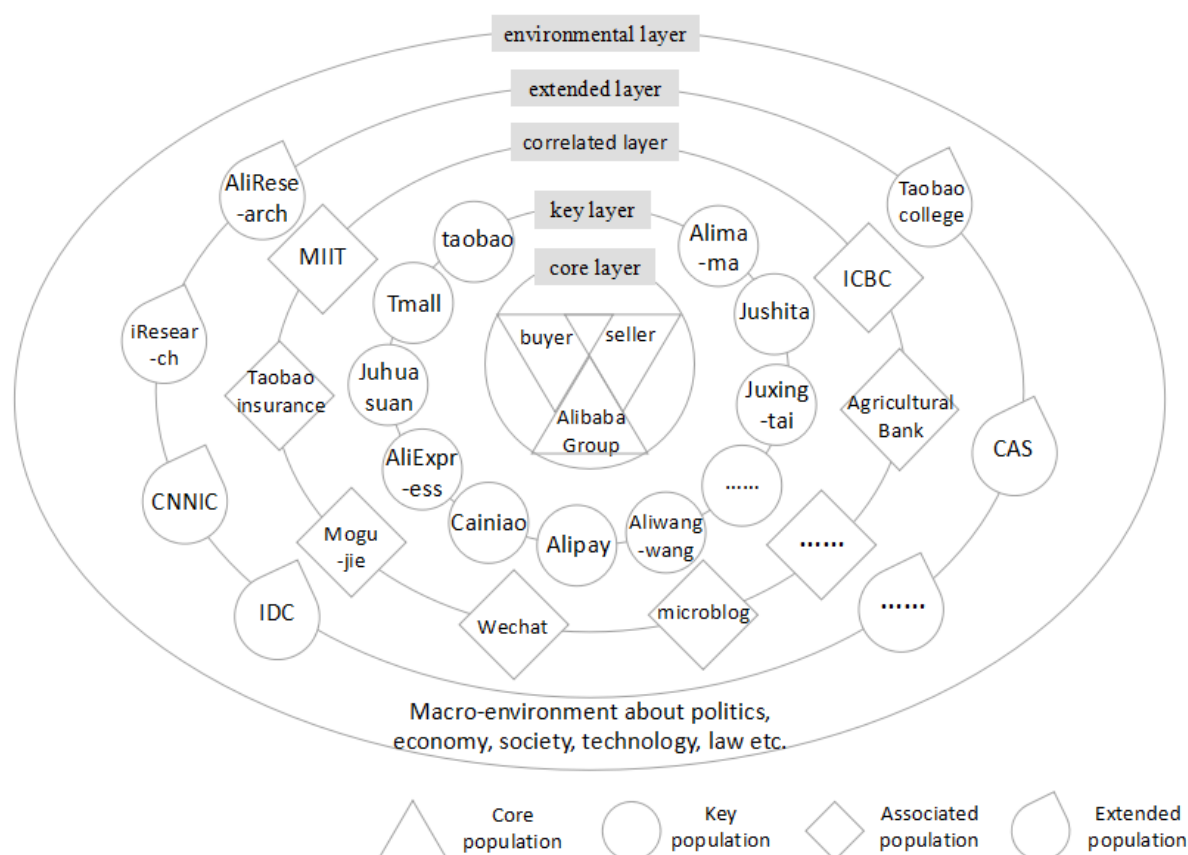


Figure 5: Alibaba's ECSEM

From the perspective of ecosystem evolution, Alibaba's ECSEM has gone through three stages of initial formation, development and expansion, maturity and coordination.

Stage of Initial Formation (1999-2007)

In 1999, Alibaba Group launched the global trade version of Alibaba in the wholesale trade market and the domestic version of the Chinese transaction market (known as "1688" now). Its e-commerce service activities began to sprout. At this time, the number and types of netizens, online merchants, and e-commerce service providers were relatively less.

Table 1: The Ecological Layout of Alibaba's ECSEM in the Stage of Initial Formation

Time	Events Related to E-commerce Service	Service Type
1999	Alibaba Group established and launched a double-version of wholesale trade market domestically and abroad	Platform service
2003	Established online retail platform, Taobao	Platform service
	Released Alipay	Payment service
2004	Taobao launched Taobao Trademanager	Customer service
	Alibaba held the first "Network Business Conference" in Hangzhou	Exhibition service
	Cooperate with advertising alliances such as "Yitian Network" to develop marketing and popularizing	Marketing service
	Established Ali College, popularize e-commerce knowledge, and cultivate electric merchants	Personnel training service
2005	Alibaba cooperates with various banks to conduct bank-enterprise cooperation such as ICBC, etc.	Financial service Payment service

2006	Cooperating with PSBC. EMS became the recommended logistic service provider of Alipay, and its postal green card was linked to Alipay's business. In the same year. EUB was released.	Logistic service
	China's E-Commerce Association and Ali Group jointly held the second "E-Commerce Application Talent Training Forum" in Hangzhou	Exhibition service
2007	Invested 100 million RMB to build Ali Software Business Management Software Co., Ltd. and launched three software product projects on the same day: Ali Software Foreign Trade Edition, Domestic Trade Edition, C2C Edition and AliTrademanager.	Information technology service
	Alipay launched the second-generation of digital certification to improve users' account security	Information security service
	"Wanghui-E" launched by Ali and PSBC successively launched on the national postal outlets to achieve direct shopping with postal remittances and free of bank cards.	Payment service
	Alibaba Research Center officially established (AliResearch)	Information service Consultant service
	Alipay announced the beginning of the Internet Trust Program	Credit service
	Alimama was established	Marketing service

At this stage, Alibaba Group had successively launched various platforms, absorbed a large number of partners, and deployed extensively in the field of e-commerce service, providing various aspects, such as platform service, logistic service, financial and payment service, information security and technical service, marketing service, exhibition service, and credit service, etc. Since then, Alibaba's ECSEM had initially taken shape.

Stage of Development and Expansion (2008-2016)

In 2008, Alibaba Group determined its next core strategy to "build an e-commerce infrastructure and foster an open, collaborative and prosperous e-commerce ecosystem", launched a series of strategies and plans to promote service ecosystem development, expansion and improvement.

The characteristics of Alibaba's ECSEM in the stage of development and expansion are mainly reflected in the following four aspects:

First, the service infrastructure continued to be built and deployed. During the stage of development and expansion, Alibaba set up a search technology center, a P4P operation center and a media sales center; established Yahoo Koubai, Alibaba Cloud, and Ali Small-Loan; launched a marketing platform Juhuasuan which focused on time-limited sales promotions, "Good business store statistics" providing statistical products for sellers with operational data, AliExpress focused on brand export, "Haitao" based on the model of interaction between TV and the Internet, mobile Taobao, cloud computing service platform JuShita, data marketing Service platform Juxingtai, etc.; acquired China's one-stop export service provider, Yidatong; established CaiNiao Network with a number of logistic service providers. While constantly improving its existing infrastructure and service systems, Alibaba provided a wide range of e-commerce service to consumers and online merchants from different perspectives.

Second, the service market was constantly expanding and subdividing. With the rapid expansion of Alibaba's e-commerce service market, its service types had also increased rapidly. Various derivative service, online shop decoration service, e-commerce photography and model service, agency operation service, data analysis and mining service, foreign trade integrated service, e-commerce parks, etc., erupted and deepened into the process of e-commerce activities. For example, marketing service continually subdivided and spread to consumers, enterprises, products, markets, channels, scenarios, supply chains and other fields. At the same time, the original transaction service and supporting service had been continuously subdivided and improved.

Third, service capabilities had increased rapidly. The number of open APIs of Taobao Open Platform increased from 148 in 2010 to 7288 in 2016; The number of daily calls for Taobao Open Platform increased from 70 million at the end of 2009 to 13.58 billion in 2016; The application operated online increased from 2632 in 2010 to 338,803 in 2016; The number of Taobao's registered partners increased from 75,000 in 2010 to 1.685 million in 2016; From 2012 to 2015, the growth rate of Alibaba e-commerce service business increased from 61.9% to 78.6%, the growth rate of active service providers increased from 1.8% to 33.5% (Alibaba Research Center & Business Department, 2017; Alibaba Research Center, 2010; Cui, 2016).

Fourth, the industrial rule and legal systems had gradually matured. The rapid expansion of e-commerce market scale had led to a rapid increase in the demand for relevant industrial rule and legal systems. Alibaba, in the course of improving its credit service, created a special publication, "the Network Regulations", in April 2010; released "Big Taobao Declaration" in September; released the "Research Instructions of New Business Civilization (2010)" in October; in 2011, Taobao signed a

"Consumer Protection Service Agreement" with all of its merchants, and invested 200 million guarantee funds to escort hundreds of millions of consumers; in 2014, AliResearch and Network Research Center jointly released the "New Century of Big Data and Anti-Counterfeiting --- China's E-commerce Anti-Counterfeiting Frontier Report of 2014"; in 2015, Ant Financial Service Group launched sesame credit points to create a personal credit service system.

Stage of Maturity and Coordination (2017-Now)

After more than ten years of rapid growth in the first two phases, the digital commercial infrastructure integrated with various new information technologies such as cloud computing, Internet finance, and intelligent logistic service etc., had been initially established. Taobao Service Market is already the largest commercial service portal in China. It contains hundreds of thousands of related service and instruments including shop decoration, product shooting, traffic promotion, commodity management, order management, internal management within enterprises, personnel outsourcing, quality inspection and quality control and so on to form a full-link diversified business ecosystem. The entire commercial ecosystem began to enter the depth water of transformation, and Alibaba's ECSEM entered a maturity and coordination phase in 2017. At this stage, Alibaba's strategy in the field of e-commerce service had shifted to further improving the merchant service system. To be specific, firstly, further standardizing the unified data interface to provide more comprehensive, smarter and better qualified basic service; secondly, using big data to explore and find the balance of traffic between consumers' individualization and stocking certainty; lastly, improving the distribution mechanism of interests, decoupling old relationships and reconstructing new relationships, including consumer perception, customer relationships, partnerships, and internal relationships.

Alibaba's ECSEM is still relatively young and in the process of healthy development. Its stage of innovation and upgrading has not come. But it lives under the environment of rapid economic and technological changes and innovation, any huge threats may subvert its original system.

CONCLUSION

The ECSEM is rich in content, covers a large market scale, contains many members and shows complex relationships among populations. Defining the connotation of ECSEM, and clearly clarifying its population structures and evolutionary process can contribute to, comprehensively, systematically and profoundly, understand and clarify the functions and roles of each part of the ecosystem, the status of its current stage, and the opportunities and risks that it may meet in the future, provide reference to the rational allocation of resources of ECSEM, and the formulation and guidance of relevant policy and the overall coordination of the ecosystem. We believe that the evolution analysis of ECSEM can also be used for problem analysis and strategic planning of e-commerce industrial belts, e-commerce industrial parks, e-commerce public operation service centers, etc., which are more obvious in industrial clusters. It will also be the future research direction of this paper.

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The Impact of Big Data Analytics Use on Supply Chain Performance --- Efficiency and Adaptability as Mediators

(Full Paper)

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ABSTRACT

This paper develops a conceptual model to examine how big data analytics use affect supply chain performance in an omni-channel. A research model is developed which comprises 4 constructs and 4 research hypotheses, the efficiency and adaptability as mediating constructs. The model is tested on data collected from 245 top manufacturing firms in Taiwan, using structural equation modeling. The research findings highlight the importance of efficiency and adaptability as mediators for ensuring supply chain performance by reinforcing big data analytics use.

Keywords : Supply chain performance, big data analytics use, efficiency, adaptability

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INTRODUCTION

Supply chain performance is the key determinants of supply chains' competitive advantages. Performance measurement is defined the process of quantifying both the efficiency and effectiveness of actions taken (Leończuk, 2016). In the retail and part of the business platform start of Omni-channel, the suppliers have not seen a new approach for the status quo. In practice, the previously mentioned foreign Amazon (amazon.com) and part of e-commerce platform has been in the layout, while in Taiwan this kind of case is not much. In addition, the supplier is not obvious on an Omni-channel. In science, we can see the change of many retail channels of literature (Tsai *et al.*, 2015), but almost did not see how the supply chain response (Kumar & Hu, 2015). Gahbiche, Hadjyoussef, Jemai and Dogui (2016) believe that through the formation of the alliance can improve supply chain performance.

Existing research of the Omni-channel in supply chains reveals that most of the studies of the marketing channel retailing change from multi-channel retailing to Omni-channel retailing that can provide a seamless experience across touch points (Verhoef *et al.*, 2015). Less research has focused on big data analytics use in an Omni-channel for the supply chain to predict the customer personalized interaction. There have been few studies on the factors that indirectly affect supply chain performance when in strengthening the efficiency and adaptability of speeding up services to customers. To achieve the benefits of supply chain performance for greater competitive advantages, it is essential for all the parties involved to ensure better efficiency and adaptability.

To verify this research model, this study proposes a novel research model to examine is how big data analytics use influencing the efficiency and adaptability and in turn, their impact on supply chain performance. This study will conduct an empirical study on the manufacturers and their partners in the supply chains of Taiwan, and use Structural equation modeling (SEM) with AMOS to analyze the hypothesized relationships of the research model.

The rest of this study is organized as follows. Section 2 provides 2 the effect of big data analytics use on supply chain performance and section 3 provide 3 theoretical framework and hypothesis development. The data collection method and research design are described in section 4, and the study's findings are presented in section 5. Section 6 provides a discussion of the results and section 7 concludes this study and offers directions for future research.

THE EFFECT OF BIG DATA ANALYTICS USE ON SUPPLY CHAIN PERFORMANCE

Omni-channel Retail

A new fashion retail processes Omni-channel retailing is just beginning concept that lacks the level of process integration in many other vanguard supply chains (Bernon *et al.*, 2016). With the development of science and technology, the retail industry is changing constantly, and also has a certain impact on the entire supply chain. Researchers have found that access is changing and retailing is constantly breaking old barriers (Verhoef *et al.*, 2015), but how the entire supply chain breaks down barriers between suppliers to the Omni-channel has been a rare research done in the past. This study will eventually use the definition of Rigby. An integrated sales experience that melds the advantages of physical stores with the information-rich experience of online shopping (Rigby, 2011).

Big Data Analytics Use

Big Data Analytics (BDA) Use is defined as “use in primary supply chain activities (i.e., purchasing, production, distribution, customer service) that can generate business insights and it impacts organizational competitive advantage according to the dynamic capabilities perspective” (Chen *et al.*, 2015). The other researcher use big data and predictive analytics are divided into acceptance, normalization and assimilation of the three processes and information sharing and supply chain performance is positively correlated (Gunasekaran *et al.*, 2017). This study will extend the dynamic capability theory used by Chen (García-Arca *et al.*, 2014) to illustrate the impact of supply chain performance of the Omni-channel.

Efficiency and adaptability in supply chain

Efficiency is defined by Lee *et al.* (2010), which the extent to which buyers saves their resources from the supply chain activities with sellers. It also Proof that information sharing has a significant impact on the buyer's efficiency. García-Arca *et al.* (2014) think the globalization of sales and suppliers can seriously affect the efficiency and sustainability of the supply chain. Adaptability is defined as an enterprise's perception of the long-term market environment and can the flexibility to adapt the supply chain to change (Eckstein *et al.*, 2015). Another paper has defined process adaptability as adopting adaptive processes through close engagement with customers (Zhang *et al.*, 2016). The Omni-channel bring efficiency includes the ability for employees to quickly deliver product information to customers via wireless devices and ship them from locations closest to customers (Motorola, 2013). A framework for comprehension and frequently formally modeling social behavior is according to rational choice theory (Durlauf & Blume, 2008).

THEORETICAL FRAMEWORK AND HYPOTHESIS DEVELOPMENT

Figure 1 depict the conceptual model with the factors affecting supply chain performance and two mediating factor as mediating effect to efficiency and adaptability on supply chain performance. The arrows indicate the hypothesized relationships.

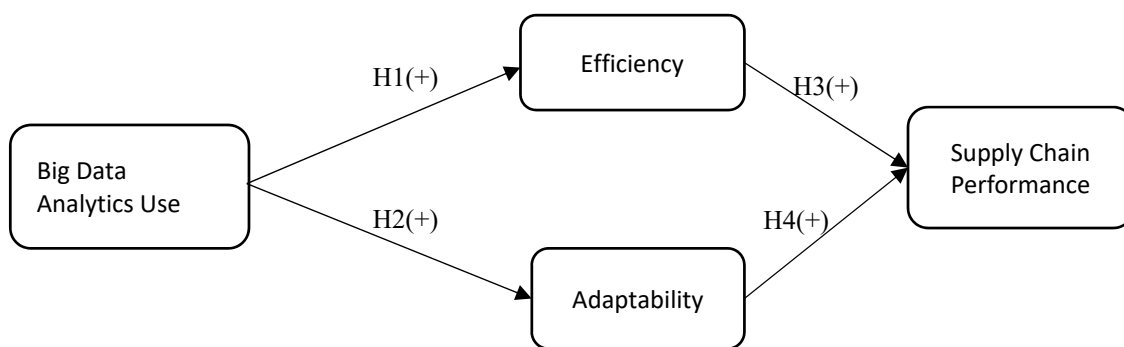


Figure 1 The research model

The path from big data analytics use to efficiency and adaptability

In the past studies, one of them has shown that big data and predictive analytics can reduce cost and achieve efficiency; it also increases the ability to cooperate in the supply chain relationship (Gunasekaran *et al.*, 2017). Through the big data analytics use can be used to re-configure the resources to adapt to changes in market supply and demand, that is accurately forecast (D. Q. Chen *et al.*, 2015). Thus, this study think in the Omni-channel driver the big data analytics use may impact efficiency and adaptability. It is thus hypothesized that:

H1: Big data analytics use is positively related to efficiency.

H2: Big data analytics use is positively related to adaptability.

The path from efficiency and adaptability to supply chain performance

In the decade of supply and demand changes, the need to quickly change the strategy, strengthen the efficiency of supply chain partners and adaptability can improve the quality of cooperation and results (Fan, 2014). Partners in the supply chain must be aware that the design and strategic analysis process will affect efficiency (Lichocik, 2013). The adaptability of supplier change to customers is the strategic flexibility factor of supply chain partners (Grant, 1991). As such, it is hypothesized that:

H3: Efficiency is positively related to supply chain performance.

H4: Adaptability is positively related to supply chain performance.

RESEARCH METHOD

To develop the survey instrument, a pool of items was first identified from the literature to measuring the constructs of the research model. Then, data from a survey sample were used to assess the instrument's validity and reliability and test the relationships hypothesized in the research model.

Content validity

All of the measures in the survey instrument were developed from the literature. The English version was developed first, and then translated into Chinese. And at the appropriate, the expression of the items was tailored to the supply chain context, as

shown in Table1. The items were measured on a 7-point Likert scale ranging from “Strongly disagree” (1) to “Strongly agree” (7).

Table 1 Constructs and measures of the research items

Construct		Source
Big Data Analytics Use		
BD1	Your company has optimization sourcing through big data analytics.	Chen et al. (2015)
BD2	Your company has improved warehousing through big data analytics.	
BD3	Your company has optimization inventory through big data analytics.	
Efficiency		
EF1	Your company was able to reduce inventory through a business relationship with major suppliers	Lee et al. (2010)
EF2	Your company was able to reduce cycle time through a business relationship with major suppliers	
EF3	Your company was able to reduce defective products through a business relationship with major suppliers	
Adaptability		
AD1	Your company will change the competitive environment through structured means. (e.g. fundamental change in the competitive landscape)	Eckstein et al. (2015)
AD2	Your company will be effective by structured flexibility to change competitive environment. (e.g. fundamental changes in the competitive landscape)	
AD3	Your company will be effective by structured flexibility to change the demand. (e.g. fundamental changes in consumer preferences)	
Supply Chain Performance		
SCP1	Your customer order fill rate(% of orders filled on time.)	Srinivasan et al. (2011)
SCP2	Your customer order on time delivery.	
SCP3	Increase your company's inventory turnover.	

Pre- and pilot-tests

Two industry seniors and four Ph.D. students were asked for pre-test a 12-item questionnaire and provide feedback on the content and appearance of the survey instrument. This study sought to choose respondents who were expected to have the best knowledge about the operation and management of the inter-organizational relationships between their manufacturing firm and its suppliers or subcontractors.

Data collection and respondents' profiles

This empirical study targeted the top 2500 manufacturing enterprises in Taiwan selected from the directories of the 2015 Chinese Credit Information Service (Taiwan's leading credit company). This study sought to choose respondents who were expected to have the experience about the operation and management of the inter-organizational relationships between their manufacturing firm and its suppliers or subcontractors.

We sent the paper questionnaire directly to all 2500 manufacturing companies and invited the general manager of the company to participate in the study. There were 821 companies willing to participate in the study. A total of 245 usable responses were collected from function managers or other members of the senior management teams, such as general managers, vice presidents, or CEOs. This resulted in a sample size of 245 with a response rate of 29.8%.

DATA ANALYSIS AND FINDINGS

Software AMOS 21.0 was used to conduct structural-equation modeling (SEM) to test and analyze the relationships hypothesized in the research model.

Assessment of the measurement model

This study performed exploratory factor analysis using principal axis factoring to ascertain whether our items loaded onto a common latent factor. First, the 12 items in the survey instrument were analyzed to assess their dimensionality and measurement properties. Analysis of their eigenvalues suggested a four-factor solution, with factors comprising big data analytics use, efficiency, adaptability and supply chain performance. Using an exploratory factor analysis, all of the items were found to perform well and were thus retained in the model, as shown in Table2.

Table 2 Results of exploratory factor analysis

	AD	EF	BD	SCP
AD1	.795	.176	.162	.051

AD2	.793	.092	.142	.103
AD3	.770	-.040	.180	.136
EF1	.111	.706	.265	.248
EF2	.138	.681	.377	.142
EF3	.222	.741	.246	.071
BD1	.172	.049	.802	.006
BD2	.103	.077	.841	.148
BD3	.119	.116	.842	.141
SCP1	.062	.140	.151	.784
SCP 2	.164	.057	.088	.804
SCP 3	.131	.134	.209	.700
Eigenvalue	7.400	1.431	1.148	1.093

The χ^2 value of the measurement model was significant ($\chi^2 = 71.599$, $df = 47$, $p < 0.001$), and the value of ($\chi^2/df = 1.526$) was smaller than 2, indicating an ideal fit (Bentler, 1990). The large χ^2 value was not surprising because the χ^2 statistic has been shown to be directly related to sample size (Jöreskog & Sörbom, 1993). An assessment of the measurement model suggested an acceptable model fit (GFI = 0.956; AGFI = 0.926; CFI = 0.985; NFI = 0.959; RMSEA = 0.046; SRMR = 0.0373).

This measurement model was carried out by two steps. The first step assesses reliability and convergent validity, and the second step is for discriminant validity. Reliability is assessed by the criterion, Cronbach's α -value larger than 0.7 (Chin, 1998). To assess the reliability of the constructs, a composite reliability (CR) test was performed. Item loadings range from 0.855 to 0.883. All of the CR values, ranging from a low of 0.843 to a high of 0.884, exceeded the recommended cut-off value of 0.8. Each variable's squared multiple correlations (SMC) is the proportion of its variance that is accounted for by its predictors. The average variance extracted (AVE) was greater than 0.5 in all cases, meaning that the variance accounted for by each of the constructs was greater than the variance accounted for by the measurement error (Hair *et al.*, 1995; Jöreskog & Sörbom, 1993). Table 3 summarizes the assessment results of the measurement model.

Table 3 Convergent validity

Construct	Item num.	Item means	Standard deviations	Item Loadings	AVE	Congeneric reliability	Cronbach's Alpha
Big Data Analytics Use	3	4.973	0.933	0.802-0.842	0.717	0.884	0.883
Efficiency	3	5.310	0.893	0.681-0.741	0.641	0.843	0.843
Adaptability	3	5.333	0.764	0.770-0.795	0.682	0.865	0.863
Supply Chain Performance	3	5.347	0.779	0.700-0.804	0.713	0.878	0.855

Assessment of the structural model

Table 4 shows the inter-correlations between the five constructs of the structural model. An assessment of the discriminant validity between the constructs supported the model fit. Discriminant validity between constructs is assessed using the criterion that the square root of AVE for each construct should be larger than its correlations with all other constructs (Fornell & Larcker, 1981). The overall fit of the structural model was acceptable because all of the measures of fit reached an acceptable level ($\chi^2 = 71.599$, $df = 47$, $\alpha = 0.000$; GFI = 0.956; AGFI = 0.926; CFI = 0.985; NFI = 0.959; RMSEA = 0.046; SRMR = 0.0373). the skewness and kurtosis indexes of all the items were lower than 2, and the Mardia's (1970) coefficient was lower than $p/(p+2)$, where p is the number of items of individual construct, indicating that there is multivariate normality (Bollen, 1989; Bollen & Long, 1993). The use of Mardia's coefficient to test multivariate normality follows previous studies (Menor & Roth, 2008; Nikolaos Tsigilis *et al.*, 2004).

Table 4 Discriminate validity

Construct	(1).	(2)	(3)	(4)
(1)Big Data Analytics Use	0.847			
(2)Efficiency	0.395**	0.801		

(3)Adaptability	0.377**	0.504**	0.826	
(4)Supply Chain Performance	0.355**	0.433**	0.344**	0.845**

Common method bias

Common method bias results from the collection of various data from a single source (Podsakoff *et al.*, 2003). Following the suggestion made by Podsakoff *et al.* (2003), this study applied several procedural and statistical mechanisms to avoid and check for this potential problem. With respect to procedural mechanisms, the respondents were encouraged to provide accurate responses by being assured of anonymity and of the confidentiality of their answers (Nell & Ambos, 2013). We also distributed items pertaining to the same constructs in different parts of the questionnaire (Salvador *et al.*, 2014).

CFA marker technique was one of the most widely used statistic techniques to address the issue of common method variance (Williams *et al.*, 2010). In line with the recommendations of Williams *et al.* (2010), we selected supply chain performance as a marker variable because it has the weakest relationships to other variables. The results showed that Method-R model was not superior to the Method-U model ($\Delta\chi^2 = 57.362$, $\Delta df = 7$, $p < 0.005$). This assessment offered evidence that no significant variance attributable to method effects. Thus, the results indicated that common method bias did not appear to be a problem in the study.

Multi-group analysis

Using the findings of the returned questionnaires, we attempted to explore the formation of relationships between the perspectives of manufacturers and subcontractors. The average total sales revenue and industry measurements were expected to have either positive or negative effects. The 245 usable responses were divided into two groups (larger sized firms in Group 1 and smaller sized firms in Group 2) in two different models shown in Tables 11 To examine the differences between the parameters of the two groups, a statistical comparison was made following the multi-group procedure suggested by Jöreskog and Sörbom (1993). The procedure of each individual path was separately examined across groups to determine whether the estimated coefficients for each group were using a χ^2 difference test. The path coefficients of both groups were then separately analyzed using a multiple group analysis to assure that the model's goodness of fit was similar for both.

According to the returned questionnaires, manufacturers and subcontractors' average total sales revenue was less than NT\$1 billion (46.5% collaboration items), which indicated that more than half of the firms were small and medium in size. Thus, the average total sales revenue for the firms in Group 1 was less than NT\$1 billion, whereas that of the firms in Group 2 was more than NT\$1 billion. The fit indices for Group ($\chi^2/df = 1.55$, GFI = 0.917; AGFI = 0.859; CFI = 0.971; NFI = 0.924; RMSEA = 0.034; SRMR = 0.0536) were acceptable. The estimation results showed that the differences between the two groups were significant.

The findings revealed that big data analytics use had a more significant associated with efficiency in Group 1 ($\gamma = 0.56$, $t = 5.359$, $p < 0.001$) than in Group 2 ($\gamma = 0.69$, $t = 5.325$, $p < 0.001$). Big data analytics use had a more significant associated with adaptability in Group 2 ($\gamma = 0.28$, $t = 2.498$, $p = 0.012$) than in Group 1 ($\gamma = 0.54$, $t = 5.522$, $p < 0.001$). Efficiency had a more significant associated with supply chain performance in Group 1 ($\gamma = 0.23$, $t = 2.172$, $p = 0.030$) than in Group 2 ($\gamma = 0.39$, $t = 3.176$, $p < 0.001$). Adaptability had a more significant associated with supply chain performance in Group 2 ($\gamma = 0.19$, $t = 1.512$, $p = 0.130$) than in Group 1 ($\gamma = 0.39$, $t = 3.570$, $p < 0.001$).

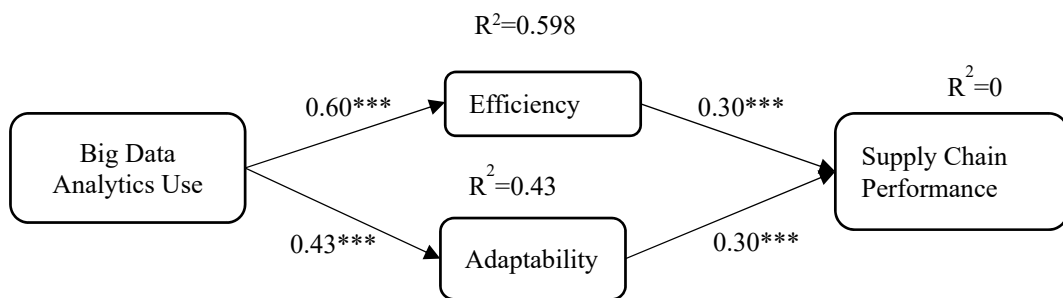
According to the returned questionnaires, the manufacturers and subcontractors indicated that more than half of the firms were related to the electronics/communication industry (37.14% of the collaboration items). The 245 usable responses were divided into two groups, with electronics/communication industry-related collaborations in Group 3 and collaborations in other industries in Group 4. The estimation results showed that the differences between the parameters of the two groups were significant.

The findings revealed that big data analytics use a more significant associated with efficiency in Group 3 ($\gamma = 0.67$, $t = 5.501$, $p < 0.001$) that was less significant in Group 4 ($\gamma = 0.52$, $t = 4.723$, $p < 0.001$). Big data analytics use had a more significant associated with adaptability in Group 4 ($\gamma = 0.51$, $t = 4.741$, $p < 0.001$) than in Group 3 ($\gamma = 0.35$, $t = 3.441$, $p < 0.001$). Efficiency had a more significant associated with supply chain performance in Group 4 ($\gamma = 0.32$, $t = 2.895$, $p = 0.004$) than in Group 3 ($\gamma = 0.22$, $t = 1.917$, $p = 0.055$). Adaptability had a more significant associated with supply chain performance in Group 3 ($\gamma = 0.37$, $t = 2.913$, $p = 0.004$) than in Group 4 ($\gamma = 0.28$, $t = 2.434$, $p = 0.015$).

Hypotheses testing

In the SEM analysis, the relationships among the independent and dependent variables were assessed simultaneously via a covariance analysis. Maximum likelihood (ML) estimation was used to estimate the model parameters, with the covariance matrix as data input. The ML estimation method has been described as being well suited to theory testing and development (Anderson & Gerbing, 1988; Jöreskog & Sörbom, 1993).

The big data analytics use (H1: $\gamma = 0.60$, $t = 7.453$, $p < 0.001$; H2: $\gamma = 0.43$, $t = 5.972$, $p < 0.001$), efficiency (H3: $\gamma = 0.30$, $t = 3.760$, $p < 0.001$) and adaptability (H4: $\gamma = 0.30$, $t = 3.666$, $p < 0.001$) had significantly positive effects on supply chain performance. Thus, all of our hypotheses were supported. The coefficient of determination (R^2) is computed to assess the predictive power of the structural model. Overall, the model explains 43.5% of the variance in efficiency ($R^2 = 0.435$), 59.8% of the variance in adaptability ($R^2 = 0.598$) and 30.7% of the variance in supply chain performance ($R^2 = 0.307$).



***denotes significance at $\alpha = 0.001$; **denotes significance at $\alpha = 0.01$; *denotes significance at $\alpha = 0.05$

Figure 2 the structural model

DISCUSSION

Consistent with our hypothesis, the results of the analyses suggest that big data analytics use, are all positive related to efficiency, which is consistent with previous studies on various frontiers (e.g., Gunasekaran *et al.*, 2017; Schoenherr & Speier-Pero, 2015; Zhang *et al.*, 2016). The finding may suggest Taiwan's supply chains that in Omni-channel, should through big data analytics use, to improve efficiency and rapid adaptability. Therefore, the analysis of big data integration among suppliers, communication and mutual complementarity of resources are key factors in improving efficiency. It also used to maintain the organization's activities.

The findings of this study also indicate that big data analytics use, are all positive related to adaptability. In Taiwan's supply chains, the analytics capability, network capability and response capability of the supply chain partner has important implications for adaptability. This finding is in line with the results of previous research on this subject. (e.g., Eckstein *et al.*, 2015; Fantazy, Tipu, & Kumar, 2016; Gligor & Holcomb, 2012). This suggests that adaptability among supply chain members will be affected by agility, coordination, cooperation, and coherence between organizations.

The results also suggest that efficiency and adaptability have a positive effect on supply chain performance. Efficiency has a significant impact on supply chain performance consistent with past research (Lichocik, 2013). Together, these findings suggest that when forming inter-organizational relationships in supply chains need to focus on improving efficiency and adaptability in order to improve supply chain performance.

Theoretical implications

With the development of the new research model, the theoretical contributions of this paper to the literature are described as follows. The results of our study contribute to the supply chain performance literature. Under the resource-based theory (RBT), scholars believe that the organization has control of entity capital, human capital and organizational capital can improve the efficiency and effectiveness of operations, which also includes the ability to implement the combination of resources (Barney *et al.*, 2001; Grant, 1991). In addition, this study also changes the dependencies with supply chain partners in response to changes in the environment through resource dependence theory (RDT) (Aiken & Hage, 1971; Pfeffer & Nowak, 1976). As a result, we are trying to fill gaps in supply chain performance of Omni-channel by using RBT and RDT. For instance, this study links big data analytics use, with efficiency and adaptability, of supply chain performance in exploring supply chain members relationship of inter-organizational. The framework of the model can be applied to other kinds of inter-organizational relationships relate to supply chain performance.

Average total sales revenue

The survey results show that the group1 effect on supply chain performance is affected by big data analysis. Only in the larger sized firms through adaptability effect on supply chain performance. So the finding concludes that larger sized firms will optimize the procurement, inventory and improvement of warehousing through data analysis techniques to achieve improved inventory and production. At the same time, the finding also learn that smaller sized firms are focused on supply chain partners in production and product delivery planning, because smaller sized firms do not have so much resources that larger sized firms can use, even have their own logistics systems.

Industry type

The survey results show that the group4 will affect the supply chain performance due to big data analysis. In the traditional industry, the focus will be placed on the ability to interact with potential partners, because the traditional industries of the same type of smaller sized firm, and is customer-oriented. In the electronics industry, analytical techniques are more aware of the importance of using big data analysis than traditional industries. With information technology, it is also important to aggregate the partners' data and conduct joint planning.

Managerial and practical implications

This study offers multiple insights into managers and practices looking for improving supply chain performance. Supply chain performance is always hot topic, has continued to have many scholars of concern. The most important managerial implication and practical insights are that a better efficiency and adaptability resulting from big data analytics use would help build better supply chain performance.

CONCLUSIONS AND FUTURE RESEARCH

This study offers multiple insights into managers and practices looking for improving supply chain performance. Through the improvement of supply chain performance, we can understand the entire operation strategy and goal is correct.

It is strategically important for firms to understand the factors that supply chain performance within inter-organizational setting of supply chain. In this study of supply chains in Taiwan, our research model investigates the factors influencing inter-organizational supply chain performance at Omni-channel. The finding indicate that big data analytics use, are affect efficiency and adaptability, and it also has significant impact on supply chain performance. When the supply chain partners can have a well interaction and information sharing, can increase the value of each other in order to respond to rapid changes in the market to improve the competitive advantage.

Given the impact of current research on the impact of big data analytics use, the future can further examine other factors that may affect consumer preferences, such as innovative services or logistics management. Future theoretical and empirical studies could explore whether alternative constructs affect big data analytics use, efficiency, adaptability and supply chain performance.

In the Omni-channel environment, the demand side to push back to the supplier of the way of big data analytics use, efficiency and adaptability, pioneer of influence on supply chain performance. This study focuses on the supply chain partners how to change due to the rapid demand side, thereby affecting the efficiency, adaptability and supply chain performance.

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The impact of gamification elements on the evaluation of marketing activities

(Full Paper)

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ABSTRACT

Recently, gamification obtains increasingly attention in marketing. Based on the S-O-R model, this research applied gamification to marketing and examined two important gamification elements (external reward and interactive competition) on evaluation of marketing activity. It was found that external reward and interactive competition have positive impacts on evaluation of marketing activity, and perceived enjoyment and immersion mediate the effects of external reward and interactive competition on such evaluation. This research contributes to gamification literature by examining the impact of different gamification elements (external reward vs interactive competition) on the evaluation of marketing activity. Further, this study contributes to marketing literature by exploring the impact of the perceived enjoyment and immersion. This research also provides insights for firms and game administrators on how to encourage customers to generate purchase intention and purchase behavior by designing appropriate gamification elements.

Keywords: Gamification, external reward, interactive competition, S-O-R model, evaluation of marketing activities.

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INTRODUCTION

Nowadays, more and more gamification elements are used in marketing, such as WeChat sports, Nike+ running APP, ant forest, ant manor, etc. Gamification in marketing refers to incorporating game design elements in marketing activities, allowing users to generate game-like experience and eventually actualizing marketing related goals (Ning and Xi, 2017). As a newly emerged and effective marketing tool, gamification has been widely used in marketing domain. It is predicted that gamification will continue to increase rapidly in next decades. Therefore, it is critical to understand how gamification affects the effects of marketing activities.

Despite the prevalence and importance of gamification, much prior research in gamification focus on educational gamification (Parreño *et al.*, 2016), medical gamification (Randy *et al.*, 2018) and the game itself (Hamari *et al.*, 2014). Recently, more and more scholars started to integrate gamification with marketing. For example, Huotari and Hamari (2017) have applied gamification to service marketing. To investigate the effects of specific gamification elements on marketing effects and its underlying psychological processes, this research investigates two gamification elements--external reward and interactive competition, and more importantly examines the mediating roles of perceived enjoyment and immersion.

Based on the S-O-R model (Mehrabian and Russell, 1974), this research examines two gamification elements--external reward and interactive competition on the evaluation of marketing activities. This study conducted an offline survey and collected data from 352 participants. After analyzing data by using regression analysis in SPSS, it was found that external reward and interactive competition in gamification have positive effects on consumers' positive evaluation of marketing activities. Further, the results showed that the impact of external reward and interactive competition on consumers' evaluation of marketing activities are mediated by immersion. However, perceived enjoyment didn't mediate the effect on external reward and interactive competition on consumers' evaluation of marketing activities. Presumably, this occurs because that perceived enjoyment as emotional response does not influence the evaluation of marketing activities.

This research makes some theoretical contributions. First, this study enriches marketing literature and gamification literature by providing an understanding of how gamification affects the effects of marketing activities. Second, this research contributes to gamification literature by examining the impact of different gamification elements (external reward vs. interactive competition) on the evaluation of marketing activity. Further, this research also helps firms to enhance their marketing effects by designing appropriate gamification elements.

THEORETICAL BACKGROUND

2.1 Gamification

2.1.1 Gamification definition

Gamification refers to the use of game design elements in non-game contexts (Deterding *et al.*, 2011; Werbach, 2014), and it involves "the process of making activities more game-like" (Werbach, 2014). Many scholars have extended the definition of

gamification from various perspectives. From the system design perspective, gamification is defined as “when used in a business context, gamification is the process of integrating game dynamics (and game mechanics) into a website, business service, online community, content portal, or marketing campaign in order to drive participation and engagement” (Penenberg, 2013). From the perspective of user experience, gamification refers to the use of the game's experience in a non-gaming environment, making the traditional organizational process fun and bringing a stakeholder-like gaming experience (Mccarthy *et al.*, 2014).

Recently, some scholars have attempted to connect gamification with marketing practices, such as applying gamification to service marketing (Huotari & Hamari, 2017), experience marketing and relationship marketing (Mccarthy *et al.*, 2014). Huotari and Hamari (2017) define gamification as “a process of enhancing a service with affordances for gamification experiences in order to support users' overall value creation”. According to Ning and Xi (2017), gamification in marketing refers to the application of game design elements to marketing activities, so that target customers generate a game-like experience, in turn enhancing customer service value and achieving value creation.

The research found that advertising games can be an effective way to promote products and branding, allowing consumers to experience fun. When “player” consumers have a positive association with the content of the advertising game, they will move this positive evaluation to the brand. In addition, certain specific game design elements may have a more significant impact on brand fit. For example, badges and virtual reward can increase brand loyalty, and leaderboards can promote differentiation between players, which can promote brand fit (Lucassen and Jansen, 2014). Practically, gamification is widely used in marketing activities. For example, in one software designed by Alipay, users accumulate energy through walking, consumption and online payment, and such energy can be traded for trees in the desert. Users gain a sense of accomplishment in the process of gamification, and users will preferentially use Alipay in order to collect energy. For the enterprise, on the one hand, the brand image of Alipay is enhanced by such gamification; on the other hand, users use Alipay more to collect more energy, and consumers have high evaluation of such marketing activity.

2.1.2 Gamification elements

Literature in gamification shows that there are different ways to classify gamification elements, such as DMC framework, MDA framework, FDD framework and Elemental tetrad. Among these theoretical frameworks related to gamification, DMC is the most frequently used framework. In DMC framework gamification elements incorporate three levels: dynamics, mechanics and components (Werbach and Hunter, 2012). Dynamics refers to the power to promote gamification behavior of users, including constraints, emotions, narratives, progression and relationships; mechanics mainly includes challenges, chances, competition, cooperation, resource acquisition, rewards, trading, turns, win states, feedback; components are specific forms of dynamics and mechanics, including achievements, points, badges, leader boards (Werbach and Hunter, 2012). Mechanics of gamification is the basic process of driving the gamification process and user participation (Werbach and Hunter, 2012). Mccarthy *et al.* (2014) proposed that mechanics are the instructions of a game, which specifies its goals, rules, and rarely change. This research explores two critical mechanics of gamification, that is external reward and interactive competition.

External reward refers to the benefits that users receive in exchange for actions or achievements, including points, badges, or extra game commodity, etc. It is an incentive factor. Postcards and souvenirs offered by travel frogs can be considered as an external reward. External reward creates incentives and appeals for users and encourages them to use the app. Interactive competition refers to the user's attempt to overcome or overwhelm each other's behavior in the form of individuals or groups during the gamification process. Leaderboards are feedback from interactive competition. In the gamification process of interactive competition, users gain a sense of accomplishment and meet social needs, thereby increasing user engagement and satisfaction.

Most prior research in gamification primarily classified game design elements but rarely examined these elements and their subsequent behavioral consequences. Particularly, few researches have applied gamification in marketing context. Therefore, we select the two important and typical gamification elements of external reward and interactive competition to explore their impacts on marketing activities.

2.2 S-O-R (Stimulus-organism-response) Model

Mehrabian and Russell (1974) proposed the S-O-R (stimulus-organism-response) theory to explore the mechanism of external environmental factors affecting individual behavior. The S-O-R model is mostly used to study consumer buying behavior, especially online consumer behavior. Specifically, the S-O-R model is used to explain the impact of different stimuli on attracting consumers to visit websites, and to use online services. For example, Gatautis *et al.* (2016) examined DMC pyramid classification method in a virtual environment based on S-O-R conceptual model. They found that firms can use the components element and the dynamics element as stimuli to influence users' mental state, prompting them to take anticipated actions. In the meanwhile, the mechanism element is directly related to the action taken (Gatautis *et al.*, 2016).

Importantly, S-O-R model can be applied in online network to enhance marketing effects. For example, Harwood and Garry (2015) explored the key processes and mechanisms for online brand engagement in gamification platforms and found that using gamification as a strategy can greatly promote online brand engagement. In the work of Harwood and Garry (2015), gamification elements serve as stimuli, can result in users' emotions as organism, and consequently in turn lead to brand engagement. It is worthwhile to note that gamification elements (e.g., challenges, badges, leader boards, cooperation), give customers an emotional

experience, which lead to complete tasks and subsequent behaviors.

In the S-O-R model, stimuli can be presented in many forms, such as gamification interaction mechanisms, competition mechanisms or reward mechanisms. In this research, we argue that external reward and interactive competition are two key stimuli in the process of evaluating the content of the activity. External reward and interactive competition can cause the user's cognitive reaction and emotional response, and ultimately improve the user's evaluation of the marketing activities. Therefore, using the S-O-R model as the overall theoretical framework of this paper, we can study the influence of gamification elements on the evaluation of marketing activities from cognitive response and emotional response.

RESEARCH MODEL AND HYPOTHESES

3.1 Evaluation of Marketing Activities

Marketing is a series of activities that engages in to satisfy customers. Marketing activities refer to a series of activities to achieve marketing goals, such as promotion, public service marketing, public relations activities and so on. The marketing activities have been carefully planned, through social activities or media advertisements, for the purpose of expanding the market share, enhancing the competitiveness of enterprises, and increasing sales.

We propose that external reward have a positive effect on evaluation of marketing activities. This occurs because when users are rewarded in the gamification, they are happier and more joyful. In this gamification activity, the user gains a game-like experience, while generating an incentive effect, achieving a higher sense of accomplishment and satisfaction. Such positive feelings can be transferred to the marketing activities, and in turn having more positive evaluation of the marketing activities.

Further, we argue that interactive competition has a positive effect on evaluation of marketing activities, because interactive competition can meet users' social and achievement needs by participating in interactive competition, and these positive associations of consumers in the gamification state will be extended to the participating marketing activities. Therefore, consumers' evaluation of marketing activities has been enhanced. Therefore, we propose the hypothesis:

H1a: External reward in gamification elements positively influence evaluation of marketing activities.

H1b: Interactive competition in gamification elements positively influences evaluation of marketing activities.

3.2 Perceived Enjoyment

Perceived enjoyment refers to the individual's enjoyment of subjective feelings when taking specific actions or performing specific activities (Moon and Kim, 2001). Moon and Kim (2001) propose three aspects of perceived enjoyment, that is concentration, curiosity, and enjoyment. The perceived enjoyment is a state of mind of the user and is an intrinsic motivation.

We propose that perceived enjoyment can mediate the effect of external reward on evaluation of activity. We first propose that external reward can positively influence perceived enjoyment. This occurs because external reward can elicit pleasantness and happiness, and consequently trigger perceived enjoyment. For example, a person would be more motivated to do a certain task and would feel more joyful during the completion of doing the task when the task is accompanied with external reward. Indeed, external reward arising from a game can lead to higher level of perceived enjoyment. Furthermore, we propose that perceived enjoyment can lead to higher evaluation of the activity. This is because that the perceived enjoyment is a state of mind and is regarded as an intrinsic motivation. Perceived enjoyment can positively influence the users' behavioral intention and evaluation.

Further, we also argue that interactive competition also mediates the effect perceived enjoyment on evaluation of marketing activities. This occurs because that interactive competition in the gamification enable users to obtain a game-like experience, and the process is considered to be interesting and joyful. Based on the S-O-R model, interactive competition as stimuli, can lead to perceived enjoyment which serves as responses, in turn positively influence evaluation of marketing activities.

In sum, based on S-O-R model, gamification elements of external reward and interactive competition enable users to obtain a game-like experience, and the process is considered to be joyful, which in turn lead to high evaluation of the marketing activities. Based on this, we propose the following assumptions:

H2a: Perceived enjoyment mediates the effect of external reward on the evaluation of marketing activities.

H2b: Perceived enjoyment mediates the effect of interactive competition on the evaluation of marketing activities.

3.3 Immersion

Immersion refers to a kind of overall experience that people experience by concentrating on a certain scene (Csikszentmihalyi, 1988). Immersion is an important reason why users are willing to continually participate in an activity. Csikszentmihalyi (1988) pointed out that people do what they want consistent with their psychological driving force, and the immersion experience is the explicit expression of conscious motivation. Choi and Kim (2004) found that when players are immersed, players will want to maintain this feeling, and this feeling will enable them to continuously participate in the game. In general, people who have experienced a temporary immersion experience often want to experience it again at any cost.

We propose that immersion can mediate the effect of external reward on evaluation of activity. We first propose that external

reward can positively affect immersion. This is because external reward can trigger pleasantness and happiness, which is a kind of experience enables users to maintain and concentrate. External reward render users to do better in a game, which can lead to them focus on their games or tasks, in turn forming an experience of immersion. For instance, a person would be more motivated to do a certain task better because of external reward and would feel immersed by the task per se. Indeed, external reward arising from a game can lead to higher level of immersion. Moreover, we propose that immersion can lead to higher evaluation of the activity. This occurs because that the immersion is a state of mind of the user and is an intrinsic motivation. The satisfaction of the basic intrinsic motivation will promote the formation of deeper immersion motivation, thus forming high evaluation of the game intention. That is, immersion can positively influence the users' behavioral intention and evaluation.

Similarly, we predict that interactive competition also mediates the effect immersion on evaluation of marketing activities. This is because that interactive competition in the gamification enable users concentrate on their tasks in order to win, namely immersion. That is, interactive competition is positively related to immersion. As argued that immersion as an intrinsic motivation can positively influence the users' evaluation of marketing activities. Based on the S-O-R model, interactive competition as stimuli, can lead to immersion which serves as responses, which in turn positively influence evaluation of marketing activities.

Taken together, consistent with S-O-R model, gamification elements of external reward and interactive competition enable users to become immersed in the gamification situation, which in turn lead to high evaluation of the marketing activities. Thus, we propose the following assumptions:

H3a: Immersion mediates the effect of external reward on the evaluation of marketing activities.

H3b: Immersion mediates the effect of interactive competition on the evaluation of marketing activities.

3.4 Research Model

Based on the “stimulus-organism-response” (S-O-R) model, we construct the theoretical model, as presented in figure 1.

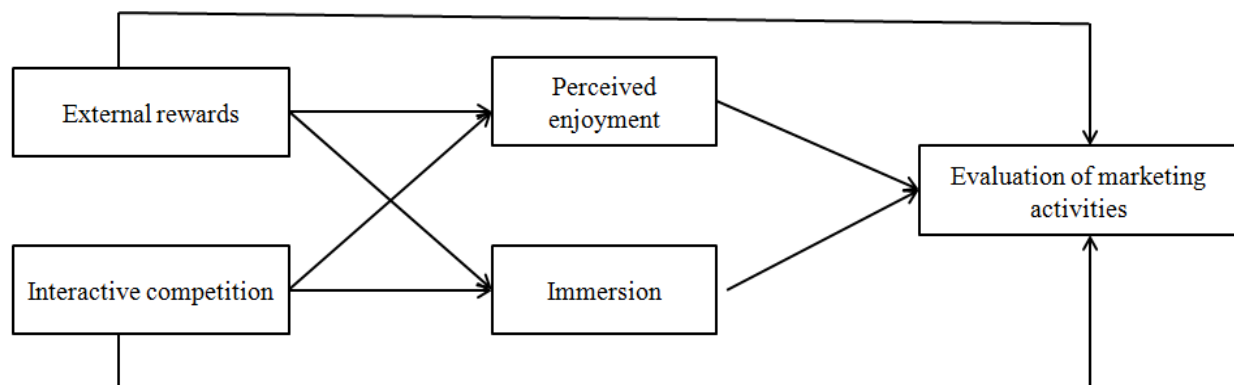


Figure 1: The research model

RESEARCH METHODOLOGY

4.1 Research Methodology

We collected data from target population through an online survey. In our theoretical model, most of the constructs are latent variables, which are appropriate to use the survey approach (Nunnally and Bernstein, 1994). The constructs were measured using instruments adapted from previous research to enhance validity. Table 1 provides definitions of the constructs.

Table 1 Formal definitions of constructs

Constructs	Definition	Sources
External Reward	The degree to incentives out of the activities, and it makes people driven by external motivations.	Kohn <i>et al.</i> (1993)
Interactive Competition	A degree of creating cooperation and competition through social network	Palmer <i>et al.</i> (2012)
Perceived Enjoyment	The individual's enjoyment of subjective feelings when taking specific actions or performing specific activities	Moon and Kim (2001)
Immersion	A kind of overall experience that people experience by concentrating on a certain scene	Csikszentmihalyi (1988)
Evaluation of Marketing	The degree of customers' evaluation of marketing activities	Li and Huang (2005)

Activities

Our survey involves three parts. The first part describes the purposes of this study. Participants were explained the definition of gamification and were given one example of gamification. Participants were asked whether they had experience of gamification or not. In the second part, participants were asked to answer the items measuring all variables, as presented in table 2. In the third part, participants were asked to give their demographic information. The online survey data was collected between March and April in 2018.

Table 2 Constructors

Constructs	Items	Sources
Interactive Competition	I will spend time interacting with other users	Chiu <i>et al.</i> (2007)
	I will discuss on how to do better with other users	
	I will compete with other users of this kind of activity	
	This kind of activity makes me remind of this brand	
	I think this kind of activity will give me some money or prize	
External Reward	I think this kind of activity can save me some money	Zhong <i>et al.</i> (2011)
	I think this kind of activity can bring me more recognition and reputation	
	I think there are some external reward will make me enjoy it more	
	I'm willing to spend a lot of time on these activities because of some external reward	
	I think this kind of activity makes me feel pleasure from choosing this brand	
Perceived Enjoyment	I think a marketing activity with gamification elements is interesting	Hassan <i>et al.</i> (2014)
	I think a marketing activity with gamification elements makes me feel happy	
	I think a marketing activity with gamification elements is vivid	
	I think a marketing activity with gamification elements makes me have the exploratory desire	
	When I found a fun activity, I often can't help putting myself into it	
Immersion	I spent a lot of time and energy in this activity	Chen (2003)
	I always paid attention to the information of this kind of activity	
	I would think about how I can play better and rank higher	
	It's easy for me to enjoy pleasure from the whole activity	
	I think I like this marketing activity of gamification	
Evaluation of Marketing Activities	I think this marketing activity of gamification is attractive	Li and Huang (2005)
	I think this marketing activity of gamification is impressive	
	I don't think this marketing activity of gamification appeals to me	

4.2 Measurement

In order to enhance the validity of the survey scales, we adapt constructs and items from past studies. Specifically, the items measuring external reward were adapted from Zhong, Wang and Qiu (2011); the items measuring interactive competition were adapted from the 5 items used by Chiu, Hsu and Wang (2007). Scales for perceived enjoyment were adapted from the 4 items of perceived enjoyment used by Hassan, Kouser and Abbas (2014). And the items measuring immersion were adapted from Chen (2003). The items measuring evaluation of marketing activities were adapted from Li and Huang (2005). All constructors and the corresponding measurement items were presented in table 2. All the items were measured using seven-point Likert scale anchored from "strongly disagree" to "strongly agree". Items were translated from English into Chinese and given to 5 information systems professors who were proficient in both languages to reverse translation. We then carefully considered all controversial translations by adjusting item wording.

4.3 Sample Characteristics

A total of 352 students participated in this survey. All participants were recruited in a public university offline. Participants mainly contain students, and faculties. After deleting the incomplete questionnaires, a total of 348 questionnaires were used for data analysis. As is shown in Table 1, there were 197 females (56.6%) having completed this questionnaire. Age ranged from 18 to 25 (75.8%) were the main respondents. Among all participants, 10 (2.9%) had middle school degree or below, 20 (5.7%) had high school degree or secondary, 34 (9.8%) had junior college, 266 (76.4%) had bachelor degree or are undergraduate students, and 18 (5.2%) had graduated from a postgraduate degree or are graduate students. Further, the results showed that the frequency of participation in gamification. 89.9% of participants participated gamification, while 35 (10.1%) participants said that they had never been involved in gamification. The descriptive information of survey respondents is shown in table 3.

Table 3 Demographics information

Measure	Item	Frequency	Percentage (%)
Gender	Total	348	100%
	Male	151	43.4%

Age	Female	197	56.6%
	Total	348	100%
	<18	27	7.8%
	18-25	264	75.8%
	26-40	57	16.4%
	41-60	0	0%
Education level	Total	348	100%
	Middle school and below	10	2.9%
	High school and secondary	20	5.7%
	Junior college	34	9.8%
	University	266	76.4%
	Master or above	18	5.2%
Frequency of participation in gamification	Total	348	100%
	usually	122	35.1%
	occasionally	191	54.8%
	never	35	10.1%

4.4 Data Analysis

The survey data was analyzed by using SPSS. SPSS is a suitable choice for analyzing regression and descriptive statistics. SPSS 20.0 was used for data analysis.

RESULTS

5.1 Measurement Reliability and Validity

Convergent validity was assessed by reliability of items and factor analysis results (Hair *et al.* 2009). Examining each item's loading on its corresponding construct assesses reliability of items (loading >0.7). Regarding internal consistency (reliability), Cronbach's alpha scores for every construct in our research were all above 0.80, which is above the suggested benchmark for acceptable reliability.

KMO and Bartlett sphericity test are used to detect structural validity. KMO is between 0 and 1, and the closer the KMO value is to 1, the stronger the correlation between variables, and the more suitable for factor analysis. The value of the sphericity of Bartlett is used to test whether the correlation coefficient between items is significant or not. If sig.<0.05, it is suitable for factor analysis (Table 4). As is shown in table, sig.=0.000 (KMO=0.900, 0.932), and it proves the acceptable reliability. Then we did the factor analysis. In this study, the loading of each item met the criterion (Table 5).

We used item loadings and cross loadings to assess convergent validity and discriminate validity by a confirmatory factor analysis (CFA). All the indicator loadings exceed 0.710, and all items load higher on their specified constructs than on other constructs, demonstrating sufficient convergent validity and discriminate validity, as shown in table 6.

Table 4 Cronbach's alpha scores

	Cronbach's Alpha	Number of items
external reward	0.896	6
interactive competition	0.860	4
perceived enjoyment	0.848	4
immersion	0.887	5
evaluation of marketing activities	0.844	3

Table 5 KMO and Bartlett sphericity test

Variable	KMO	Bartlett		
		Chi-square	df	Sig.
external reward	.900	4013.500	325	.000
interactive competition	.932	3893.252	528	.000

Table 6 Exploratory Factor Analysis Results

	1	2	3	4
External Reward 1	.159	.771	.405	.048
External Reward 2	.033	.763	.181	.222
External Reward 3	.113	.792	.296	.102
External Reward 4	.325	.715	.215	.240
External Reward 5	.176	.723	.185	.260
Interactive Competition 1	.196	.191	.761	.188
Interactive Competition 2	.265	.229	.798	.111
Interactive Competition 3	.143	.342	.691	.257

Interactive Competition 4	.188	.250	.753	.180
Perceived Enjoyment 1	.195	.814	.159	.193
Perceived Enjoyment 2	.220	.755	.195	.121
Perceived Enjoyment 3	.073	.740	.246	.157
Perceived Enjoyment 4	.160	.740	.254	.022
Immersion 1	.706	.109	.140	.125
Immersion 2	.705	.267	.164	.165
Immersion 3	.820	.092	.171	.110
Immersion 4	.821	.178	.107	.047
Immersion 5	.786	.100	.208	.169
Evaluation of Marketing Activities 1	.199	.194	.218	.800
Evaluation of Marketing Activities 2	.116	.169	.211	.813
Evaluation of Marketing Activities 3	.171	.094	.150	.842

5.2 Common Method Bias

It is well documented that the effect of common method bias (CMB) arises from self-reported data and other sources (e.g., social desirability) (Mac Kenzie and Podsakoff, 2012). Harman's single-factor test is regarded as the most common method to test the common method bias, in which all measures were introduced into a principal component analysis with varimax rotation. By conducting factor analysis in SPSS, it was revealed that the first principal component accounts for less than 30% of variance, suggesting that this component did not account for the majority of the variance (<50%). Therefore, common method bias is not a big issue in this study.

5.3 Hypothesis Testing

By conducting regression analysis, it was found that external reward has a positive effect on evaluation of marketing activities ($b=.363$, $t=3.6517$, $p=.0000$) (a-path), supporting H1(a). Further, interactive competition positively influences on evaluation of marketing activities ($b=.4227$, $t=4.7267$, $p=.0000$) (a-path), supporting H1(b). The hypothesis testing is shown in table 7.

Following Baron and Kenny's (1986) steps, we tested the mediating effects. First, we found that external reward on immersion was significant ($b=.4902$, $t=6.4127$, $p=0.0230$), and immersion on the effect on consumers' evaluation of marketing activities was also (c-path) ($b=.3717$, $t=4.6892$, $p=0.0000$). Further, the mediating role of immersion on the external reward on evaluation of marketing activity is also significant ($b=0.3717$, $t=4.6892$, $p=0.0000$), supporting H3(a).

First, we found that interactive competition on immersion was significant ($b=.5075$, $t=8.2821$, $p=0.0230$), and immersion on the effect on consumers' evaluation of marketing activities was also (c-path) ($b=.3717$, $t=4.6892$, $p=0.0000$). Further, the mediating role of immersion on the interactive competition on evaluation of marketing activity is also significant ($b=0.1766$, $t=2.2919$, $p=0.0230$), supporting H3(b).

However, it was found perceived enjoyment did not mediate the effect of external reward on evaluation of marketing activity ($b=0.1065$, $t=1.1077$, $p=0.2698$), and perceived enjoyment also did not mediate the effect of interactive competition on evaluation of marketing activity ($b=0.0988$, $t=1.1139$, $p=0.2667$). Thus, H2(a) and H2(b) were not supported. And the tests of research hypothesis are shown in table 7.

Table 7 Hypothesis Testing

	Paths	Coefficient	t-statistics	p
Independent variable→ dependent variable (a path)	External Reward→ Evaluation of Marketing Activities	.3630	3.6517	.0000
	Interactive Competition → Evaluation of Marketing Activities	.4227	4.7267	.0000
Independent variable→ mediator (b path)	External Reward→ Perceived Enjoyment	.6935	11.0022	.0000
	External Reward→ Immersion	.4902	6.4127	.0000
	Interactive Competition → Perceived Enjoyment	.6121	11.5034	.0000
	Interactive Competition → Immersion	.5075	8.2821	.0000
		.1065	1.1077	.2698
Mediators→ dependent variable (c path)	Perceived Enjoyment → Evaluation of Marketing Activities (External Reward)			
	Immersion → Evaluation of Marketing Activities (External Reward)	.3717	4.6892	.0000
	Perceived Enjoyment → Evaluation of Marketing Activities (Interactive Competition)	.0988	1.1139	.2667
	Immersion → Evaluation of Marketing Activities (Interactive Competition)	.1766	2.2919	.0230

Table8: Tests of research hypothesis

Proposed	Paths	Hypothesis tests
H1a	External Reward→ Evaluation of Marketing Activities	supported
H1b	Interactive Competition → Evaluation of Marketing Activities	supported
H2a	Perceived Enjoyment → Evaluation of Marketing Activities (External Reward)	nonsupport
H2b	Perceived Enjoyment → Evaluation of Marketing Activities (Interactive Competition)	nonsupport
H3a	Immersion → Evaluation of Marketing Activities (External Reward)	supported
H3b	Immersion → Evaluation of Marketing Activities (Interactive Competition)	supported

DISCUSSION

This study examines the effects of external reward and interactive competition on consumers' evaluation of marketing activities. By conducting a survey, it was found that external reward and interactive competition in gamification have positive effects on consumers' positive evaluation of marketing activities. Further, we found that the impact of external reward and interactive competition on consumers' evaluation of marketing activities are mediated by immersion. However, perceived enjoyment didn't mediate the effect on external reward and interactive competition on consumers' evaluation of marketing activities. This may be because that perceived enjoyment as emotional response does not influence the evaluation of marketing activities.

6.1 Theoretical Implications

This study makes several important theoretical contributions. First, this study contributes to literature in gamification by identifying factors impacting consumers' evaluation of marketing activities. Previous research did not combine the elements of gamification with customers' evaluation. We explored the role of external reward and interactive competition on consumers' evaluation of marketing activities. This paves a way for future study on the other elements of gamification for customers.

Second, this study contributes to the literature in marketing by connecting gamification and marketing fields. Previous study on gamification just emphasized the elements, rather than applying it to marketing. Thus, we combine the elements of gamification in marketing and explore the effects of two gamification elements on the evaluation of marketing activities in marketing to broaden the marketing theory.

Third, this study contributes to literature in gamification by exploring the impact of the perceived enjoyment and immersion. Previous research on gamification didn't involve the mediators. Through data analysis, we found that the impact of external reward and interactive competition on consumers' evaluation of marketing activities are mediated by immersion.

6.2 Practical Implications

This research also provides insights for firms and game administrators on how to encourage customers to generate purchase intention and purchase behavior by designing more gamification elements. Specifically, this study contributes to practice in three ways. First, our results suggested that firms should design more external reward on gamification to attract customers. For cosmetic firms, they can carefully design point external rewarding games online to attract customers. Cosmetic firms can give customers some discount or coupons of their products when customers start to brow their website or advertisement. In so doing, according to our results, such external reward can greatly enhance consumers' evaluation, which in turn may increase their purchase intention. For example, firms can set point rewarding. By making reasonable rules, participants can earn points. When points reach a certain level, they can exchange for what they want.

Second, our results also show that it is critical to design appropriate interactive competition on gamification. Interactive competition can enhance consumers' experience and communication effects. When interacting among themselves, consumers can make new friends and learn more skills and knowledge from others, which in turn increase their happiness. Besides, consumers can communicate their opinion and suggestions about the products. Competition can cultivate their abilities in all aspects and inspire their potential. For example, the company can design a game for group participation. The group needs 3 to 8 players, and they need to compete with other groups in order to win.

Third, designers could attempt to reinforce users' sense of immersion. Our findings suggest that the sense of immersion can influence the customers' evaluation on gamification. Thus, companies can develop good products and service that can increase users' sense of immersion. There are various ways that can enhance users' sense of immersion. For example, companies can design some games, which have excellent story plot and picture. In that way, users can immerse themselves in it, and have purchasing intention.

6.3 Limitations and Future Directions

Although we made efforts to innovate in research angle and method of this study, there were still some deficiencies, which were summarized as follows, providing certain enlightenment for similar research in the future.

First of all, the study sample size is not big enough. The samples focus more on the students, which can't represent the whole situation. Therefore, in future studies, the sample size should be expanded as much as possible, and questionnaires should be collected in more places to improve the sample representation.

Second, the game for academic research subject is relatively immature. Thus, it lacks the perfect theoretical framework. And

there is no more authoritative measurement scale now. Although in this paper, some other research dimensions are used to design the measurement scale, the items may not be comprehensive and accurate enough.

Finally, considering the huge amount of work, this study is just select two elements, which are external reward and interactive competition. It can be conducted on other gamified elements, as well as the differences in consumers' perceived value and purchase intention to different gamified elements in the future, so as to have a deeper understanding of consumers' views on gamified marketing to enterprises.

ACKNOWLEDGMENT

This work is partially supported by the National Natural Science Foundation of China (Project No.71602122), the National Natural Science Foundation of China (Project No. 71702111), and the National Natural Science Foundation of China (Project No. 71572116).

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The Impact of Perceived Risk on Customers' Intention to Use -- An Empirical Analysis of DiDi Car-Sharing Services

(Full Paper)

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ABSTRACT

With the development of internet and modern technologies, sharing economy grows quickly and attracts more attention. Sharing platforms have more uncertainty and perceived risk, which influences the customers' intention to use. In this paper, we take DiDi, a ridesharing platform in China as a case to study. We take the perspective of customers and investigate the implications of perceived risk and trust on customers' intention to use. We conceptualized perceived risk as a multi dimension construct and differentiate trust on DiDi and trust on drivers. The study employs survey data (n = 365) and structural equation modeling (SEM). Our results provide empirical evidence for the relationship between perceived risk, trust and customers' intention to use. This research has both significant theoretical and practical implications. It applies the theory of perceived risk and trust in Chinses situation. In practice, the ridesharing platform need to pay more attention to the security of customers, thus more speculation and control on drivers are expected.

Keywords: perceived risk, trust, sharing economy.

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INTRODUCTION

In recent years, the consumption habits of customers in China have changed a lot. With the development of modern technology and information system, a new culture of sharing has been more and more popular especially among young people. The Chinese government also state to support and introduce the development of sharing economy. Nowadays, sharing economy is present in various industries like hospitality and ride sharing industry. In this paper, we focus on the ride sharing platform DiDi, which is the most widely used platform in China.

DiDi is the world's leading mobile transportation platform. The company offers a full range of app-based transportation options for 550 million users, including Taxi, Express, Premier, Luxe, Hitch, Bus, Minibus, Designated Driving, Enterprise Solutions, Bike Sharing, E-bike Sharing, Car Sharing and food delivery. There are 30 million daily rides in DiDi, allowing over millions of drivers on the DiDi platform to find flexible work and income opportunities. In this paper we specially pay attention to one of its service -- DiDi Hitch. Using smart route-matching algorithms, DiDi Hitch share mobility among car owners and passengers on the same route, thereby boosting the vehicle utilization rate and decreasing energy consumption.

As several studies have showed, the key to long-term success for a company is to build consumer trust, but consumer trust is negatively influenced by perceived risk. As a result, it is vital to evaluate the risk factors affecting trust in online consuming. In sharing economy, most transactions are based online, but when it comes to providing service, the service provider still need to interact with customers offline, which means higher risk than traditional P2P e-commerce platform. Besides potential financial loss, the customers may even confront potential security risk. The sensational news that an airline stewardess being murdered by a DiDi driver in China caused panic in the society. Consequently, the perceived risk for customers may be higher than before, and in the end, it may change their intention to use, which is a valuable issue to study.

As shown in the existing literature, perceived risk and trust are main drivers of customers' intention to use in the background of sharing economy (Mittendorf, 2017a). So how does increasing perceived risk influence the customers' intention to use? How does it influence customers' trust? The main purpose of this study is to examine the impact of perceived risk on customers' intention to use. To answer this research question, we introduce trust as a mediating variable, dividing it into trust on the platform and trust on the service provider.

This paper has been organized in the following order: the second section reviews the theoretical background and the third part develops the hypothesis and research model. Section four explains the research methodology. Then the data are analyzed and the results are discussed in section five. Finally, section six presents the conclusions and suggestions for future research.

THEORETICAL BACKGROUND

In this section, the literature is reviewed from four perspectives. In the first part, sharing economy is reviewed. In the second and third part, perceived risk and trust are reviewed respectively. Then the forth part reviewed the relationship between perceived risk and trust.

Sharing economy

Based on the current literature, there is no specific definition of sharing economy yet, but it can be regarded as an umbrella term including access-based consumption, collaborative consumption, commercial sharing systems and so on, all of which share a common feature: making underutilized assets available to a large online community (Hawlitschek, Teubner, & Gimpel, 2016). Nowadays, people no longer focus on product ownership but emphasize on the product usage. In sharing economy, the access to product may be limited, but this innovative concept also reduces the transaction cost because it saves the cost of ownership (Hawapi, Sulaiman, Abdul Kohar, & Talib, 2017). In this paper, we assign DiDi to the sharing economy as we regard sharing as the intention to provide temporary access to private goods and services without transferring ownership. In this regard, we are in line with researchers such as Hall and Royles (2018) and Mittendorf (2017a).

As an online sharing platform, DiDi uses location-based services in order to connect drivers and potential customers with each other over a smart phone application. Compared with other sharing economy platforms like Airbnb, DiDi's customers are not able to evaluate specific details about their service counterpart before ordering a transportation service. When customers request a ride, the app sends the request to nearby drivers to pick them up at the pickup location, the driver can choose whether to take the order or not. It is impossible to evaluate an available driver in advance, nor is it possible for customers to order a specific driver, which significantly increases the uncertainty. As a result, the perceived risk is higher than normal sharing platforms (Mittendorf, 2017a).

Perceived risk

The original concept of perceived risk is extending out from psychology by Bauer in 1960. According to Bauer, there is risk for consumers' behavior in that their purchasing actions will lead to consequences which cannot be anticipated with anything approximating certainty, and some of which at least are likely to be unpleasant. According to this concept, the consumer's choices are divided into risk-increasing or risk decreasing behavior. Consumers try to reduce perceived risk by searching for information which enables them to gain more confidence and avoid uncertainty (R.A.Bauer, 1960).

The definition of perceived risk is varied. In the field of e-commerce, perceived risk refers to the customer's thought and belief in the likelihood of having an adverse outcome and consequence in online and electronic trading (Kim, Ferrin, & Rao, 2008). Perceived risk has been regarded as one of the most core motivators in consumer behavior. The relationship between perceived risk and user's intentions has long been verified by the Theory of Reasoned Action (TRA). Research stated that high degrees of perceived risk increase negative expectations, which creates an unfavorable attitude that ultimately results in a negative influence on transaction intentions (Paul A Pavlou & Gefen, 2004).

In e-commerce, because there is no face to face communication, consumers cannot examine products before their purchase, so uncertainty is more salient and perceived risk attracts more attention than traditional commerce (Chiu, Wang, Fang, & Huang, 2013). The increasing information asymmetry between buyers and sellers also increases the perceived risk of buyers and reduces their buying intentions (Verhagen, Meents, & Tan, 2006).

In a theory known as perceived risk theory (PRT), researchers have considered perceived risk as a combination of several facets. Facet, also called as type or dimension in research literature. Bauer initially proposed perceived risk, but not involved specific types. Jacoby and Kaplan (1972) identified five types of perceived product risks, which are financial risk, performance risk, social risk, physical risk, and psychological risk. Under the new Internet environment, scholars also adjusted the model according to the development of technology, economy and society, more and more dimensions are identified. For example, Jarvenpaa and Todd (1996) firstly proposed privacy risk as a dimension of perceived risk in online shopping. Through the researches by far, it can be concluded that there is no agreement on the dimensions of perceived risk, researches on perceived risk divide it into different dimensions according to different situations. However, not all dimensions of perceived risk were found to have significant effects on consumer's behavior (Lim, 2004). So, there is a need to examine the effect of different dimensions of perceived risk on consumer's behavior in sharing economy.

Trust

In uncertain situations, when consumers have to make a decision, trust comes into play as a solution for specific problems of risk. Trust is regarded as one of the most significant factors for the success of e-commerce, as a result, many studies have been conducted on trust across various disciplines such as anthropology, psychology, social psychology and sociology. As a research object, trust is conceptualized and defined in many different ways according to different disciplines. In this paper, we define trust as "the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party (Mayer, Davis, &

Schoorman, 1995). There were many researchers who conducted studies on trust. Many of the original researches on trust come from psychologists and sociologists, trying to assess the building and implications of trust in interpersonal and inter organizational relationships (Kurdjokova *et al.*, 2013).

Previous research has shown that trust is a complexity-reduction mechanism, which is significant to initiate and retain interpersonal and commercial relationships (Mcknight & Chervany, 2001). Trust is noted for being particularly influential in online environment, such as in e-commerce industry, where products are sold and purchased on platforms with unknown counterparts (Paul & Gefen, 2004).

Studies on the implications of trust in the sharing economy, however, is lack, particularly the ride sharing industry (Mittendorf, 2017b). DiDi combines special attributes together, such as one-time shared rides on short notice between private individuals, the usage of a mobile application, transparency of GPS location, interactions with strangers. As a result, trust plays an imperative role and have extensive implications in this industry (Chen, Zhang, & Xu, 2009). Overall, the results of researches in the sharing economy for different industries seem to be inconsistent. Hence, there is an upcoming need to continue research on trust in sharing economy.

Generally, trust can be divided to trust on the intermediary and trust on service provider. Trust on the intermediary, hereinafter referred to as trust on DiDi, means consumers' confidence that DiDi will behave in a favorable way, which makes users comfortable to use the app and helps them to overcome perceptions of risk and insecurity. Trust on service provider, hereinafter referred to as trust on drivers, means consumers' willingness to rely on favorable future actions of drivers to overcome perceptions of risk and insecurity. By separating trust on DiDi from trust on drivers we can further assess the influence of the respective trust construct on the customers' intention to use, which is more relevant in practice (Mittendorf, 2017b).

Perceived risk and trust

There is no agreement on the relationship between perceived risk and trust based on the existing literature. Although closely related, it is still unknown how they are related. To put it in another way, it is unclear whether risk is an antecedent to trust, or is an outcome of trust. Various researchers found empirical evidence of the negative relationship between perceived risk and online trust (Pappas, 2016; Zhang, Tang, Lu, & Dong, 2014). A quantity of researches have proved empirically that trust has a negative effect on perceived risk. For example, Paul A. Pavlou (2003) found that with the consumers' trust increase, the perceived risk is reduced. Cheung and Lee (2000) regarded trust as an antecedent of perceived risk, and their model shows that in online purchase, customers' trust in internet vendors is negatively related with their perceived risk. Some researches proposed that perceived risk is the antecedent of trust and the relationship is non-recursive (Mitchell, 1999). Some researchers, however, proved that perceived risk could be a vital predictor of trust. If the risk is expected to outweigh the perceived benefit, trust will not present. As is stated by Olivero and Lunt (2004), the perception of a high level of risk may reduce the level of trust in the online transaction. In this study, we are in line with the last point of view and propose that perceived risk has a significant negative effect on trust.

HYPOTHESIS DEVELOPMENT AND RESEARCH MODEL

In this study, we propose a modified research model which allows us to analyze the impact of perceived risk and trust on the customers' intention to use in sharing economy. Our constructs and items are adopted from previous literature and slightly modified to represent the sharing economy platform in our case - DiDi.

Perceived risk

In this paper, we choose five facets of perceived risk, each facet is defined both generally and in the field of sharing economy, and the importance of each dimension in sharing economy is also pointed out. As is discussed in the literature review, existing researches support that perceived risk are likely to negatively related with consumers' trust.

Financial risk

It refers to the likelihood of financial loss in addition to the product or service maintenance costs as the result of purchasing (Khedmatgozar & Shahnazi, 2017). In sharing economy, consumers may worry that they will be overcharged for a ride, or that their financial information will fall into wrong hands.

Generally speaking, DiDi is cheaper than traditional taxi, and customers can track the journey to see if drivers go off the planned route. Customers can have an idea of how much it will cost before departure, which is an important factor before making a decision. However, some customers may concern that the end price of the journey may differ from the suggested price that is offered by the app before the journey (Hall & Royles, 2018). Some news in China shows that some drivers of DiDi use certain app to make the end price higher than the initial price, which decreases customers' trust for drivers. Thus, we proposed that perceived financial risk has a negative relationship with customers' trust.

H1a: *Perceived financial risk has a negative relationship with trust on DiDi.*

H1b: *Perceived financial risk has a negative relationship with trust on drivers.*

Security risk:

It generally refers to hazards to the health or appearance of consumers and physical exhaustion and mental capacity devoted to the purchase (Hall & Royles, 2018). It is similar to the perceived physical risk, which can be defined as the possibility that products are harmful to individuals' health (Lim, 2004).

In our case, consumers may worry that the driver has not been properly vetted by the company, and is a bad driver. Some drivers may be irresponsible and break traffic rules, some even check their cellphone while driving. Unlike taxi drivers, who take driving as their main job, DiDi drivers only do this as their part-time job so they are not as professional and well trained as taxi drivers. In addition to this, female consumers in particular may concern that the driver will sexually harass them or physically assault them. After the breaking news of an airline stewardess being murdered by the DiDi driver, the perceived security become more salient. Especially for DiDi Hitch, in which the route is relatively long, the possibility of crime can be higher. Based on these phenomena, we propose that:

H2a: *Perceived security risk has a negative relationship with trust on DiDi.*

H2b: *Perceived security risk has a negative relationship with trust on drivers.*

Performance risk:

It is defined as the consumer's perception that the product or service may fail to meet their requirements (Jarvenpaa & Todd, 1996). To put it in another way, it refers to the possibility of bad performance of the product or service in way that cannot satisfy the claimed benefits or facilities (Khedmatgozar & Shahnazi, 2017). In our case, consumers may be concerned that the car will experience mechanical problems or a complete breakdown in the way to destination. Some people may perceive DiDi as having a higher level of performance quality because it is a big corporate company rather than as small local business (Hall & Royles, 2018). However, most of DiDi Hitch drivers are non-professional drivers and they are likely to be unfamiliar with certain road or places. Although all the drivers have driving license, some of them may break the traffic rules, which increase the risk (Hall & Royles, 2018). Because most of drivers are not trained professionally, the perceived performance risk may be higher. Consequently, we propose:

H3a: *Perceived performance risk has a negative relationship with trust on DiDi.*

H3b: *Perceived performance risk has a negative relationship with trust on drivers.*

Social risk:

This dimension of perceived risk is related to the likelihood of losing the position of an institution in a social group as the result of using a product or service that seems to be stupid (Khedmatgozar & Shahnazi, 2017). As for the potential social risks of using DiDi, consumers may worry that their peers and neighbors will negatively judge them for using the service. Generally, DiDi is considered as innovative and trendy, some people think that using this kind of service will have a positive effect on their social status (Hall & Royles, 2018). But for DiDi Hitch, customers may need to take more time if there are more than one customer in a car and their destination is differed. Compared to drive your own car, using DiDi Hitch may be a problem for those who care about their position and image in other people's mind. Thus, we propose:

H4a: *Perceived social risk has a negative relationship with trust on DiDi.*

H4b: *Perceived social risk has a negative relationship with trust on drivers.*

Psychological risk

Psychological risk is the possibility that individuals suffer mental stress because of their purchasing behavior (Jacoby & Kaplan, 1972). For example, while using DiDi, the customers may be anxious about being in the same cab with someone they don't like. Some drivers like to communicate with customers while some customers do not like to talk with other people. Besides, in DiDi Hitch, the counterparts who share the service together will also increase the perceived psychological risk because you can never anticipate who you will share the journey with. With the worry about the drivers and counterparts, the trust of customers may decrease. Hence, we propose:

H5a: *Perceived psychological risk has a negative relationship with trust on DiDi.*

H5b: *Perceived psychological risk has a negative relationship with trust on drivers.*

Trust

In terms of trust on the platform and the drivers, Hong and Cho (2011) argue that platform trust is the only driver of user intentions in an intermediary framework. Mittendorf (2016) found that platform trust and customer trust have a significant positive effect on the user's intention to accept a booking request on Airbnb. Kim et al. (2008) had shown direct relationship between trust and

intention to use.

Mittendorf (2017b) had found that trust in Uber positively influences the customers' intentions. Therefore, we expect that increases in trust will directly and positively affect users' intentions in the sharing economy. In other words, we assume that the user's intention to use rises with increased degrees of trust (Chen et al., 2009). In addition, if customers trust the platform, they are more likely to trust the service provider in the platform, thus we expect that trust on collective consumption platform will influence the trust on drivers. Based on the earlier arguments, we propose:

H6: Trust on DiDi has a positive relationship with customer's intention to use.

H7: Trust on drivers has a positive relationship with customer's intention to use.

H8: Trust on DiDi has a positive relationship with trust on drivers.

Based on the literature and discussion, we proposed the research model as shown in figure 1.

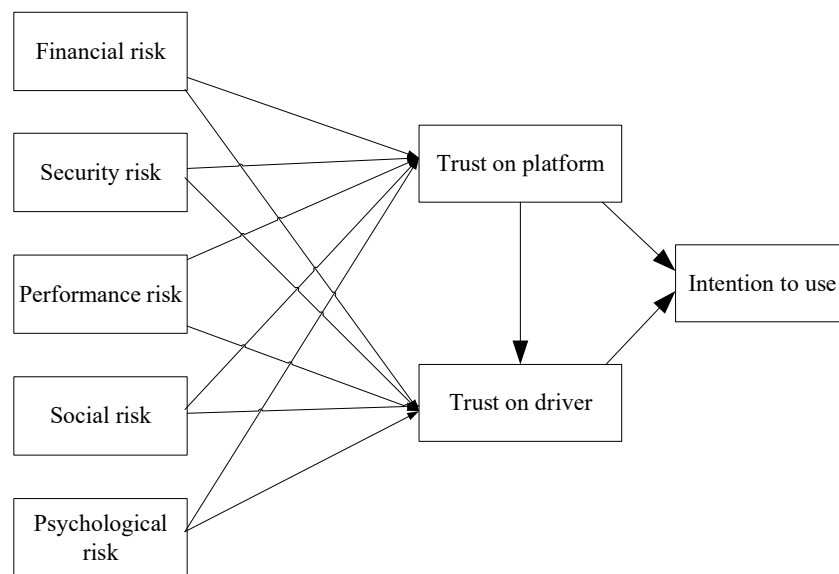


Figure 1: The model of the study

RESEARCH METHODOLOGY

Based on the related literates (Ert, Fleischer, & Magen, 2016), we designed a questionnaire. Firstly, we collected all the items about perceived risks, trust and consumer behavior in previous literature. Then, we adjusted some items according to our situation. At last, we got our final questionnaire, in which there are 15 measurement items listed for part 1 used to measure five different dimensions of perceived risk, and the other 6 items for part 2 used to measure trust, and 3 items for part 3 to measure customers' intention to use. A five-point Likert scale was used to measure the respondents' view ranging from "strongly disagree" to "strongly agree" to measure these items. The questionnaire measuring each construct and their references are showed in the following table 1.

Table 1: The questionnaire.

Construct	Code	Item	Reference
Perceived financial risk	FI1	I would be concerned that the payment method may not be safe.	Hong (2015)
	FI2	I would be concerned that the price of this product may be too high.	
	FI3	I would be concerned that I may suffer from monetary loss due to the seller's fraudulent acts.	
Perceived security risk	SE1	I might get physically hurt during the journey.	Malazizi, Alipour, and Olya (2018)
	SE2	I could be subject to a crime during the journey.	
	SE3	I may have a car accident during the journey.	
Perceived performance risk	PE1	There is high likelihood that the car I want will not be available when I want it.	Hawapi et al. (2017)
	PE2	There is high likelihood that the car I want will not arrive on time.	
	PE3	I cannot examine the quality of DiDi car.	
Perceived social risk	SO1	By sharing a car, my peers will regard me as a stingy person.	Hawapi et al. (2017)
	SO2	My friends would approve of the sharing option.	
	SO3	My family would approve of the sharing option.	

Perceived psychological risk	PS1	I feel anxious about accommodating an undesirable driver.	Malazizi et al. (2018)
	PS2	I feel pressure because of potential losses in payment.	
	PS3	I feel anxious about socio-cultural conflicts with drivers.	
Trust on the platform	Ptr1	I feel that DiDi is trustworthy.	Mittendorf (2017b)
	Ptr2	I feel DiDi is reliable.	
	Ptr3	Even if not monitored, I would trust DiDi to do the right job.	
Trust on the driver	Dtr1	I trust the drivers using DiDi.	Mittendorf (2017b)
	Dtr2	I believe that the drivers on DiDi are trustworthy.	
	Dtr3	Even if not monitored, I would trust drivers on DiDi.	
customers' intention to use	In1	All things I considered, I expect to continue collaborative consumption often in the future.	Hawapi et al. (2017)
	In2	Compared to other means, I like collaborative consumption more.	
	In3	Compared to other means, I am inclined to choose collaborative consumption.	

To ensure content validity of the questionnaire, it was piloted with 10 participants. Also, in order to reduce the rate of non-response, introduction letter at the top of the questionnaire was used. The main survey was conducted in July 2018. There are 365 respondents for the main survey, while 19 of them are incomplete. Overall there are 364 valid answers collected. Table2 provides the profile of the respondents.

Table 2: The respondents' profile.

Attribute	Value	Frequency	Percentage
Gender	Male	133	38.44
	Female	213	61.56
Age groups	Twenties	259	74.86
	Thirties	51	14.74
	Forties	36	10.40
	Below RMB 2000	236	68.21
Monthly income	RMB 2000-5000	96	27.75
	Above RMB 5000	14	4.05

RESULT AND DISCUSSION

Measurement model testing

To examine the reliability of the constructs, SPSS 19.0 was used to evaluate internal consistency, which refers to what extent can the scale items provide consistent results. Cronbach's alpha coefficient was used to test the internal consistency. If Cronbach's alpha is 0.7 or higher for each construct, the reliability is suggested good (Nunnally, 1978). As shown in table 3, the lowest α coefficient is 0.785 for social risk, which exceed 0.7. Other coefficients all exceed 0.8, which represents sufficient reliability of measurements and good internal consistency among the scale items.

Table 3: Reliability of the measurement model.

Scale	Number of items	Cronbach's α
Financial risk	3	0.815
Security risk	3	0.943
Performance risk	3	0.840
Social risk	3	0.785
Psychological risk	3	0.862
Trust on platform	3	0.911
Trust on driver	3	0.922
Intention to use	3	0.886

Table 4: Correlation matrix.

Variables	PS	SO	PE	SE	FI	Dtr	Ptr	In
Psychological risk	1.000							

Variables	PS	SO	PE	SE	FI	Dtr	Ptr	In
Social risk	.063	1.000						
Performance risk	.349	.135	1.000					
Security risk	.460	.192	.496	1.000				
Financial risk	.595	.134	.557	.545	1.000			
Trust on driver	-.336	-.274	-.297	-.401	-.291	1.000		
Trust on platform	-.219	-.323	-.313	-.329	-.220	.213	1.000	
Intention to use	-.150	-.199	-.196	-.215	-.146	.211	.555	1.000

To examine the validity of the constructs, Amos 20.0 was used to conduct a confirmatory factorial analysis (CFA). We tested the validity for three types: convergent validity, discriminant validity, and nomological validity, which represent whether we measure indicators as what we designed to measure. The results show that the construct validity of all types are significant and sufficient. For convergent validity, as shown in table 5, the lowest value of the standardized factor loading is 0.714(>0.7), the lowest value of the average variance extracted (AVE) is 0.551(>0.5), and the lowest value of the composite reliability is 0.786(>0.7), demonstrating sufficient convergent validity. For discriminant validity, as shown in table 4 and table 5, the lowest AVE value is 0.551, which is higher than the square of the highest inter-correlation coefficient (0.354), representing good discriminant validity. For nomological validity, as shown in table 4, all dimensions of risk are presented negative relationships with trust on platform and trust on driver, and trust is presented positive relationships with intention to use, as posited in the hypotheses.

Table 5: Confirmatory factor analysis of the measurement model.

Latent variables	Item variable	Factor loadings	Standardized factor loadings	AVE	Composite reliability
Financial risk	FI1	1.000	.811	.608	.823
	FI2	.901	.797		
	FI3	.973	.729		
Security risk	SE1	1.000	.880	.849	.944
	SE2	1.140	.950		
	SE3	1.100	.932		
Performance risk	PE1	1.000	.768	.641	.842
	PE2	1.070	.803		
	PE3	1.094	.829		
Social risk	SO1	1.000	.714	.551	.786
	SO2	.992	.740		
	SO3	1.006	.771		
Psychological risk	PS1	1.000	.833	.678	.863
	PS2	1.052	.855		
	PS3	.897	.780		
Trust on platform	Ptr1	1.000	.866	.784	.916
	Ptr2	1.188	.961		
	Ptr3	1.008	.825		
Trust on driver	Dtr1	1.000	.890	.798	.922
	Dtr2	1.095	.925		
	Dtr3	1.033	.864		
Intention to use	In1	1.000	.776	.728	.889
	In2	1.214	.887		
	In3	1.216	.891		

Hypothesis Testing

Our research tests the hypothesis by structural equation modeling (SEM). As shown in table 6, the goodness of model fit is quite satisfactory ($X^2/df = 1.54$, $IFI = 0.979$, $PNFI = 0.781$, $RMSEA = 0.04$). Then, as shown in table 7 and figure 2, the result of the hypothesis testing reveals that the effect of trust on driver on intention to use, the effects of financial risk and psychological risk on trust on platform, and the effects of financial risk, performance risk and social risk on trust on driver are not significant. Thus, H1a, H5a, H1b, H3b, H4b and H7 are not supported. Besides, security risk has a significant and negative effect on trust on platform ($\beta = -$

0.171, $p < 0.05$) and trust on driver ($\beta = -0.109$, $p < 0.05$), thus supporting H2a and H2b. In addition, performance risk ($\beta = -0.245$, $p < 0.01$) and social risk ($\beta = -0.331$, $p < 0.001$) have significant and negative effects on trust on platform, thus supporting H3a and H4a. Moreover, psychological risk has a significant and negative effect on trust on driver ($\beta = -0.145$, $p < 0.05$), thus supporting H5b. Furthermore, trust on platform has a significant and positive effect on intention to use ($\beta = 0.615$, $p < 0.001$), providing support for H6. Finally, trust on platform has a significant and positive effect on trust on driver ($\beta = 0.736$, $p < 0.001$), thus supporting H8.

Table 6: Goodness of fit test result.

Category	Measure	Value	Acceptable values	Source
Absolute fit indices	$\chi^2/d.f$	1.54	5 or below	Hair, Black, Babin, and Anderson (2010)
	GFI	.924	0.90 or above	Hair et al. (2010)
	RMSEA	.04	0.08 or below	Browne and Cudeck (1993)
	SRMR	.045	0.08 or below	Hu and Bentler (1999)
Incremental fit indices	NFI	.941	0.90 or above	Bentler and Bonett (1980)
	RFI	.929	0.90 or above	Hu and Bentler (1999)
	IFI	.979	0.90 or above	Bentler and Bonett (1980)
	TLI	.974	0.90 or above	Hu and Bentler (1999)
	CFI	.978	0.90 or above	Hair et al. (2010)
Parsimony fit indices	PNFI	.781	0.50 or above	Bentler and Bonett (1980)

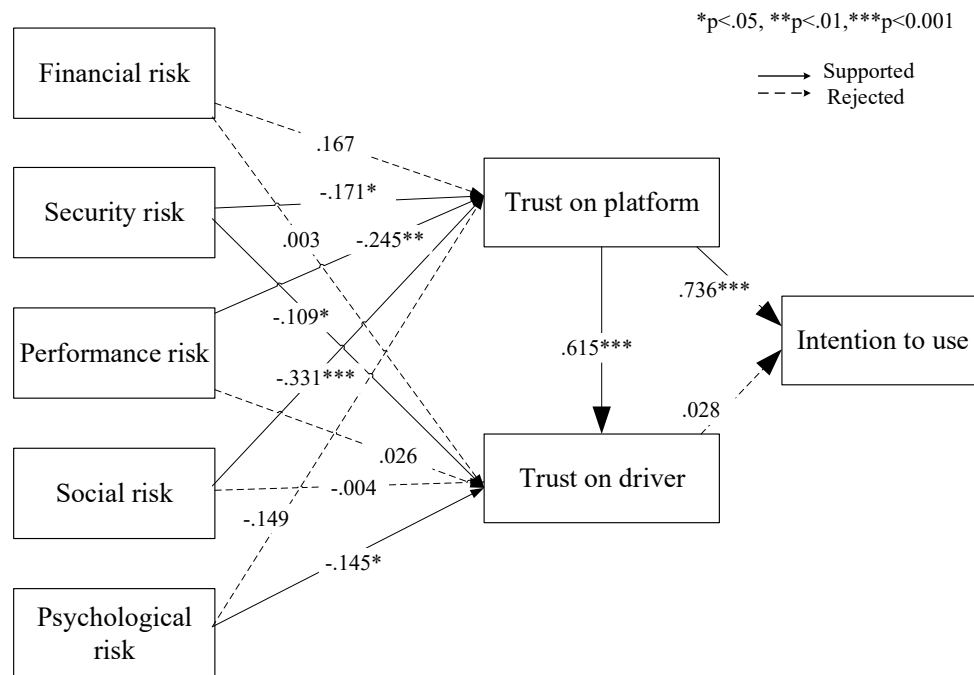


Figure 2: Path coefficients for the tested hypotheses

Table 7: Summary of hypothesis test result.

Hypothesis	Path	Standardized coefficient	C.R.(t-value)	Significant at	Result
H1a	Financial risk → Trust on platform	.167	1.403	-	Rejected
H2a	Security risk → Trust on platform	-.171	-2.424	.05	Supported
H3a	Performance risk → Trust on platform	-.245	-2.835	.01	Supported
H4a	Social risk → Trust on platform	-.331	-5.337	.001	Supported
H5a	Psychological risk → Trust on platform	-.149	-1.713	-	Rejected
H1b	Financial risk → Trust on driver	.003	.032	-	Rejected
H2b	Security risk → Trust on driver	-.109	-2.145	.05	Supported

H3b	Performance risk → Trust on driver	.026	.421	-	Rejected
H4b	Social risk → Trust on driver	-.004	-.097	-	Rejected
H5b	Psychological risk → Trust on driver	-.145	-2.295	.05	Supported
H6	Trust on platform → Intention to use	.615	6.565	.001	Supported
H7	Trust on driver → Intention to use	.028	.314	-	Rejected
H8	Trust on platform → Trust on driver	.736	13.949	.001	Supported

Discussion

First of all, our findings indicate that perceived security risk, performance risk and social risk are significantly negatively related to trust on platform, while security risk and psychological risk are significantly negatively related to trust on driver. As is discussed in the literature review, the concern of security is an important factor for online trust or offline trust. Our results verify that people with high perceived security risk are not likely to trust the sharing platform and the offline service provider. To the contrary, our results show financial risk has no significant relationship with neither online nor offline trust, which means financial risk isn't the main cause of trust reduction. In addition, the last three dimensions of perceived risk present different relationships with trust on platform and trust on driver. On the one hand, perceived performance risk and social risk have significant and negative effects on trust on platform, while no significant effects on trust on driver. Therefore, people may be more likely to blame the platform not the driver for not being able to use cars in time or having objections from friends and family. On the other hand, perceived psychological risk has significant and negative effects on trust on driver, while no significant effect on trust on platform. Hence, the concern of psychological risk is more likely to be related to the service provider, not the platform. People always worry whether they will be satisfied or not in the trip with the driver, and our results show that it is not decided by the platform most of the time. Further, trust on platform has a significant and positive effect on customers' intention to use, which means that people who has high trust on platform is willing to use the sharing car in the future. However, trust on driver doesn't show significant effect on intention to use, supporting that the choice of shared travel is more based on the trust of sharing platforms than on the trust of service providers. Finally, trust on platform is positively related to trust on driver, suggesting that a consumer perceiving high trust on platform is more likely trust offline service providers.

CONCLUSIONS AND SUGGESTIONS

Implications

In this study, we mainly center on different types of perceived risk, trust and customers' intention to use. We constructed a research model with a series of constructs and conducted an empirical analysis. The findings of this study have important theoretical and practical implications. First, it contributes to the implication of perceived risk theory and trust in Chinese situation, with DiDi as the research object. Second, some dimensions of perceived risk are proved to be more important than the overall perceived risk as a research component in sharing economy, which can help other researchers understand the most important area of perceived risk. Third, there is scarce research that regard perceived risk as the antecedent of trust, and this study adds more support to this field.

In addition, this study also has important practical implications for sharing economy. First, our results show that financial security is not that important while using DiDi, which indicates that the existing mechanism of charging is satisfactory. The second practical implication is that security risk plays a vital role while using DiDi, especially after some malignant event, customers pay more attention to their security, thus more speculation and control on drivers are expected to decrease the perceived security risk of customers. Finally, platform trust is essential for customers' intention to use, so it is important for sharing company to build a good image of the platform to increase customers' trust on the platform.

Limitations and suggestions for future research

This study still has some limitations. First, we conducted the empirical study with the sample most from college students, which is not representative of the actual customers group of DiDi. As a result, the findings are limited. Secondly, there are many antecedents of trust that may influence the outcome like disposition to trust, familiarity and so on. They can be regarded as precondition of trust in our sharing economy setup, it is better to have them controlled. Finally, we didn't differentiate customers' continued intention to use and initial intention to use, which still have some differences and would influence the results.

For future research, more controlled variables can be added to the research. In addition to this, customers' continued intention to use and initial intention to use can be separated to see whether there will be a different result.

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The Influence and Countermeasures of Technical Barriers to Trade on the Export of Electromechanical Products in China

(Full Paper)

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ABSTRACT

Since the entry of China into WTO, the increasingly active foreign trade activities of China have played a huge role in promoting the economic growth and development of our country. At the same time, TBT (Technical barriers to Trade) has developed rapidly and become a non-tariff barrier for the export of Chinese foreign trade enterprises. As a result, the export of mechanical and electrical products in China has been greatly affected by the TBT of importing countries. In this paper, the current situation of technical barriers to trade in the export of mechanical and electrical products in China is first expounded, and the negative and positive effects of technical barriers to trade on the export of mechanical and electrical products of our country are analyzed. Then, based on the trade gravity model, using the panel data of 26 trading countries of China from 2008 to 2017, this paper empirically investigates the influence of importing country's TBT on the export of mechanical and electrical products of China, and analyzes the reasons why Chinese mechanical and electrical products export encounters with TBT according to the above research. According to these reasons, the corresponding countermeasures are put forward.

Keywords: Technical barriers to trade (TBT), electromechanical products, export

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INTRODUCTION

Since the reform and opening-up, China's economic growth has become increasingly remarkable, and the implementation of the "One Belt And One Road" strategy in recent years has made China's foreign trade more active. However, due to the differences in international trade policies, international status, world discourse power and national customs and features, different countries have different trade attitudes towards imported products, and each country has set certain trade barriers against the imported products of different countries. Technical Barriers of Trade (TBT) have a great impact on China's exports, which has become the first non-tariff barrier that China's foreign Trade enterprises are facing.

In international trade, TBT refers to the measures adopted by commodity importing countries for the implementation of trade import control, usually in the form of laws, decrees, regulations, standards and certification systems. It mainly involves many technical regulations and standards such as science and technology, product quality and certification, safety, health and environmental protection, as well as their conformity assessment procedures and standards, but not the measures covered by SPS agreement.

The emergence of the TBT in the world is driven by the rapid development of economic globalization, the rapid development of trade liberalization and the popularization of "sustainable development". The reasons for the rise of TBT are as follows: firstly, in the international trade, the starting point of each country is to safeguard the interests of the country, since most of the traditional non-tariff barriers are obviously contrary to the "spirit of WTO", so when these barriers are gradually cancelled, the more concealed technical trade barrier is favored by the trade countries and are continuously pushed out. Secondly, the loopholes and exceptions in the WTO agreement provide corresponding legal basis for the implementation of TBT. Thirdly, the global voices calling for environmental protection are getting louder and louder. The status of relevant environmental protection organizations in countries around the world has been greatly enhanced, and the influence of these organizations on the decision-making of governments is also increasing. Fourth, sustainable development provides strong theoretical support for the wide implementation of TBT.

The rapid development of TBT has great influence on the export of mechanical and electrical products in China. According to the international trade classification standards, mechanical and electrical products belong to the category of machinery and transport equipment. According to the data of national bureau of statistics, China's machinery and transport equipment export accounted for

46.92% of the total export value in 2016, and the ratio was basically unchanged in recent ten years, fluctuating around 47%, accounting for nearly half of China's total export value. It can be seen that the export of mechanical and electrical products has great influence on China's foreign trade development. With the rise and development of TBT, although the export of mechanical and electrical products in China has been going up in general, there has been a small decline in the last two years. According to the data listed in the annual report of China's technical trade measures (2016), the direct loss caused by technical trade barriers of mechanical and electrical products in China reached 40,716.521 million us dollars in 2015. In the same year, the total export of mechanical and electrical products decreased by 11386 million us dollars, down by 1.06% compared with the previous year. Therefore, the rising trend of export volume has ended and turned downward. It can be seen that TBT has a particularly significant impact on the export of electromechanical products in China.

LITERATURE REVIEW

Foreign Research Results

Fontagné and Orefice (2018) matched TBT's database with WTO concerns and compared it with a panel of French exporters to arrive at the complex effects of restrictive TBT on different trade balances. In addition, they estimated the overall level, thus demonstrating that the effects of restrictive TBT on reducing exports were magnified in more uniform areas.

Yousefi and Liu (2013) selected the trade cases of China, Japan, South Korea and the United States in the manufacturing industry and used the gravity model to obtain the impact of TBT on the trade value. The results showed that TBT had a certain negative impact on long-term trade and was not conducive to economic development, and suggested that governments reduce the number of non-tariff barriers.

Bao (2014) adopts the method of heterogeneity enterprise and analyzes the influence of the technical trade barriers implemented by our country on imports of China. This research based on the samples of all import restriction measures (such as TBT, tariff, license and quota) implemented in China from 1998 to 2006, the modified two-stage gravity model was used to modify the model. The results show that TBT reduces the import probability of China and potential trading partners, but it increases the import amount with existing trading partners. It is further proved that although the technical trade barriers set by China have a relatively stable impact on trade volume, the impact of TBT on trade probability varies greatly among different industries and countries.

Domestic Research Results

Cai *et al.* (2017) used the panel data of China and 22 international trading partners from 2000 to 2015, introduced the variable of intellectual property based on the expanded trade gravity model, and conducted an empirical analysis of "TBT's impact on the export of high-tech products in China". The analysis results show that China should consider the IPR protection policies of the importing countries when dealing with the TBT of the importing countries.

Chen *et al.* (2014) analyzed and compared the total export value of electromechanical products from 2008 to 2012 in an in-depth way by combining the theories of technical trade barriers, and conducted profound research and exploration on the current situation of electromechanical products suffering from TBT in China by applying theoretical and empirical analysis. It was concluded that TBT set up by developed countries has a promoting effect on the export of electromechanical products in China.

Li (2014) analyzed the current situation and causes of Chinese electromechanical products' export suffering from EU TBT, and demonstrated the impact of EU TBT on Chinese electromechanical products' export by combining theoretical research and empirical analysis. The results show that in the short term, the TBT set by EU has a certain inhibitory effect on the growth of China's mechanical and electrical product export. In the long run, the determination and action of Chinese electromechanical enterprises to upgrade and improve their products and keep close to international standards make TBT play a role in promoting the green transformation of Chinese electromechanical enterprises to a certain extent. Finally, based on the analysis of the three levels of corporate, government, and industry associations, the countermeasures were proposed.

The Literature Review

To sum up, TBT has become the largest non-tariff barrier that China's foreign trade enterprises are facing in recent years, as the foreign trade activities of various countries become increasingly active and the export products of the exporting countries are frequently confronted with the technical barriers to trade of the importing countries. Many scholars have studied the effects of TBT on electromechanical products and put forward their own views and opinions. Some are analyzed from an empirical perspective, some from a theoretical perspective, and some are combined with theoretical analysis and empirical analysis. This paper mainly focuses on the export of electromechanical products in China, analyzes the status quo of TBT suffered by foreign trade enterprises of electromechanical products in China, and studies the impact of TBT on the export of electromechanical products in China from positive and negative theoretical and empirical perspectives respectively. Based on the above analysis results, further analysis is made on the causes of TBT in China's electromechanical products export, and corresponding countermeasures and Suggestions are put forward according to these reasons.

THE CURRENT SITUATION IN CHINA ABOUT MECHANICAL AND ELECTRICAL PRODUCTS EXPORTS SUFFERED FROM TECHNICAL BARRIERS TO TRADE

Mechanical and electrical products, including machinery and transportation equipment, various electronic products, instrumentation and electrical equipment, account for about 47% of total exports every year. And this part is also the biggest impact of China's export products on changes in total exports.

In recent years, the export volume of China's mechanical and electrical products has generally shown an upward trend, but there has been a slight decline in 2008 and 2015. In 2007, the export volume was 577044.7 million US dollars. Under the impact of the 2008 financial crisis, the economies of all countries in the world have experienced decline in different degrees. Because of this, export volume of Chinese mechanical and electrical products fell after two consecutive years of rising. With the slow recovery of the world economy, the export volume of Chinese mechanical and electrical products has risen for five years after 2010. In 2015, the export volume of mechanical and electrical products decreased slightly compared with 2014, and decreased by 11,386 million dollar, accounting for 1.06%. In 2016, the decline was more dramatic than that in 2015. The figure continued to decrease by 74905.7 million dollar, accounting for 7.07%.

As the export of electromechanical products increases, the technical barriers to trade are also increasing. The following is an analysis from the two aspects—the number and export volume of TBTs (Technical Barriers to Trade) in major exporters of electromechanical products and the change in export losses of Chinese electromechanical products under TBT.

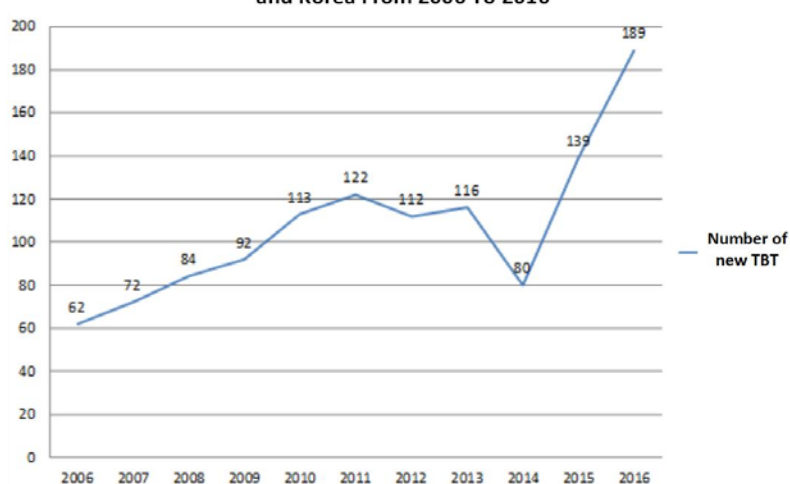
Analysis of the Number and Export Volume of TBT in Major Exporters of Mechanical and Electrical Products

In recent years, Chinese mechanical and electrical products are mainly exported to the United States, Japan and South Korea. The average annual export volume of mechanical and electrical products exported to these three countries accounts for nearly 30% of the total exports every year.

As shown in Figure 1, the total number of TBTs, which were related to mechanical and electrical products in the US, Japan and Korea, showed an upward trend from 2006 to 2011. And as shown in Figure 2, although the export volume of Chinese mechanical and electrical products were increasing year by year in addition to 2009, the growth rate was still small. Between 2011 and 2014, the number of new TBTs in the United States, Japan and South Korea fell, and the export volume of these three countries has increased considerably compared with previous years. However, the sudden surge in the number of new TBTs in the United States, Japan and South Korea began in 2014, which directly led to a decline in the corresponding export volume.

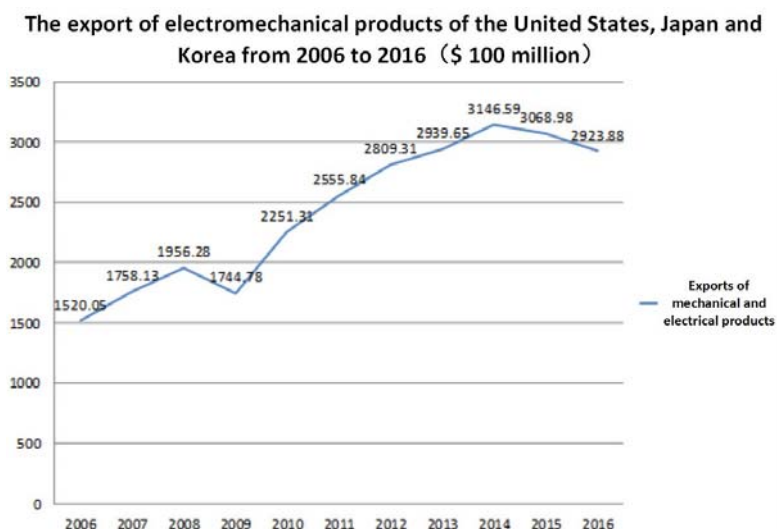
As a consequence, you can see that the increase of TBT in the importing countries has a negative effect on the export volume of Chinese mechanical and electrical products. In addition, slight increase usually slow down the growth rate of export volume, and sudden surge may even affect the export of Chinese mechanical and electrical products. And that means the end of the growth trend and the beginning of the downward trend.

**Number of new TBT on relevant electromechanical products in the USA, Japan
and Korea From 2006 To 2016**



Source: WTO official website TBT IMS database

Figure 1: Number of new TBTs for mechanical and electrical
products in the US, Japan and Korea in 2006-2016



Source: The United Nations Comtrade database

Figure 2: Exports of mechanical and electrical products exported by China, Japan, and Korea from 2006 to 2016

Changes in Export Losses of China's Mechanical and Electrical Products after Encountering TBT

In 2013, Chinese mechanical and electrical products suffered from TBT. And after that, the export loss reached 27587.29 million dollar, accounting for 41.67% of total TBT losses. In 2014, the loss reached 31,173.69 million dollar, increasing by 13.0% compared with 2013, accounting for 41.28 of the total loss. %. In 2015 the loss reached 40,716.52 million dollars, increasing by 30.6% compared with 2014, accounting for 43.60% of the total loss.

The growth rate of direct loss of TBT in Chinese electromechanical enterprises and national foreign trade enterprises suddenly increased after the surge in the number of new TBTs in 2014, which was changed from 13.0% and 14.1% to 30.6% and 23.6% respectively. In the short term, the increase in the number of new TBTs has directly affected the export of Chinese electromechanical products, resulting in an accelerated increase in direct losses of electromechanical enterprises.

THE IMPACT OF TECHNICAL BARRIERS TO TRADE ON THE EXPORT OF CHINA'S MECHANICAL AND ELECTRICAL PRODUCTS

Negative Impacts

Export Suppressed Effect

The technical trade barriers set by the importing countries to protect their own interests will block the electromechanical export enterprises that do not meet their technical or certification requirements from the international market, resulting in the reduction of supply in the international market of mechanical and electrical products. Supply curve S move left to become S'. As shown in Figure 3, after the supply and demand reached a new equilibrium, other conditions remaining unchanged, the export volume of electromechanical products decreases from Q1 to Q2. Therefore, in terms of the quantity of mechanical and electrical products exported, the TBT of the importing country will cause certain obstacles to the entry of China's electromechanical export enterprises into the international market. The short-term export to China's electromechanical products has a certain inhibitory effect.

This part of the product was either rejected if it did not meet the international standards or the requirements of the importing country in terms of technology or certification, or because the exporting company could not afford the high cost of entering the international market due to the huge new cost. Forced these parts of technologies or products to withdraw from the international market. For whatever reason, the production of the company cannot be completed smoothly, and more losses are caused to the enterprise by losing the order and returning the order. For example, in 2014, the direct loss of China's exports to Latin American countries was 2.27 billion US dollars. In 2015, with the substantial increase in the number of new TBTs in 2014, the loss reached 5.71 billion US dollars, more than doubled.

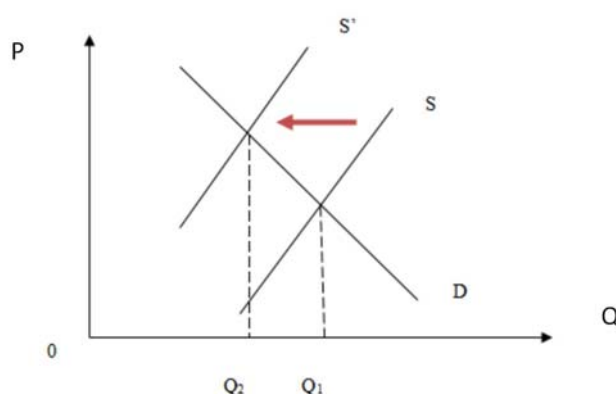


Figure 3: Short-term analysis of TBT's impact on the export of electromechanical products in China

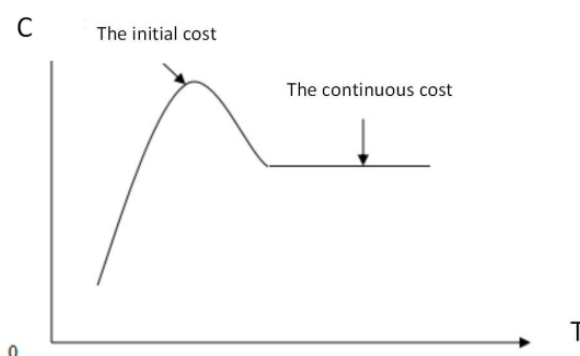


Figure 4: Effects of importing country TBT on export cost of mechanical and electrical products in China

Leading To An Increase In The Export Cost Of China's Mechanical And Electrical Products

In order to meet the technical requirements and certification standards of importing countries and reduce the impact of TBT set up by importing countries, China's electromechanical enterprises have to invest more, reset technology, improve processes and purchase more sophisticated testing equipment, hiring more professional technicians to test the products, which lengthens the production and testing cycle, coupled with the increase of various expensive international certification fees, increasing the cost of mechanical and electrical products exports under various factors. For example, in 2014, the increased cost of China's electromechanical enterprises reached US\$9.41 billion, and in 2015 it was US\$15.11 billion. In 2016, it reached a new record high of US\$24.34 billion.

However, this increase in export costs refers not only to the initial cost of the TBT in the importing country that year, but also to ongoing costs. As shown in Figure 4, the exporting country's electromechanical enterprises have spent a considerable initial cost in order to allow their electromechanical products to enter the international market. However, after entering the market, enterprises only need to make fixed costs, so the continuous cost is basically stable.

Affecting The International Image Of China's Mechanical And Electrical Products And Enterprises

Since some of China's electromechanical enterprises have not met the technology or certification standards of importing countries, these enterprises have suffered direct economic losses. At the same time, foreign media have also made negative publicity and even slammed them, leading the confidence of the products of overseas consumers to China's electromechanical has been hit hard, which has greatly reduced the image of China's mechanical and electrical products and enterprises in the international market. As a result, the share of China's mechanical and electrical products in the international market has decreased, which has weakened the international competitiveness of China's mechanical and electrical products exports.

Leading To Imbalance Between Supply And Demand In The Domestic Mechanical And Electrical Products Market

Due to the variety of TBT, the strict requirements of technical standards, and the differences in technical level and environmental awareness among Chinese and foreign countries, TBT in the importing countries has blocked the “unqualified” Electromechanical enterprises from the international market, resulting in China's electronics exports were blocked. For this part of the export-blocked electronics, if it is resold to a third country, it will increase costs, reduce China's foreign exchange earnings, and affect the growth rate of China's exports of mechanical and electrical products. If it is resold to the domestic market, it will lead to a slowdown in the growth rate of mechanical and electrical products, and even a decline. At the same time, domestic electromechanical products are oversupply, as shown in Figure 5. The right shift of the domestic electromechanical product supply curve causes the price to decrease, from P_1 to P_2 , and some domestic electromechanical enterprises will reduce profits and even lose money to bankruptcy.

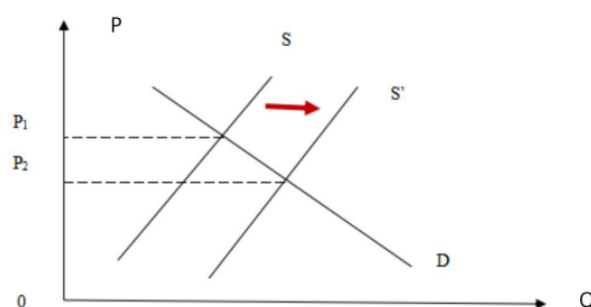


Figure 5: Analysis of supply and demand of domestic mechanical and electrical products after blocked product resale

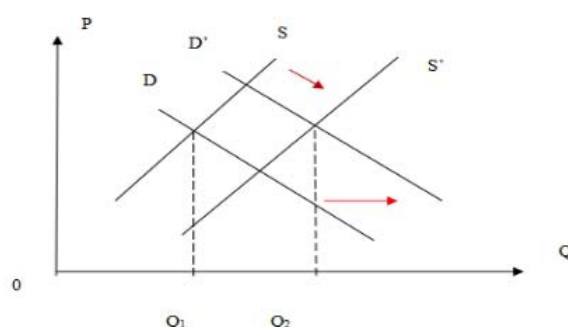


Figure 6: Long-term analysis of the effects of importing country TBT on the export of mechanical and electrical products in China

Positive Influence

Conducive To Improving The Quality Of China's Mechanical And Electrical Products

Faced with more complicated and demanding product standards in importing countries, companies that choose to improve, optimize and upgrade their products in the face of difficulties, while trying to break TBT, also improve the quality of products and provide consumers with more Excellent product service.

As shown in Figure 6, in the long run, China's electromechanical enterprises have made technological improvements in order to enable the smooth completion of production, in order to meet the technical and certification requirements of importing countries. This technology improvement makes China's export of electromechanical products more capable. Meeting the needs of consumers in importing countries, causing their demand to increase, the demand curve shifts to the right, from D to D' . As a result, the supply curve of China's electromechanical products export market moved to the lower right, and the curve changed from S to S' . After reaching a new equilibrium, the export volume of China's mechanical and electrical products increased, from Q_1 to Q_2 . Therefore, in the long run, the importing country TBT has a certain positive impact on the export of China's mechanical and electrical products.

Conducive To Promoting The Upgrading Of China's Industrial Structure

From a long-term perspective, the driving force of economic development lies in technological innovation. Enterprises that can break through TBT must make certain improvements or innovations in production technology, promote the upgrading of industrial structure, and accelerate the rapid development of China's economy transforming to high quality development.

Conducive To The Active Integration Of China's Mechanical And Electrical Products With International Standards

In the short-term, most of the enterprises that have been eliminated by TBT have not paid enough attention to the technical standards and various related policies of the importing countries. The asymmetry of information has caused huge losses for these enterprises. On the other hand, this also precisely promotes the active and active attention of China's electromechanical enterprises in the direction of changes in international standards, and has a certain role in promoting the environmental awareness of China's electromechanical foreign trade enterprises and fostering export-oriented awareness of legalization and legalization. At the same time, it also promoted the process of connecting China's mechanical and electrical products with international standards.

EMPIRICAL ANALYSIS OF THE IMPACT OF TECHNICAL BARRIERS TO TRADE ON THE EXPORT OF MECHANICAL AND ELECTRICAL PRODUCTS IN CHINA

Model Specification

26 importing countries, including the United States, Japan, Canada, Switzerland and India, which have trade transactions with mechanical and electrical products in China from 2008 to 2017, were randomly selected to make statistics on their per capita GDP, population size, innovation capacity index, TBT notification quantity and intellectual property protection index. On this basis, the impact of technical trade barriers of importing countries on the exports of mechanical and electrical products in China was studied. Therefore, the gravity model of trade is set as:

$$\text{LnExport} = \alpha_1 + \alpha_2 \text{LnTBT} + \alpha_3 \text{LnIPR} + \alpha_4 \text{LnCI} + \alpha_5 \text{LnPOP} + \alpha_6 \text{LnGDP} + \mu \quad (1)$$

Variable Description And Data Source

Explained Variable -- China's Mechanical And Electrical Product (Export)

Mechanical and electrical products are classified according to the international trade standard classification SITC/ rev.3. Mechanical and electrical products belong to the category of machinery and transport equipment, and combined with the United Nations Comtrade database, the specific data of 26 trading countries selected for the export of mechanical and electrical products of foreign trade enterprises from 2008 to 2017 are obtained, and these data are taken as explanatory variables.

TBT Notification Quantity (TBT)

According to the classification standards of the customs HS catalogue and the international standard classification of CIS, a total of 22 categories of standards related to mechanical and electrical products were selected for professional division. Considering the continuity and long-term nature of TBT notification quantity in time, the paper adopted the accumulated TBT notification quantity and conducted query statistics on the TBT notification quantity of mechanical and electrical products in each country from 2008 to 2017. The data comes from the TBT IMS database on the WTO's official website.

Intellectual Property Protection Index (IPR) And Capacity Of Innovation Index (CI)

In recent years, TBT is often combined with the degree of protection of intellectual property rights, and the competitiveness and innovation ability of each country directly leads to the different requirements on imported products. The global competitiveness report, published by the world economic BBS (WEF) in the last decade, has acquired the IPR and CI indices, which have averaged an annual quantitative analysis of the capacity of 137 countries around the world, and have been divided into 1 to 7 grades (7 is the highest) for each capacity index including IPR and CI. The article uses these two indices to quantify the extent of intellectual property protection and innovation in the importing countries, both of which have a range of 1 to 7, 1 is the lowest degree, and 7 is the highest degree.

See table 1 for detailed information of specific variables:

Table 1: Variables And Variable Descriptions

Variables	Variable Descriptions	The Minimum Values	The Maximum Values
Export	Exports of electromechanical products to trade partners in China (US \$10,000)	2294	21840066.6
TBT	Notification of technical trade barriers in importing countries	1	202
IPR	Intellectual property protection index (1-7) for importing countries	2.3	6.6
CI	Innovation capacity index of importing country (1-7)	2.29	6.2

POP	The population of importing countries (10,000)	32	130420
GDP	Per capita GDP of the importing country (\$)	476.553	102573.67

Model Test And Regression Analysis

Unit Root Test And Basic Regression

In this paper, the unit root test was carried out for each variable. The first-order difference results passed the LLC, ADF, PP and IPS tests, and the model was one-order integral (table 2 is the unit root test result of first-order difference). Therefore, the logarithm of all variables was taken for regression analysis.

Table 2: First Order Differential Unit Root Test Results

Variables	LLC	ADF	PP	IPS
P Values	0.0000	0.0000	0.0000	0.0000

According to Hausman test, $P=0.8574>0.05$, so the original hypothesis (the random effect model should be established) should not be rejected, and the establishment of the random effect model should be determined. Table 3 shows the basic regression results of the random effect model.

Table 3: The Basic Regression Results of The Stochastic Effect Model

Model	Coefficient	Standard Deviation	t Values	P Values
LnTBT	0.102223	0.022572	4.528652	0.0000
LnPOP	1.145972	0.580879	1.972825	0.0501
LnGDP	0.607583	0.085249	7.127124	0.0000
LnIPR	-0.640188	0.171316	-3.736885	0.0003
LnCI	0.602477	0.154928	3.888759	0.0001

Regression Analysis

Regression results show that the importer of TBT notification and the mechanical and electrical products exports were positively correlated, but has little effect, because the importer of import of mechanical and electronic products, technology, quality certification standards strictly controlled and constant attention, will promote the development of the high quality mechanical and electrical products industry transformation, and makes the overall cost, quality and price of mechanical and electronic products in China will increase to a certain extent, in the long run, the growth in exports of mechanical and electronic products in our country has some positive impact.

In view of that increase of state awareness of protection of intellectual property rights, the technical barrier to trade introduced in recent years were more or less relevant to the protection of intellectual property rights, and it can be seen from the result of the regression that the IPR indices of the importing countries, namely, the intellectual property protection index, were negatively correlated with the exports of electromechanical products in China. This means that the increase of TBT notification on intellectual property protection in the importing country will lead to a certain decline in China's exports of mechanical and electrical products.

THE REASON WHY MECHANICAL AND ELECTRICAL PRODUCTS IN CHINA SUFFER TECHNICAL BARRIER TO TRADE

Outdated Technology

Among the electromechanical products of TBT suffered by the importing country, some of them were eliminated by the international market due to their backward technology. The backward production technology of this part of electromechanical products makes it unable to adapt to the development trend and direction of electromechanical products in the modern international market, and cannot better meet the demands of consumers in the international market.

In addition, the testing technology, professional degree of testing personnel and authority of testing institutions involved in China's testing process have not met the requirements of international standards, and there is a big gap between China and developed countries. For example, in January 2018, the United States has issued a recall of light sets, cordless electric chainsaws and heaters, which were made in China. And a joint Canadian recall of Chinese camera power adapters has issued as well, due to the possible short circuits, the risk of electrical shock, the possible failure of protective devices, the possible fire or burns and the risk of electric shock by exposing live contacts. These are all because of the backward testing technology and the lack of testing level, which makes the test results not up to the international standards, so that the results of the final recall can be implemented.

China's Exports Of Mechanical And Electrical Products Are Too Concentrated

China's exports of mechanical and electrical products are too concentrated in the United States, Japan and South Korea. From 2010 to 2016, China's total exports of mechanical and electrical products to the United States, Japan and South Korea accounted for

28.93% of the total exports of mechanical and electrical products annually. However, the concentration of export areas is not conducive to risk aversion. According to the data of annual report on China's technical trade measures (2016), the direct loss of TBT suffered by Chinese mechanical and electrical enterprises in the United States, Japan and South Korea in 2015 reached \$ 6,560.487 million, accounting for 16.11% of the total direct loss of TBT, while the direct loss of TBT in 28 member states in the EU totaled 9574.163 million dollars, accounting for 23.51% of total losses, only 7% more higher than American, Japan, South Korea, which explains the excessive concentration of export region increases risk and the difficulty of the enterprise risk prevention management.

Differences in Product Standards between China and The Importing Countries

Compared with developed countries, China's product standard system still has a large gap. If China's mechanical and electrical products want to achieve successful export, they have to meet the relevant international standards and the standards set by the importing countries. In the United States, for example, there are 8 standards of conformity assessment for mechanical and electrical products in use (excluding international standards), including UL certification, energy star certification, ETL certification, FCC certification, QS9000 certification, ANSI certification, ANAB certification and CEC certification, while the standards in use in China (excluding international standards) only have one CCC certification. Just because of the difference in the certification standards, some electromechanical enterprises in China, when their production technology fails to meet the international standards, face the relevant technical regulations of the importing countries and suffer the blow of TBT, which brings huge losses to the enterprises.

Insufficient Attention to Relevant Technical Regulations of the Importing Country

The electromechanical enterprises in China do not have a deep understanding of the technical trade barriers, relevant technical standards and regulatory systems of the importing countries. Some small and medium-sized electromechanical enterprises are not merely backward in production technology and can barely reach the relevant standards of the importing countries, but lack the awareness of standards and certification as well. They fear that the high certification costs of the importing countries will increase the costs of the enterprises. Then they choose to escape certification, but rather suffered the blow of TBT, and have brought more serious loss for the enterprise.

Incomplete WTO TBT Agreement

Many import councils use the TBT exception to create a complex, exacting set of technical standards with operational freedom as a means of trade protection. For example, all WTO members have the "environmental protection exception right", but the WTO is not clear about the conditions for the exercise of this right, and the WTO fails to take into account the gap between developing countries and developed countries in environmental protection level and awareness. In addition, the WTO allows member states to take certain "necessary measures" within the "appropriate degree", while the criteria for "appropriate" and "necessary" are vague and difficult to measure. This, therefore, allows some countries to take technical trade measures against importing countries "reasonably" and unfetteredly.

CONCLUSION AND SUGGESTION

Today, the main exporting countries of Chinese mechanical and electrical products are the United States, Japan and South Korea. The total amount of new TBT in these three countries is generally on the rise. The export volume of Chinese mechanical and electrical products to these three countries is rising, but the rate of increase gradually slow down. And the direct loss of TBT in Chinese electromechanical products has shown an increasing trend in recent years.

The impact of TBT on Chinese exports of mechanical and electrical products has two sides. On the negative side, the technical trade barriers set up by importing countries have a certain inhibitory effect on the export in the short term, which will increase the production costs (including initial cost and continuous cost), and affect the export value of Chinese mechanical and electrical products. As a consequence, we cannot keep a balance between supply and demand in Chinese domestic electromechanical products market. And the most important is that the international image of export is impaired and the international competitiveness is weakened. On the positive side, TBT will improve the quality of Chinese electromechanical products in the long run, and accelerate the upgrading of industrial structure. Finally, according to the analysis of this paper, five causes of Chinese electromechanical products suffering from TBT of the importing country are obtained, namely (1) backward technology, (2) excessive concentration of Chinese electromechanical products in export areas, (3) differences in product standard system between China and the importing country, (4) lack of attention to international standards and relevant technical regulations of the importing country, (5) imperfection of WTO's TBT agreement, and the following countermeasures are proposed:

Accelerating Technological Innovation

The development concept of "Innovation, Coordination, Green, Openness and Sharing" is a new development concept, which was put forward by the Fifth Plenary Session of the 18th CPC Central Committee. The conference emphasized that "innovation is the first driving force for development". Joseph Schumpeter's "innovation theory" shows that the constant innovation of technology, the constant change of industry, and the emergence of "creative destruction" are the most important essence of modern economic

growth. Therefore, in the foreign trade of Chinese electromechanical products, technological progress and innovation cannot be delayed.

In terms of companies, technology investment should be increased. They should combine the product-centered "4P" theory and the customer-centered "4C" theory. And after that, they should use this connection as a starting point, and then increase the technological innovation and carry out research and development work. In addition, invest enough professional scientific research personnel resources, introduce advanced foreign testing technology and learn the excellent foreign testing institution management system. It's necessary to ensure sufficient and strong scientific research force to support the progress of testing technology in order to achieve the purpose of testing technology innovation.

In terms of the government, it is necessary to vigorously promote the progress of technological progress of enterprises, and support and encourage electromechanical enterprises to innovate their products and innovation in detection technology. The major enterprises that have technological innovation achievements will get some bonuses and honors. And we should support small and weak enterprises by providing financial support. Except these, we should also make relevant laws and regulations so that we can enable enterprises to innovate in technology.

Exploring a Wide Range of Electromechanical Products Market

In fact, Chinese electromechanical products are concentrated in the three countries, including United States, Japan and South Korea. Therefore, once a serious TBT strike is encountered, electromechanical enterprises in China will inevitably produce huge losses. In the meanwhile, it also has a certain negative impact on the international image of Chinese mechanical and electrical products. In order to spread the risk, companies should appropriately reduce the export volume of the products of the most important exporting countries, and export their products to more countries to open up a wider international market. The government can use the rules of the WTO to expand the development of emerging markets, such as holding trade fairs, conducting larger-scale advertising and other policy support, and giving certain major financial support to major electromechanical enterprises.

Accelerating the Improvement of Product Standard System

In order to make the export activities of electromechanical products go smoothly, the government should speed up the construction of the electromechanical product standard system, testing system and certification and accreditation system. In addition, the government should implement the integration of exporting enterprises with international standards, and reduce the loss because of shortages of product standard system.

Raising Standards Awareness and Certification Awareness

As we know, if we want to successfully resolve the problems about the technical barriers to trade, only relying on advanced testing techniques is not right. Enterprises should be deeply aware of standards and certifications, and should actively provide products and services in accordance with international standards and standards (Zneg *et al.*, 2016). When enterprisers try to improve product quality, they try to provide consumers with a pleasant shopping experience. Therefore, enterprises should increase the publicity of international standards and certification awareness, and regularly open relevant courses for relevant employees to let them know about the changes in relevant technical regulations. As a consequence, the most basic employees can understand the importance of international standards. In the meanwhile, the government should cooperate with the company's vigorous publicity, and make some relevant laws and regulations. Because of this, the electromechanical enterprises would be more likely to understand the importance of the state's technical standards and certification standards for electromechanical products. That means that the awareness of standards and certification will be strengthened.

ACKNOWLEDGMENT

This work is partially sponsored by grant 14BGL186 of National Planning Office of Philosophy and Social Science, grant SC13A007 of Sichuan Philosophy and Social Science Planning Key Projects of China and grant XZX18011 of Project of Basic Scientific Research Operation of Central University of Southwestern University of Finance and Economics.

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The Marketing Effects of Recommender Systems in a B2C E-commerce Context: A Review and Future Directions

(Full Paper)

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ABSTRACT

As a kind of digital marketing technology, recommender systems (RSs) have already been widely applied for online retailers. Empirical studies have proved that RSs can increase the number of items sold, sell more diverse items, increase the user satisfaction and user fidelity and so on. However, our understanding of the marketing effects of RSs is still fragmented. Few comprehensive literature reviews have been published. This paper mainly reviews and synthesizes extant related literature in the last five years on the marketing effects of RSs, specifically focuses on how RSs influence consumers' decision quality, product demand and retailer profits in e-commerce market and e-commerce companies. From the angles of consumer behavior and marketing strategies, this study aims to discuss the positive and negative impacts which RSs bring to consumer and its providers, and presents some suggestions and potential directions for future research on RSs.

Keywords: Recommender systems, marketing effects, consumer decision-making, e-commerce market, online retailers.

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INTRODUCTION

With the rapid development of Internet and e-commerce technology, online shopping has become an important part of people's daily life. According to data released by CIECC, the global online retail transaction volume reached \$2.304 trillion in 2017, an increase of 24.8% compared with 2016. And the proportion of online retail transaction volume to global retail sales increased from 8.6% in 2016 to 10.2%. In China, e-commerce has already occupied more than 60% of the network economy. Recommender systems are software tools and techniques which have proven to be a valuable means of coping with the information overload problems in the e-commerce websites. As users found it difficult to arrive at the most appropriate choices from the immense variety of items (products and services) that these websites offered. Amazon claimed that 35% of its sales are attributed to the recommendation systems. Dangdang's senior development director Fu Qiang gave a set of data: only need a technical team of dozens of people, the average daily contribution of recommended products can be worth 50% of the sales contribution of some business units. Recommender technology has become an important marketing tool for B2C e-commerce websites.

From the business perspective, RS provides new opportunities and means to implement known effective marketing strategies, such as personal targeting or dynamic pricing, incorporating various price and profit-related information into recommendation process, and at the same time achieving the proper balance between consumer's needs and suppliers' purposes. However, there has been relatively less studies on RSs in the business-oriented areas such as management science, consumer behavior and marketing than studies in technology-oriented areas such as computer science and information systems (Michalis & Michael, 2013). In recent years, many domestic and foreign scholars have summarized the research progress of e-commerce RSs. But those study reviews mainly focus on the recommendation algorithms and models, RSs evaluation and RSs' impact on consumer online shopping behavior and so on (Sun et al., 2017; Sun, Zhang, & Wang, 2016; Xiao & Benbasat, 2014), less on the economic effectiveness of recommendations. A study by Yang, Wang, and Sun (2016) explored the marketing effects of the RS on consumers and its influencing factors based on the consumer perspective. They presented that the characteristics of the shopping website, RS and recommendation information influence the marketing effect of the RS on consumers, but did not involve the actual interests of e-commerce vendors. Li and Karahanna (2015) proposed that more attention should be paid to the actual impact of recommendation systems on e-commerce markets and e-commerce companies. Therefore, the main objective of the current paper is to review empirical studies on e-commerce product recommendation systems published in the last five years, particularly focuses on the impact of RS on consumers' decision quality and its economic effectiveness such as increase in product demand and retailers' profits in e-commerce market and e-commerce companies. This study synthesizes empirical findings in each area to show the extant state of understanding on the impact of RS, and presents some suggestions and potential directions for future research on B2C e-commerce product recommender systems.

IMPACTS ON CONSUMER DECISION-MAKING

Consumer Intention to Adopt RS

RS in the e-commerce context refers to a web-based technology that explicitly or implicitly collects a consumer's preferences and recommend tailored e-vendors' products or services accordingly. As a type of interactive decision aid tool, if consumers believe that the RS has no value or is unwilling to adopt the recommended products, there will be no impact on consumer decision-making at all (Li & Karahanna, 2015). In other words, consumer's adoption of RS is a prerequisite for consumer decision-making and a prerequisite for economic effectiveness in market and companies.

In order to study whether users accept and adopt RS, scholars based on theoretical models such as technology acceptance model (TAM) and the theory of reasoned action (TRA), combined with consumer factors and system factors to study the consumer's willingness to use RS. Table 1 summarizes existing studies in this area.

In terms of consumer factors, scholars mainly study the subjective feelings of consumers on RSs and the characteristics of consumers themselves, including subjective norm, satisfaction, trust, perceived care, perceived pleasure, perceived usefulness and perceived ease of use.

For system factors, Ku, Peng, and Yang (2014) and Ozok, Fan, and Norcio (2010) pointed out that the price, image and name of products in the personalized recommendation interface are regarded as important information. Product promotions, user ratings, and feedback are identified as secondary information types. And they suggested recommending up to three recommendations on a single page. Lately, some scholars have analyzed the influence of the relationship between the social existence characteristics of the RS interface and trust on the adoption of RS by consumers. This social existence refers to the anthropomorphic characteristics of the RS, such as humanoid avatars and human voices, is positively affecting consumers' willingness to adopt the RS (Etemad-Sajadi, 2016; Wang et al., 2016).

Impacts on Consumer Decision-Making

A complete decision includes both the decision process and the decision outcome. Personalized recommendation not only affects product evaluation, product preferences, decision effort in the decision-making process of consumers, but also influences the decision quality, decision confidence and final purchase choices of decision-making results (Xiao & Benbasat, 2014). For example, F. Huseynov, S.Y. Huseynov, and Özkan (2016) assessed the impact of knowledge-based recommender agents on the online-consumer decision-making processes through objective measures and found that they improve consumer decision-making process by reducing the shopping duration and effort spent in searching for suitable products. Xu, Benbasat, and Cenfetelli (2017) proposed and empirically evaluated a two-stage model of generating product advice using recommendations in the first stage and RI functionality in the second stage. Results show that the complementary synergies between the two stages result in higher perceived decision quality, but at the expense of higher perceived decision effort.

Since the overall purpose of personalized recommendations is to influence the consumer's final purchase choice throughout the consumer's overall purchase decision. According to the two-stage theory of consumer purchase decision, in the selection stage, consumers will carefully evaluate and compare the products in the selected set, and finally make a purchase decision. At this stage, consumers will have a certain degree of desire for a certain product. The higher the degree of craving, the stronger the willingness to purchase, and the greater the possibility of final purchase. Therefore, many researchers have studied the impacts of personalized recommendations on consumers' willingness to purchase, and mainly focused on online consumer reviews of recommended products.

Product reviews are an increasingly important type of user-generated content as they offer a valuable source of information. Product manufacturers and designers, e-commerce websites, and potential consumers can all potentially benefit from the posted data. Baum and Spann (2014) analyzed the interplay between online consumer reviews and recommender systems and its effects on consumers' decision making. The main results are that providing online consumer reviews does not necessarily have to be beneficial for an online retailer, as inconsistent recommendations do negatively influence consumers' purchase decisions. In addition, by providing positive opinions of previous customers to a recommender system's recommendation, online retailers may increase the effectiveness of their recommender system. However, if a previous customer's recommendation contradicts that of a recommender system, positive consumer reviews may even have negative consequences for online retailers. Yao and Cui (2017) pointed out that the location on web page and WOM direction of recommended commodities have significantly positive influence on consumers' purchase intention, but the number of online WOM of recommendations has weak influence on consumers' purchase intention. Benlian, Titah, and Hess (2012) tested a conceptual model linking provider recommendations (PR) and consumer reviews (CR) to four consumer beliefs (perceived usefulness, perceived ease of use, perceived affective quality, and trust) in two different product settings (search products vs. experience products). Users of PR express significantly higher perceived usefulness and perceived ease of use than users of CR, while users of CR express higher trusting beliefs and perceived affective quality than users of PR, resulting in different effect mechanisms towards OPR reuse and purchase intentions in e-Commerce transactions. Further, CR were found to elicit higher perceived usefulness, trusting beliefs and perceived affective quality for experience goods, while PR were found to unfold higher effects on all of these variables for search goods.

Table 1: Empirical Studies on Consumer Intention to Adopt RS

Paper	Conceptual foundation	Variables	Major findings
Martínez-López <i>et al.</i> (2015)	Theory of reasoned action; Technology acceptance model; Trust-TAM; Theory of planned behavior	Perceived ease of use, perceived usefulness, trust, familiarity, perceived risk, perceived behavior control, subjective norms	Trust and perceived usefulness of the recommender stand out as the determining factors of its use, though the consumer's attitude toward the recommender and others' opinion of its use also have significant influence too.
Dai <i>et al.</i> (2015)	Consumer behavior theory; Consumer value theory	Functional value, social value, emotional value, epistemic value, conditional value	Functional value, social value and emotional value factors are the key factors that mainly affect users' adoption of personalized recommendations, while cognitive value and conditional value factors have relatively low impact.
Wang <i>et al.</i> (2017)	The modification of technology acceptance model(TAM2)	Subjective norm, perceived personalization, quality of recommendation, perceived ease of use, perceived usefulness, perceived mobility, privacy concerns, users' innovativeness	Users' innovativeness and perceived usefulness have significant positive effects on users' adoption on personalized recommendation, while the privacy concerns have negative impacts on users' adoption.
Wang & Benbasat (2016)	Trust-TAM; Attribution theory; The effort-accuracy-restrictiveness (ERA)	Trust, advice quality, perceived cognitive effort, perceived strategy restrictiveness, transparency	Three performance factors affect only the competence belief, whereas perceived RA transparency influences all three trusting beliefs. The effects of perceived transparency on competence are partially mediated by perceived cognitive effort and advice quality
Yang <i>et al.</i> (2016)	The information systems success model ; Technology acceptance model	Website service quality, quality, recommender system quality, recommendation information quality, perceived usefulness, perceived ease of use	Recommendation information quality has the strongest total effect on adoption intention of recommendations, followed by website service quality and recommender system quality, respectively.
Chen & Pu (2014)	Multi-attribution utility theory; Theory of reasoned action; Technology acceptance model; The theory of planned behavior	Competence constructs, trustworthiness, decision quality, behavioral intentions	The ORG performed significantly better in terms of enhancing users' perceived recommendation quality, perceived ease of use and perceived usefulness of the system.
Zhang & Curley (2018)	Advice taking theory; Trust theory	Explanation availability, explanation mode, perceived personalization, trust	Effects of both the availability and mode of explanations on consumers' trust beliefs are found to be mediated by consumer's perceived personalization of the RA that, in turn, mediate the effects on intention to use.
Choi <i>et al.</i> (2014)	Theory of reasoned action; Innovation diffusion theory	Perceived ease of use, perceived recommendation quality, perceived enjoyment, social influence, Mobility, collectivism, uncertainty avoidance	Functional and social factors have significant impacts on user attitudes towards mobile recommender systems. The relationships between belief factors and attitudes are moderated by two cultural values: collectivism and uncertainty avoidance.

Source: This study.

In response to the importance of consumer reviews, studies have proposed to improve the quality of the top reviews shown to a user when he/she is investigating some product. Yu et al., (2013) took the coverage of product aspects into consideration as well as the overall quality of the top reviews set. Tu, Cheung, and Mamoulis (2017) considered the personal preferences of users in review recommendation, by selecting a personalized top reviews set (PTRS), which includes reviews of which the content is related to the aspects important to the user. Experiments showed that their methodology selects reviews that focus more on the product aspects that are important to the user, without sacrificing coverage and high degree of quality.

IMPACTS ON MARKET AND ONLINE RETAILERS

Most of the studies on the impact of RSs on consumer decision-making are based on the self-reported behavior intention of the participants and the “return willingness” or “purchase intention” of asking them, for example, self-report after using the recommendation system. However, in many cases, these user studies do not involve any actual purchasing decisions. So analyzing the actual data of e-commerce platform trading activities, including sales data or consumer behavior data, has become the direction of researchers to further study the impacts of RSs on market and online retailers.

Impacts on Product Demand and Product Sales

In e-commerce contexts, a recommender can encourage a consumer to buy, orient their decisions towards specific directions (e.g., by fostering or avoiding the purchase of specific items), and ultimately, increase sales. Cremonesi, Garzotto, and Turrin (2012) explored the persuasiveness of RSs in the context of large interactive TV services. Research results show that RSs can affect the lift factor and conversion rate, which is a clear increase in sales and affects the user's actual purchase decision for the recommended product, while the introduction of an RS tends to diversify the purchase and orient users towards less obvious choices (the long tail). The findings of Panniello, Gorgoglione, and Tuzhilin (2016) indicate that by transitivity, using contextual information in RSs can improve accuracy and diversification, which in turn affects trust, which, finally, affects purchases (measured by quantity of items purchased and by the customers' expenditure). Using data on the digital camera category from the largest business-to-consumer platform in china, Tmall.com, Lin (2014) assessed the relative impact of user recommendations and system recommendations on the sales of products in e-commerce, and further explored the interaction effects between these two recommendations. The main results are that a 1% increase in the volume (valence) of user recommendations on a product increases the product's sales quantity by 0.013% (0.022%), whereas a 1% increase in the strength of system recommendations on a product increases the product's sales quantity by 0.006%. They also highlighted that user recommendations are more effective than system recommendations in driving product sales.

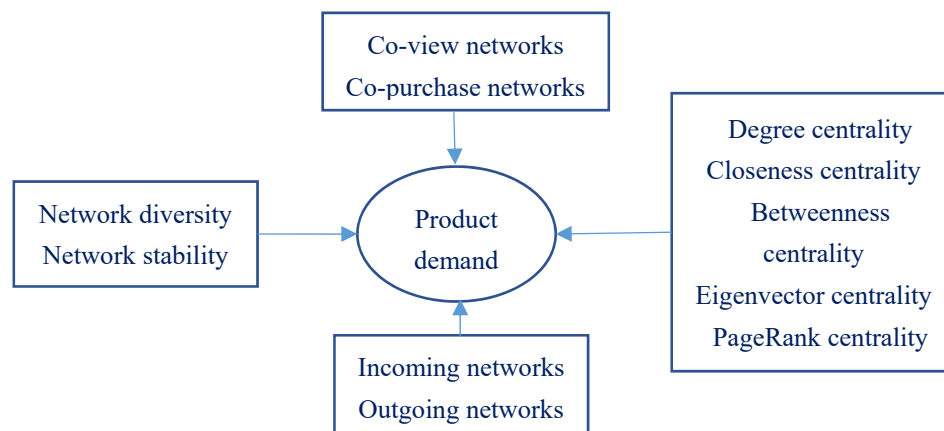
As recommenders provided visible connections to recommended products, RSs can eventually form a visible directed product recommendation network where products (i.e., network nodes) are explicitly connected by hyperlinks (i.e., network ties). Thus, some researchers were particularly interested in the impact of RS on product demand from the recommendation network's perspective. Lin, Goh, and Heng (2017) investigated the effects of network diversity and network stability on product demand in an e-commerce setting. Controlling for relevant factors at the individual product, pricing, product network, product category, and time unit levels, they found that a 1% increase in the category diversity of the incoming (outgoing) co-purchase network of a product is associated with a 0.011% (0.012%) increase (decrease) in the product's demand, while a 1% increase in the stability of the outgoing co-purchase network is associated with a 0.012% decrease in demand. And the co-purchase recommendation network has a stronger association with product demand than the co-view recommendation network for both network diversity and stability. According to Jabr and Zheng (2014), once products are hyperlinked through recommendations, those with higher centrality within the resulting network of referrals are associated with higher sales. However, the central position of competitive products plays an opposite role in the sales of focal products. The higher level of centrality of competitive products enhances its appeal, but weakens the centrality of the focal products.

Some research work specifically investigated the demand effects of co-purchase recommendation networks using data collected from the product network of books on Amazon.com (Oestreicher-Singer & Sundararajan, 2012; Oestreicher-Singer et al., 2013). The main empirical findings suggest that the visibility of the product network can result in up to a threefold average increase in the influence that complementary products have on one another's demand. Moreover, if the product is evaluated solely on direct revenue, regardless of its network value, then the value of low sellers may be underestimated, whereas the value of best sellers may be overestimated. In addition, Leem and Chun (2014) provided a new perspective on how Social Network Analysis (SNA) can be used to study the influence on product demand by the recommendation network. The result of regression analysis demonstrates that five of six SNA measures in the recommendation network have a significant effect towards demand, and then the largest effect towards a book's demand is associated with degree centrality.

Impacts on Market Prices and Advertising Strategies

A recommender system deployed by an electronic marketplace functions as a medium for targeted advertising for sellers, analogous to traditional advertising media such as TV, newspaper, and, recently, the Internet. When the purpose of recommendations as well as seller advertising is creating consumer awareness about products, the presence of the recommender system poses new challenges to sellers in electronic marketplaces regarding their advertising and pricing decisions. Li, Chen, and Raghunathan (2016) examined the intricate interaction between competing sellers' advertising and pricing strategies in the presence of a recommender system in an electronic marketplace. Research results show that the impacts of the RS are the result of a subtle interaction between advertising effect and competition effect. The advertising effect causes sellers to advertise less on their own and the competition effect causes them to decrease prices in the presence of RS. Since RS has become ubiquitous

in electronic marketplaces and precisions of these systems have been continuously improving, a pertinent question relates to how RS precision affects the sellers and consumers in marketplaces with the RSs. This research found that an increase in the RS precision softens the price competition. On the other hand, increased RS precision implies that consumers are more likely to buy the product suggested by the RS, thus reducing the marginal benefit from sellers' advertising and limiting their incentives to advertise. Consequently, "sellers' advertising level follows an inverse U-shape with recommender system precision" (p. 6).



Source: This study.

Figure 1: Recommendation Networks and Product Demand.

Increasing Retailers Profits

Maximizing profits by estimating consumers' willingness to pay for recommended products

Consumers' willingness to pay (WTP) and their utilities for different products are indispensable inputs for many prediction and optimization models that support core business decisions and processes. They help decision makers define efficient pricing strategies (Wu, Li, & Xu, 2014), estimate market share, determine the optimal pace for product updates (Rusmevichientong, Shen, & Shmoys, 2010), or identify optimal product assortments. Zhao et al. (2015) proposed to exchange utility in price for the utility of entire products to estimate consumers' WTP. Based on experimental data set, they showed how retailers can use these willingness to pay estimates for profit-maximizing pricing decisions. Scholz et al. (2015) proposed a utility-based RS which measures consumer preferences and WTP reliably and at low costs for companies and low cognitive effort for consumers. A number of factors were identified as influential on the customers' WTP for an item, e.g., the item's brand or the item's average rating. Their result showed that the ability to successfully predict consumers' WTP and acceptable prices can lead to significant increase in profitability. However, the impact of such dynamic pricing on long-term customer satisfaction has not been studied.

Attracting customers and increasing profits through price promotions

Price promotions are the daily marketing activities of the competitive B2C market. Determining the best promotion policy is a daunting task that requires balancing the price reduction to attract customers and maintaining a reasonable price to achieve profitability, which can greatly affect the company's profitability and long-term survival. To maximize the profit, Jiang et al. (2015) proposed an analytical model to help e-retailers exploit the potential of online promotion, and to maximize the influence of product recommendation on e-retailer's sales and profits. They argued that RS can and should include pricing decisions, and make use of the intricate complementary and substitute relationship to enhance a firm's profits. Through attractive price discounts, e-retailers can motivate customers to purchase the promoted product, and by way of online RSs, e-retailers can encourage customers to buy non-discounted items. The best promotional effect can be achieved by concurrently optimizing price promotion and product recommendation, because the loss from discount can be compensated for by the gains from the regular items.

The general assumption in the above study is that retailers want to attract customers through discounts on promotional items and then use RS to increase sales of undiscounted items. But in reality, the most relevant products for users may often be different from the products with the most profitable value of suppliers. Based on this, Lu et al. (2014) took into yet another set of additional factors such as saturation effects, capacities, or competition amongst products. The authors furthermore optimized the revenue over a finite time horizon, aiming to find the optimal point in time to recommend certain items. To further investigate the relationship between short-term profit maximization, relevance ranking, and trust, Panniello, Hill, and Gorgoglione (2016) conducted an empirical study and tested different marketing strategies. Their email-based research showed that balancing relevance and profitability lead to higher profits than simple content-based recommendations. This conclusion suggests that the profit-maximizing recommendation does not immediately lead to lower consumer trust.

Enhancing Customer Relationships

In customer relationship management, consumers' retention rates can be a salient determinant to evaluate consumers' long-term performance. In addition, this metric is directly associated with consumers' lifetime monetary value. Park and Han (2013)

explored the impact of product category diversity on customer retention rates. Through economic analyses, they found that as the number of purchased product categories increase, customer retention rates dramatically increase, and the effectiveness (e.g., changes in retention rates) from an increase in diversity is larger than the effectiveness from an increase in the number of purchases within the same (single) product category. Moreover, through additional scenario analyses, they also showed that recommending a new category item is much more effective than recommending an existing category item in improving customer retention rates (and therefore long-term profitability).

Due to the virtual nature of e-commerce, thus a consumer may be in an unclear thought process that whether or not he should opt for online shopping. Thus loyalty involves as a major deciding factor if a vendor wants the consumer to buy something from his website. Zhang, Agarwal, and Lucas (2011) used the theoretical framework of the family production function model in the consumer economics literature to explain the mechanism by which personalized recommendations influence customers' loyalty to online retailers. In particular, drawing on the theoretical framework of consumer inferences of marketer motives, Jeong and Lee (2013) compared the effectiveness of different types of RSs in forming favourable consumer attitudes towards an e-commerce website.

RESEARCH ON THE NEGATIVE IMPACTS OF RS

Although RSs have brought a lot of positive effects on consumer decision-making and merchant profitability, some scholars have explored the potential (and possibly unintended) negative effects associated with the recommendation system.

The Effects of RS Bias

The ultimate goal of an online merchant with RSs is to generate more business opportunities by providing consumers with personalized product recommendations. Therefore, merchants do not simply maximize the benefits of consumers in the shopping process, but rather seek to strike a balance between consumers' benefits and business criteria. With such mixed motivations in mind, the merchants may implement RS to provide recommendations that are not solely preference-matched to benefit consumers but instead biased toward its own interests.

Xiao and Benbasat (2018) examined how biased personalized product recommendations influence consumers' decision quality and decision effort when they are shopping online. This study focused on undesirable consequences of PRA use and answered the call that more academic research is needed to explore the dark side of information technology (IT). According to their research, "if the biased personalized recommendations do not result in improving objective decision quality for the consumer, while at the same time these recommendations lead the consumer to believe that her product choice is an optimal one, leading to her continued reliance on the PRA, then unscrupulous online merchants will have a powerful means with which they can influence consumer decision making towards the merchants' own benefits" (p. 2). Xiao and Tan (2012) pointed out that consumers who are sensitized to the double role played by online PRAs, via news stories or warnings issued by consumer organizations, may become hesitant to use the assistance of PRAs when making purchases online, for fear of being exploited by unscrupulous PRA providers (e.g., dishonest online retailers). Such general reluctance not only deprives consumers of the potential benefits offered by PRAs but also makes a mockery of the effort exerted by honest online retailers in implementing PRAs on their websites. However, explicitly telling consumers that potential personalized recommendations are biased will improve their performance in detecting prejudice in personalized recommendations. The most effective mechanism to support consumers in detecting bias is to provide them with warning messages, including suggestions (or tips) for personalized recommendation bias risks, and to emphasize to consumers the potential loss of not following the recommendations (Xiao & Benbasat, 2015).

Fragmentation vs. Homogenization

Some scholars argue that recommender systems can lead to a reduction in sales diversity, as they only reinforce the popularity of already-popular products. Others believe that because of lower search costs, users tend to discover new (or unseen products) and more diverse products by using these systems. What means that RSs will create fragmentation, causing users to have less and less in common with one another or recommenders may do the opposite: recommenders may have homogenizing effects because they share information among users who otherwise would not communicate.

Hosanagar et al. (2013) presented empirical evidence for the debate on whether RSs fragment versus homogenize internet users. In contrast to concerns that users are becoming more fragmented, they found that a network of users becomes more similar to one another after recommendations, as defined by purchase similarity. This increase in commonality occurs for two reasons, which they termed volume and product mix effects. "The volume effect is that consumers simply consume more after personalized recommendations, increasing the chance of having more items in common. The product mix effect is that, conditional on volume, consumers buy a more similar mix of products after recommendations" (p. 1). Bodoff and Ho (2015) extended the prior literature on website personalization by drawing attention to the effects of website personalization on online users' activities on the entire website, not only their response to the personalized recommendations themselves. They examined whether the increase in sampling of personalized items comes at the expense of sampling of other items on the site. In other words, does sampling personalized items increase total sampling activity, or does it cannibalize sampling of other items? In the latter case, there may be no benefit to the website. The research confirmed that personalized recommendations limit the research hypothesis that consumers discover novelty products. And it pointed out that the personalization of the website is not beneficial from every angle. What the website needs to do is how to effectively use the personalized recommendation technology to produce positive effects.

Finally, the work of Adomavicius et al.(2017) suggested that RS has significant side effects on consumer economic behavior, as inaccurate advice may distort the willingness of consumers to pay. Based on portfolio theory, Zhang et al. (2013) suggested that it is sometimes best not to make personalized recommendations for certain users, but only recommend popular ones. Because, in some cases, non-personalized recommendations can provide more relevant (or interesting) items, and personalized techniques may not capture the user's current personal interests and lead to low quality recommendations. In a market where providers compete with each other, Li et al. (2016) found that personalized recommendations may have both positive and negative effects. RSs can increase the market by recommending products to consumers, and may also result in price competition and low profitability of providers.

CONCLUSION AND FUTURE WORK

With the rapid development of the Internet and mobile commerce, many companies have begun to establish their own websites or join third-party platforms to carry out e-commerce and network marketing. But how do you effectively translate customer click-through rates into turnover rates? How to effectively and accurately control corporate marketing costs? In response to this series of problems, many companies have begun to apply digital marketing methods. As a digital marketing technology, RS has strong marketing advantages. It can not only provide consumers with suggestions for products and information, but also simulate sales personal to help customers complete the purchase decision process. RS has attracted more and more researchers' attention in the business value of B2C e-commerce.

First, the premise of personalized recommendation on consumers' purchasing decisions is to attract consumers to use RS. For this reason, scholars have done research on consumer self-factors, system factors and social factors based on the theories of technology acceptance and focused on the issue of consumer's trust in personalized recommendation. As interactive assistant decision-making tools, RSs can reduce the decision-making effort and decision-making time of consumers, increase the input of user information, and thus improve the quality of decision-making. At the same time, with the development of social e-commerce, online consumer reviews of recommended products have become an important source for consumers to make purchases decision.

Second, with the application of big data and artificial intelligence technology, analyzing the actual data of e-commerce transaction activities, including sales data or consumer behavior data, has become a new direction for researchers to further study the business value of RSs to e-commerce market and e-commerce firm. Social e-commerce represented by internet celebrity, micro-business, etc. enables product information to be shared into people's lives through social channels. Consumers access shopping information through social relationship chains and share shopping experiences through social networks. The social media and social network have stimulated scholars to explore the impact of user recommendations and product recommendation networks on product demand and product sales respectively and jointly. The ultimate goal of the company to provide RSs is to make a profit. Therefore, how to attract customers and increase profits by price promotion and estimating consumers' willingness to pay for recommended products are both the focus of future research.

Finally, the application of personalized recommendation technology has been continuously proved by researchers to benefit consumers and business, but its negative effects are less studied. Some scholars believe that the website may provide RS, which may be more in consideration of their own interests, thus resulting in biased personalized recommendations. How to reduce consumers' perception of the RS's deceptiveness and establish more effective guidelines of good business practices online should be the next research directions. In terms of homogenization effects and heterogeneity effects, researchers still have not reached a consensus conclusion. Considering that different recommendation methods, different RS types and consumers' own traits may lead to different research conclusions, we suggest that future research should continue to explore further on the basis of comprehensive consideration of the above factors.

ACKNOWLEDGMENT

This work is partially supported by grant U1711263 of the Natural Science Foundation of China; 2017AA16004 of the Science and Technology Project of Guangxi Province, China.

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The Use of Electronic Medical Record System on Dynamic Capabilities and Physician Productivity (Full Paper)

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ABSTRACT

Transiting from manual to electronic medical record (EMR) system is a managerial concern due to human resistance to change and potential interruption to the existing workflow operation. Using PLS-SEM, findings show that doctors' perceived usefulness and ease of using the EMR system can be leveraged to enhance their dynamic capabilities for knowledge acquisition and deployment, thus having a positive impact on physician productivity. The study contributes towards policies and strategies that can enhance doctors' dynamic capabilities to leverage the implementation of the EMR system towards improving physician productivity from a developing country perspective.

Keywords: Electronic medical record, intensive care unit, information systems, dynamic capabilities, physician productivity, developing country.

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INTRODUCTION

The United Nations' Sustainable Development Goal for "good health and wellbeing" calls for better health coverage to promote wellbeing by 2030. In response to the call, countries are investing in healthcare services to ensure healthier lives to promote wellbeing. As such, the information technology platform is identified and utilized by health care providers to improve patient care and safety while ensuring universal health coverage. Studies often relate quality healthcare with patient mortality and readmission rates, patients' satisfaction with quality care or physical health, infrastructure, and availability of preventative care (Legatum Prosperity Index, 2017). The prevalence of data and extensive use of information systems in developed countries has urged the implementation of electronic medical record (EMR) system in the developing countries for public healthcare development. The EMR system has radically transformed the healthcare sector in developed countries and evidence points towards savings of an estimated USD \$81 billion in United States alone (Hillestad et al, 2005). Subsequently, the adoption of EMR systems can lead to improved patient care, reduced medical errors among medical practitioners, and improved transmission of laboratory tests. In addition, the EMR has also benefited day-to-day operations through efficient admission and billing charges.

The EMR system being a component of the available healthcare information systems is being implemented in stages by hospitals in developing countries. As the EMR system moves healthcare information and knowledge resources towards an integrated interface, an effective use of the system would improve staff efficiency, accountability, and error reduction in hospitals as it systematically manages patients' clinical data. Physicians are human and not infallible hence they are unable to be the authority in every medical discipline even within their own specialty, they cannot claim to 'know everything'. The use of EMR reduces human error and improves medical diagnostics as physicians do not work in silos and are able to make better patient care decisions based on available information. In this age of rapid medical advancement, doctors have to rely on reliable systems to ensure real-time access to information and enable regular communication between teams of multidisciplinary specialists involved in the care of a patient. In addition, little is known about physicians' belief about the usage of the EMR to aid decision-making from a developing country perspective and the drivers of IT use behavior in the context of healthcare delivery. Empirical support on the use of EMR system has so far been varied and Western-centric. The high costs associated with the implementation of the EMR is another deterrent from the institution's perspective. Unlike a profit-making firm, many hospitals struggle to measure the return on investment (ROI) from IT applications. Berner, Detmer, and Simborg (2005) further illustrates that in the early years EMR adoption, hospitals struggle with "technology immaturity, health administrator focus on financial systems, application "unfriendliness," and physician resistance". However, changes in government policies, computer literacy and physicians' attitudes have led to better acceptance of the EMR in the United States. From a developing country's perspective, the costs associated with healthcare technology investment has not been uniformly justified, often leading to slow adoption of the EMR. Currently, countries in Southeast Asia spend between 3-5% of GDP on health expenditure (Health, Nutrition and Population Statistics, 2018).

The study integrates theoretical perspectives from the information systems and dynamic capabilities literature to examine the impact of using the EMR system on individual doctors' dynamic capabilities for knowledge acquisition and deployment as well as physician productivity during the switch from manual to electronic workflow operation. Such examination would provide insights on whether the benefit of implementing the EMR system fulfills its potential to curtail the heavy cost of healthcare technology investment. Three research objectives would be addressed as follows:

1. To examine doctors' technology perceptions of using the EMR system on dynamic capabilities enhancement and physician productivity.
2. To examine the effect of doctors' dynamic capabilities enhancement on physician productivity.
3. To examine whether doctors' dynamic capabilities enhancement mediates technology perceptions of using the EMR system on physician productivity.

Results from the study will inform policy implications on using the EMR system for leveraging doctors' dynamic capabilities and physician productivity from a developing country perspective. This is necessary since numerous policy implication can be proposed based on the usage and acceptance of the EMR from the perspective of health care practitioners.

The structure of this paper is as follows. In the following section, we provide a review of current literature on the role of dynamic capabilities to inform the theoretical framework of the study. This is followed by the conceptual framework which presents the hypotheses development of the study. Next, the empirical methodology section outlines the data, sampling design, and methodology employed in the study. The result section presents the measurement and structural models obtained from the multivariate analysis, followed by the discussion section. Finally, the conclusion section summarizes the limitations, future research direction, and concluding remarks of the study.

LITERATURE REVIEW

While rapid technological development presents great potential for healthcare advancement, the actual use of these technologies may be resisted by individual healthcare professionals for fear of changing their work processes, consequently affecting their job performance (Kankanhalli et al., 2016). This may further impair the allocation of technology and knowledge resources that would impact not only patient care but also socioeconomic outcomes for various stakeholders in the community. The literature often views technological infrastructure as a trajectory to effective knowledge management which would have a positive impact on job performance (Easterby-Smith & Prieto, 2008). An emerging aspect of knowledge management is the development of dynamic capabilities.

Dynamic capabilities are the ability of an organization to manage its vast resources in a rapidly changing environment, allowing for improvisations where necessary. The concept, first defined by Teece and Pisano was built on a resource-based view (Barney, 1991) dealing with the evolutionary nature of resources and capabilities in a rapidly evolving environment. However, having resource advantage is necessary but not sufficient for gaining competitive advantage. To achieve competitive advantage, the enhancement of distinctive capabilities is essential to make better use of organizational resources (Wang & Ahmed, 2007).

The development of dynamic capabilities can be understood as an evolving process based on the interaction between daily operation and knowledge-creating activities. It is not a one-off ad-hoc problem-solving mechanism (Zahra et al., 2006). The enhancement of dynamic capabilities is an ongoing process that would redefine the knowledge base of organizations or individuals, which eventually would lead to value creation (Barreto, 2010).

In the healthcare industry, individual healthcare professionals should not only be able to perform their duties (operational capabilities) but comprehend changes in their external environment, seize the opportunity to utilize technology and knowledge resources or competencies to meet new challenges (Teece, 2007) as and when they arise in healthcare industry. The quality of job performed by individual healthcare professionals would directly ensure for the quality of healthcare services provided, which may further impact patient care and socioeconomic outcomes at the macro-level.

Furthermore, individual healthcare professionals often "learn by doing" (Cohen & Levinthal, 1990) and are called to provide accurate diagnosis involving life-and-death decisions. Learning is central to developing dynamic capabilities (Cohen & Levinthal, 1990). It is as they learn by accessing explicit patient data and assessing these data based on tacit medical knowledge that they are able to articulate sound diagnosis on patients. Trial and error, improvisation, and imitation (Zahra et al., 2006) may also be useful in the process of reconfiguring knowledge resources and competencies to better address the medical conditions at hand. When

individual healthcare professionals are actually engaging in such knowledge-creating activities, they are indeed learning and consciously develop their dynamic capabilities for better job performance (Easterby-Smith & Prieto, 2008).

Literature discussed thus far has pointed out that the development of dynamic capabilities will lead to change in operational capabilities and improvement in job performance. This study seeks to address an important literature gap, which is about the possible impact of actual use behavior of healthcare technology on the relationship between dynamic capabilities and job performance. Increasingly, explicit healthcare and patient data are being digitized and migrated to various technological platforms. Individual healthcare professionals are also increasingly required to use technology in their day-to-day operational activities at work. Based on the literature discussed, the use of technology in healthcare may be akin to operational capabilities, which are said to have an impact on individual's performance. However, it is unclear how the quality of their actual use behavior of healthcare technology may affect their individual performance. It is also unclear whether their actual use behavior of these technologies may have a farther impact on patient care and socioeconomic outcomes at the broader level.

Should the actual use of quality technology enhance performance in making informed decisions, this will subsequently influence better patient care which leads to improved wellbeing. This improved performance will encourage other departments to adopt the quality use of healthcare technology in their daily operations. Furthermore, in terms of policy formulation in the healthcare industry, the government may choose to implement the quality use of technology (as part of process flow) as a result of the value that it adds to the industry and society.

CONCEPTUAL FRAMEWORK

Drawing from the information systems and dynamic capabilities literature, the study develops a research model (Figure 1) that examines the relationship between technology perceptions (perceived usefulness and perceived ease of use), dynamic capabilities, and physician productivity. The study focuses on individual doctors who are at the frontline of interactions with the EMR system reviewing patients' information, making decisions, executing treatments, and entering patients' updates into the system (Bhargava & Mishra, 2014).

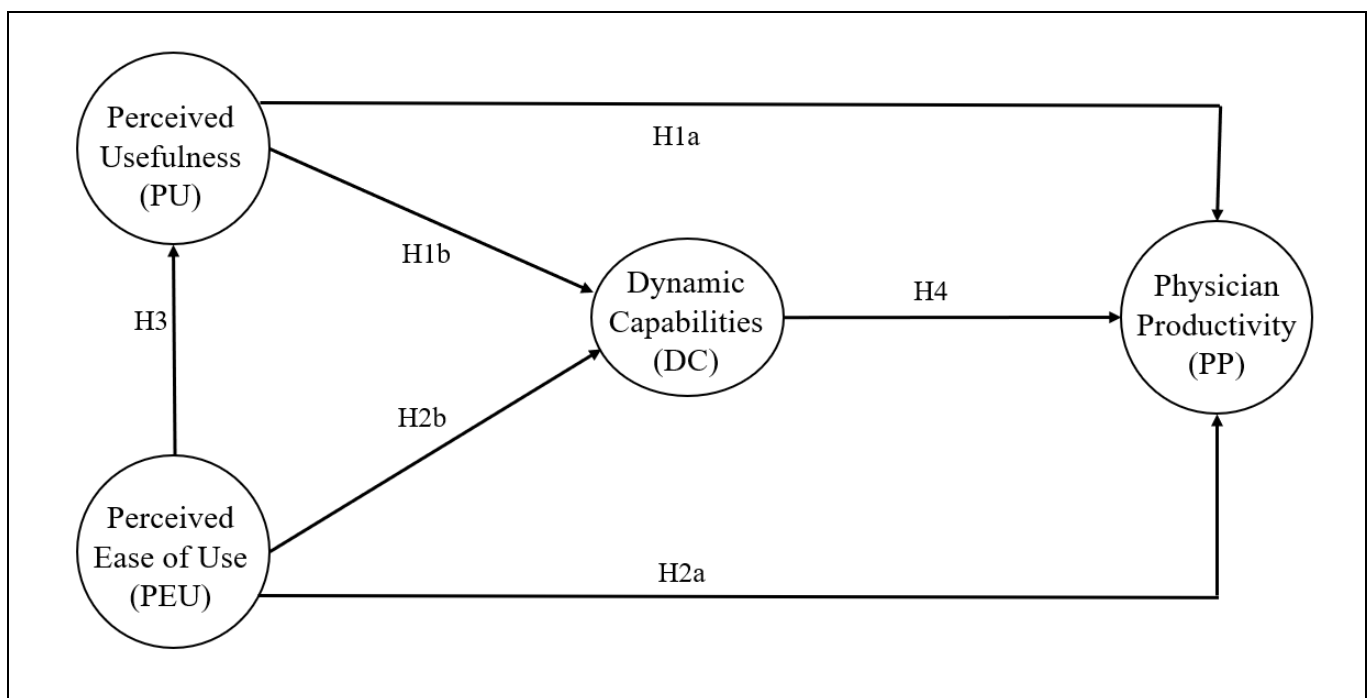


Figure 1: Research Model

The information systems research identifies two technology perceptions that have successfully explained most system use (Venkatesh, Morris, Gordon, & Davis, 2003). Originally developed in Davis' (1989) Technology Acceptance Model (TAM), perceived usefulness (PU) is defined as the degree to which an individual believes that using an EMR system would enhance his or her job performance while perceived ease of use (PEU) is defined as the degree to which an individual believes that using an EMR system would be easy and free from effort. PU has always been the primary determinant of system adoption and use (King & He, 2006; Venkatesh et al., 2003). With an already busy workload, the implementation of EMR system may exacerbate the burden on doctors who show significant concerns over their responsibilities for medical decisions, clinical documentation, patient care,

administration issues, and research especially in teaching hospitals (Bhargava & Mishra, 2014; Sykes, Venkatesh, & Rai, 2011). This study postulates that doctors who find it useful to use the EMR system for their operational routine and performance benefits would be likely to use it for enhancing their dynamic capabilities and physician productivity. Thus, hypotheses 1 are as follows:

H1a: Perceived usefulness (PU) has a direct positive effect on using the EMR system for physician productivity.

H1b: Perceived usefulness (PU) has a direct positive effect on using the EMR system for dynamic capabilities enhancement.

Most EMR systems are designed with multiple screens and rigid navigation options that are not customized for doctors. The initial learning time may put off doctors in transiting from their habitual use of the manual system to the new EMR system. Furthermore, some doctors may perceive that learning to use and master a new EMR system is a bad trade-off as they rather spend their time being more involved in patient care. Although Sykes et al. (2011) find that only PU is a key factor influencing doctors' use of the EMR system, the study also points out the potential association between PEU and physician productivity. This study postulates that doctors who find it easy and comfortable to use the EMR system would be likely to use it for enhancing their dynamic capabilities and physician productivity. Thus, hypotheses 2 are as follows:

H2a: Perceived ease of use (PEU) has a direct positive effect on using the EMR system for physician productivity.

H2b: Perceived ease of use (PEU) has a direct positive effect on using the EMR system for dynamic capabilities enhancement.

Davis (1989) and Venkatesh (Venkatesh, 2000; Venkatesh et al., 2003) discover that PEU can directly impact PU for technology adoption and use, but not otherwise. The positive correlation between PEU and PU is also observed in the use of EMR system (Sykes et al., 2011). This study postulates that doctors who find it easy and comfortable to use the EMR system would be likely to overcome the perceived difficulty in using it and willing to spend time learning to master any useful aspects of the system. Hence, hypothesis 3 is as follows:

H3: Perceived ease of use (PEU) has a direct positive effect on perceived usefulness (PU) of using the EMR system.

An obvious advantage of implementing the EMR system is to move away from information silos among multidisciplinary healthcare professionals towards an integrated interface. Decision making in hospitals and especially in hospital units that require high vigilance such as the Intensive Care Unit (ICU) is a complex process requiring sound medical knowledge from appropriate information sources. Quick and accurate decision may be the difference in preventing deterioration or pulling patients out of life-threatening conditions. As the EMR system helps to facilitate patient information and consolidate multidisciplinary knowledge resources, this study postulates that using the EMR system would be likely to enhance doctors' dynamic capabilities for knowledge acquisition and deployment in practical aspects of patient care, and thus having a positive impact on physician productivity. Hence, hypothesis 4 is as follows:

H4: The use of EMR system positively and directly enhances dynamic capabilities (DC) on physician productivity (PP).

EMPIRICAL METHODOLOGY

Data And Sampling Designs

This study was part of a larger study conducted in the Intensive Care Unit (ICU) of a tertiary government hospital that was implementing an in-house developed EMR system. The ICU is renowned in Malaysia for its medical expertise and excellent patient care. In this study, the ICU was selected because it was the last hospital unit to fully implement the EMR system across all its operations and the implementation has faced much resistance from doctors. A clustered random sampling technique was employed to reach out to all doctors (in the categories of specialists, medical officers, and house officers) involved with patient care in the ICU. The sampling frame contains a list of all doctors who were working in the ICU during the period of our data collection. The doctors were given the option to complete either a paper-based or an online-based questionnaire survey. Our survey questions were part of a larger survey administered in the hospital. A total of 60 valid responses was obtained, yielding an effective response rate of about 90%.

Content Validity

To ensure for content validity of the multi-item scales used in the study, readily established instruments were adapted from prior research. Instruments measuring perceived ease of use and perceived usefulness of using the EMR system were obtained from Sykes, Venkatesh, & Rai (2011). Instruments measuring dynamic capabilities enhancement were obtained from Sher and Lee (2004). Instruments measuring physician productivity were obtained from Bhargava and Mishra (2014). All items were measured on a 7-point Likert scale.

RESULTS

The empirical results were obtained from a multivariate analysis based on partial least square structural equation modelling technique (PLS-SEM). The SmartPLS 3 software was used to estimate the measurement and structural models (Ringle, Wende, &

Becker, 2015). The PLS-SEM was employed as it allows for exploratory analysis and distribution-free assumptions to be made on small sample size.

Measurement Model

Measurement model was evaluated to ensure for construct reliability and validity, particularly the convergent and discriminant validity of the measurement model. From Table 1, the results show good indicator reliability with most items loadings above 0.708. PU04 was the only nonconforming item with indicator loadings less than 0.60, hence was removed from further analysis. DC08 and PP05 had item loadings between 0.60 and 0.708, but a further test showed that they did not significantly threaten construct reliability and validity, hence was retained for further analysis.

Table 1: Measuring Items Loadings

Construct	Item	Description	Loadings
Perceived Usefulness (PU)	PU01	I believe EMR would be useful in my job.	0.913
	PU02	Using EMR will enable me to accomplish tasks more quickly.	0.934
	PU03	Using EMR will increase my productivity.	0.961
Perceived Ease of Use (PEU)	PEU01	My interaction with EMR would be clear and understandable.	0.829
	PEU02	It would be easy for me to become skillful at using EMR.	0.904
	PEU03	I would find EMR to be easy to use.	0.895
	PEU04	Learning to operate EMR would be easy for me.	0.899
Dynamic Capabilities (DC)	DC01	EMR enhances learning effectiveness of new knowledge.	0.721
	DC02	EMR enhances decision quality.	0.906
	DC03	EMR enhances capabilities of communication and coordination.	0.866
	DC04	EMR enhances responsiveness.	0.849
	DC05	EMR enhances integration in hospital practice.	0.829
	DC06	EMR enhances accumulation of knowledge.	0.772
	DC07	EMR enhances capabilities of resource deployment.	0.799
	DC08	EMR enhances patient relationship.	0.699
	DC09	EMR enhances trust with healthcare providers.	0.792
	DC10	EMR enhances unimitability (unique) of strategic knowledge asset.	0.749
Physician Productivity (PP)	PP01	EMR allows me to easily synthesize information from multiple sources.	0.878
	PP02	EMR allows me to make patient treatment decisions efficiently.	0.895
	PP04	I enter a lot of information about patients, which can be helpful to other physicians.	0.708
	PP05	On the balance, I do more information entry than information synthesis using EMR.	0.651

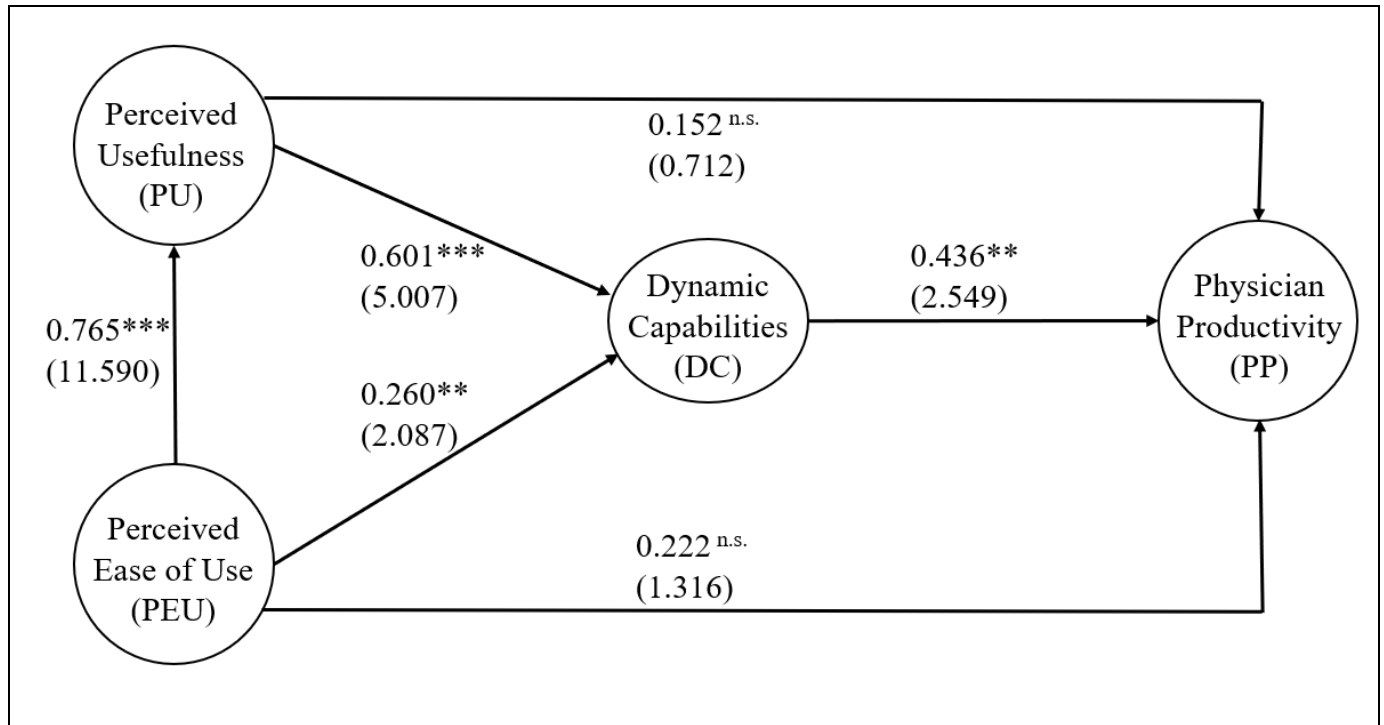
From Table 2, the results show that all multi-item scales had good construct reliability with composite reliability (CR) higher than 0.70 and good construct validity with average variance extracted (AVE) higher than 0.50. Sufficient discriminant validity was also evident based on Henseler, Ringle, and Sarstedt's (2015) heterotrait-monotrait ratio of correlations (HTMT). The HTMT was used as it better evaluates discriminant validity in variance-based PLS-SEM and is more sensitive to detect discriminant validity problem.

Table 2: Construct Reliability and Validity of the Measurement Model

Constructs	CR	AVE	Discriminant Validity		
			PEU	PU	DC
DC	0.947	0.641			
PEU	0.867	0.624			
PU	0.934	0.779	0.830		
DC	0.947	0.641	0.789	0.861	
PP	0.955	0.876	0.754	0.744	0.802

Structural Model

The structural model was analyzed with a bootstrapping procedure of 5000 resamples to prevent inflated test-statistics and increase estimation confidence based on distribution-free sampling method (Hair, Hult, Ringle, & Sarstedt, 2014). The magnitude and significance of all hypothesized path coefficients are presented in the result model below (Figure 2). Inferences were drawn based on the threshold critical value (bootstrapped t-statistics) at the specified significance level.



Note: Significance level: *** $p < .01$; ** $p < .05$; * $p < .10$; n.s. non-significant.

Figure 2: Result Model

Based on the adjusted R-square, the model explained 53.7% of the variance in physician productivity and 66.7% of the variance in dynamic capabilities at 1% significance level. No evidence of multicollinearity between constructs was observed as most VIF values were below 3 and all VIF values were below the threshold cutoff value of 5.

The empirical results show that perceived usefulness (PU) and perceived ease of use (PEU) have no significant direct impact on physician productivity (PP), but dynamic capabilities (DC) have significant direct impact on PP (0.436). With the enhancement of DC, PU and PEU show significant indirect impact on PP (0.262 and 0.433, respectively). While PU has stronger direct effect on DC (0.601) than PEU on DC (0.267), the effect of PEU on PU is even stronger (0.765) thus causing the total effect of PEU on DC (0.727) and PP (0.655) to be more salient and stronger than PU on DC (0.601) and PP (0.414).

Table 3 shows that the direct effects of PU and PEU on PP were not significant, thus not supporting hypotheses H1a and H2a. The positive effect of PEU on PU was significant, thus supporting hypothesis 3. The indirect effects of PU and PEU on PP were significant via DC, thus supporting hypotheses 1b, 2b, and 4. The total effects of PEU, PU, and DC on PP were all significant.

Table 3: Direct, Indirect, and Total Effects

Hypotheses	Direct Effect	Total Indirect Effect	Total Effect
H1a PU -> PP	0.152 (0.712) n.s.	0.262 (2.052) **	0.414 (2.110) **
H1b PU -> DC	0.601 (5.007) ***	-	0.601 (5.007) ***
H2a PEU -> PP	0.222 (1.316) n.s.	0.433 (3.019) ***	0.655 (7.752) ***
H2b PEU -> DC	0.267 (2.087) **	0.460 (4.019) ***	0.727 (12.518) ***
H3 PEU -> PU	0.765 (11.590) ***	-	0.765 (11.590) ***
H4 DC -> PP	0.436 (2.549) **	-	0.436 (2.549) **

Note: Significance level: *** $p < .01$; ** $p < .05$; * $p < .10$; n.s. non-significant.

DISCUSSION

This study presents findings that investigate the relationship between doctors' technology perceptions on using the EMR system, in terms of perceived usefulness and perceived ease of use, dynamic capabilities enhancement for knowledge acquisition and deployment, and physician productivity in the Intensive Care Unit (ICU) that was newly implementing the EMR system. The empirical results supported four significant hypotheses: (1) doctors' technology perceptions (perceived usefulness and perceived ease of use) do not significantly affect physician productivity; however, (2) doctors' technology perceptions (perceived usefulness and perceived ease of use) significantly enhance their dynamic capabilities for knowledge acquisition and deployment; as a result of which, (3) dynamic capabilities enhancement directly affect physician productivity while technology perceptions (perceived usefulness and ease of use) indirectly affect physician productivity; and finally, (4) although the effect of perceived ease of use on dynamic capabilities is less salient than perceived usefulness, policy makers can leverage on the strong direct positive impact of perceived ease of use on perceived usefulness of the EMR system.

Our findings support earlier study by Agwunobi and Osborne (2016) that hospitals can utilize physician's dynamic capabilities as a source of competitive advantage. The EMR organizes structured clinical data which helps physicians make informed decision to provide accurate diagnosis during their performance in the ICU. Furthermore, the system is often dependent on the collective users of the system. This is because decisions in the ICU require consolidating patient data from various sources to allow doctors a holistic overview of the patient's condition. Huckman and Pisano (2006) examine procedures performed by 203 surgeons in Pennsylvania and find that a portion of surgeon performance is specific to the hospital. Their results suggest that doctor's performance is linked to the familiarity of systems in place and their marginal productivity is not constant across firms.

Doctors involved in the ICU need to make accurate and appropriate medical decisions which usually involve stress and uncertainty when patients have compromised physiological reserve. Bornstein and Emler (2001) discuss the role of biasness when doctors decide on a treatment course after making a definitive diagnosis or the consequences of an wrong diagnosis. The EMR system minimizes such occurrences as doctors will not have to second guess their decision making since all decisions will be made objectively based on the data provided by the EMR. In addition, doctors can access an array of information that would be difficult to present in paper charts. This information includes some of the following (i) longitudinal hemodynamic parameters data, (ii) extensive and frequent blood investigation result patterns (especially in the critically ill), (iii) facilitate risk assessment, and (iv) even provide a means of communication between the different disciplines. This information can then be used by doctors in providing treatment and deciding the best direction of care for patients. The EMR, if used effectively, can remove barriers in healthcare services in terms of quality patient care, improve health services, and communication between healthcare personnel (Noraziani et al, 2013).

As such, the EMR reduces the occurrence of human error. Each healthcare personnel whether doctors, nurses or administrative staff can refer to the same data recorded in the EMR in decision making or providing care. Since EMR stores records online, patient data can be stored for long periods and can be assessed from any point within the hospital vicinity. If the doctor is at one end of the hospital and the patient is located at another end of the hospital. Although studies have found that computerized entry by specialists or physicians may initially slow down physicians' productivity during the transition period (Noraziani et al, 2013), but this was not captured in our findings. Instead doctors find that their productivity increased with the use of EMR. It can be accounted by the heavy usage and familiarity with electronic devices. All these account for the potential advantages of implementing the EMR system and the benefits of the EMR system as an aid for decision making in critical care medicine.

Despite the potential benefits of using the EMR system, certain challenges in using the system have also been highlighted. Doctors have described requiring longer working time learning to use the EMR effectively as most systems have multiple screens and navigation options. With an already heavy workload, doctors would prefer spending their time by the patient's bedside and getting more involved in the practical aspects of patient care. Lack of IT support has also been cited as a barrier to effective use of the EMR system. When probed further, some doctors indicated that there was inadequate assistance when encountering difficulty in navigating the EMR system. Subsequently this can become a deterrent in utilizing the EMR system effectively. Good IT support is therefore imperative for the successful implementation and adoption of the EMR system.

Our study provide implication for practice in that enhancing physician's dynamic capabilities can be leveraged as a source of competitive advantage in environments such as the ICU. The increased use of the EMR will not only increase physician's dynamic capabilities but also their productivity. Specifically, perceived usefulness and perceived ease of using the EMR would determine whether the enhancement of physicians' dynamic capabilities could be a source of their increased productivity. Physicians' productivity is strongly linked to how they utilize the EMR for building and integrating their competencies in daily operations of an intense situation in the ICU.

CONCLUSION

This study is not without limitation. Access to busy doctors who are working in the ICU that demands high attention had been a major challenge during the data collection process. While the questionnaire survey was administered to all doctors working in the ICU, the study could only reach out to doctors on duty during the time of our visit to the ICU. Although the selection of ICU has been justified as the selected cluster for the study, future research should consider extending the study to include a wider sample size that contain doctors from all other units in the hospital. This will be particularly important in units which are fast-paced and high stressed, for example Emergency department. In addition, the study was conducted at a tertiary, not for profit hospital. As such, the generalizability of its culture or organizational structure may indirectly impact our results.

Nonetheless, the ideas we put forward contribute to the wider discussion on the role of dynamic capabilities in the healthcare sector. This study makes new contributions to the literature by examining individual doctors' technology perceptions of using the EMR system on the enhancement of dynamic capabilities for knowledge acquisition and deployment, hence having a positive impact on the physician productivity. Decision making in the ICU may differ from decision making in other departments due to the circumstance of providing critical care to critically ill patients.

The benefits of implementing the EMR system in the ICU are highly skewed towards time consumption and critical decision making on patients involving life-threatening conditions. However, as the EMR system enables doctors to make decisions based on consolidated patient information and multidisciplinary knowledge resources, future research should also extend the current model to examine the use of big data resources embedded in the EMR system for effective decision making in critical care medicine. Studies may also explore the role of shared decision making as a potential model for life threatening diseases for patients in the ICU (Charles, Gafni & Whelan, 1997; Gerber & Eiser, 2001). In response to the UN's Sustainable Development Goal for "Good health and wellbeing", developing countries are fast leveraging on the information technology platform to enhance good decision making and patient care. This study demonstrates how this is being rolled out in a case study of a tertiary hospital.

ACKNOWLEDGEMENT

This work is supported by grant GA-MA-16-L01 of Global Asia in the 21st Century (GA21) Multidisciplinary Funding Platform from Monash University Malaysia.

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Understanding Booking Intention of Consumers in Online Short Rental Platforms: Social Presence, Perceived Social Benefits, and Trust

(Full Paper)

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ABSTRACT

For studying the whole process of online short rental platform consumers, which start from the attention to the booking intention, this paper based on the social presence theory, analyzed the consumers' online short rental booking intention from the social perspective. Taking the consumers' perceived social benefits and trust as mediators, we explored the process and mechanism of consumers' booking intention on the short rental platform and constructs a research model of consumer online short rental booking intention. Then, the empirical studies have shown that social presence can influence consumers' booking intention by increasing their perceived social benefits and trust. Finally, based on the results, the recommendations of online short rental platform and the host were put forward.

Keywords: Social presence; online short rental; booking intention; perceived social benefits; trust.

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INTRODUCTION

In recent years, the concept of sharing economy has attracted lots of attention, the shared housing industry is developing rapidly, and it is expected to usher in a new round of growth. Shared accommodation refers to the economic activity that integrates the sharing of massive and scattered accommodation resources to meet the needs of diverse accommodations based on the Internet platform ("The Report of Shared Accommodation Development in China 2018"). Below this new trend, how to let more consumers turn such preference into the actual booking intention, it requires us to explore the mechanism of consumer's booking intention.

In order to improve the consumer conversion rate of the online short rental platform, exploring the mechanism of consumers' booking intention have become a problem cried out for settling. Most of researches focus on the motivation and experience satisfaction of hosts and guests (Liang, Choi, & Joppe, 2018), and the research on the willingness to book online short rental mainly focuses on the influencing factors, few based on consumers' browsing and interacting behaviors on the online short rental platforms to study the influence mechanism of consumers' booking intention.

We use the social presence theory to explore the influence mechanism based on a series of pre-booking behaviors like the user's browsing behavior and interaction behavior with the platform, the hosts and other consumers, all of them can be called social factors. We expect to solve the following critical problems: First, in the socialized environment, what social benefits are that consumers will perceive from the online short rental. Secondly, in the online short rental platform, whether the social presence generated by the interaction between consumers and websites, other consumers and the hosts can influence consumers' perceived social benefits and trust, and further influence the booking intention. Finally, how the platform and the hosts to effectively manage the listings to improve their room booking rate?

LITERATURE REVIEW

2.1 Studies on Online Short Rental

Scholars have conducted a variety of research on online short rental. Some researches focus on the legal and regulatory issues of online short rental (Edelman & Geradin, 2015; Guttentag, 2015; Lee, 2016), discussing the impact of the sharing economy on tourism (Heo, 2016), comparing it with the traditional accommodation industry (Li, 2017), and analysis it as a case of value co-creation (Jiang & Li, 2016).

2.2 Studies on Booking Intention of Online Short Rental

In terms of booking intention studies, Tussyadiah (2016) explored the impact of enjoyment, monetary benefit, amenities, social benefits, and perceived value on peer to peer accommodation consumer satisfaction and future booking intention. Kim *et al.* (2015) argue that reputation, social presence, and benevolence will bring trust, social benefits and economic benefits, cognitive benefits will bring relative advantages, while trust and relative advantages and perceived risk affect booking intentions. We found that some studies used the similar factors as the antecedent affecting the booking intention especially the perceived social benefits, that reflect the importance of social benefits in online short rental. So, we plan to use this factors as a mediator

to booking intention.

We found that most of the current foreign research on the booking intention has shifted from the initial booking intention to the re-booking intention or customer loyalty (Liang *et al.*, 2018; Lalicic & Weismayer, 2018). Therefore, based on the actual situation, we aim to explore how to attract and transform new users and establish a model of online short rental booking intention influence mechanism.

THEORETICAL BACKGROUND AND HYPOTHESES

We applied the social presence theory to explain the consumer's perception of the property and the hosts on the online short rental platform through product presentation, electronic word of mouth and online interaction with the merchant. We study the mechanism affects consumers' willingness to book and establishes a theoretical model based on consumer perception of social benefits and trust.

3.1 Social Presence

The social presence theory was proposed by Short *et al.* in the 1870s to explain how media influence communication (Short, Williams, & Christie, 1976). He defines social presence as the degree of salience of others in interaction and the conspicuous degree of interpersonal relationships.

When consumers feel the warmth between people in a series of interactions, they will think that the host can bring the desired social benefits to themselves. Therefore, when the social presence is higher, consumers' perceptions of social benefits will be more clear and profound. Therefore, we proposed the following:

Hypothesis 1. Social presence is positively affecting consumer perceived social benefits.

When websites and merchants give consumers' low perceived social presence, this means that the information consumers received is "poor" and the attitude they feel is "indifferent". At this time, it is difficult to build trust. Therefore, we proposed the following:

Hypothesis 2. Social presence is positively affecting consumer trust.

When people have a better understanding of a target product, the psychological conviction will naturally deepen, which will increase their willingness to book. And so far, there have been many studies that demonstrate that social presence affects consumers' booking intention (Gefen & Straub, 2004; Shen, 2012; Hajli, Sims, Zadeh, & Richard, 2017). Therefore, we proposed the following:

Hypothesis 3. Social presence is positively affecting consumers' booking intention.

3.2 Perceived Social Benefits

Consumer perceived benefits refer to the consumer's perceived positive value of an experience (Holbrook, 1978; Keller, 1993), which is what benefits this product can bring to consumers. Kim, Ferrin, and Rao (2008) argue that perceived earnings in online transactions are beliefs that consumers believe they will get better from the transaction. Therefore, combined with the unique social attributes of online short rental, we believe that social benefits refers to consumers developing social relationships with hosts, guests, neighbors, etc. through online short rental, and obtaining local people's sincere suggestions and strategies.

Consumers will deepen their perception of social benefits from the platform and interaction, and then generate corresponding emotional reactions. This can be understood as that when consumers perceive the exact benefits, they will increase their sense of identity for online short rental, thus increasing their trust. Trust can be built by meeting expectations, when consumers' perceived social benefits are in line with their expectations, it will have an impact on trust. Therefore, we proposed the following:

Hypothesis 4. Consumer perceived social benefits positively affecting consumer trust.

Consumers are goal-oriented. When consumers perceive that the room will meet their social needs from the online short rental platform and the communication with the hosts, they will have the willingness to book the room. Therefore, we proposed the following:

Hypothesis 5. Consumer perceived social benefits positively affecting consumers' booking intention.

3.3 Consumer Trust

Trust is very important in an e-commerce environment, so when the rules provided by the website cannot reduce customers' social uncertainty, they often reduce their social uncertainty based on their trust and familiarity with the merchants (Gefen & Straub, 2004). Combined with the characteristics of online short rental trust objects, we define trust as the consumer's perception of the online short rental platform and the host's reliability through interaction with online short rental platforms and merchants.

Consumers make purchase decisions based on the belief in trust objects. In this paper, hosts and accommodation providers are important objects of trust in online short rental transactions. When consumers believe that the host is trustworthy and would

meet their service requirements and ensure that themselves' personal and property security will not be threatened, their booking intention will increase greatly. And some studies have found that trust is a decisive factor in the willingness of online shopping (Hajli *et al.*, 2017; Lu *et al.*, 2016; Ogonowski *et al.*, 2014; Kim *et al.*, 2008). Therefore, we proposed the following: Hypothesis 6. Consumer trust is positively affecting consumers' booking intention of online short rental.

Based on the postulated terms, a conceptual framework (see Figure 1) and corresponding research hypotheses are proposed.

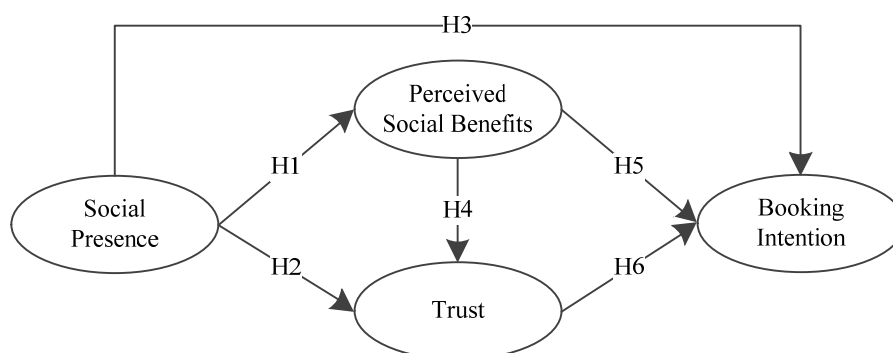


Figure 1: Theoretical research model.

RESEARCH METHODOLOGY

4.1 Research Survey

In view of the above theoretical model, we draw on the other research result and designs a questionnaire for the online short rental booking intention mechanism. All items used a 7-point Likert scale, ranging from “1 = strongly disagree” to “7 = strongly agree”. The questionnaire items (Table 1) of this study were all cited from the items used in the previous study and modified according to the content of the study. We were fully discussed with the teachers and classmates, and strictly examined the content of the questionnaire. A preliminary survey was conducted with a small sample before the formal investigation, and the contents of the questionnaire were further adjusted based on the results, thereby forming a formal questionnaire. Therefore, it can be considered that the measurement content covers the framework and content discussed in this study, and has a good content validity to a certain extent.

Table 1: Constructs and measurement items.

Construct	Question items	Origins
Social Presence	SP1: I can imagine how the house may look like by the information from the process of booking.	Hassanein and Head(2007); Xin Yu <i>et al.</i> (2017)
	SP2: I can feel unconsciously in the house by the information from the process of booking.	
	SP3: There is a sense of human warmth in the online short rental.	
Perceived Social Benefits	PSB1: Living in online short rental's house allows me to develop social relationships.	Tussyadiah(2016)
	PSB2: Living in online short rental's house allows me to get insider tips on local attractions.	
	PSB3: Living in online short rental's house allows me to have a more meaningful interaction with locals.	
	PSB4: Living in online short rental's house allows me to get to know people from the local neighborhoods.	
Trust	TR1: I think the host was honest.	Liang <i>et al.</i> (2018)
	TR2: I believe the host was trustworthy.	
	TR3: I believe the host was dependable	
	TR4: I believe the online short rental is trustworthy.	
Booking Intention	BI1: I am willing to book an online short rental's room when traveling	Tussyadiah(2016)
	BI2: I will probably book online short rental.	
	BI3: I plan to book an online short rental's room when traveling	

4.2 Data Sample

The survey was conducted from the end of June 2018 to the end of July 2018. It lasted for one month and was edited and distributed through the questionnaire platform. A total of 366 questionnaires were obtained after basic logic check and discarded incomplete answer. The main features of the sample are shown in Table 2. Among them, 30.9% are males and 69.1% are females, the largest number of people aged 18 to 24(63.4%), undergraduate or junior college students(78.1%), the monthly

disposable income range of 800-2000 yuan(42.1%), and 34.9% of the samples are not familiar with online short rental. Paralleling the Sharing Accommodation Development Report of China (2018) (70% of the total guests aged 18-30 and 35% of the monthly income of 5000-10000). So we can confirm that the sample is effective and representative, and data analysis can be further carried out.

Table 2: Demographic Characteristics of Respondents.

Characteristics		Frequency	Percent
Gender	Male	113	30.9
	Female	253	69.1
Age	Under 18 years	26	7.1
	18 to 24 years	232	63.4
	24 to 30 years	73	19.9
	30 to 36 years	19	5.2
	36 to 42 years	7	1.9
	Over 42 years	9	2.5
Education level	High School and below	31	8.5
	Undergraduate or specialist	286	78.1
	Master's degree and above	49	13.4
Monthly income	Under ¥800	44	12.0
	8000-2,000	154	42.1
	2,000-4,000	95	26.0
	4,000-6,000	46	12.6
	Over 6,000	27	7.4
Kownlegement degree	Lived before	147	40.2
	Searched and evaluated before	91	24.9
	Don't know	128	34.9
Preference of property type	Entire home	174	47.5
	Private room	173	47.3
	Shared room	19	5.2

DATA ANALYSIS AND RESULTS

5.1 Measurement Model Testing

According to the theoretical model of this paper, variables cannot be directly observed, so the structural equation model is used for testing. The measurement model was estimated using CFA. We use the measurement item factor load, the Cronbach's α coefficient, the composite reliability (CR), and the average variance extracted (AVE) scores to test the reliabilities of the model. The various latent variables are tested for reliability and validity. As shown in Table 3 and Table 4, the load of all indicators exceeds 0.6, which means that the reliability of each construct is sufficient; all the Cronbach's α coefficient of the corresponding latent variable is higher than 0.7, and the composite reliability is greater than 0.7, which indicate that the internal consistency of the latent variable is suitable, and the measurement model has good reliability, and all the AVE is greater than 0.5, indicating that the measurement model has good convergence validity. The square roots of AVE are greater than any correlations between the associated construct and other constructs, suggesting discriminant validity.

Table 3: Results of Reliability and Validity Analysis.

Constructs	Items	Standardized factors loading	Cronbach' α	CR	AVE
Social Presence	SP1	0.766	0.787	0.789	0.555
	SP2	0.731			
	SP3	0.737			
Perceived Social Benefits	PSB1	0.684	0.832	0.835	0.559
	PSB2	0.728			
	PSB3	0.800			
	PSB 4	0.774			
Trust	TR1	0.804	0.870	0.878	0.643
	TR2	0.808			
	TR3	0.782			
	TR4	0.814			
Booking Intention	BI1	0.775	0.845	0.848	0.651
	BI2	0.822			
	BI3	0.823			

Table 4: Analysis of discriminant validity.

Constructs	SP	PSB	TR	BI
Social Presence	0.745			
Perceived Social Benefit	0.710	0.748		
Trust	0.739	0.724	0.802	
Booking Intention	0.644	0.746	0.782	0.807
Diagonals represent the sqrt of average variance extracted (AVE), while the other matrix entries represent the correlations.				

5.2 Structural Model Testing

We used a set of fit indices to examine the structural model's fitness (see Table 5). A comparison of all fit indices with their corresponding recommended values provided evidence of an acceptable model fit. Hence, we could proceed to examine the path coefficients of the structural model.

Table 5: Test of Model-Fit.

Indexes	Suggested	Actual
χ^2/df	2-5	1.574
GFI	>0.9	0.961
AGFI	>0.9	0.936
NFI	>0.9	0.965
CFI	>0.9	0.987
RMSEA	<0.08	0.040

5.2.1 Direct Effect Analysis

In SEM, the significance of the model's path coefficient provides support for the hypothesized relationships among the constructs. We use Amos22.0 to test the significance of the model path. The path analysis results are shown in Figure 2. As illustrated in Figure 2, social presence significantly influences perceived social benefits ($\beta = 0.635, p < 0.001$) and trust ($\beta = 0.463, p < 0.001$), thus supporting H1 and H2. However, social presence had no direct influence on booking intention, therefore, H3 was not supported.

Perceived social benefits significantly influences trust ($\beta = 0.460, p < 0.001$) and booking intention ($\beta = 0.361, p < 0.001$), thus supporting H4 and H5. Trust significantly influences booking intention ($\beta = 0.436, p < 0.001$), thus supporting H6. The results were contrary to propositions and findings from Tussyadiah (2016) study, perceived social benefits positively affect booking intention, which represents the difference of domestic and foreign. The model accounted for 50% of the variance in perceived social benefits, 63% of the variance in trust, and 68% of the variance in booking intention.

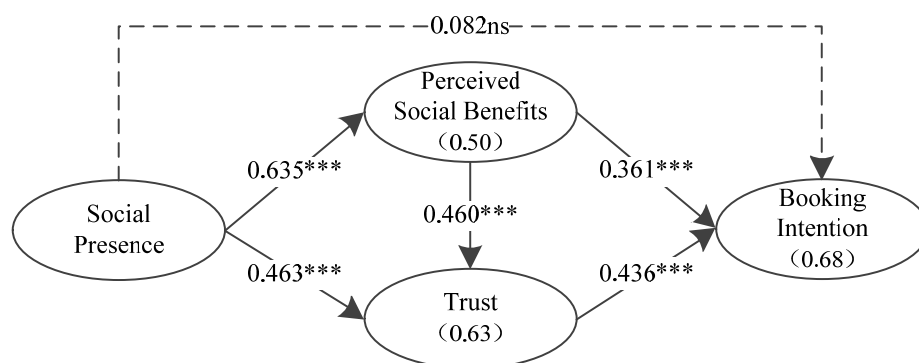


Figure 2: Results of structural modeling analysis

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$; ns: not significant; the parentheses below the constructs are R^2

5.2.2 Indirect Effect Analysis

We need to explore the mediating role of perceived social benefits and trust in the relationship between social presence and booking intention. We tested mediation, using bootstrapping in Amos 22.0. First, we examined whether social presence has a mediating effect on booking intentions. Bootstrapping results show that under the 95% confidence interval, the results of the intermediary test do not include 0 ([0.413, 0.736]), which indicates there is a mediating effect between social presence and booking intention.

Then, we examined the significance of three indirect paths between social presence and booking intention by the reference of MacKinnon (2008), and examined the specific indirect effects by PRODCLIN2 software, that computes confidence limits for the specific indirect path, and it can be used to obtain more accurate confidence limits for the indirect effect MacKinnon, Fritz,

Williams, & Lockwood, 2007). Specific indirect effects represent the portion of the total indirect effect that works through a single intervening variable (Fox, 1980). The results are shown in Table 6. We can find that all the three indirect paths were significant, for 0 is not included in the confidence interval of any indirect paths. Among them, the path “SP -> PSB -> BI” has the largest indirect effect, which accounted for 41% indirect effects of the social presence and the booking intention, so this path can be regarded as the best indirect path. The other paths “SP -> TR -> BI” and “SP -> PSB -> TR -> BI” means that trust, perceived social benefits and trust mediate the relation between social presence and the booking intention.

The results show that social factors have a critical impact on the willingness to book online short rental and also proves that China is a typical relational society. People would like to pay more attention to the generation of social relations and local life experience. And the traditional Chinese acquaintance society causes the lack of trust between strangers, we can recognize as the emotional judgment is more effective than cognitive judgment for building consumer trust.

Table 6: Mediating effect test results.

Indirect Path	Mackinnon PRODCLIN 2 95% CI		Specific Indirect Effects
	Lower	Upper	
SP -> PSB -> BI	0.104	0.389	0.229/0.559=0.410
SP -> TR -> BI	0.100	0.344	0.201/0.559=0.360
SP -> PSB -> TR -> BI	0.154	0.467	0.127/0.559=0.227
PSB -> TR -> BI	0.095	0.340	

CONCLUSION AND RECOMMENDATION

6.1 Conclusion

In the online short rental environment, we use social presence theory as the theoretical background, take the social presence as the antecedent factor, perceived social benefits and trust as the mediator factors, and consumers' booking intention as the outcome factor, explored the relationship between the four factors. The main conclusions of the study are the following:

- (1) The social presence can enhance the perceived social benefits of consumers. The social presence of consumers through the presentation information, reviews information, and online communication information with the hosts will give consumers a sense of "immersive" and make their perception of social benefits more profound.
- (2) The social presence can enhance consumers' perceived trust. Enjoyment communication will also minimize the psychological distance to the consumer, as the social presence is a sense of the house and hosts are vividly present in front of you, which means you can get a mental close to generate a sense of familiarity, and then enhance the trust of consumers.
- (3) The social presence can enhance the booking intention through the perceived social benefits and trust of consumers. The direct effect of social presence on consumers' booking intention is not significant. Based on the theory of social exchange, it can be found that the most important thing for consumers is utility maximization (Tussyadiah, 2016).

6.2 Recommendation

In order to better promote consumers' willingness to book online short rental, we proposed some suggestion to the platforms and the hosts based on the research results of this paper. For the platforms, on the one hand, optimize the built-in online chat function. The built-in chat function of most online short rental platforms is very simple, only simple text and expressions can be sent.

On the other hand, increase consumer online comment interaction. Based on the uniqueness of the host in the online short rental, the platform has the function of mutual evaluation between the host and guests to protect the interests of both parties. However, at present, most online short rental platforms can only see the unilateral comments of consumers, this will cause a problem that users who read the comments can't ask the reviewers directly if they have doubts, this will weaken the consumer's social presence perception. So it is recommended to add comment question-answering functions like Taobao.

6.3 Limitation and Future Work

The survey object of this paper is aimed at all consumers and does not consider the influence of consumers' involvement in the online short rental. For consumers may have different perceptions due to different experiences. Therefore, the degree of consumer involvement can be studied as a moderator variable in the future. And the perceived benefits are usually divided into hedonic benefits, utilitarian benefits, and social benefits.

ACKNOWLEDGEMENTS

This work is partially supported by grant SDJJ1607 of Sichuan national mountain economic development research center, the key humanities and social sciences research from the Sichuan provincial department of education.

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Understanding Consumer Preferences---Eliciting Topics from Online Q&A Community

(Full Paper)

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ABSTRACT

Online Q&A community provides a platform to create and share knowledge by posting and answering questions. Soliciting information from Q&A thus offers an alternative approach for firms to understand their consumers. This paper proposes an innovative approach to extract consumer preferences based on the online Q&A information. We develop a framework to conduct the analysis and employ Latent Dirichlet Allocation (LDA) algorithm to distill and cluster topics. Based on Zhihu, the most popular online Q&A community in China, we collect almost 50000 answers under the discussion topics of “iPhone 7” and “iPhone X”. We find that our approach can effectively extract and rank consumer preferences to the product. In addition, we find those preferences are inter-related.

Keywords: Consumer preference, online Q&A community, topic model, word co-occurrence.

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INTRODUCTION

In the past few years online Q&A communities have grown explosively into important knowledge-sharing platforms, for example, Quora and StackOverflow in the United States, and Zhihu in China. Online Q&A community provides a platform to create and share knowledge by posting and answering questions. Topics in the platforms cover a wide range of subjects via the form of questions, opinions, experiences and comments, etc.. By posting (or searching) questions and collecting answers, users can quickly learn and adopt the domain knowledge relating to their concerns, most of which are first-hand answers from domain experts (Wang et al., 2013).

On the flip side, soliciting information from Q&A in the platform also provides an alternative approach for firms to understand their consumers. Understanding consumer preferences is important to a firm. It helps to determine a firm's business strategy and identify its competitive position. However, to understand consumer is not easy although firms employ different approaches to do so. For example, a consistent narrative was that Apple Inc. was struggling to compete with local brands and that its flagship iPhone X model was too expensive for Chinese consumers (Ben, 2018). In contrast, according to the most recent report of Apple, in the year of 2018 Q2 has reached a 21% growth in Great China, which is the strongest growth rate in 10 quarters.

This paper proposes an innovative approach to understand consumer preferences based on the online Q&A information. Unlike the short-text posted in micro-blog (Li & Du, 2014), the answers in online Q&A community are in general longer than micro-blog. This thus calls for new approaches to handle the user-generated contents (UGC) for topic extraction. Our paper proposes a framework to conduct the text analysis and employ LDA algorithm (Blei, Ng, & Jordan, 2003), a natural language processing algorithm, to distill and cluster topics from the online Q&A information. LDA is an unsupervised machine learning algorithm, based on “bag of words” pattern, which uses the co-occurrence to measure the global relationships between words (Weng et al., 2010). LDA is widely used to discover hidden topics from text corpus and generates document-topic (documents are modeled as a mixture of topics) relationship, as well as topic-word (a topic is contributed by words) relationship. By LDA, it can automatically identify topics in which platform users take interests based on the contents they generate.

Based on the most popular online Q&A community in China, Zhihu, we first crawl the textual content of answers under the platform topics of “iPhone 7” and “iPhone X”. Then, after data preprocessing we use LDA algorithm to analyze the texts and extract the clustered topics. Our findings are summarized below. First, we find that LDA approach can effectively extract consumer concerns fitting the product's physical attributes. With Zhihu's online Q&A information, the clustering topics can be labelled as “camera”, “screen”, “charging”, “handset”, etc.. In addition, LDA also discloses that some non-physical attributes, for example, “life style”, “brand reputation”, contribute to the concerns of the consumers. Second, by LDA we find that those topics are not equally important and consumers have different preferences to the attributes. This thus helps firms to understand the rank of the concerns and disclose the contributions of each attribute to the adoption of the product. In addition, we find that those concerned topics are inter-related. For example, topic “display” is related to topic “experience” considering both topics contain the keyword of “screen”.

The rest of the paper is organized as follows. Section 2 reviews the related work. Section 3 presents the framework of the methodology. Section 4 depicts the dataset and the procedure to conduct the analysis. Section 5 reports the findings and section 6 concludes the whole paper.

RELATED LITERATURE

Studies relating to this paper can be divided into three categories: understanding consumer preferences, text-based analysis of user-generated content (UGC) and topic extraction models.

Understanding consumer perceptions and preferences about products is important in designing goods and service products, making communication strategies and brand decisions. One of the most popular methods to understand consumer preferences is conjoint analysis (Green & Srinivasan, 1978). Green and Srinivasan (1990) introduce a model to evaluate customer preferences by using party-worth utilities of products' attribute levels. Traditionally, firms try to understand consumer needs by questionnaires and real sales data, and marketers know that only customers can decide which attributes of products are important and which one should be chose (Louviere & Hout, 1988). Therefore, it is useful for marketers to improve product configurations, predict market response to new products, and diagnose competitive strength (North & Vos, 2002).

Text mining in UGC was largely ignored in business research decades ago because of the lack of practical tools to analyze those unstructured data (Lee, 2007; Archak, Ghose, & Ipeirotis, 2007). However, due to the exponential growth of textual data, text-based analysis of UGC has attracted considerable attention in recent years. It has been widely applied to discover key product attributes (Lee & Bradlow, 2011), to develop product recommendations (Ghose, Ipeirotis, & Li, 2012), to predict the sales of products (Dellarocas, Zhang, & Awad, 2007), as well as to determine market structure (Netzer et al., 2012). A large number of studies use econometrics and psychometric tools to conduct the research (Dellarocas, Zhang, & Awad, 2007; Decker & Trusov, 2010).

Another closely related research is studies on how to extract topics from UGC. According to Tirunillai and Tellis (2014), the specific words in UGC are only indicators of latent and priori unknown topics, which are defined by a cluster of words with a high frequency or probability of usage. This is the core idea of latent topic modeling in LDA (Blei, Ng, & Jordan, 2003) and the author-topic model (Rosen-Zvi et al., 2012). LDA is one kind of the Probabilistic Topic Model (Steyvers, Griffiths, & Dennis, 2006), which is a widely used technique for text analysis. LDA combines those similar words into a cluster based on the frequency of occurrence of words in each document. It is built on a three-layer Bayesian network to calculate the topic probability distribution of the words. According to "bag of words" pattern, the algorithm consists of the following assumptions, (a) given a corpus, (b) built a dictionary comprised by unique tokens appeared in this corpus at least once, (c) each document is represented as a probability distribution over some topics, and (d) each word in the document is generated by a specific topic (Weng et al., 2010).

There has been an increasing trend in applying text mining and topic extraction techniques to business decisions in recent years. For example, Lee et al. automatically derive market structure from consumer reviews collected from epinions.com using an optimization approach (Lee & Bradlow, 2011); Ghose and Ipeirotis (2011) combine multi-attribute choice models with multiple text analysis methods to examine the influence of product reviews on consumers' product choice decisions. Netzer et al. (2012) define similarity between products based on exploiting the co-occurrence of words and semantic network analysis. Büschken and Allenby (2016) propose an LDA model that uses the sentence structure of reviews to improve prediction of consumer ratings. Our work contributes to the literature by proposing an innovative approach to understand consumer preferences with online Q&A information, based on an LDA model.

THE FRAMEWORK

In this section, we first make a brief description of Zhihu.com, China's largest online Q&A community. We then propose a two-step framework to conduct text analysis and topic extraction, namely, (1) information preparation and (2) topic Modeling. Step one collects the UGC data from Zhihu platform and transforms the unstructured texts to a structured form that can be analyzed in the next stage. In step two, the structured data are input to the classic topic model to identify and cluster the topics through the Latent Dirichlet Allocation Algorithm. Figure 1 depicts an illustration.

Introduction of Zhihu.com

Zhihu is the most popular online Q&A community in China, where users can ask and answer questions and comment on or vote for existing answers. Platform users can search questions by keywords, or find their interests or relevant knowledge by topics and users. Zhihu also allows users to follow each other and share their knowledge via social connections. As in Twitter, users can follow anyone without explicit permission. If user A have followed user B, B's actions, including new questions, answers, comments and votes, will push to A's timeline stream. In this way, A is B's follower or fans and B is A's followee or friend.

Step one. Information preparation

As mentioned, the framework consists of two steps. The first step, so-called information preparation, collects UGC data from Zhihu platform and conducts data preprocessing to transform the unstructured texts to texts with structured form, as shown in Figure 1.

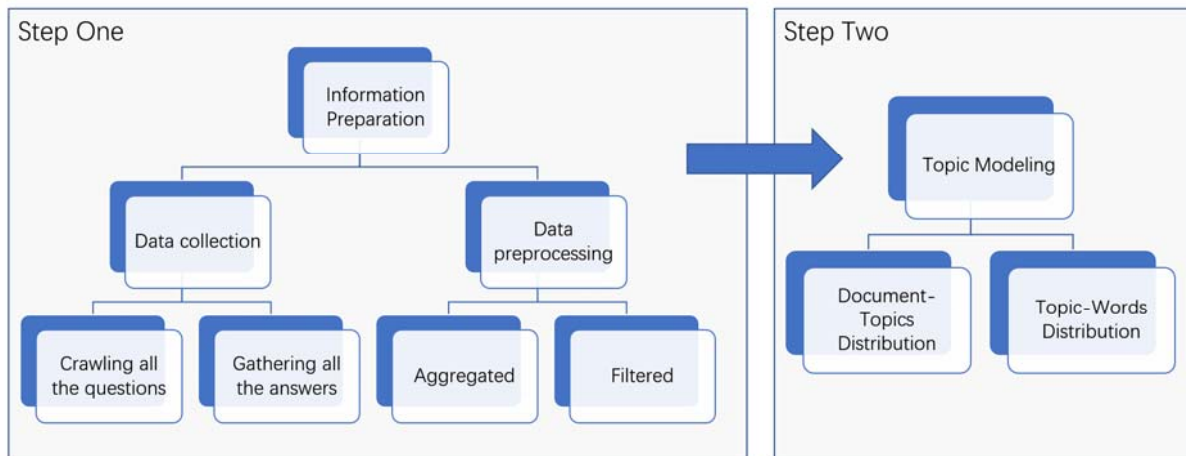


Figure 1: The two-step framework to conduct text analysis and topic extraction

Data collection

In Zhihu, each discussion topic generated by the platform has its own homepage, which includes all related questions and answers. Figure 2 presents a snapshot of a Zhihu topic's homepage. A page consists of five parts: (1) introduction, (2) number of followers and questions, (3) active users, (4) topic tags and information of questions and (5) answers under this topic. Under this topic homepage, all questions and answers could be gathered by the URL API of Zhihu.com with a web-based crawler tool. We develop a tool with python (version 3.6) to crawl the data under the topics' homepages.



Figure 2: The homepage of topic “iPhone X” in Zhihu.com.

The crawling process is also shown in Figure 1. We first crawl all the questions' information under the topic. Each question contains information such as author profile, title, content, followers count, comments count, answers count, and creating time, etc.. Then we collect all the answers' information to each question, including answer contents, author profile, voter count, comment count, etc. Considering our purpose is not to match the answers to the questions but to understand topics of user interests, we aggregate all the answers delivered by an individual user into a text document following Weng et al. (2010). Thus, a document essentially corresponds to an individual user's generated content.

Data preprocessing

With each individual user's document prepared, the first step of data preprocessing is to transform the unstructured text documents into a structured form that is amenable to analysis (Mankad et al., 2016). We employ a popular transformation approach with the "bag of words" representation of text, where the set of documents to be analyzed (usually referred to as a "corpus") is represented by a document-term matrix (Kosala & Blockeel, 2000). This document-term matrix is a structured table with two dimensions, the column for each term and the row for each document in the corpus. Each element in the matrix is a count of the number of times the corresponding word appears in each document.

Thus, the analyses based on text mining require special preprocessing of the corpus, where the general objective is to emphasize meaningful words by removing uninformative ones and to keep the number of unique terms that appear in the corpus from becoming extremely large (Mankad et al., 2016). We conduct the data preprocessing of Chinese words into seven steps, as indicated in Figure 3: (1) removing all the html tags and urls in documents; (2) customizing dictionary and stop words (very common words); (3) detecting new words and word segmentation; (4) transforming all English text into lowercase; (5) gathering all answers posted by the same author into one document (6) removing exceptional words that occur either too frequently or very rarely; (7) establishing a unique token dictionary of corpus where each word corresponds to a unique index number; and finally (8) transforming all the documents to a document-term matrix.

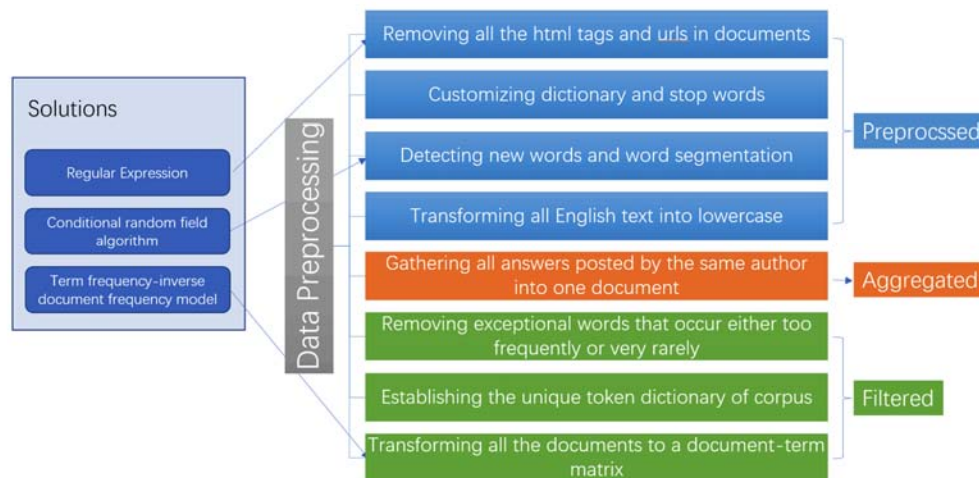


Figure 3: Chinese words preprocessing steps.

Step two: Topic modelling

With the structured texts as input, step two aims to generate clustering topics. Topic modeling is a type of text-mining algorithms that can be used to discover latent topics automatically. A simple model of the topic model is the LDA model. One important parameter of LDA model is the number of latent topics that appear across multiple documents. It determines the data granularity of result by the clustering words that appeared in each document.

In this framework, the LDA model plays a pivotal role due to the core idea behind this method is that latent and priori unknown topics are defined by a cluster of words with a high frequency or probability of usage. In addition, each document is regarded as a mixture of various topics where each document is considered to have a set of topics that are assigned via LDA. Consequently, there are two probability distributions generated by LDA. The "document-topic" distribution describes the probability of topics occurring in a given document. Since all documents share the same topic set, which is determined by the number of latent topics, and each document has a different probabilistic mixture of those topics (Mankad et al., 2016). The "topic-word" distribution describes the probability of words occurring in a given topic. An underlying assumption is that documents covers only a small set of topics and that topics use only a small set of words frequently. LDA assumes a generative process infer the latent topics in a corpus as indicated in the following steps: (a) choosing the document by a prior parameter "alpha", picking a topic from its "document-topic" distribution, (b) associated with the selected topic, sampling a word by a hyper-parameter "beta" from the "topic-word" distribution, (c) repeating the process for all the words in corpus until the sampling is convergent. The two hyper-parameters, alpha and beta, are priori parameters which could be inferred by experience or existing work. As alpha gets smaller, the document is close to one topic. Similarly, as beta gets smaller, all words tend to belonging to the same topic.

DATA AND METHODS

Data Collection

We developed a python (version 3.6) project to implement the procedure. Some python libraries were called in the program, as demonstrated below. The web crawler was created by Scrapy 1.4, a fast and powerful scraping and web crawling framework in python. Gensim was a python library for document indexing and topic modelling. We used Matplotlib 2.2.3 to deliver the figures of

the result, which was a Python 2D plotting library. All the data were stored in MongoDB 3.2, a document database that can be used to flexibly store the JSON data, considering the crawling results from API of Zhihu.com were JSON-type documents.

Table 1: The number of answers and users from dataset.

	iPhone 7	iPhone X	Total
Time Period	2016.6.10-2017.7.21	2017.7.21-2018.4.2	2016.6.10-2018.4.2
Number of answers	16240	35809	52409
Number of users	11493	25587	35888

We used an open application-programming interface (API) provided by Zhihu.com to crawl data. We collected all the answers under the platform topic of “iPhone 7” in the period between June 10, 2016 and July 21, 2017, and the topic of “iPhone X” in the period between July 21, 2017 and April 2, 2018. The number of answers and users are listed in Table 1. Figure 4 plots the number of answers dynamically changes as time proceeds monthly. We implemented the preprocessing steps as described in section “The framework”.

After data preprocessing we then obtained a refined subset of all the answers, as a document-term matrix. Only answers containing more than 15 terms were retained and constructed as a document-term vector. Table 2 exhibits a processing flow table of the refining process. We further refined the dataset by first gathering all content posted by a user into a document, and then removing exceptional words that occur too frequently or too rarely. Although after data preprocessing the number of answers has been reduced from 52409 to 23794, the remaining data is more informative and abundant enough to conduct LDA analysis.

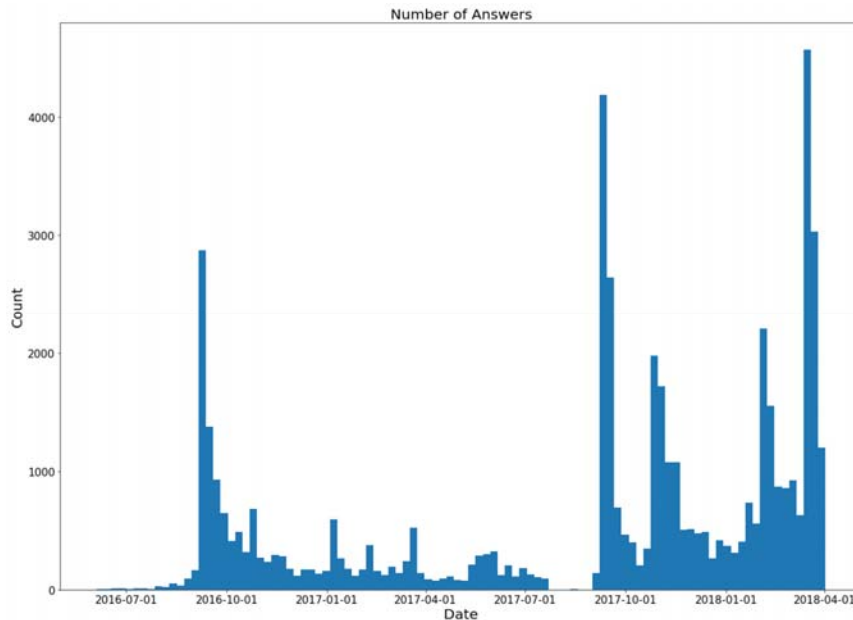


Figure 4: The number of answers dynamically changes as time proceeds monthly.

Table 2: The processing flow of dataset.

Processing sequence	Before	Preprocessed	Aggregated	Filtered
Number of answers	52409	23794	19512	19512
Number of authors	35888	17062	17062	17062
Total terms		1863409	1863409	1111374
Average number of terms per answer		78.4	95.5	56.96
Length of Dictionary		69542	69542	7426

Topic modelling analysis

We used a python library, called “Gensim”, to implement the LDA algorithm and applied Gibbs sampling to compute the whole data. The LDA model is conditioned on three parameters: two hyper-parameters alpha and beta, and the number of topics, T. In order to perform topic modeling effectively, we set the parameter values following (Griffiths & Steyvers, 2004), who suggested to fix alpha

to 50/T, beta to 0.1 and change the number of topics in a range from 8 to 20. Here we set the number of topics to be 15. Table 3 lists part of the results, that is, the top 20 high-frequency words in six clustered topics among the fifteen topics.

To have an overview of the output clustering topics, we used “Gephi (0.91)” to visualize the topics and their high-frequency words’ network in Figure 5. As shown in the figure, some high-frequency words contribute to more than one topic and thus topics are connected due to the common words.

Table 3: High-frequency words in each topic.

Term	Topic 2	Topic 4	Topic 11	Topic 12	Topic 13	Topic 14
1	Advertising	Charging	Unlock	Headset	Feature	Screen
2	Shoot	Wireless	Key	airpods	lens	iPhone x
3	Shooting	Battery	home	interface	Effect	Full screen
4	Three minutes	Use	Face id	Sound quality	inside	Bangs
5	Movie	Customer	Identification	cancel	camera	Design
6	iPhone x	Chip	Screen	Bluetooth headset	photos	iPhone x
7	Chen Kexin	Support	Fingerprint	bluetooth	use	Technique
8	Story	Fast charge	Operation	Listen to music	plus	Face id
9	Video	Usage	Feature	Listen	advance	Screen
10	Lens	Device	Need	Wireless headset	shooting	Oled
11	Short movie	Hour	Password	connect	camera	Camera
12	SLR	Need	Face	take	device	X
13	Director	Wire	Interface	music	support	Frame
14	Children	Charger	Touch id	sound	ar	Question
15	Profession	Technique	application	case	pixes	Display
16	Mother	Interface	app	Headset plug	game	Fingerprint
17	Inside	Standard	Can not	Easy	video	Glass
18	Film	Endurance	id	Inside	both	Influence
19	Photography	Ad	setting	lightning	technique	Face identification
20	Device	Question	use	charging	different	Sumsung

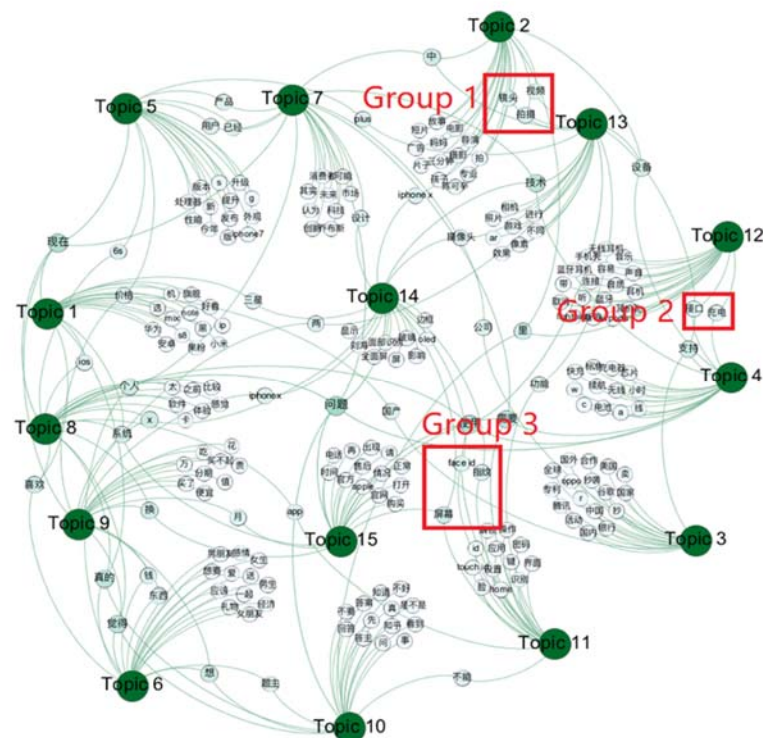


Figure 5: The high-frequency words’ network based on LDA topics.

FINDINGS AND RESULTS

We summarize our findings and interpret the results as follows. First, based on the list of high-frequency words in Table 3, we categorize them into different topics about iPhone product and interpret them as customer preferences as follows.

- Topic 2 (Advertising). The high-frequency words such as “shoot(拍),” “lens(镜头),” “advertising(广告),” “three minutes(三分钟)” and “Chen Kexin(陈可辛)” are associated with a popular three-minute video taken by Chen Kexin, a famous Chinese movie director, with his brand-new iPhone; thus, it could be labeled as “Advertising”.
- Topic 4 (Charging). The high-frequency words of this topic include “charging(充电),” “battery(电池),” “Fast charge(快充),” and “charger(充电器)” and associated with the charging feature of iPhone. It means that some customers are concerned about the charging feature of mobile phone.
- Topic 11 (Unlock). The high-frequency words of this topic include “Unlock(解锁),” “Home,” “Face id,” and “fingerprint(指纹)” and associated with the unlock feature of iPhone.
- Topic 12 (Headset). The high-frequency words of this topic include “Headset(耳机),” “airpods,” “Sound quality(音质),” and “Bluetooth headset(蓝牙耳机)” and associated with the headset feature of iPhone.
- Topic 13 (Camera). The high-frequency words of this topic include “lens(镜头),” “camera(摄像机),” “photos(照片),” and “shooting(拍摄)” and associated with the camera feature of iPhone.
- Topic 14 (Screen). The high-frequency words include “Screen(屏幕),” “Oled,” “Face identification,” “Frame(边框),” “Glass(玻璃)” and “Bangs(刘海)” and are associated with the screen feature of iPhone. It means that some customers are concerned about the screen of mobile phone.

According to the analysis, we find that the classified labels (topics) match iPhone’s product features to a great extent. Therefore, we can claim that the topic model can effectively understand customer preferences or customer concerns. In addition, we also find other non-physical attributes, for example, “advertising”, are also parts of the consumer concerns. This is evident that marketing campaigns can effectively increase firms’ brand reputation and promote their products.

To further understand the importance of each topic, we follow the work of Sievert and Shirley (2014) and call the python library “pyldavis” to calculate the ranking of each topic. The output is listed in Table 4, at a descending order. Figure 6 visualizes the results, where the area of each circle is proportional to the relative prevalence of the topic in the corpus. The larger the circle is displayed in the left panel, the higher frequency the topic has, meaning the topic is more important. For each topic selected, pyldavis can also output its top 30 most relevant terms. As depicted in the right hand side of Figure 6, the top 30 high-frequency words for topic 8 are listed and ranked, which constitutes the proportion of total tokens at about 6.3%. Therefore, our second finding is that we can prioritize the topics and find out the importance of consumer concerns. This is important to a firm to understand which concerns contribute more to the adoption of the product.

Table 4: The proportion of each topic

Topic	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Proportion	12.6%	12%	12%	8.7%	8%	7.5%	6.6%	6%	5.8%	4.8%	4.7%	4.5%	3.2%	2.2%	1.2%

Another way to conceptualize these topics is to find out the relation between topics by the relevant terms. As shown in Figure 4, group 1 includes words of “lens(镜头),” “shooting(拍摄),” and “video(视频)” and connects two clusters, “Topic 2” and “Topic 13”. Topic 2 labelled with “advertising” and Topic 13 labeled with “Camera” before. Therefore, we can easily find that both two topics have three relevant terms and are predominantly related to the event using iPhone to shoot the three-minute advertising. Meanwhile, group 2 is comprised with two words, “interface(接口)” and “charging(充电)” and connects “Topic4” and “Topic 12”. It means that customers usually put these two attributes together to discuss. Because of the innovation design of iPhone7, the device has only one interface for the charging and headset. In group 3, three words, “face id,” “screen(屏幕),” and “fingerprint(指纹)”, has been detected as a bridge between “Topic 11” labelled with “Unlock” and “Topic 14” labelled with “Screen”. “Face ID”, the innovation feature of iPhone X, is a new technology created by Apple company that can use face to unlock iPhone. Therefore, it is an effective approach to find the similar topics using the high-frequency words’ network.

CONCLUSION AND DISCUSSION

In this study, we propose an innovative approach to understand consumer preferences based on the online information of Q&A platform. We propose a two-step framework to conduct text analysis and topic extraction: (1) information preparation, and (2) topic Modeling. Step one collects the UGC data from the Q&A platform and transforms the unstructured texts to a structured form that can be analyzed in the next stage. In step two, the structured data are input to the classic topic model to identify and cluster the topics through the Latent Dirichlet Allocation Algorithm. Based on Zhihu, the most popular online Q&A community in China, we collect

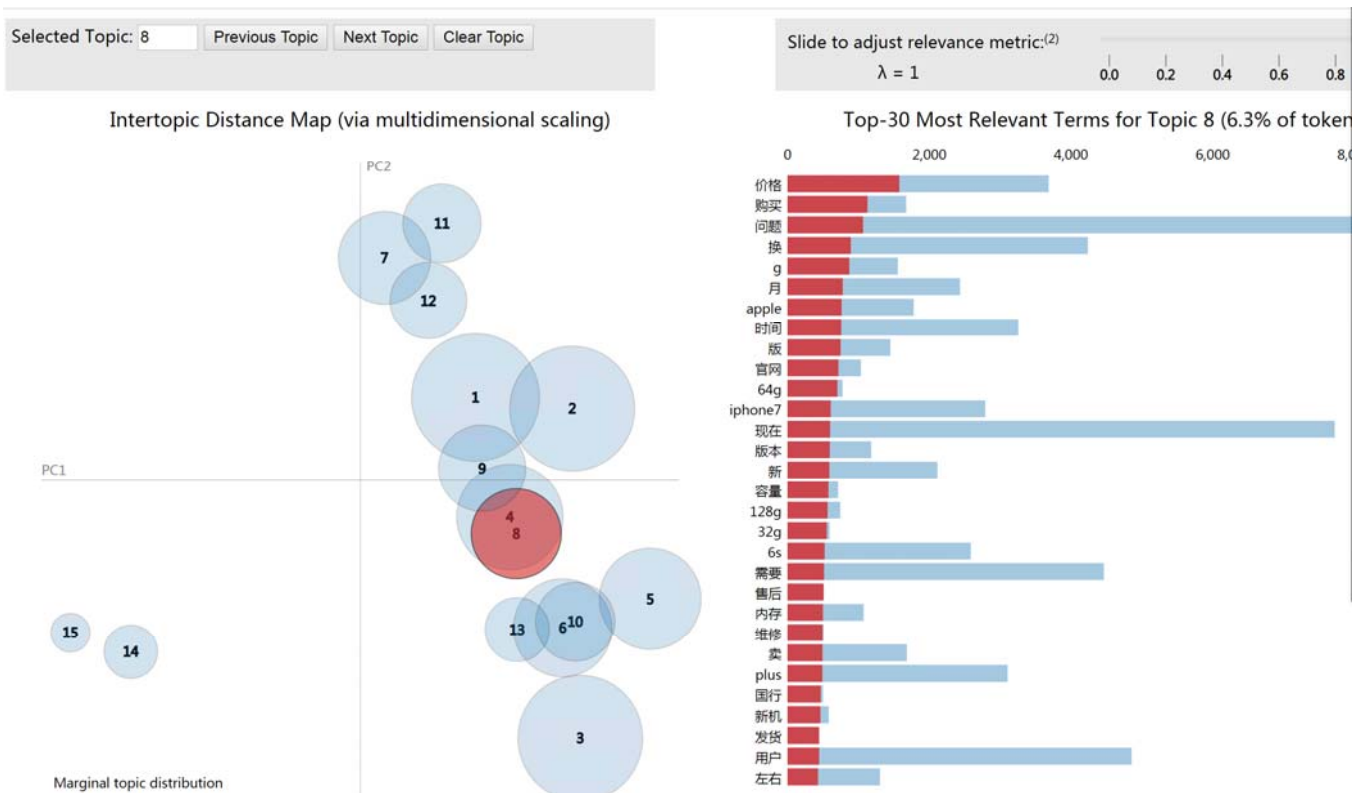


Figure 6: The ranking of topics using the relevance of terms to topics.

almost 50000 answers under the discussion topics of “iPhone 7” and “iPhone X”. We find that our approach can effectively extract and rank Chinese consumer’ preferences to the product. In addition, we find consumers preferences are inter-related.

Understanding consumer preferences is fundamental work. Based on our research, extensions could be varied. To name a few, currently we only use UGC to analyze consumers preferences, an extension with platform users’ social connections would be an interesting exploration; with consumer preferences ranking orders, it also helps firm to identify which attributes to upgrade with limited budget concern.

ACKNOWLEDGMENT

This work is partially supported by the Natural Science Foundation of China [Grant no. 71572070]; the Fundamental Research Funds for the Central Universities [Jinan University, Grant no. 15JNQM003].

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Understanding Usage Intention of Social Media's Innovative Functions: Based on Expanded Innovation Diffusion Theory

(Full Paper)

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ABSTRACT

Drawing upon expanded innovation diffusion theory (IDT), this study investigates the social media users' usage intention toward its innovative functions. 532 data were collected from the Chinese leading social media—WeChat. The results show that the relative advantage, ease of use, trialability, observability, subjective norm and image have positive effect on users' usage intention. Whereas compatibility has no significant impact. Based upon these findings, we discussed the theoretical contributions and practical implication of this study.

Keywords: Innovation diffusion theory, social media, usage intention

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INTRODUCTION

In recent years, the development of the Internet technologies has promoted the development of social media. Social media has been defined as a particular consumption of digital media, through which users can connect, communicate and interact with each other (Correa, Hinsley, & Zúñiga, 2010). Social media is increasingly popular and affects thousands of people's life and work (CNNIC, 2016). Current, the most popular social media soft wares include WeChat, Facebook, QQ, Twitter, RenRen and so on. The social media take significant roles in people's daily life and users can use it to work, to develop social networks, to receive news, and so on.

The importance of social media has been recognized by various previous studies (Che & Cao, 2014; Cheng, Fu, & Vreede, 2017; Dai, Han, Dai, & Xu, 2015; Zhang, Li, Wu, & Li, 2016) for a long time. Thus, exploring the factors that have significant influence on users' usage intention has become one of the key research issues in electronic commerce domain. Usage intention has been defined as the likelihood that customers will use a particular product or a service (Kowatsch and 'Maass 2010). However, according to our best knowledge, most previous studies often focus on exploring the antecedents of social media users' usage intention of their communication functions. Actually, in order to keep old customers and develop new markets, these social media have designed various innovative new functions, such as banking, payment, games, GPS, shopping and so on (CNNIC, 2016). As Hameed, Counsell, and Swift (2012) indicated, "Innovation is one of the most critical forces in creating new services and products, developing new markets, promoting organizations' competitiveness and transforming industries." This study will fill in this research gap and focus on exploring the crucial factors, which may affect social media users' usage intention on the various innovative functions.

The remainder of this paper is structured as follows. Next section is literature review and theoretical foundation. Then we propose the research model and deduce the hypotheses; after that, we describe the research methodology and the data analyses procedure; the last section provides a discussion of the results, theoretical contributions, practical implications, as well as limitations.

LITERATURE REVIEW AND THEORETICAL FOUNDATION

Social Media

Web-based social media allow users to connect and interact with one another. Popular social media include WeChat, Facebook, QQ, Twitter, RenRen and so on (Ifinedo, 2016). The web-based social media enables users to make friends online and maintain communications with offline friends as well. It has quickly penetrated into our lives. Social media help users to access news and messages, as well as to connect with their friends worldwide. Because of the popularity, many researchers have investigated the communication functions of the social media as instant messenger. For instance, Wang and Qian (2015) explored the continuance intention of the WeChat's instant massager function. Ifinedo (2016) adopted the gratifications theory and social influence framework to explore the pervasive adoption of social media. Chiu, Cheng, Huang, and Chen (2013) investigated the loyalty toward the social media from the perspective of network externalities. Besides, Yan and Chua (2017) explored whether the personality traits of users will influence their attitude toward using the social media.

But recent years, many innovative functions were incorporated into social media, such as banking, payment, gaming, GPS, shopping and so on (CNNIC, 2016). According to our best knowledge, few previous research has investigated the antecedents of

adopting these new functions, so this research is conducted to fill this research gap, we plan to explore what factors will influence users to use social media's innovative functions. As these functions can be regarded as the social media's innovations, therefore, we will adopt expanded innovation diffusion theory (IDT) as our theoretical foundation to construct our research model.

Innovation Diffusion Theory

E. Rogers *et al.* (1960) introduced the innovation diffusion theory in 1960 and this well establish theory has been used to study various innovations ranging from agricultural practices to high-tech products (Yi, Jackson, Park, & Probst, 2006). Rogers synthesized thousands of such studies result in a communication-based theory of innovation diffusion and identified five characteristics of the innovation, which determine the users' adoption intention and behavior, including: relative advantage, compatibility, complexity, trialability and observability (Moore & Benbasat, 1991). Furthermore, Moore and Benbasat (1991) added image and voluntary as two additional impact factors into this theory.

Previous researchers have adopted the IDT to explore the usage of technology innovations in various research domains. Such as, Tsai, Lai, and Hsu (2012) expanded the theory with social behavior, to explore the suppliers' adoption intention for ratio frequency interface devices. Lu, Yang, Chau, and Cao (2011) tested the impact of three IDT attributes (relative advantage, image and compatibility) on mobile services promotion. These researches all showed that the IDT could well explain the adoption of the technology innovation.

Although previous studies have already confirmed the IDT characteristics will influence the users' usage intention in various fields. They have not tested the IDT characteristics' effect on the users' usage intention toward the social media's innovative functions. This research will try to explore this unanswered question. We plan to utilize Rogers' IDT as the theoretical foundation and will add some more IDT characteristics according to the work of Moore and Benbasat (1991). Specifically, we predict the relative advantage, ease of use, compatibility, visibility, trialability and the expanded variables—subjective norm and image will take strong effects on users' usage intention of various innovative functions embedded in social media. In the following section, we will explicitly describe our research model and hypotheses.

RESEARCH MODEL AND HYPOTHESES

The IDT posits that the consumers will decide to accept or reject the innovation in pre-adoption stage (Montazemi & Qahri-Saremi, 2015). In the pre-adoption stage, five innovation characteristics--relative advantage, ease of use, trialability, observability and compatibility will affect the consumers' usage intention (E. Rogers *et al.*, 1960).

Relative advantage is a degree that an innovation is thought to be better than its precursors (E. Rogers *et al.*, 1960). It represents the extent to which a consumer views the innovation is better than previous tools when fulfil a task (Agarwal & Prasad, 1998), it is similar to the notion of usefulness in the technology acceptance model. Relative advantage has been empirically validated as an important determinant of usage intention (Moore & Benbasat, 1991; E. Rogers *et al.*, 1960; E. M. Rogers, 2003). First, because of the switching cost—includes time, monetary cost and energy effort, people will not adopt the new social media if she or he does not perceive it's relative advantage. Second, in the case of equal cost, the users will choose the innovation which can bring more benefits, people always intend to pay the least cost (such as time cost) to achieve the maximum benefit. In general, we consider the benefit and time-saving are the forms of the relative advantage, they will influence the users' usage intention (E. Rogers *et al.*, 1960). So we predict:

H1. The relative advantage positively affects the social media users' usage intention.

“Compatibility has been defined as the degree to which an innovation is consistent with the existing values, needs and post experiences of potential adopters” (Rogers, 2003). Venkatesh, Davis & College (2000) thought compatibility is an important factor which will influence user's usage intention. First, people's behavior is consistent with their ingrained views (Higgins, Compeau, & Meister, 2007). That's to say, it is easier for users to accept the innovation which fits more naturally with his/her preferred way of working, thinking and life. Second, when the innovation is not compatible with the user's values and post experience, he/she would spend more time and effort to adjust even verify his/her value and preferred style, so the adopters may be more likely to choose the innovation, which is compatible with his/her value and post experience. Thirdly, due to the existing of switching cost, the potential users would not adopt an innovation, which is not compatible with the users' needs. The last but not the least, relative advantage refers to the benefits derived from using the innovation, a wise decision maker can't find advantage in an innovation that conflicts with the held values. That's to say, if the innovation is incompatible with potential users' value, needs and post experience, it is difficult for potential users to find the innovation's relative advantage, as a result, people's usage intention will be negatively influenced. So we predict:

H2. Compatibility positively affects the social media users' usage intention.

Complexity is considered to be the extent to which innovation is considered to be difficult to use (E. M. Rogers, 2003). Moore and Benbasat (1991) thought the complexity is very similar with the term--ease of use in technology acceptance model (Davis, 1986). In this study, we use ease of use to represent complexity in IDT. Ease of use refers to the required physical and mental effort when individuals use something (Davis, 1986). Many researchers have investigated that the ease of use would influence

the users' usage intention, such as in online banking adoption (Montazemi & Qahri-Saremi, 2015), mobile-marketing adoption (Tanakinjal, Deans, & Gray, 2010), automatic cash payment system (Yang, Lay, & Tsai, 2006), and so on.

In social media, when the users perceived the innovation is complex, many advantages of the innovation would be ignored, so the intention to try the innovation would be negatively affected. In contrast, if the users perceived the innovation is easy to use and learn, that's to say, if this innovation is used, users can save some time and energy, so he/she will be more willing to try and accept the innovation. Above all, the simpler the learning and using of the innovation, the more people are willing to use it. Therefore, we predict:

H3: Ease of use positively affects the social media users' usage intention.

Observability is the extent to which an innovation's result can be observed by others (E. M. Rogers, 2003). Bandura (1977) suggests that the observed behavior can influence the learner's adoption behavior because the learn and usage behavior are based on what the one sees others. The innovation is more observable, the easier it is discussed (Yi *et al.*, 2006). This is because when tangible results of the innovation are directly apparent, the innovation can be better understood by the adopters (Yi *et al.*, 2006). That will increase the users' confidence to learn and use the innovation. Besides, imitation is a significant factor, which will affect the people's usage intention. When people see others' usage and usage results, they will imitate others' behavior because of the subjective norm and desired result. Above all, the result demonstrability can positively affect the people's usage intention. In social media, people often have wide social networks, if they can get enough usage result information about the new functions from others, their usage intention will be strengthened. Therefore, we predict:

H4: Observability positively affects the social media users' usage intention.

Trialability, which was defined as that an innovation may be experimented before be adopted (Rogers, 1983). E. M. Rogers (2003) believed that people who have the ability to experiment an innovation are more likely to adopt it.

The process of deciding whether or not to adopt these new functions is a process of gathering information to reduce uncertainty. There are two sources of these information, the first is the indirect experience and the second is direct experience. The indirect experience include advertisement, other people's use experience and so on. The direct experience comes from the users' own trial experience, and the users can get the direct experience only through trying out the functions. Compared with the indirect experiences, these direct experiences have a greater influence on reducing the uncertainty of the innovation. Thus, these direct experiences have a greater persuasiveness and the users' usage intention will be positively affected. As a result, people are more likely to adopt these innovative functions. On the contrary, if these functions can't be tried or the cost of trying is high, the potential adopters are unable to obtain direct experience to reduce the uncertainty of the innovation, thus the possibility of adopting the innovation will decrease. We consider that there is a positive relationship between the trialability and the usage intention. Therefore, we predict:

H5: Trialability positively affects the social media users' usage intention.

Moore and Benbasat (1991) expanded the IDT with two more factors: voluntariness of use and image, in the context of organizations. The voluntariness means the voluntary or free will when the users adopt an innovation; and the image means whether one's image or status will be enhanced after the innovation be adopted (Moore & Benbasat, 1991).

The social media's functions generally include instant message, banking, payment, games, GPS, shopping and so on (CNNIC, 2016). The users are usually in a social group; as a result, there is no compulsion for users to use the social media's innovative functions. But there is a social influence because they are in the social group, and one of the most important social influence is subjective norm (Malhotra & Galletta, 1999). Therefore, we consider that the subjective norm will take place of the voluntariness to affect the users' usage intention.

"Subjective norm was defined as an individual's perception that important others such as peers and supervisors think she or he should or should not use the focal technology" (Venkatesh *et al.*, 2000). Subjective norm is an important determinant of intention in psychology theories (Yi *et al.*, 2006). At the same time, Venkatesh *et al.* (2000) also believed that the effect of subjective norm on behavioral intention is largely due to the punishment of the noncompliance. The punishment may be that you can't join in a group when your usage intention is different from others. In order to avoid this situation and join in the social group, individuals tend to follow others' usage intention and behavior.

In social media, the norm exists because there are many people use the social media. The more people use the innovative functions, there are more social influence, the effect of subjective norm on people's usage intention is greater and people are more likely to adopt the innovative functions. So we predict:

H6: Subjective norm positively affects the social media users' usage intention.

Image means the adoption of something makes you feel that you are fashionable and can keep up with the development of the times. Innovation adopters can be classified into five groups: innovators, early adopters, early majority, late majority and the laggards (E. M. Rogers, 2003). In the context of social media, the innovative functions are optional for life and work, but it is believed that the early adopters are generally more fashionable, intelligent and closely related to the development of the times (E. M. Rogers, 2003). So if the social media users feel fashionable and happy when they use the social media's innovative functions, he or she will be more willing to adopt them. Therefore, we predict:

H7: Image positively affects the social media users' usage intention.

The research model is shown in Figure.1.

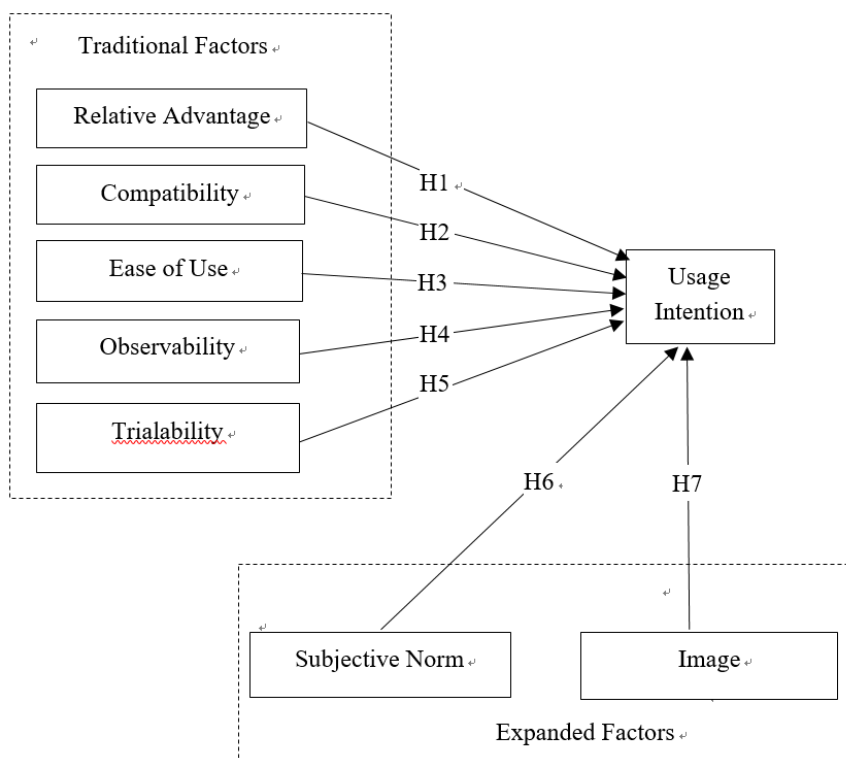


Figure1: Research Model

METHODOLOGY

We believe that collecting field data from real social media will enhance the reality of the findings, so we selected the Chinese most famous social media--WeChat as our survey area. We choose China as the survey area does not indicate that China has unique or special characteristics; we just treat it as an example to collect data and test the relationships between the expanded IDT factors and the users' usage intention.

The participants of the survey in this study are the users of WeChat, one of the Chinese most famous social media. WeChat was founded in 2011. The traditional service of the WeChat is social communication. In recent years, WeChat has added the payment, games and life services, etc., as its innovative functions. According to the statistic report, on average, there are 768-million persons use the WeChat (CNNIC, 2016). The users include students, civil servant, farmers, employees, and so on; their age range from under 10 to over 60 and the main age group is 18 to 50 years old, thus we think the WeChat is one of the best survey area which can ensure collecting enough and nationwide data for this study.

We randomly selected more than two thousand members from the WeChat users as our survey pool. We think using the data obtained from actual users of WeChat can improve the reliability of the research results. In addition, we distribute the questionnaire through WeChat's instant messaging function and sent invitation letters to these candidates, if they agreed to participate, we informed them the hyperlink of the questionnaire.

The online questionnaire has three main sections. A brief introduction of this study and an instruction to finish the questionnaire are shown on the section 1. At the end of the section 1, we informed to the respondents that they should complete the questionnaire based on their perceptions because there are no correct answers to any questions. After that, the participants were told that we would keep their information confidentially because the data just be used to do academic research. The second section includes the constructs' items of our research model. The 7-point Likert scale was used to measure the constructs' scales. The last section was the demographic questions.

In our research model, all of the instrument items for the constructs were adapted from previous research. To fit our research context, we also amended all the items slightly (see Appendix A). Because all the items were from the English papers, so we translated these English items of the constructs into Chinese. After that, to ensure the accuracy of the translation, we also invited two native Chinese-speaking professors of management information systems who had earned advanced degrees overseas to check the translations. This validation process offset the glitches in meaning and the trivial wording.

Through investigation, we obtained 532 samples. They are from 75 cities, which cover 23 provinces of Mainland China, and two of them are from Germany and Japan. Their occupations include clerks, students, teachers, workers, managers and others. We conceive our subjects can adequately represent the distribution of the WeChat users' population. Table 1 shows more demographic information of these samples.

Table 1: Sample demographics.

Measure	Item	Frequency	Percentage (%)
Gender	Male	289	54.5
	Female	243	45.5
Age	<=20	73	13.7
	21--25	259	48.7
	26--30	81	15.2
	31--35	43	8.1
	36--40	22	4.1
	>40	54	10.2
Education	Junior school Graduate	48	9
	High School Graduate	71	13.3
	Junior College Graduate	54	10.2
	Bachelor's Degree	244	45.9
	Master's Degree and above	115	21.6

RESULTS

Measurement Model Analyses

Confirmatory factor analysis (CFA) was used to test the measurement model. In general, convergent validity and discriminant validity were used to test the constructs of the research model. Fornell and Larcker (1981) suggest utilizing item reliability, composite reliability, Cronbach's Alpha and average variance extracted (AVE) for each construct to access the convergent validity. As shown in Table 2, the composite reliability of all of the constructs is above 0.9, AVE is above 0.8 and Cronbach's Alpha is above 0.85, which are all beyond their corresponding thresholds. Table 2 also shows that the factors loading of most items was above 0.85, which confirms that the item reliability is acceptance. In general, these results confirm the high convergent validity of our data. Discriminant validity refers to the extent to which the items in a construct are distinct from those of other constructs. As shown in Table 3, all constructs' square roots of the AVE were much larger than all other cross-correlations, which confirmed sufficient discriminant validity of the constructs.

Table 2: Psychometric properties of measurements

Construct	Means	Standard deviation	Cronbach's alpha	AVE	Composite reliability	Item	Item Loading
Relative Advantage (RAD)	4.740	1.200	0.878	0.731	0.916	RAD1	0.809
						RAD2	0.885
						RAD3	0.868
						RAD4	0.856
Compatibility (CMP)	4.971	1.188	0.894	0.759	0.926	CMP1	0.869
						CMP2	0.898
						CMP3	0.867
						CMP4	0.850
Ease of Use (EOU)	5.520	1.090	0.898	0.830	0.936	EOU1	0.909
						EOU2	0.924
						EOU3	0.901
Observability (OBS)	6.150	1.090	0.929	0.875	0.95	OBS1	0.901
						OBS2	0.955
						OBS3	0.950

Trialability (TRI)	5.121	1.136	0.882	0.739	0.919	TRI1 TRI2 TRI3 TRI4	0.859 0.875 0.876 0.828
Subjective Norm (SBN)	5.029	1.11	0.877	0.803	0.924	SBN1 SBN2 SBN3	0.881 0.921 0.886
Image (IMG)	4.633	1.231	0.902	0.773	0.931	IMG1 IMG2 IMG3 IMG4	0.900 0.889 0.906 0.819
Usage Intention (UIN)	5.210	1.067	0.948	0.866	0.963	UIN1 UIN2 UIN3 UIN4	0.940 0.948 0.912 0.922

Table 3: Square root of AVE and cross-correlations

	RAD	CMP	EOU	OBS	TRI	SBN	IMG	UIN
RAD	0.855							
CMP	0.703	0.871						
EOU	0.540	0.673	0.911					
OBS	0.376	0.457	0.642	0.936				
TRI	0.559	0.675	0.718	0.487	0.860			
SBN	0.570	0.610	0.592	0.480	0.574	0.896		
IMA	0.606	0.660	0.533	0.312	0.591	0.618	0.897	
UIN	0.573	0.618	0.669	0.518	0.681	0.666	0.621	0.930

Structural Model Analyses

We utilized Smart PLS 2.0(Ringle, Wende, & Will, 2005) to test the main effects of the seven independent variables on the users' usage intention. As is shown in table 4, $R^2 = 0.63$, and $p < 0.01$, the full model is significant. The results showed that six independent variables--RAD, EOU, OBS, TRI, SBN and IMA, can significantly affected the dependent variable. However, the CMP was not significant in the model.

The path coefficients of each independent variables represents the strength and direction of the relationship between the constructs. For RAD, the coefficient=0.083, $T=1.923$ and $p < 0.05$; for EOU, the coefficient=0.165, $T=3.103$ and $p < 0.01$; for OBS, the coefficient=0.108, $T=3.099$ and $p < 0.01$; for TRI, the coefficient=0.236, $T=3.905$ and $p < 0.01$; for SBN, the coefficient=0.238, $T= 5.225$ and $p < 0.01$, for IMA, the coefficient=0.176, $T=4.341$ and $p < 0.01$. These results support H1, H3, H4, H5, H6 and H7. Whereas for CMP, the $T=0.362$, $P > 0.1$, thus, H2 is not supported. All of the results analyses are shown in Fig.2 and table 4.

Table 4: Results of structural model

Hypotheses	Coefficients	T	Hypotheses
RAD (H1)	0.083*	1.923	Supported
CMP(H2)	-0.021	0.362	Not supported
EOU(H3)	0.165**	3.103	Supported
OBS(H4)	0.108**	3.099	Supported
TRI(H5)	0.236**	3.905	Supported
SBN(H6)	0.238**	5.225	Supported
IMA(H7)	0.176**	4.341	Supported
Dependent variable: Usage intention, $R^2 = 0.63$			

Note: * indicates $P < 0.05$, ** indicates $P < 0.01$

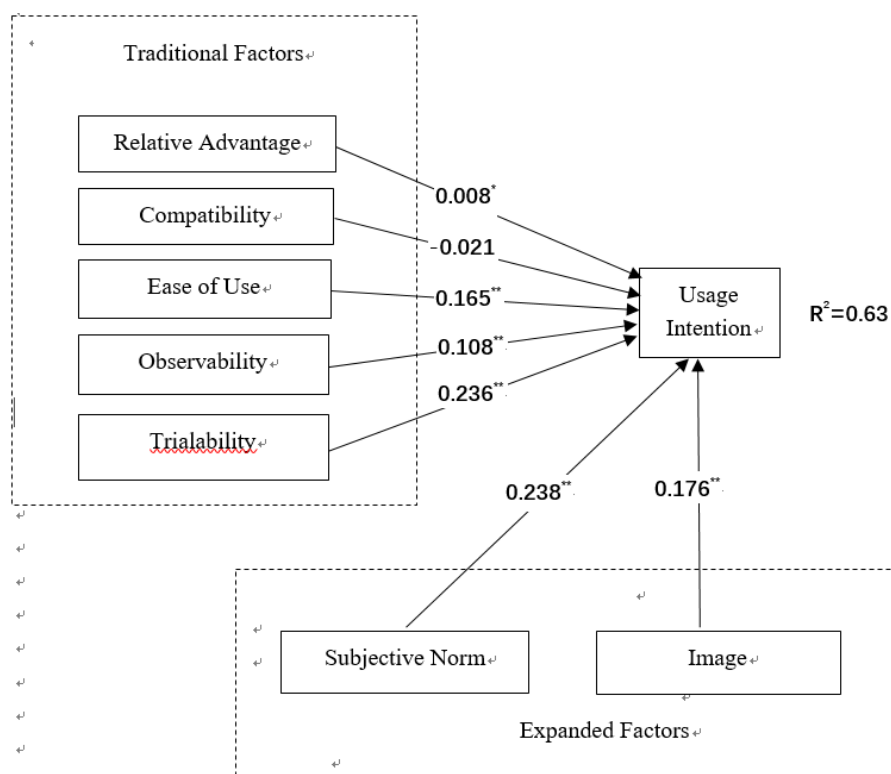


Figure2: Results of the research model. Note: * indicates $p < 0.05$, ** indicates $p < 0.01$

DISCUSSION AND CONCLUSION

Discussion of the Results

This research utilizes expanded IDT as the theoretical background. We explore the effects of seven IDT factors on the social media users' usage intention. The statistic results confirm six of the seven hypotheses; however, we find that the traditional influence factor--compatibility has no significant effect on the users' usage intention. These results generally confirm that the innovation diffusion theory has strong explanatory power on social media user's usage intention for innovative functions. The results also indicate that some IDT factors may not be the crucial factors in our research.

Specifically, we found that the relative advantage took positive effect on usage intention. This finding confirmed H1, which indicates that the usage intention will be strengthened if the innovative functions are perceived as being better than the precursors. That's to say, the more relative advantage of the innovative function be perceived by the users, they are more willingness to adopt the new function. Besides, innovation's ease of use has a significantly effect on social users' usage intention, the users are more inclined to adopt the innovation which is easy to learn and use. The results of this study also showed that the observability and trialability could positively affect the users' usage intention. These confirm H4 and H5 and imply that the users tend to adopt the innovation which is popular and easy to try.

For the two expanded factors, we found subjective norm exerted a positive influence on people's usage intention. People's usage intentions are influenced by the social pressure. Besides, the image also has an influence on usage intention. This confirms H7 and implies that users will be more willing to adopt the innovation if they think the innovation can improve their image.

We predicted that the compatibility would have a positive effect on users' usage intention. Contrary to the innovation diffusion theory and previous researchers' findings (Agarwal & Prasad, 1997; Lu *et al.*, 2011; E. M. Rogers, 2003), it is insignificant. That's to say, maybe the compatibility cannot influence the usage intention in social media context. We think it may be due to the following reasons. First, in this rapidly changing society, people like to pursue novelty. If the innovative functions introduced by social media are similar to the old one, the users may think that these innovative functions' novelty is not enough and cannot bring extra surprises. People may be more willing to adopt the innovation, which is different from their previous experience and cognition. Second, some of the innovative features of social media are the mirrors and modifications of traditional offline activities. The use of these new functions may be different from our usual experience and habits, but these online new functions can really bring benefit for them, so users are willing to accept these new function. Last, due to their trust to the social media companies, even if these new functions are not complying with people's habits and experiences, they may also adopt the new function.

Theoretical Contributions and Practice Implications

This study has several important theoretical contributions. First, we extend the diffusion of innovation research scope by adopting the innovation diffusion theory into social media domain. We confirm that four of the five original IDT factors' significant effects on social media user's usage intention on various innovative functions. It generally confirms the applicability of IDT in

our research context. We also notice that compatibility cannot be the crucial factor to affect the users. This finding is important and interesting; it indicates that in different innovation contexts, different kinds of IDT factors may take different roles. In the social media context, users are willing to adopt the innovative functions regardless of the compatibility with their previous habits and experiences.

Second, following the research of Moore and Benbasat (1991), we added two extra IDT factors into our research model. Especially, we utilize subjective norm to substitute voluntariness because of the differences of research contexts. When utilizing the social media, we consider that there is no compulsion for users to use the social media's innovative functions. Whereas the social influences may replace it because the users may perceive a social pressure. We find both subjective norm and image can significantly affect users' usage intention. It confirms our prediction and indicates that Moore and Benbasat (1991) expanded IDT theory is adjustable. In different research contexts, following the core idea of Moore and Benbasat (1991), researchers can make corresponding adjustments and add some substitutive factors according to the attributes of the research context.

Third, according to our best knowledge, many previous studies (Chao & Chan, 2017; Dai *et al.*, 2015) always focus on exploring the communication functions of social media, and ignoring their innovative functions such as banking, payment, games, GPS, shopping and so on. This study is one of the initial studies, which emphasizes on investigating the crucial impact factors of adopting social media's innovative functions. We believe to expand the research target of social media is an important and interesting research orientation, since various social media have designed various innovative functions to develop new markets. This study also provides many significant practical implications to the social media companies. When social media companies incorporate innovative functions into their software and applications, they can clearly inform the users what kind of advantages these functions can bring to them; besides, exhibiting other users' adoptions in the users' friend circles may improve the innovative functions' observability, it may also exert social pressure to users. Furthermore, they may pay attention to the trialability of the innovative functions, improving the trialability of the innovative functions can effectively enhance the users' usage intention.

Limitation

Inevitably, this study contains some limitations. First, data were collected from one Chinese social medium (WeChat). Therefore, scholars should be cautious in generalizing the results of our study, which might vary across different social media. We suggest future research to investigate the antecedents of usage of social media's new functions from other social media, to further test the generalizability of our study. Second, we only incorporate 5 IDT original factors, and add two extra factors based upon Moore and Benbasat (1991) research, into our research model. We consider it is not a comprehensive model. We encourage future research explores more factors' effects on people's usage intention of social media's innovative functions. Last, more than 40 percent of the participants are 20-25 years old; this might affect the external validity of this research to some extent. However, we still consider our sample generally represents the demographic distribution of current Chinese WeChat users, according to WeChat's last year's data (CNNIC, 2016), 45.4 percent of WeChat's users are between 18 and 25 years old.

Conclusion

Utilizing the Expanded IDT as our research foundation, this research identifies the crucial impact factors that can affect the social media users' usage intention of innovative functions. Our finding confirms that relative advantage, ease of use, trialability, observability, subjective norm and identification can positively influence people's usage intention, whereas compatibility has no significant effect. The finding confirms the validity of our research model, it also serves as a sound foundation for future research in social media domain.

ACKNOWLEDGEMENT

This work is supported by the Fundamental Research Funds for the Central Universities (Grant No. JBK1802012, JBK120505), the Fund from Collaborative Innovation Center for the Innovation and Regulation of Internet-based-Finance (Grant No. JBK150407), and Fund from Laboratory for Financial Intelligence and Financial Engineering, Southwestern University of Finance and Economics

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APPENDIX A: Measurement Items

Relative advantage (RAD):

- RAD1: Using WeChat's innovative functions enable me to improve my quality of life.
- RAD2: Using WeChat's innovative functions improve my job performance.
- RAD3: Using WeChat's innovative functions help with my life and job.
- RAD4: Using WeChat's innovative functions improve my efficiency of work.

Compatibility (CMP):

- CMP1: Using the WeChat's innovative functions are compatible with my habit.
- CMP2: Using the WeChat's innovative functions are compatible with my life style.
- CMP3: Using the WeChat's innovative functions are compatible with my current environment.
- CMP4: Using the WeChat's innovative functions are compatible with my work style.

Ease of use (EOU):

- EOU1: I find that the WeChat's innovative functions are easy to use.
- EOU2: Learn to use the WeChat's innovative functions do not need too much time and energy.
- EOU3: It is easy for me to use the WeChat's innovative functions proficiently.

Observability (OBS):

- OBS1: I have seen many people use WeChat's innovative functions.
- OBS2: In my organization, there are many people use WeChat's innovative functions.
- OBS3: People using WeChat's innovative functions can be seen everywhere.

Trialability (TRI):

- TRI1: I have had a great deal of opportunity to try various innovative functions of WeChat.
- TRI2: Before deciding whether to use the innovative function of WeChat, I was able to properly try it out.
- TRI3: WeChat allows me to try its innovative functions.
- TRI4: I know where I can go to satisfactorily try out various innovative functions of WeChat.

Subjective Norm (SBN):

- SBN1: People who have an impact on me think I should use WeChat's innovative functions.
- SBN2: People around me think I should use WeChat's innovative functions.
- SBN3: The environment I was in prompts me to use WeChat's innovative functions.

Image (IMA):

- IMA1: Using WeChat's innovative functions improves my image within the circle of friends.
- IMA2: Using of WeChat's innovative functions help me get approval from my friends.
- IMA3: Using WeChat's innovative functions can make me get a high reputation in the circle of friends.

Usage Intention (UIN):

- UIN1: I intend to continue using the various innovative functions of WeChat.
- UIN2: For a long time, I will continue to use the various innovative functions of WeChat.
- UIN3: I will often use the various innovative functions of WeChat in the future.
- UIN4: I will continue to use the innovative functions of WeChat when I need it.

Understanding Users' Multi-Homing Intention on Peer-to-Peer Accommodation Platforms

(Full Paper)

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ABSTRACT

An intriguing phenomenon in short-term accommodation market is that most users would adopt more than one accommodation platforms simultaneously, instead of being committed to utilizing only one platform. However, little attention has been paid to the underlying mechanisms about why users employ multiple accommodation platforms concurrently. To bridge the research gap, this study proposes a research model to investigate users' multi-homing intention on accommodation platforms by combining benefit-cost framework, social influence and need for cognition theory. This model is tested using data collected from 437 users who have ever used multiple accommodation platforms. Analytical results indicate that perceived information complementarity and decision complementarity contribute to users' multi-homing intention. Social influence and need for cognition have significant positive effects on the intention. Moreover, seeking cost decreases users' intention to adopt several competing platforms at the same time, while integration cost promotes the intention. At the end, implications for research and practice as well as limitations of this study are discussed.

Keywords: Peer-to-Peer accommodation platforms, multi-homing intention, information complementarity, decision complementarity, seeking cost, need for cognition.

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INTRODUCTION

With the rise of the sharing economy, peer-to-peer accommodations have become popular in tourism and hospitality markets. Numerous peer-to-peer accommodation platforms rose quickly, such as Airbnb, HomeAway, XiaoZhu, TuJia and so on. A survey conducted by National Information Center revealed that in China, the market turnover of the sharing accommodation was about 14.5 billion yuan in 2017, up 70.6% year-on-year. The main peer-to-peer accommodation platforms offer 3 million houses, with a total of about 76 million users.

The rapid development of peer-to-peer accommodation platforms (PPAP) provides more choices for people. They can freely choose hotels or multifarious sharing accommodations through different accommodation platforms according to their travel conditions. Interestingly, people are not completely loyal to one accommodation platform. It is a common practice that people are multi-homing on accommodation platforms, that is, people adopt several competing platforms concurrently (Gu, Oh, & Wang, 2016; Hu, Zhao, Zou, & Teng, 2017; Hwang & Oh, 2009).

Competing platforms usually offer services that are similar in nature but slightly different in features (Hu et al., 2017; Hwang & Oh, 2009). Consequently, when faced with multiple competing platforms, users do not adopt just one of those platforms, but tend to use multiple platforms at the same time to capture more benefits. Users' concurrent utilization of competing platforms has intensified the competition between different accommodation platforms (Cennamo, Ozalp, & Kretschmer, 2018; Koh & Fichman, 2014; Loginova, Wang, & Liu, 2018). Therefore, it is interesting to identify the antecedents of users' multi-homing intention on accommodation platforms, which would make both academics and practitioners gain insights into users' platform usage behavior, thus helping the accommodation platform service providers improve their competitive strategies to attract and retain users.

However, scant attention has been paid to the multi-homing of accommodation platforms. Previous studies on the usage of accommodation platforms mainly focused on users' adoption intention (Poon & Huang, 2017; So, Oh, & Min, 2018; Tussyadiah & Pesonen, 2018; Wu, Zeng, & Xie, 2017), continuous use intention (Mao & Lyu, 2017; Tussyadiah, 2016; C. R. Wang & Jeong, 2018; Yang, Lee, Lee, Chung, & Koo, 2016) and switching intention of a particular peer-to-peer accommodation platform (L. J. Liang, Choi, & Joppe, 2018), or the impact of peer-to-peer accommodation platforms on hotel industry (Blal, Singal, & Templin, 2018; Guttentag & Smith, 2017), but largely ignored the underlying mechanisms of the simultaneous use of multiple competing accommodation platforms which is an intriguing phenomenon in the accommodation sector. Therefore, this study sets up to investigate what drives users' multiple usage of accommodation platforms.

Since users always act after weighing costs against benefits (F. C. Tseng & Teng, 2014), this study draws on the benefit-cost framework to explore the factors which lead to the concurrent use of competing accommodation platforms. As users obtain accommodation information and make choices depending on the information which is provided by multifarious accommodation

platforms, the benefit that users perceived from multi-homing usage on accommodation platforms is that they can access and compare a variety of information to satisfy their diverse needs. While the multifarious information also means that users need to spend more time and energy searching for and integrating information. Thus, this study concentrates on the perceived benefits and costs from information aspect.

In addition to benefit-cost factors, social factors and individual personality factors may also affect users' multi-homing behavior as this behavior occurs in certain social environment and is closely associated with users' cognitive capacity to deal with multiple-source information. Specifically, social influence which has been widely discussed in the adoption behavior of a single technology as well as need for cognition which reflects users' tendency to consider more information when making a decision are included in the research model.

The remainder of this paper is structured as follows. In the next section, we review extant related literature and present the theoretical background for this study. Then we put forward the research model and develop the hypotheses. In the two subsequent sections, the research methodology is introduced and the data analysis results are reported. At the end, the key findings of this study, the implications for theory and practice, as well as the limitations of this paper are discussed.

LITERATURE REVIEW

Multi-homing Behavior

Multi-homing can be described as the propensity that a user has access to multiple services or platforms with similar functions concurrently (Gu et al., 2016; Hu et al., 2017; Kwon & Oh, 2014; Rochet & Tirole, 2003). Multi-homing behavior has been widely researched in various fields, such as credit card industry, telecommunication industry, e-commerce industry, social networking sites (SNSs), mobile applications and so on (Finley & Basaure, 2018; Gu et al., 2016; Hu et al., 2017; Koh & Fichman, 2014; Kwon & Oh, 2014; Mital & Sarkar, 2011; F. C. Tseng & Teng, 2014).

Much of the literature on multi-homing has explored the antecedents of users' multi-homing behavior. These papers mainly study this phenomenon from three aspects, namely product-related factors, personality-related factors and external environment-related factors.

As for the product-related aspect, product complementarity is acknowledged as an important driver of multi-homing behavior. The complementarities among platforms which are caused by the slight differentiation of competing products provide users with more benefits, thus leading users to adopt several platforms at the same time (Gu et al., 2016; Hu et al., 2017; Hwang & Oh, 2009). In addition to the complementary feature, perceived cost is another product-related factor that affects users' multi-homing intention. With the development of internet technology, it is possible for users to embrace several online services concurrently without incurring a high cost (Hwang & Oh, 2009). The relatively low adoption or switching costs allow users to mix the utilization of multiple online platforms. While F. C. Tseng and Teng (2014) also proposed that perceived relational switching cost lower users' intention to utilize multiple platforms.

In terms of personality-related factors, extant researches on multi-homing behavior concentrated on personal traits like inherent novelty seeking and variety seeking. Optimum stimulation level theory, a psychological theory which is similar to the need for cognition theory that emphasizes individuals' preference for more novel or complex activities (Cacioppo & Petty, 1982; Gu et al., 2016; Utkarsh, 2017), is often applied to explain why users adopt a portfolio of competing services or platforms rather than committing to using just one of them (Gu et al., 2016; Hu et al., 2017; F. C. Tseng & Teng, 2014). Regarding external environment-related factors, prior studies mainly pay attention to the impact of other users, such as network externalities and social influence, which can induce users to consider it useful and worthwhile to use multiple platforms concurrently (Gu et al., 2016; F. C. Tseng & Teng, 2014).

Extant literature on multi-homing behavior motivates us to explore the simultaneous use of multiple accommodation platforms from the three aspects, namely product-related benefit-cost factors, personality trait namely need for cognition, and external factor namely social influence.

The Benefit Side: Complementarity

The concept "complementarity" is defined that "whereby activities are considered complements if doing (more of) any one of them increases the returns to doing (more of) the others" (Gu et al., 2016, p754). The notion of complementarity has been widely applied to many areas to explore users' or consumers' adoption or usage behavior, such as electronic commerce (Hwang & Oh, 2009), marketing (Koukova, Kannan, & Ratchford, 2008), social networking site (Gu et al., 2016), mobile instant messaging (F. C. Tseng, Pham, Cheng, & Teng, 2018) and knowledge management (Choi, Poon, & Davis, 2008). Previous studies on complementarity have showed that complementarity exerts a profound impact on an individual's behavior. Therefore, it is crucial to take the complementarity factors into account when studying users' utilization behaviors.

Users adopt products with complementarity entailing that they can obtain a higher utility than just using one product (Hwang & Oh, 2009). That is, users perceive more benefits because complementary products meet their various demands. As users' purpose of using accommodation platforms is to obtain various kinds of accommodation information and information varies from platform to platform (Hu et al., 2017), users would have to adopt several accommodation platforms to satisfy their information

demands. Besides, different platforms may have different functions (e.g., recommendation systems or decision support systems) to help users to make decisions. Thus, users can employ a variety of functions of different platforms to make their decisions. Therefore, in this study, the complementarity benefits perceived by users include both information complementarity and decision complementarity (e.g., information processing).

The Cost Side: Cost in Information Seeking and Integrating

There is a common view that perceived costs would reduce users' willingness to adopt one platform (F. C. Tseng & Teng, 2014; S. M. Tseng & Lee, 2016; Zhu, So, & Hudson, 2017). In this study, perceived costs can be classified into two aspects: seeking cost and integration cost. Seeking cost, arising from the process of finding product or service related information, includes the time and effort costs of undertaking the information search activities (T. P. Liang & Huang, 1998; Srinivasan & Ratchford, 1991; S. M. Tseng & Lee, 2016). Integration cost incurs at the stage of processing and comparing information (S. M. Tseng & Lee, 2016). In order to find an appropriate service or product and get the best transaction possible, people would spend more time and effort comparing information, such as comparing prices or other features based on what they searched (Teo & Yu, 2005; S. M. Tseng & Lee, 2016). Wang and Sahin (2018) stated that as search cost which is a combination of seeking cost and integration cost is an integral part of individual search and choice behavior, it is necessary to consider the impact of search cost when studying user behavior. The high seeking and integration costs bring users losses directly and then influence the subsequent user behavior (Hoque & Lohse, 1999; Teo & Yu, 2005).

Social Influence

Social influence is one of the most frequently used concepts to explain individuals' usage behavior. Social influence refers to the manner in which people affect a person's decision-making (E. S. T. Wang & Chou, 2016). It occurs when an individual's behavior is influenced by those around him or her (Qin, Kim, Hsu, & Tan, 2011). Social influence has been theorized in IT usage researches and theories, such as the unified theory of acceptance and use of technology (Venkatesh, Morris, Davis, & Davis, 2003). A large body of literature has empirically demonstrated that social influence has a positive correlation with user's adoption behavior (Gu et al., 2016; So et al., 2018; Venkatesh et al., 2003; Venkatesh, Thong, & Xu, 2012; Yap & Gaur, 2016).

Need for Cognition

Need for cognition (NFC), a personality trait which is closely associated with the decision-making process, is defined as "a need to structure relevant situations in a meaningful, integrated ways" and "a need to understand and make reasonable the experimental world" (Cohen, Stotland, & Wolf, 1955, p. 291). More generally, NFC connotes the extent to which people like seeking out cognitive stimulation and handling tasks that require cognitive activities (Cohen, Stotland, & Wolf, 1955; Verplanken, 1993). People with a high level of NFC prefer to involve themselves in abstract and rational thinking activities. Specifically, they are more inclined to actively acquire all kinds of information, scrutinize and reflect on relevant information to make sense of events, enjoy complex problem-solving, and make decisions based on rational considerations. On the contrary, individuals who are low in NFC always avoid engaging in effortful cognitive activities (Cacioppo & Petty, 1982).

NFC is vital to one's motivation for information processing (Zhong, Hardin, & Sun, 2011). And it has been found to positively affect an individual's usage behavior, such as social networking or social media usage (Hughes, Rowe, Batey, & Lee, 2012; Yap & Gaur, 2016; Zhong et al., 2011), smartphone adoption (Cho & Park, 2014), online learning engagement (Arquero, Del Barrio-Garcia, & Romero-Frias, 2017) and so on. It is appropriate to use NFC to explore users' multiple usage behavior in this study because multi-homing behavior is accompanied by diverse and complex information which requires users to think seriously and thoroughly.

RESEARCH MODEL AND HYPOTHESES

Based on the benefit-cost framework, social influence and need for cognition theory, we proposed a model of users' multi-homing intention on accommodation platforms, as shown in Fig.1. In this model, users' perceived benefits are perceived information complementarity and decision complementarity, which are considered as facilitators of multi-homing intention. Perceived costs namely seeking cost and integration cost are negatively related to users' intention to adopt multiple accommodation platforms concurrently. In addition, social influence and need for cognition both drive users' multi-homing intention.

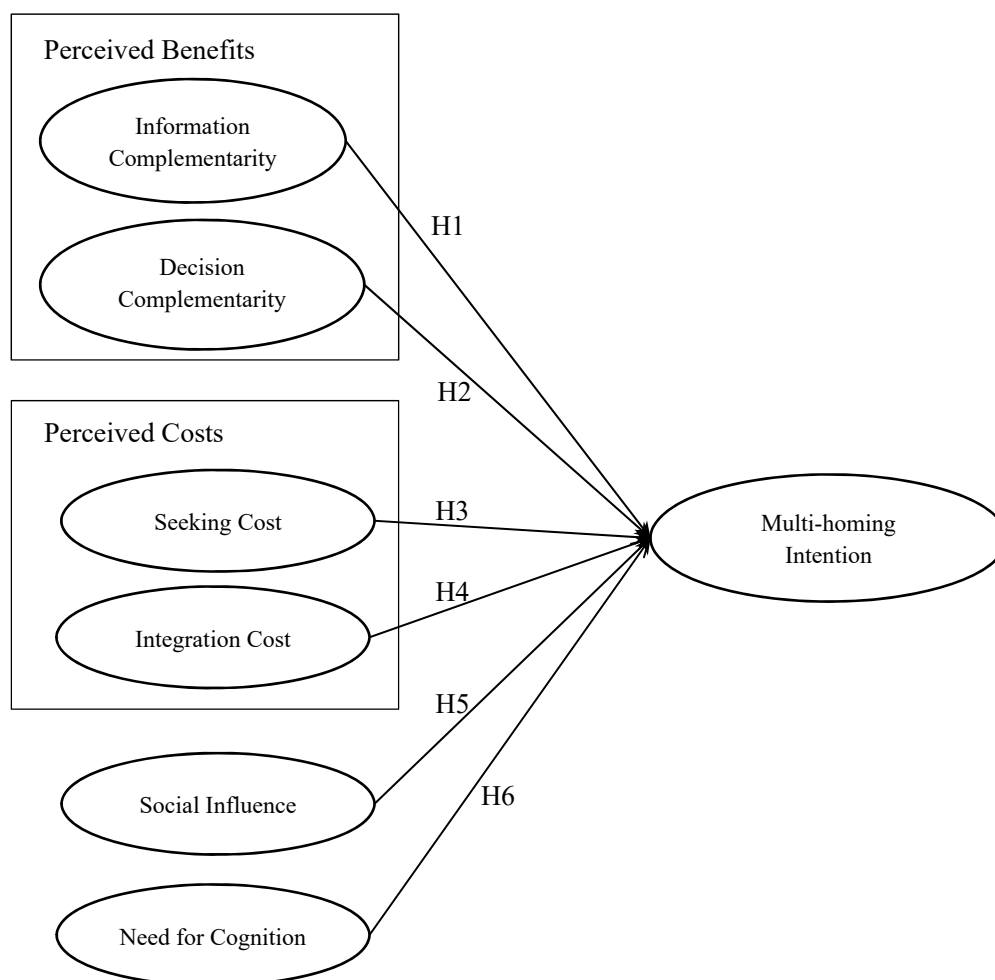


Figure 1: Research Model.

Complementarity and Multi-homing Intention

Information complementarity captures that the heterogeneous information provided by multiple competing accommodation platforms could jointly meet users' various demands (Hu et al., 2017). As discussed earlier, in order to make the right purchase choice, people attempt to obtain comprehensive and multifarious accommodation information. And the accommodation information offered by competing platforms is different because of the differentiated features of each platform (Hwang & Oh, 2009). Thus, people tend to use multiple competing accommodation platforms to satisfy their information demands. It has been pointed out that an increase in users' perception of information complementarity enhances their intention to multi-home on services or platforms (Gu et al., 2016; Hu et al., 2017; Hwang & Oh, 2009).

Besides information complementarity, decision complementarity also reflects the relative benefit of different accommodation platforms' joint usage. Decision complementarity in this study refers to the extent to which users perceive easier and efficient to make choices because of the complementarity of multiple accommodation platforms. The comprehensive information provided by several accommodation platforms offers users a higher utility to make better decisions, thus stimulating users' multi-homing intention. Based on the above arguments, we hypothesize that:

H1: Information complementarity between different accommodation platforms has a positive impact on users' multi-homing intention on accommodation platforms.

H2: Decision complementarity between different accommodation platforms has a positive impact on users' multi-homing intention on accommodation platforms.

Cost and Multi-homing Intention

Seeking cost refers to the time and effort cost for finding satisfactory accommodation information, while integration cost represents the time and effort cost for processing accommodation information (S. M. Tseng & Lee, 2016). Compared with just using one platform, adopting multiple platforms entails that it takes more time and effort for users to search for the appropriate

accommodation. Moreover, before they make a purchase decision, users will spend more time distinguishing the information quality (e.g. whether the housing information is trustworthy and complete) and comparing information between different platforms (e.g. accommodation price, location, household amenities etc.). Previous researches have stated that individuals always want to minimize costs, thus, perceived costs are negatively associated with their behavior intention (Sun, Fang, & Lim, 2014; F. C. Tseng & Teng, 2014; Zhu et al., 2017). It is reasonable to assume that people who perceive seeking cost and integration cost tend to engender more negative feelings toward using multiple accommodation platforms. As the costs increase, users' multi-homing intention on accommodation platforms will decrease. Therefore, we hypothesize that:

H3: Seeking cost is negatively associated with users' multi-homing intention on accommodation platforms.

H4: Integration cost is negatively associated with users' multi-homing intention on accommodation platforms.

Social Influence and Multi-homing Intention

Social influence here describes the extent to which users perceive that important others believe they should use multiple accommodation platforms simultaneously (Venkatesh et al., 2012). Numerous theories (e.g. UTAUT, TRA, TPB) and researches recognize social influence as a crucial facilitator of users' technology usage behavior (Venkatesh et al., 2003; Venkatesh et al., 2012; E. S. T. Wang & Chou, 2016). Especially, Gu et al. (2016) have empirically proved that social influence makes a salient effect on users' intention to utilize multiple SNSs. Based on previous researches, it can be assumed that when people who are important to users recommend adopting multiple accommodation platforms, users will think that it is worth doing and have a stronger intention to multi-home on accommodation platforms. Therefore, we hypothesize that:

H5: Social influence has a positive impact on users' multi-homing intention on accommodation platforms.

Need for Cognition and Multi-homing Intention

The personality trait need for cognition represents one's tendency to seek out cognitive activities and enjoy thinking (Cacioppo & Petty, 1982). NFC is considered to significantly change an individual's behavior in processing information and making a decision (Verplanken, 1993). People with higher degree of NFC really enjoy seeking new information and handling complex tasks (Cacioppo & Petty, 1982; Zhong et al., 2011). Using several accommodation platforms requires users to deal with a variety of accommodation information, and it is a rational decision-making process. Thus high-NFC individuals are more willing to adopt multiple accommodation platforms because they enjoy effortful cognitive activities. Therefore, we hypothesize that:

H6: Need for cognition has a positive impact on users' multi-homing intention on accommodation platforms.

METHOD

Data Collection

In this study, the data were collected by conducting an online survey using sojump.com, which is a popular and professional questionnaire survey platform in China. At the beginning of the questionnaire, we set up screening questions to ensure that participants had used multiple accommodation platforms concurrently. After excluding the unqualified responses in this survey, we obtained 437 valid responses. Among these respondents, 37.54% were male, 62.47% were female. Most of them (59.73%) aged 25-34 years old. In terms of education background demographics, 81.0% of the respondents obtained or are currently acquiring bachelor degree. About travel purposes, 31.35% of the respondents' feedback about their business travel frequency is 2-3 times per year, and more than half of the respondents said that their leisure travel frequency is 2-3 times per year. As for the past usage experience, 40.27% had more than 1 year of online peer-to-peer accommodation platform usage experience. The specific demographics of the respondents are shown in Table 1.

Measurement

Most of the constructs' measures in this study were adapted from extant literature except for decision complementarity and integration cost (see Appendix). Slight wording modifications were applied to fit our research context. All constructs were measured using multi-item perceptual scales. Seven-point Likert scales were used for all items, ranging from "strongly disagree" to "strongly agree". The scales for information complementarity were borrowed from Gu et al. (2016) and Hu et al. (2017). The scales for seeking cost were adapted from Srinivasan and Ratchford (1991). Social influence was measured using four items from Hew, Lee, Ooi, and Wei (2015). The scales for need for cognition were derived from the study of Yap and Gaur (2016). And we used the scale for multi-homing intention developed by Gu et al. (2016).

Due to the lack of decision complementarity and integration cost instruments in prior studies, we developed measurement items according to the structural definitions and the characteristics of the research context. Decision complementarity could be assessed from the decision-making process aspect. Making a decision pays attention to the efficiency and effectiveness of the decision-making forms. Compared with using only one accommodation platform, adopting multiple platforms provides users with more information which could help users make the best decision. Thus, we assessed decision complementarity from the usefulness and effectiveness of making decisions. As for integration cost, prior literature has pointed out that information integration is a stage of individual search and choice behavior (R. X. Wang & Sahin, 2018), thus the cost incurred at the integration stage involves two elements of seeking cost, namely time cost and effort cost. Besides, integration behavior occurs in the process of dealing with information, which requires the rational thinking to evaluate and compare information they have searched for. Therefore, we developed our integration cost instrument from the time and effort aspects of the evaluation and comparison process.

Table 1: Demographics.

Variables	Category	Frequency	Percentage (%)
Gender	Male	164	37.54
	Female	273	62.47
Age	Under 18	3	0.69
	19-24	104	23.80
	25-34	261	59.73
	35-44	65	14.87
	Above 45	4	0.92
Education	Middle school or lower	7	1.60
	Two-year college	42	9.61
	Bachelor	354	81.0
	Master or above	34	7.78
Business travel frequency (per year) (at least one-night stay)	One time and below	58	13.27
	2-3 times	137	31.35
	4-5 times	135	30.89
	More than 5 times	107	24.49
Leisure travel frequency (per year) (at least one-night stay)	One time and below	15	3.43
	2-3 times	228	52.17
	4-5 times	128	29.29
	More than 5 times	66	15.10
Peer-to-peer accommodation platform usage experience	Under 3 months	41	9.38
	3-6 months	79	18.08
	6-12 months	141	32.37
	Above 12 months	176	40.27

DATA ANALYSIS

The partial least squares (PLS) method was chosen to test the research model. PLS is capable of simultaneously estimating the measurement model and the structural model by testing the loadings of indicators on constructs and the causal relationships among constructs (Fornell & Bookstein, 1982). In comparison with covariance-based structural equation modeling (CB-SEM), PLS is more suitable for models with formative constructs, and it has no restriction on normal distribution and sample size (Chin & Newsted, 1997). Based on the above reasons, PLS is appropriate for this study. Thus, SmartPLS was used as the analytic tool to conduct data analysis. In the following section, measurement model and structural model will be examined and reported respectively.

Measurement Model

Reliability and validity of the constructs were assessed in the measurement model. Reliability can be tested by Cronbach's α , Composite Reliability (CR) and average variance extracted (AVE). The criteria of reliability were proposed that the values for Cronbach's α , CR should higher than 0.7, and the critical value for AVE is 0.5 (Fornell & Larcker, 1981). As shown in Table 2, the minimum values of Cronbach's α , CR and AVE were 0.702, 0.820 and 0.534 respectively, which exceeded the recommended threshold value. This result showed that all constructs were reliable.

Table 2: Reliability.

	AVE	CR	Cronbach's α
MHI	0.762	0.906	0.844
ICP	0.613	0.826	0.702
DCP	0.637	0.840	0.717
SC	0.806	0.892	0.767
IC	0.730	0.890	0.817
SIN	0.534	0.820	0.708
NFC	0.552	0.860	0.798

Note: ICP=Information Complementarity; DCP=Decision Complementarity; SC=Seeking Cost; IC=Integration Cost; SIN=Social Influence; NFC=Need for Cognition; MHI=Multi-homing Intention

The validity analysis includes convergent validity and discriminant validity. Convergent validity was tested by checking the item loadings on the respective constructs. According to Table 3, the factor loading of each indicator of a construct is higher than 0.7, suggesting good convergent validity. And each item loading is greater than all of its cross-loadings, satisfying the requirement of discriminant validity. The discriminant validity also can be tested by comparing the correlation coefficient between the latent variables and the square roots of AVE. The square root of AVE of each construct should be higher than the correlation of the specific construct with all the other constructs in the model. From the results of Table 4, all square roots of AVE values exceed the correlations, justifying the good discriminant validity.

Table 3: Cross-loadings.

	MHI	ICP	DCP	SC	IC	SIN	NFC
MHI1	0.914	0.464	0.411	0.164	0.344	0.464	0.331
MHI2	0.841	0.367	0.336	0.050	0.220	0.336	0.230
MHI3	0.861	0.339	0.331	0.101	0.300	0.381	0.311
ICP1	0.390	0.841	0.437	0.288	0.308	0.303	0.332
ICP2	0.320	0.719	0.440	0.213	0.311	0.276	0.377
ICP3	0.347	0.784	0.378	0.270	0.335	0.277	0.356
DCP1	0.332	0.479	0.782	0.137	0.296	0.250	0.303
DCP2	0.275	0.372	0.759	0.080	0.132	0.327	0.368
DCP3	0.376	0.422	0.851	0.148	0.254	0.379	0.380
SC1	0.131	0.315	0.167	0.936	0.538	0.138	0.158
SC2	0.089	0.275	0.103	0.857	0.525	0.125	0.106
IC1	0.296	0.325	0.227	0.479	0.884	0.173	0.163
IC2	0.226	0.364	0.275	0.521	0.796	0.241	0.260
IC3	0.323	0.357	0.256	0.520	0.881	0.210	0.236
SIN1	0.298	0.287	0.308	0.145	0.202	0.756	0.216
SIN2	0.302	0.267	0.325	0.044	0.147	0.748	0.191
SIN3	0.372	0.243	0.259	0.126	0.168	0.759	0.243
SIN4	0.346	0.271	0.283	0.108	0.181	0.704	0.232
NFC1	0.257	0.381	0.386	0.202	0.199	0.203	0.763
NFC2	0.201	0.197	0.310	0.055	0.067	0.250	0.706
NFC3	0.258	0.359	0.341	0.061	0.198	0.276	0.767
NFC4	0.221	0.309	0.280	0.091	0.196	0.210	0.731
NFC5	0.295	0.389	0.305	0.136	0.246	0.201	0.745

Table 4: Correlation Matrix with the Square Root of the AVE in the Diagonal.

	MHI	ICP	DCP	SC	IC	SIN	NFC
MHI	0.873						
ICP	0.452	0.783					
DCP	0.415	0.533	0.798				
SC	0.126	0.331	0.156	0.898			
IC	0.335	0.405	0.292	0.589	0.854		
SIN	0.457	0.365	0.400	0.147	0.239	0.731	
NFC	0.337	0.450	0.437	0.152	0.252	0.305	0.742

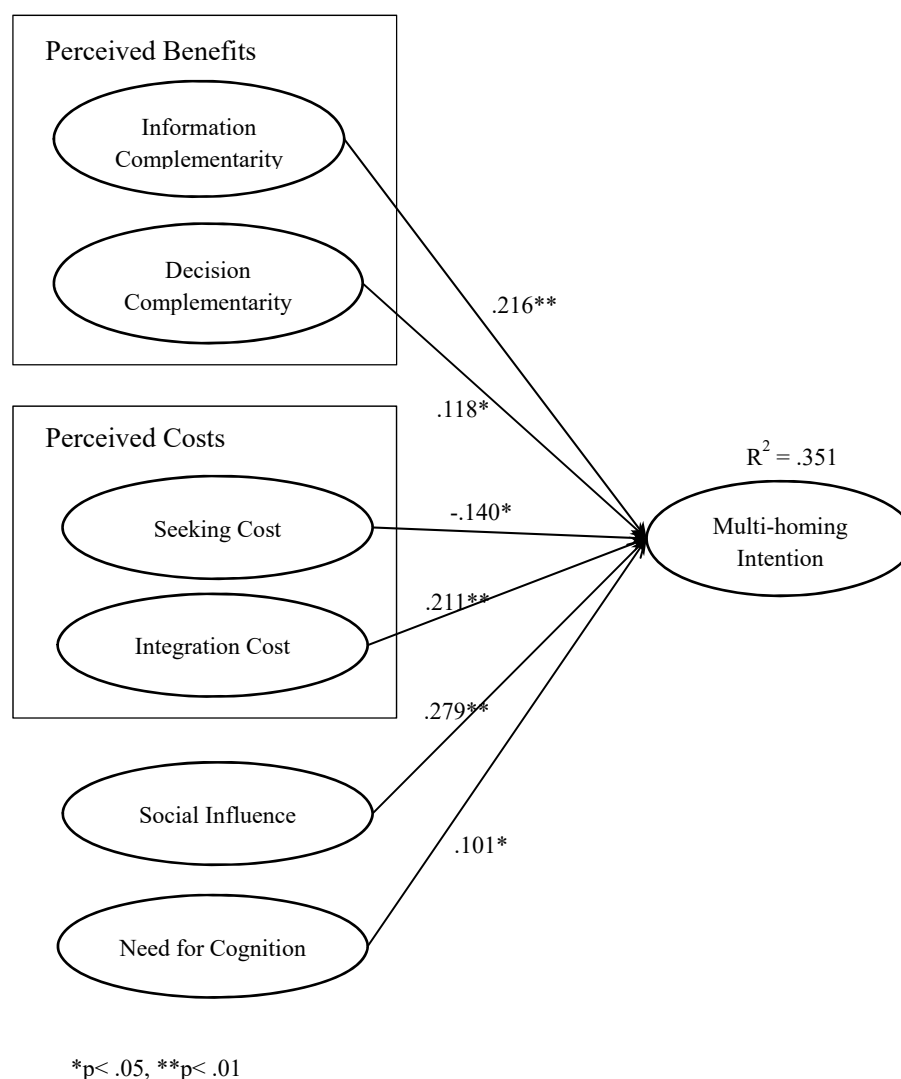


Figure 2: Results of Structural Model.

Structural Model

The PLS results of the structural model are presented in Fig. 2. According to the results, information complementarity has a significant positive effect on multi-homing intention ($\beta=0.216$, $t=3.635$, $p<0.01$), supporting H1. Decision complementarity exerts an important direct effect on multi-homing intention ($\beta=0.118$, $t=1.982$, $p<0.05$), validating H2. Seeking cost is negatively related to multi-homing intention ($\beta=-0.140$, $t=2.399$, $p<0.05$), so H3 is supported. Contrary to our expectation, integration cost has a positive impact on multi-homing intention ($\beta=0.211$, $t=3.308$, $p<0.01$). Although the effect is significant, the impact mechanism is opposite to the assumption, thus H4 is not supported. Social influence is positively associated with multi-homing intention ($\beta=0.279$, $t=5.793$, $p<0.01$), supporting H5. Need for cognition is found to be positively related to multi-homing intention ($\beta=0.101$, $t=1.962$, $p<0.05$), supporting H6. Overall, 35.1% of the variance in users' multi-homing intention on accommodation platforms is explained by information complementarity, decision complementarity, seeking cost, integration cost, social influence and need for cognition.

DISCUSSION

This study explored the factors that influence users' multi-homing intention on accommodation platforms. Findings of this study offered some interesting insights to understand the usage of accommodation platforms.

First, we found that information complementarity and decision complementarity had significant impacts on users' multi-homing intention. Compared with one accommodation platform, a combination of several platforms could offer users additional benefits. As different accommodation platforms provide different accommodation information and services, users can access all kinds of housing information to fully satisfy their diverse travel accommodation needs. With such comprehensive information, users can easily make the best decision. When users perceive above complementarity benefits, they will consider that the adoption of multiple accommodation platforms is worthwhile, thus enhancing their intention to use several platforms concurrently. This result is in line with the study of Gu et al. (2016) which states the important effect of information complementarity on users' multi-homing intention in the context of SNSs.

Second, the results revealed that seeking cost negatively influenced users' multi-homing intention. When users perceive that the time and effort losses induced by using several platforms are too high, they would think that multi-homing behavior makes information searching cumbersome. Thus, the benefits brought by multi-homing behavior became devaluated and they will refuse the simultaneous use of multiple accommodation platforms. This finding is consistent with prior literature which suggests that perceived cost hinders users' adoption and usage behavior (F. C. Tseng & Teng, 2014; Zhu et al., 2017). In addition to seeking cost, we also explored the impact of integration cost on the multi-homing intention. Surprisingly, integration cost has a positive impact on multi-homing intention, which is exactly the opposite of our expectation. A possible explanation could be that for users, the value of information integration is accompanied by integration cost, such that when integration cost is high, the integration value should be high accordingly. In this case, high integration cost may signal high integration value and demonstrate a positive impact on multi-homing intention.

Third, social influence and need for cognition are positively associated with users' multi-homing intention, indicating that an individual's behavior is influenced by important others as well as their own personality traits. If others suggest utilizing multiple accommodation platforms concurrently, they have a great chance of following the recommendations. It echoes with extant studies which show the positive impact of social influence on users' adoption and usage behavior (Gu et al., 2016; So et al., 2018; Venkatesh et al., 2012). Besides, although using multiple platforms requires users to spend more effort searching for and dealing with a variety of accommodation information, users presenting high level of NFC are still willing to adopt several platforms simultaneously as they enjoy performing effortful cognitive activities. It is consistent with NFC literature which contends that NFC positively affect users' technology usage behavior (Cho & Park, 2014; Hughes et al., 2012; Yap & Gaur, 2016).

Theoretical Implications

In investigating the accommodation platform usage behavior, this study can extend previous research in several ways. First, to the best of our knowledge, this study is one of the earliest studies to explore users' multi-homing intention in the context of peer-to-peer accommodation platform (PPAP). Most prior studies on PPAP concentrated on single platform usage behavior, but ignored the multi-homing use behavior of accommodation platforms which is fairly prevalent in our life. The present study fills this void by developing a research model of users' multi-homing intention on accommodation platforms and exploring the underlying mechanism by applying benefit-cost framework (namely complementarity and cost), social influence and need for cognition. It stimulates future studies to further explore the influencing mechanisms of an individual's decision to adopt multiple platforms concurrently.

Second, proposing information complementarity and decision complementarity as key factors promoting users' multi-homing intention is a novel contribution of this study, deepening our understanding of the complementarity among different products and giving a new insight into users' concurrent use of multiple platforms. Based on the characteristics of accommodation platforms multi-homing usage behavior, we subdivide perceived complementarity into information complementarity and decision complementarity. And the results suggest that both two complementarities have significant impacts on users' multi-homing intention. It indicates that in order to complement information and decision-making needs, users would be more proactive in utilizing different platforms. It implies that future studies can further explore the impact of other subdivisions of complementarity on multi-homing behavior.

Third, this study contributes to the understanding of the perceived costs by considering seeking cost and integration cost as important barriers of multi-homing behavior. Corresponding to the above complementarities, this study proposes two components of perceived costs, namely seeking cost and integration cost. The result demonstrates the negative influence of seeking cost on users' multi-homing intention, while the integration cost positively affects multi-homing intention. It indicates that compared with perceived costs which arise in the information integration stage, perceived cost in the information searching process is more likely to hinder users' multi-homing intention. It reminds follow-up research to pay attention to different types of costs when investigating multi-homing behaviors.

Fourth, this study empirically examines the impact of need for cognition on multi-homing intention, introducing a new personality theory into the study of accommodation platforms multi-homing behavior. Our study suggests that users who have a higher degree of need for cognition have a stronger intention to multi-home on accommodation platforms. This finding gives an implication to future researchers that in addition to product-related factors, personality-related factors are also important for multi-homing behavior.

Practical Implications

With the severe competition in the accommodation market, operators are trying to understand what affects users' adoption intention to attract and retain users. This study offers some implications to accommodation market practitioners. First, as people always use several competing platforms concurrently rather than remaining loyal to only one platform, PPAP firms can benefit from coopetition strategy. That is, cooperate with competitors. Firms are suggested to form alliances with competitors in brand promotion and operations to enhance common benefits.

Second, perceiving information complementarity and decision complementarity among different accommodation platforms can evoke users' multi-homing intention. This finding illustrates the importance of complement factors. When operators develop competitive strategies, it would be useful to take complement strategy into account. We recommend that accommodation

platforms could first conduct surveys and interviews to identify users' accommodation needs that have not been fully met, and then provide relevant accommodation information and services based on the survey results that are moderately different from competitors.

Third, high seeking cost decreases users' willingness to adopt other accommodation platforms. In order to reduce the cost that incurred at users' accommodation information searching process, the platform can make efforts to optimize search function and filter function, and strictly control the authenticity of the accommodation information posted on the platform, so that users can quickly and efficiently find the most satisfactory accommodation information.

Fourth, social influence is crucial to users' multi-homing intention. Accommodation platforms can add slight social interaction functions and encourage users to share platform information with their friends through some operational activities, for instance, users can obtain platform credits or coupons by sharing platform accommodation information or inviting their friends to use this platform. Thus, platforms can attract and lock-in more users.

Limitations and Future Research

Despite the valuable findings, this study is subject to certain limitations. First, all the influencing factors identified in this study together explain only 35.1% of the variance in users' multi-homing intention, indicating that there are additional factors to be explored. For instance, as accommodation platform connects online and offline services, trust (includes trust in the platform and trust in the host) and perceived risk (includes perceived online risk and perceived offline risk) might also influence users' multi-homing intention on accommodation platforms. Therefore, future researches can explore the underlying mechanisms to explain why users adopt multiple platforms concurrently based on the characteristics of accommodation platforms. Second, we draw our conclusions based on the self-report results of users' multi-homing intention, but do not assess users' actual behavior. Some studies pointed out that an individual's intention may be inconsistent with his/her behavior as the transformation from intention to action might depend on personality characteristics. Therefore, in order to make the results more convincing, future studies can expand the research by tracking users' actual multi-homing behavior.

ACKNOWLEDGEMENTS

The work described in this paper was partially supported by the grants from the Humanities and Social Sciences Foundation of the Ministry of Education, China (Project No. 16YJC870011, 17YJC630157), the Major Project of the Ministry of Education of China (Grant No. 17JZD034), and the Research Fund for Academic Team of Young Scholars at Wuhan University (Project No. Whu2016013).

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(*Full reference list is available upon request from the corresponding author.)

APPENDIX

Constructs	Items	Source
Information complementarity	ICP1: Using multiple accommodation platforms is more useful for me to obtain information than using just one single platform. ICP2: There is additional value in using multiple accommodation platforms for my information acquisition compared with using only one of them. ICP3: Using multiple accommodation platforms helps me combine heterogeneous information resources to satisfy my needs.	(Gu et al., 2016; Hu et al., 2017)
Decision complementarity	DCP1: Using multiple accommodation platforms is more useful for me to make better decisions than using just one single platform. DCP2: Using multiple accommodation platforms helps me make decisions more easily than using just one single platform. DCP3: There is additional value in using multiple accommodation platforms for effectively making choices compared with using only one of them.	Self developed
Seeking cost	SC1: Using multiple accommodation platforms makes me spend more time searching information compared with using only one of them. SC2: Using multiple accommodation platforms makes me spend more effort needed to search information compared with using only one of them.	(Srinivasan & Ratchford, 1991)
Integration cost	IC1: I spend more time and effort integrating information given by different accommodation platforms when I use multiple accommodation platforms. IC2: I spend more time and effort distinguishing the quality of platform information when I use multiple accommodation platforms. IC3: I spend more time and effort comparing information between different platforms when I use multiple accommodation platforms.	Self developed
Social influence	SIN1: People who are important to me think that I should use multiple accommodation platforms. SIN2: People who influence my behavior think that I should use multiple accommodation platforms. SIN3: People whose opinions that I value prefer that I use multiple accommodation platforms. SIN4: People around me consider it is appropriate to use multiple accommodation platforms.	(Hew et al., 2015)
Need for cognition	NFC1: Thinking is my idea of fun. NFC2: I like the responsibility of handling a situation that requires a lot of thinking. NFC3: I really enjoy a task that involves coming up with new solutions to problems. NFC4: Learning new ways to think does excite me. NFC5: I like to search for new information.	(Yap & Gaur, 2016)
Multi-homing Intention	MHI1: I intend to use multiple accommodation platforms in the future. MHI2: I predict that I would not use multiple accommodation platforms in the future. MHI3: In the future, I plan to use multiple accommodation platforms.	(Gu et al., 2016)

Unsupervised Feature Selection Algorithm via Local Structure Learning and Kernel Function

(Full Paper)

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ABSTRACT

In order to reduce dimensionality of high-dimensional data, a series of feature selection algorithms have been proposed. But these algorithms have the following disadvantages: (1) they do not fully consider the nonlinear relationship between data features (2) they do not consider the similarity between data features. To solve the above two problems, we propose an unsupervised feature selection algorithm based on local structure learning and kernel function. First, through the kernel function, we map each feature of the data to the kernel space, so that the nonlinear relationship of the data features can be fully exploited. Secondly, we apply the theory of local structure learning to the features of data, so that the similarity of data features is considered. Then we added a low rank constraint to consider the global information of the data. Finally, we add sparse learning to make feature selection. The experimental results show that the proposed algorithm has better results than the comparison methods.

Keywords: Feature selection · Kernel function · Sparse learning · Local structure learning

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INTRODUCTION

With the development of computer science and technology, the information age is coming. At the same time, a large number of high-dimensional data are brought (Zhu *et al.*, 2014). Artificial intelligence, data mining and other fields are also booming (Zhang *et al.*, 2018). It is very difficult for people to deal with thousands of data, sometimes it will bring problems of dimensional disaster (Zhu *et al.*, 2013; Zhu *et al.*, 2010). For these high-dimensional data, people must preprocess it. The feature selection is one of the most effective ways (Bolón-Canedo *et al.*, 2016). It is necessary to preprocess the data through feature selection to narrow the data dimension (Ling *et al.*, 2004).

Feature selection (Zhu *et al.*, 2013) includes linear feature selection and nonlinear feature selection (Zhang *et al.*, 2007). Their fundamental purpose is to find a relatively small and representative subset of features (Qin *et al.*, 2007; Sheeja *et al.*, 2018). There are many commonly used feature selection methods (Zhang *et al.*, 2011), but they cannot unearth the nonlinear relationship between data features. The local structure learning is applied to the sample at the beginning, and the structure between the samples is fully embodied by constructing the similarity matrix between the samples (Nie *et al.*, 2016), so as to achieve better experimental results. But it does not fully embody the structural relationship between features. To this end, we maps each feature of the data to a high-dimensional space by a kernel function, so that the nonlinear relationship between them is linearly separable in the high-dimensional space. At the same time, the local structure learning is applied to the data features. To better represent the local structural relationship of data features in low-dimensional space. A more efficient feature selection algorithm is proposed, which is called Unsupervised Feature Selection Algorithm via Local Structure Learning and Kernel Function (LSK FS).

This paper firstly processes the data through the kernel function to obtain the kernel matrix, which solves the limitation that the linear feature selection can be only performed. Secondly, it constructs the similarity matrix for the data feature to perform the local structure learning, it can improve the classification accuracy. Low rank constraints can eliminate noise interference. Finally we use l_1 -norm of a vector for feature selection. Because this paper considers the nonlinear relationship and similarity between data features at the same time, it has better effect than the single linear feature selection method. The experimental results show that the algorithm can achieve better results in classification accuracy.

The algorithm proposed in this paper has the following advantages:

(1) Since the general feature selection algorithm can only find the linear relationship between data features, it cannot find the nonlinear relationship between data features. Therefore, the algorithm maps each feature of the data matrix to a kernel matrix through the kernel function, so as to fully exploit the complex nonlinear relationship between the data features in the kernel space. Furthermore, the relationship between data features is more thoroughly explored.

(2) Different from ordinary local structure learning, it only calculates the optimal result of the similarity relationship between samples. Our algorithm is aimed at data features, and the similar matrix learning and low-dimensional space learning are alternated to achieve the optimal feature selection effect.

(3) Low rank constraints can significantly reduce the amount of computation, while low rank characterizes the degree of data redundancy. Noise samples increase the rank of the coefficient matrix, and low rank constraints can reduce noise interference, while low rank is a consideration of the global structure of the data. It can improve the operating efficiency and classification accuracy of the algorithm.

OUR METHOD

In this section, we first introduce the symbols used in this article and then explain our proposed LSK FS algorithm, in Sections 2.1 and 2.2, respectively, and then elaborate the proposed optimization method in Section 2.3.

2.1 Notations

For the data matrix $X \in \mathbf{R}^{n \times d}$, the i -th row and the j -th column are denoted as X^i and X_j respectively, and the elements of the i -th row and the j -th column are denoted as $x_{i,j}$. The trace of the matrix X is denoted by $\text{tr}(X)$, X^T denotes the transpose of the matrix X , and X^{-1} represents the inverse of the matrix X .

2.2 LSK FS Algorithm

Suppose a given sample data set $X \in \mathbf{R}^{n \times d}$, where n and d represent the number of samples and the number of attributes, respectively. This paper first breaks the data set $X \in \mathbf{R}^{n \times d}$ into d column vectors, each vector $x_i \in \mathbf{R}^{n \times 1}$, $i = 1, \dots, d$. Then it treats each element in each x_i as an independent feature value $x_{ij} \in \mathbf{R}$, $j = 1, \dots, n$. And projects them into the kernel space to get the kernel matrix $\mathbf{K}^{(i)} \in \mathbf{R}^{n \times n}$, namely:

$$\mathbf{K}^{(i)} = \begin{bmatrix} k(x_{i1}, x_{i1}) & k(x_{i1}, x_{i2}) & \dots & k(x_{i1}, x_{in}) \\ k(x_{i2}, x_{i1}) & k(x_{i2}, x_{i2}) & \dots & k(x_{i2}, x_{in}) \\ \dots & \dots & \dots & \dots \\ k(x_{in}, x_{i1}) & k(x_{in}, x_{i2}) & \dots & k(x_{in}, x_{in}) \end{bmatrix} \quad (1)$$

Thus the original $X \in \mathbf{R}^{n \times d}$ becomes d kernel matrix.

The unsupervised feature selection algorithm mainly mines more representative features in the data. In the absence of the class label Y , using the data matrix X as a response matrix, the internal structure of the original features of the data can be better preserved (Almusallam *et al.*, 2018; Xue *et al.*, 2016). In order to fully exploit the nonlinear relationship of data features. Get the following expression:

$$X = \sum_{i=1}^d \alpha_i \mathbf{K}^{(i)} \mathbf{W} \quad (2)$$

Where: $\mathbf{W} \in \mathbf{R}^{n \times d}$ represents the kernel coefficient matrix; $\alpha \in \mathbf{R}^{d \times 1}$ is used to perform feature selection, which is equivalent to the weight vector of the feature; α_i is an element of the vector α ; $\mathbf{K}^{(i)} \in \mathbf{R}^{n \times n}$ is the kernel matrix.

Predecessors have proved that the local structure between data can be used to reduce the dimension (Liu *et al.*, 2017), so this paper makes local structure learning by establishing a similarity matrix between data features in low-dimensional space. The following formula is obtained through local structure learning:

$$\min \sum_{i,j}^d \|x_i^T \mathbf{W} - x_j^T \mathbf{W}\|_2^2 s_{i,j} \quad (3)$$

Where $x_i \in \mathbf{R}^{n \times 1}$ represents i -th feature. $\mathbf{W} \in \mathbf{R}^{n \times d}$ is the conversion matrix of high-dimensional data in low-dimensional space, $s_{i,j}$ is an element of matrix \mathbf{S} , indicating the similarity between feature x_i and feature x_j . If the feature x_i is the k -th nearest neighbor of the feature x_j , then the value $s_{i,j}$ is obtained by the Gaussian kernel function; otherwise =0. In order to make X get a better fitting effect, and consider the structural relationship between data features in low-dimensional space, we get the following formula:

$$\min_{\mathbf{S}, \mathbf{W}, \alpha} \left\| X - \sum_{i=1}^d \alpha_i \mathbf{K}^{(i)} \mathbf{W} \right\|_F^2 + \lambda_1 \sum_{i,j}^d \|x_i^T \mathbf{W} - x_j^T \mathbf{W}\|_2^2 s_{i,j} \quad (4)$$

Since the similarity matrix \mathbf{S} is particularly affected by the influence of parameters σ . In order to reduce the number of adjustment parameters, a more efficient similarity matrix is learned. In this paper, structural learning and low-dimensional space learning are alternated to achieve their optimal results. Specifically get the following formula:

$$\min_{\mathbf{S}, \mathbf{W}, \alpha} \left\| \mathbf{X} - \sum_{i=1}^d \alpha_i \mathbf{K}^{(i)} \mathbf{W} \right\|_F^2 + \lambda_1 \sum_{i,j}^d \left\| \mathbf{x}_i^T \mathbf{W} - \mathbf{x}_j^T \mathbf{W} \right\|_2^2 s_{i,j} + \lambda_2 \left\| \mathbf{s}_i \right\|_2^2 \quad (5)$$

$$s.t., \forall i, s_i^T \mathbf{1} = 1, s_{i,j} = 0, s_{i,j} \geq 0, \text{if } j \in N(i), \text{otherwise } 0$$

Among them, λ_1, λ_2 is the tuning parameter, s_i is the i -th column of the similar matrix \mathbf{S} , and $\left\| \mathbf{s}_i \right\|_2^2$ is used to avoid unimportant results. $\mathbf{1}$ represents a vector with all elements of 1. $N(i)$ represents a set of neighbors the i -th feature. In order to maintain rotation invariance, we set $s_i^T \mathbf{1} = 1$. Therefore, the above formula can make the value $s_{i,j}$ corresponding to the feature closer to the distance larger, and the value $s_{i,j}$ corresponding to the feature whose distance is farther is smaller.

In order to eliminate the interference of the outliers, the noise samples are removed at the same time (Wan *et al.*, 2018). This paper adds a low rank constraint to the matrix \mathbf{W} (Li *et al.*, 2017), namely:

$$\mathbf{W} = \mathbf{A}\mathbf{B} \quad (6)$$

Among them, $\mathbf{A} \in \mathbf{R}^{n \times r}$, $\mathbf{B} \in \mathbf{R}^{r \times d}$, $r \leq \min(n, d)$, we also orthogonally limit the matrix \mathbf{A} , in order to fully consider the correlation between the output variables. We add a l_1 -norm of α for sparse learning and feature selection (Tsagris *et al.*, 2018). Finally we get our final objective function as follows:

$$\min_{\mathbf{S}, \mathbf{A}, \mathbf{B}, \alpha} \left\| \mathbf{X} - \sum_{i=1}^d \alpha_i \mathbf{K}^{(i)} \mathbf{A}\mathbf{B} \right\|_F^2 + \lambda_1 \sum_{i,j}^d \left\| \mathbf{x}_i^T \mathbf{A}\mathbf{B} - \mathbf{x}_j^T \mathbf{A}\mathbf{B} \right\|_2^2 s_{i,j} + \lambda_2 \left\| \mathbf{s}_i \right\|_2^2 + \lambda_3 \left\| \alpha \right\|_1 \quad (7)$$

$$s.t., \forall i, s_i^T \mathbf{1} = 1, s_{i,j} = 0,$$

$$s_{i,j} \geq 0, \text{if } j \in N(i), \text{otherwise } 0, \mathbf{A}^T \mathbf{A} = \mathbf{I}$$

Among them, $\mathbf{A}^T \mathbf{A} = \mathbf{I} \in \mathbf{R}^{r \times r}$, λ_1, λ_2 and λ_3 are the tuning parameter. The kernel matrix \mathbf{K} is calculated by the Gaussian kernel function, and its main function is to map the data to the kernel space, thereby mining the nonlinear relationship between the data features. The l_1 -norm of the last item α is used to sparse the features for feature selection. If the value of the element corresponding to the vector α is zero, it means that the feature is not selected.

2.3 Optimization

Since the objective function is not co-convex, the closed solution cannot be directly obtained. Therefore, this paper proposes an alternate iterative optimization method to solve the problem, which is divided into the following four steps:

Update \mathbf{A} by fixing \mathbf{S} , α and \mathbf{B} :

When \mathbf{S} , α and \mathbf{B} are fixed, the optimization (7) problem becomes:

$$\min_{\mathbf{A}} \left\| \mathbf{X} - \sum_{i=1}^d \alpha_i \mathbf{K}^{(i)} \mathbf{A}\mathbf{B} \right\|_F^2 + \lambda_1 \sum_{i,j}^d \left\| \mathbf{x}_i^T \mathbf{A}\mathbf{B} - \mathbf{x}_j^T \mathbf{A}\mathbf{B} \right\|_2^2 s_{i,j} \quad (8)$$

$$s.t., \mathbf{A}^T \mathbf{A} = \mathbf{I}$$

We make $\mathbf{P} = \sum_{i=1}^d \alpha_i \mathbf{K}^{(i)}$, then the (8) formula can be transformed into:

$$\min_{\mathbf{A}} \left\| \mathbf{X} - \mathbf{P}\mathbf{A}\mathbf{B} \right\|_F^2 + \lambda_1 \sum_{i,j}^d \left\| \mathbf{x}_i^T \mathbf{A}\mathbf{B} - \mathbf{x}_j^T \mathbf{A}\mathbf{B} \right\|_2^2 s_{i,j} \quad (9)$$

$$s.t., \mathbf{A}^T \mathbf{A} = \mathbf{I}$$

We simplify the (9), we have:

$$\min_{\mathbf{A}} \text{tr}(\mathbf{X}^T \mathbf{X} - \mathbf{X}^T \mathbf{P}\mathbf{A}\mathbf{B} - \mathbf{B}^T \mathbf{A}^T \mathbf{P}^T \mathbf{X} + \mathbf{B}^T \mathbf{A}^T \mathbf{P}^T \mathbf{P}\mathbf{A}\mathbf{B}) + \lambda_1 \text{tr}(\mathbf{B}^T \mathbf{A}^T \mathbf{X} \mathbf{L} \mathbf{X}^T \mathbf{A}\mathbf{B}), s.t., \mathbf{A}^T \mathbf{A} = \mathbf{I} \quad (10)$$

Where $\text{tr}(\cdot)$ represents the trace of matrix, $\mathbf{L} = \mathbf{Q} - \mathbf{S} \in \mathbf{R}^{d \times d}$ is a Laplace matrix, \mathbf{Q} is a diagonal matrix, and the elements of each column are $q_{i,i} = \sum_{j=1}^d s_{i,j}$. Deriving for \mathbf{A} , we have:

$$2\lambda_1 \mathbf{X} \mathbf{L} \mathbf{X}^T \mathbf{A} \mathbf{B} \mathbf{B}^T - 2\mathbf{P}^T \mathbf{X} \mathbf{B}^T + 2\mathbf{P}^T \mathbf{P} \mathbf{A} \mathbf{B} \mathbf{B}^T \quad (11)$$

Due to the orthogonality of \mathbf{A} , we can optimize it by the method in (Zhao H *et al.*, 2016).

Update \mathbf{B} by fixing \mathbf{S} , α and \mathbf{A}

By fixing \mathbf{S} , α and \mathbf{A} , the objective function (7) can be simplified as follows:

$$\min_{\mathbf{B}} \left\| \mathbf{X} - \sum_{i=1}^d \alpha_i \mathbf{K}^{(i)} \mathbf{AB} \right\|_F^2 + \lambda_1 \sum_{i,j}^d \|x_i^T \mathbf{AB} - x_j^T \mathbf{AB}\|_2^2 s_{i,j} \quad (12)$$

It is easy to get (12) is equivalent to the following formula:

$$\begin{aligned} \min_{\mathbf{B}} & \text{tr}(\mathbf{X}^T \mathbf{X} - \mathbf{X}^T \mathbf{PAB} - \mathbf{B}^T \mathbf{A}^T \mathbf{P}^T \mathbf{X} + \mathbf{B}^T \mathbf{A}^T \mathbf{P}^T \mathbf{PAB}) \\ & + \lambda_1 \text{tr}(\mathbf{B}^T \mathbf{A}^T \mathbf{XLX}^T \mathbf{AB}) \end{aligned} \quad (13)$$

When we ask for \mathbf{B} and let its derivative be zero, we can get:

$$\mathbf{B} = (\mathbf{A}^T \mathbf{P}^T \mathbf{PA} + \lambda_1 \mathbf{A}^T \mathbf{XLX}^T \mathbf{A})^{-1} \mathbf{A}^T \mathbf{P}^T \mathbf{X} \quad (14)$$

Update \mathbf{S} by fixing \mathbf{A} , α and \mathbf{B}

After fixing \mathbf{A} , α and \mathbf{B} , the objective function (7) becomes:

$$\begin{aligned} \min_{\mathbf{S}} & \lambda_1 \sum_{i,j}^d \|x_i^T \mathbf{AB} - x_j^T \mathbf{AB}\|_2^2 s_{i,j} + \lambda_2 \|\mathbf{s}_i\|_2^2 \\ \text{s.t.}, & \forall i, s_i^T \mathbf{1} = 1, s_{i,j} = 0, \\ & s_{i,j} \geq 0, \text{ if } j \in N(i), \text{ otherwise } 0 \end{aligned} \quad (15)$$

We first calculate the Euclidean distance between every two data features to construct the neighbors of all the features. If the j -th feature does not belong to the nearest neighbor of the i -th feature, then the value of $s_{i,j}$ is zero; otherwise, the value of $s_{i,j}$ is solved by equation (18).

At the same time, optimizing \mathbf{S} is equivalent to optimizing each $s_i (i=1, \dots, d)$ individually, so we further translate the optimization problem into the following equation:

$$\min_{s_i^T \mathbf{1} = 1, s_{i,j} = 0, s_{i,j} \geq 0} \sum_{i,j}^d (\lambda_1 \|x_i^T \mathbf{AB} - x_j^T \mathbf{AB}\|_2^2 s_{i,j} + \lambda_2 s_{i,j}^2) \quad (16)$$

Here, $\mathbf{Z} \in \mathbf{R}^{d \times d}$, in which $\mathbf{Z}_{i,j} = \lambda_1 \|x_i^T \mathbf{AB} - x_j^T \mathbf{AB}\|_2^2$, such (16) further becomes:

$$\min_{s_i^T \mathbf{1} = 1, s_{i,j} = 0, s_{i,j} \geq 0} \left\| s_i + \frac{\lambda_1}{2\lambda_2} \mathbf{Z}_i \right\|_2^2 \quad (17)$$

Under KKT conditions, we can get the following:

$$s_{i,j} = \left(-\frac{\lambda_1}{2\lambda_2} \mathbf{Z}_{i,j} + \tau \right)_+ \quad (18)$$

Since each data feature has a neighbor, we sort each $\mathbf{Z}_i (i=1, \dots, d)$ in descending order, that is $\hat{\mathbf{Z}}_i = \{\hat{\mathbf{Z}}_{i,1}, \dots, \hat{\mathbf{Z}}_{i,d}\}$, we know: $s_{i,k+1} = 0$, $s_{i,k} > 0$. We have:

$$-\frac{\lambda_1}{2\lambda_2} \hat{\mathbf{Z}}_{i,k+1} + \tau \leq 0 \quad (19)$$

Under the conditions $s_i^T \mathbf{1} = 1$, we can get:

$$\sum_{j=1}^k \left(\frac{\lambda_1}{2\lambda_2} \hat{\mathbf{Z}}_{i,k} + \tau \right) = 1 \Rightarrow \tau = \frac{1}{k} + \frac{\lambda_1}{2k\lambda_2} \sum_{j=1}^k \hat{\mathbf{Z}}_{i,k} \quad (20)$$

Update α by fixing \mathbf{A} , \mathbf{B} and \mathbf{S}

After fixing \mathbf{A} , \mathbf{B} and \mathbf{S} , the objective function (7) becomes:

$$\min_{\alpha} \left\| \mathbf{X} - \sum_{i=1}^d \alpha_i \mathbf{K}^{(i)} \mathbf{AB} \right\|_F^2 + \lambda_3 \|\alpha\| \quad (21)$$

In order to optimize the next step, here is the simplification of the above formula, namely:

$$\begin{aligned} & \Leftrightarrow \min_{\alpha} \left\| \mathbf{X} - (\alpha_1 \mathbf{K}^{(1)} \mathbf{AB} + \dots + \alpha_d \mathbf{K}^{(d)} \mathbf{AB}) \right\|_F^2 + \lambda_3 \|\alpha\| \\ & \stackrel{\mathbf{Q}^{(i)} = \mathbf{K}^{(i)} \mathbf{AB} \in \mathbf{R}^{d \times d}}{\Leftrightarrow} \min_{\alpha} \left\| \mathbf{X} - (\alpha_1 \mathbf{Q}^{(1)} + \dots + \alpha_d \mathbf{Q}^{(d)}) \right\|_F^2 + \lambda_3 \|\alpha\| \\ & \Leftrightarrow \min_{\alpha} \sum_{i=1}^d \left\| \mathbf{X}_i - (\alpha_1 q_{i,1}^{(1)} + \dots + \alpha_d q_{i,d}^{(d)}) \right\|_2^2 + \lambda_3 \|\alpha\| \end{aligned} \quad (22)$$

We set $\mathbf{M}^{(i)} = \begin{pmatrix} q_{i,1}^{(1)} & q_{i,d}^{(1)} \\ \vdots & \vdots \\ q_{i,1}^{(d)} & q_{i,d}^{(d)} \end{pmatrix} \in \mathbf{R}^{d \times d}$ and have:

$$\begin{aligned}
&\Leftrightarrow \min_{\alpha} \sum_{i=1}^n \|X_i - \alpha^T M^{(i)}\|_2^2 + \lambda_3 \|\alpha\| \\
&\Leftrightarrow \min_{\alpha} \sum_{i=1}^n \|X_i^T - (M^{(i)})^T \alpha\|_2^2 + \lambda_3 \|\alpha\| \\
&\Leftrightarrow \min_{\alpha} \sum_{i=1}^n X_i X_i^T - 2\alpha^T \sum_{i=1}^n M^{(i)} X_i^T \\
&\quad + \alpha^T \sum_{i=1}^n (M^{(i)} (M^{(i)})^T) \alpha + \lambda_3 \|\alpha\|
\end{aligned} \tag{23}$$

The above simplification is only for the convenience of the following gradient descent (Wang *et al.*, 2016). We make:

$$\begin{aligned}
f(\alpha) &= \left\| X - \sum_{i=1}^d \alpha_i K^{(i)} AB \right\|_F^2 \\
F(\alpha) &= f(\alpha) + \lambda_3 \|\alpha\|
\end{aligned} \tag{24}$$

Note that $\|\alpha\|$ is convex but not smooth. So using approximate gradient to optimize α , we can update iterations α by the following rules.

$$\alpha_{t+1} = \arg \min_{\alpha} G_{\eta_t}(\alpha, \alpha_t) \tag{25}$$

$$G_{\eta_t}(\alpha, \alpha_t) = f(\alpha_t) + \langle \nabla f(\alpha_t), \alpha - \alpha_t \rangle + \frac{\eta_t}{2} \|\alpha - \alpha_t\|^2 + \lambda_3 \|\alpha\| \tag{26}$$

In the above formula, $\nabla f(\alpha_t) = 2\alpha_t^T \sum_{i=1}^n (M^{(i)} (M^{(i)})^T) - 2 \sum_{i=1}^n X_i (M^{(i)})^T$, η_t is a tuning parameter, α_t is the value of α in the t -th iteration.

By ignoring the independence in equation (26), we can get:

$$\alpha_{t+1} = \pi_{\eta_t}(\alpha_t) = \arg \min_{\alpha} \frac{1}{2} \|\alpha - U_t\|_F^2 + \frac{\lambda_3}{\eta_t} \|\alpha\| \tag{27}$$

Among them $U_t = \alpha_t - \frac{1}{\eta_t} \nabla f(\alpha_t)$, $\pi_{\eta_t}(\alpha_t)$ is the Euclidean projection on the convex set η_t , because $\|\alpha\|$ has a separable form, the formula (27) can be written as follows:

$$\alpha_{t+1}^i = \arg \min_{\alpha^i} \frac{1}{2} \|\alpha^i - U_t^i\|_2^2 + \frac{\lambda_3}{\eta_t} |\alpha^i| \tag{28}$$

Where α^i and α_{t+1}^i are the i -th elements of α and α_{t+1} respectively, then according to formula (28), α_{t+1}^i can obtain the following closed solution:

$$\alpha^i = \begin{cases} u_t^i - \frac{\lambda_3}{\eta_t} \times \text{sign}(u_t^i), & \text{if } \|u_t^i\| > \frac{\lambda_3}{\eta_t} \\ 0, & \text{otherwise.} \end{cases} \tag{29}$$

To speed up the approximate gradient algorithm in equation (26), we have added auxiliary variables:

$$V_{t+1} = \alpha_t + \frac{\beta_t - 1}{\beta_{t+1}} (\alpha_{t+1} - \alpha_t) \tag{30}$$

Where $\beta_{t+1} = \frac{1 + \sqrt{1 + 4\beta_t^2}}{2}$.

EXPERIMENTS

In this part, we arrange the proposed algorithm and the comparison algorithm in the same environment for experiment, and classify the data after the algorithm is reduced by SVM. Finally, the validity and performance of the feature selection algorithm are measured according to the classification accuracy.

3.1 Experiment Settings

We tested our proposed unsupervised feature selection algorithm on four binary data sets and eight multi-class data sets. They are Yale, Colon, Lung_discrete, Glass, SPECTF, Sonar, Clean, Arrhythmia, Movements, Ecoli, Urban_land and Forest, where the first three data sets are from feature selection data, and the last nine data sets are from the UCI data set. The details of the data set are shown in Table 1:

Table1: The information of the data sets

Datasets	Samples	Dimensions	Classes
Glass	214	9	6
Movements	360	90	15
SPECTF	267	44	2
Ecoli	336	343	8
Sonar	208	60	2

Urban_land	168	147	9
Clean	476	167	2
Forest	325	27	4
Arrhythmia	452	279	13
Colon	62	2000	2
Yale	165	1024	15
Lungdiscrete	73	325	7

At the same time, we found eight representative feature selection comparison algorithms to compare with our proposed algorithm. The main introduction of the algorithm is as follows:

EUFS (Wang *et al.*, 2015): It directly embeds the unsupervised feature selection algorithm into the clustering algorithm through sparse learning, which is an embedded feature selection algorithm. It applies the $l_{2,1}$ -norm to the cost function to reduce the impact of reconstructed data matrices and feature selection on V .

FSASL (Du L and Shen Y D, 2015): By classifying the previous unsupervised feature selection algorithm, a novel learning framework is proposed, which is an unsupervised feature selection algorithm for adaptive structure learning, which combines structure learning and feature learning. Finally, the experiment also shows that the algorithm is very effective.

NDFS (Li *et al.*, 2012): The algorithm makes the algorithm select more representative features through the cluster learning and feature selection matrix of the class label. In order to learn more accurate clustering labels, it performs non-negative constraints. The $l_{2,1}$ -norm is also added to remove the effects of redundant features and noise.

NetFS (Li *et al.*, 2016): Embedding a principle method into the representation learning from network structure learning to feature selection is a robust unsupervised feature selection algorithm. The algorithm uses an alternate optimization algorithm to optimize itself and validate its performance through realistic data representation.

RLSR (Chen *et al.*, 2017): The algorithm is a novel semi-supervised feature selection algorithm that evaluates the importance of features by performing a least squares regression by re-adjusting the regression coefficients with a set of scale factors. At the same time, the $l_{2,1}$ -norm was added. The model not only performs global learning, but also performs sparse learning.

RFS (Nie *et al.*, 2010): The algorithm is an efficient and robust feature selection algorithm that applies the $l_{2,1}$ -norm to both the loss function and the regularization term. It can regularize sparsely all data to select more representative features. The algorithm performs better in genomic and proteomic biology and can perform good biological information learning tasks.

RSR (Zhu *et al.*, 2015): The algorithm is an unsupervised feature selection algorithm for self-characterization learning. Each feature is linearly combined by other features, and the $l_{2,1}$ -norm is applied to the coefficient matrix and the residual matrix. It effectively selects features and ensures robustness to outliers. If a feature is important, it will participate in the representation of most other features, resulting in a series of important representation coefficients, and vice versa.

K_OFSD (Zhou *et al.*, 2017): This article defines the online stream feature selection problem of class imbalance data, and proposes an online feature selection framework. The algorithm is based on the dependency between conditional features and decision-making classes, while refining the neighborhood rough set theory and using a fixed number of nearest neighbors of the selected features to solve the class imbalance problem.

In our proposed model, we set $\{\lambda_1, \lambda_2\} \in \{10^{-4}, \dots, 10^8\}$, the rank of the kernel coefficient matrix $r \in \{1, \dots, \min(n, d)\}$, and the parameter of $l_{2,p}$ -norm $p \in \{0.1, \dots, 1.9\}$. The parameters $c \in \{2^{-5}, \dots, 2^5\}$ and $g \in \{2^{-5}, \dots, 2^5\}$ are used to select the best SVM for classification. Through 10-fold cross-validation, we divide the data set into a training set and a test set. In order to minimize the experimental error, we perform 10 times and 10 folds, and finally find the average of the classification accuracy.

Since the experiment uses the classification accuracy rate to measure the performance of the algorithm, we define the classification accuracy as follows:

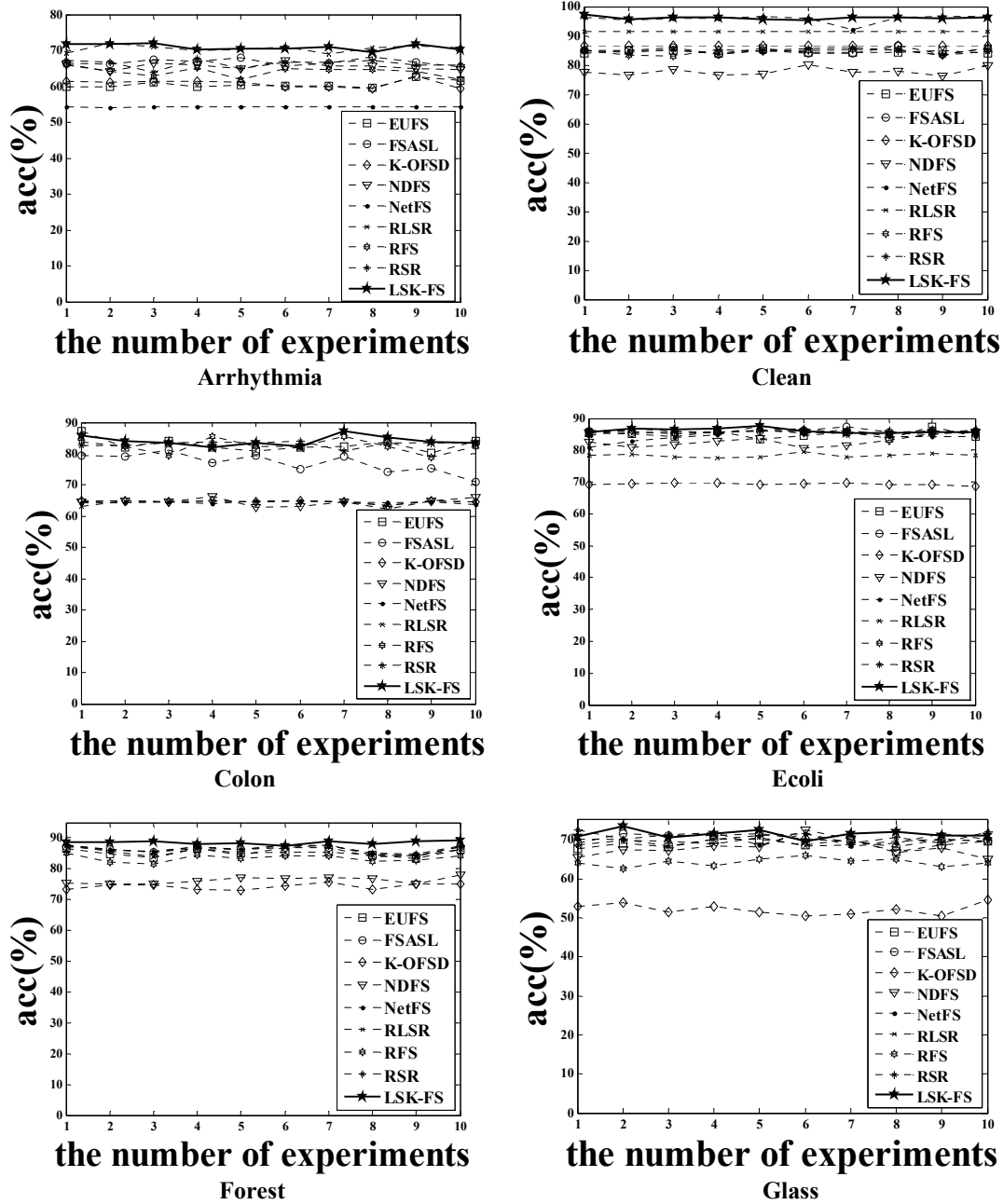
$$acc = X_{correct} / X \quad (31)$$

Where X represents the total number of samples and $X_{correct}$ represents the correct number of samples for classification. At the same time we define the standard deviation to measure the stability of our algorithm, as follows:

$$std = \sqrt{\frac{1}{N} \sum_{i=1}^N (acc_i - \mu)^2} \quad (32)$$

Where N represents the number of experiments, acc_i represents the classification accuracy of the i -th experiment, μ represents the average classification accuracy, and the smaller the std, the more stable the representative algorithm.

3.2 Experiment Results and Analysis



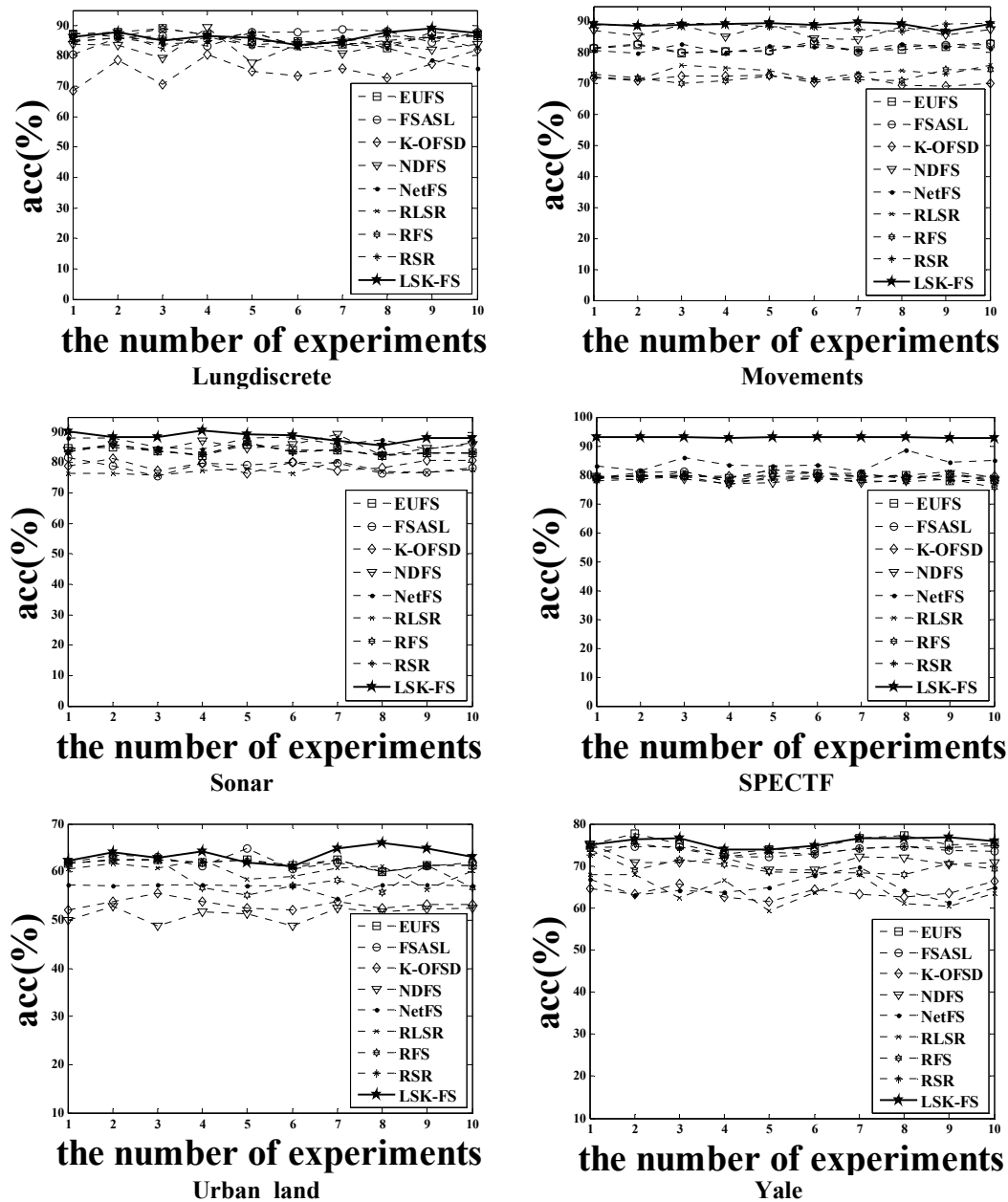


Fig 1 : Average classification accuracy of all methods for all datasets

In Figure 1, we can clearly see the classification accuracy of the 10 experiments. The algorithm we proposed is not the highest every time, but most of the cases are the highest. In Table 2, we can see the average classification accuracy of each algorithm on 12 data sets. The algorithm proposed by us is obviously superior to other comparison algorithms. Specifically, it is 4.78% higher than EUFS in average classification accuracy and 5.05% higher than FSASL, which indicates that our algorithm is better than the general feature selection algorithm. Compared with K_OFSD, NDFS, NetFS, RLSR, RFS, and RSR, LSK_FS increased 13.63%, 8.55%, 6.69%, 7.88%, 6.68%, and 3.59%, respectively. In particular, our algorithm is particularly effective on the dataset SPECTF.

Table2: Average classification accuracy (acc(%))

Datasets	EUFS	FSASL	K_OFSD	NDFS	NetFS	RLSR	RFS	RSR	LSK_FS
Arrhythmia	60.52	66.71	60.74	65.57	54.20	70.53	64.02	66.33	70.96
Clean	84.61	84.83	86.53	77.82	95.78	91.53	84.64	84.77	96.13
Colon	82.88	77.07	64.60	64.43	64.38	64.42	82.48	83.17	84.14
Ecoli	84.97	86.01	69.28	82.81	84.47	78.31	85.74	85.81	86.19

Forest	85.23	86.06	74.23	76.31	86.43	85.78	83.50	86.55	88.50
Glass	68.90	70.17	52.09	67.86	70.20	69.36	64.17	70.42	71.38
Lungdiscrete	86.11	86.07	75.45	82.77	73.41	84.43	85.88	85.55	86.41
Movements	81.36	81.61	71.19	86.61	81.42	73.58	72.08	88.61	88.92
Sonar	83.81	78.67	79.11	85.43	86.66	77.26	83.91	83.91	88.48
SPECTF	79.54	79.70	79.40	78.48	83.95	79.22	78.04	79.54	92.94
Urban_land	61.78	62.05	53.25	51.27	56.96	60.20	58.82	61.72	63.56
Yale	75.27	73.69	63.78	71.22	65.04	64.05	69.76	73.81	75.63
Average value	77.92	77.72	69.14	74.22	76.08	74.89	76.09	79.18	82.77

In Table 3, we can see the average standard deviation of each algorithm on 12 data sets. The standard deviation of the proposed LSK_FS algorithm is the smallest, indicating that our algorithm has the best stability.

Table3: Standard deviation of classification accuracy (std(%))

Datasets	EUFS	FSASL	K_OFSD	NDFS	NetFS	RLSR	RFS	RSR	LSK_FS
Arrhythmia	0.88	0.85	1.04	0.89	0.02	0.85	1.29	1.09	0.79
Clean	0.54	0.94	0.03	1.29	1.32	0.03	0.97	0.74	0.49
Colon	1.88	2.99	0.38	1.31	0.29	0.59	2.08	0.93	1.5
Ecoli	1.18	0.47	0.30	1.59	1.78	0.55	0.40	0.82	0.69
Forest	1.05	1.05	0.93	1.05	1.06	1.29	1.16	0.99	0.54
Glass	1.05	1.02	1.37	2.07	1.15	0.70	1.00	1.29	1.01
Lungdiscrete	1.92	2.52	4.07	3.03	3.43	1.82	1.67	1.21	1.60
Movements	1.04	1.31	1.33	1.76	1.06	1.65	1.44	0.80	0.72
Sonar	1.18	1.81	1.62	1.85	1.45	1.19	1.28	1.28	1.38
SPECTF	1.01	1.24	0.03	1.20	2.08	1.10	1.11	1.01	0.04
Urban_land	0.77	1.38	1.01	1.44	0.88	1.69	2.74	0.83	1.41
Yale	1.44	0.95	1.4	1.71	2.28	3.16	1.74	0.99	1.08
Average value	1.16	1.38	1.13	1.60	1.40	1.22	1.41	1.00	0.94

The LSK_FS algorithm can achieve such good results, mainly for the following two reasons: 1. Consider the similarity between data features. 2. Fully consider the nonlinear relationship between data features.

CONCLUSION

In this paper, a new unsupervised nonlinear feature selection algorithm is proposed by considering the similarity and nonlinear relationship between data features. That is, the local structure learning is used to find the similarity between the features, then the kernel method is used to find the nonlinear relationship between the data features, and finally the feature selection is performed by the sparse regularization factor. Low rank constraints have also been added to the model to better refine the proposed model. More significant mining results than the general feature selection algorithm. The experimental results show that the proposed algorithm has achieved great improvement in classification accuracy and stability. In the future work, we attempt to combine more advanced theoretical improvement algorithms.

ACKNOWLEDGMENTS

This work is partially supported by the China Key Research Program (Grant No: 2016YFB1000905); the Key Program of the National Natural Science Foundation of China (Grant No: 61836016); the Natural Science Foundation of China (Grants No: 61876046, 61573270, 81701780 and 61672177); the Project of Guangxi Science and Technology (GuiKeAD17195062); the Guangxi Natural Science Foundation (Grant No: 2015GXNSFCB139011, 2017GXNSFBA198221); the Guangxi Collaborative Innovation Center of Multi-Source Information Integration and Intelligent Processing; the Guangxi High Institutions Program of Introducing 100 High-Level Overseas Talents; and the Research Fund of Guangxi Key Lab of Multisource Information Mining and Security (18-A-01-01).

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Why Do Customers Buy Products on Social Commerce Platform? A Study from Affordance Theory

(Full Paper)

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ABSTRACT

This study examines the influence mechanism of the factors of influencing live streaming shopping which is a new social commerce mode for customer purchase based on the affordance theory. Our research examines how visibility affordance, metavoicing affordance and guidance shopping affordance which are three main affordances in live streaming shopping influence the customers' purchase intention. The results show that visibility affordance, metavoicing affordance and guidance shopping affordance will positively impact customer purchase intention. And our research is of great help in live streaming shopping research in social commerce research field. Also, our research provides some advices for social commerce operators.

Keywords: Affordance theory, visibility, metavoicing, guidance shopping, purchase intention.

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INTRODUCTION

Live streaming shopping as a new social commerce mode has made rapid development. According to the 2017 China online live streaming performance development reports, the overall revenue of China's online live performance market reached 30.45 billion yuan in 2017, up 39% from 218.5 billion yuan in 2016. E-commerce platforms and social commerce platforms quickly followed the trend of live streaming, and Alibaba, JuMeiyouping, Vipshop, MoGuji and other e-commerce platforms of all sizes have devoted themselves to this field, which led to the birth of the live streaming shopping. Different from other live streaming, streamers can introduce products to customers in live streaming shopping and streamers can interact with customers in real time about products and promote their purchase. Live streaming has become one of the important ways for customers to shopping on social commerce platforms. So, it's important to understand what factors influence customers' shopping behavior in live streaming shopping.

Purchasing as one of the most important user's behaviors, there are a lot of studies have investigated the factors influencing customers' purchase intention. But there are few studies have investigated why customer purchase in live streaming shopping. Yu et al. (2018) found customer engagement had positive impacts on customers to purchase virtual gifts in live streaming. What's more, Yu et al. (2018) thought because interaction in live streaming is in real time, previous researches can't explain why customer purchase in live streaming. Based on this point, we think previous researches can't completely explain customers buy products in live streaming shopping because it realizes the real time interaction and customers can see the sellers in live streaming shopping. And some studies have indicated that affordance can explain why customer buy products on social commerce platforms (Dong & Wang, 2018; Lin et al., 2018). However, why customer like purchasing on live streaming, and if the affordance of social commerce has some impact on customers' purchase intention in the context of live streaming shopping are unknown.

To fill up the gap, our research takes visibility affordance, metavoicing affordance, and guidance shopping affordance as IT affordance in live streaming shopping based on previous research (Dong & Wang, 2018), to explain why customer purchase products by live streaming shopping. Our research will provide a new view in studying live streaming and enrich social commerce research.

THEORETICAL FRAMEWORK

Affordances Lens

Different research fields have different definitions of affordance. In the field of information system, affordance is defined as "the possibility that an object provides an individual to realize a certain behavior" (Volkoff et al., 2013). In the social media field, affordance refers to "the potential of behaviors that constitute the interaction between users and social media" (Cabiddu, Carlo, & Piccoli, 2014). In social commerce, Dong, Wang, and Benbasat (2016) define the affordance as the possibility that information technology helps customer purchase, and our study adopt this concept.

The characteristics of affordance may vary depending on the use and context (Koroleva & Kane, 2017). And the theory of

affordance has been widely used to better understand the relationship between information technology and social practice (Treem & Leonardi, 2012). Affordance has been widely studied in social media researches (Argyris & Monu, 2015; Treem & Leonardi, 2012), but is few in social commerce. Koroleva and Kane (2017) research the relational affordance under the context of Facebook. Lin et al. (2018) thought that the affordance of social commerce includes interactivity, stickiness and word of mouth, and the affordance of social commerce would have a positive impact on swift guanxi which is positively associated with the customers' purchase intentions through swift guanxi. Dong and Wang (2018) researched how visibility affordance, metavoicing affordance, triggered attending affordance, guidance shopping affordance, social connecting affordance and trading affordance in social commerce platform build strong ties and weak ties between customers and sellers. While as a new social commerce mode, which affordance impact customer behavior in live streaming shopping is unknown.

In our research, the visibility affordance, metavoicing affordance and guidance shopping affordance are adopted as IT (IT in social commerce) affordances. Dong et al. (2016) thought that visibility affordance meets the consumer's motivation approaching the product but not to do some works when they take part in social commerce activities, and the technical ability required by visibility affordance is to list the related attributes of the product. In social commerce, the sellers can send pictures which contain the related attributes of the product to customers. Dong et al. (2016) believes that metavoicing affordance can meet the consumer's needs to acquire useful product information, and the technology required is communicating tools. In social commerce, the customers can communicate with sellers by the live chat room (Lv, Jin, & Huang, 2018), and also can comment on the product reviews section. What shopping guide affordance satisfies is that customers can obtain more satisfied products through not too much efforts to find, and the required technical expenditure is to provide personalized service to customers (Dong et al., 2016). In social commerce, the seller will introduce product information to guide customers to buy, and guide customers to buy through live chat tools (for example, AliTM of Taobao.com). So, based on the background of social commerce and previous studies, we believe that the affordance in the context of live streaming in social commerce includes visibility affordance, metavoicing affordance and guidance shopping affordance (Dong et al., 2016). Visibility affordance is about the possibility letting customers know about that the product is visible; metavoicing affordance refers to the possibility for customers to respond to product content; Shopping guidance affordance refers to the possibility of helping customers make purchasing decisions by providing personalized service (Dong et al., 2016). We believe that visibility affordance, metavoicing affordance, guidance shopping affordance as a kind of affordance, customers will be exposed to them when taking part in online shopping activities. So, in our research, we take visibility affordance, metavoicing affordance and guidance shopping affordance as external factors in live streaming shopping.

Customer Purchase Intention

Customer purchase decisions are one of the most important indicators in online shopping (Hu et al., 2016). In social commerce, purchase intention is the most important indicator of customers' consumption decisions. Han, Xu, and Chen (2018) classified and summarized 407 articles on social commerce and found that 199 papers which cover 48.9% of past studies studied customer behavior. In some researches, purchase behavior was taken as the customers' response to shopping environment in social commerce (Zhang & Benyoucef, 2016). Because live streaming shopping is a new mode in social commerce, we think purchase intention is also an important indicator of customer behavior in live streaming shopping based on the previous researches.

Live Streaming

Recent researches on live streaming mainly focus on user motivations, factors influencing users' use of live broadcasting, and user behaviors. To know what motivations of users using live streaming is important in researching the new research field. Sjöblom and Hamari (2017) classified six users' motivations to watch others who play video games through live streaming. Chen and Lin (2018) found the entertainment factors is the main factors influencing the users usage intention, and also found the users would watch different streamers between different genders. Hilvert-Bruce et al. (2018) classified eight user motivations to watch live streaming. Based on previous researches about using live streaming motivations, we can find customers use the live streaming is mainly because utilitarian motivations, hedonic motivations and social motivations. Different other studies researching user's motivations in using live streaming, Zhao et al. (2018) researched why streamers use the live streaming from the intrinsic motivations and extrinsic motivations perspective. About influencing factors and users behavior in live streaming researches, Yu et al. (2018) investigated the impact of viewer engagement on gift giving behavior. But what factors impact customers engagement is known. Liking other types of social commerce, customer engagement is important for the performance of live streaming shopping. To fill up this gap, Wongkitrungrueng and Assarut (2018) researched how live streaming help customer engage in live streaming shopping from the Perceived value perspective. Live streaming shopping is different from other live streaming, customers behavior on live streaming shopping is shopping which like in social commerce. Wongkitrungrueng and Assarut (2018) only researched why customers engage in live streaming shopping, but customers may don't purchase products even they engage in live streaming shopping. From this perspective, what factors influence customer's purchase intention is still unknown after they engage in live streaming shopping. This research studies what factors impact customer purchase intention in live streaming shopping from the affordance perspective to fill the gap.

The online social commerce context is complex, and previous explanations about why customer purchase products on social commerce platforms may not be applicable in live streaming shopping. Based on the above discussion, we can find the affordance theory has been used to study customers' behavior in social commerce (Dong & Wang, 2018; Lin et al., 2018). Live

streaming shopping as one of the modes of social commerce, we think the affordance theory is also can be used in this context. And because what factors influence customer purchase is unknown, we explain why customers purchase products in live streaming shopping from the affordance perspective.

HYPOTHESIS

Visibility affordance takes the product become visible to customers (Dong et al., 2016). Customers can use the tools in social commerce to visualize the products displayed by sellers in social commerce. Visibility affordance enables sellers to pass pictures and information of products to customers to reducing perceived risks and product uncertainties (Dong & Wang, 2018). And the seller can display the product information to the customer via social commerce tools such as live chat rooms or other communication tools to reduce the customer's purchase uncertainty and perceived risk, and reduce the customer's purchase resistance (Chung, Song, & Lee, 2017), which will positively impact customer purchase in live streaming shopping. What's more, because of the visibility affordance, other people's comments and ratings which customers can learn from social commerce sites are visual. And the comments and ratings have a positive impact on customer purchase by influencing customer's cognitive appraisals (Chen, Lu, & Wang, 2017). In addition, visual attraction plays a positive role in promoting the perceived enjoyment of customers, which also plays a positive role in customer purchase (Xiang et al., 2016). So, we hypothesize that:

H1: Visibility affordance has a positive effect on customer purchase intention in live streaming shopping.

In social commerce, the metavoicing affordance enables the efficient communication between customers and sellers and customers can provide feedback on products (Dong & Wang, 2018). Metavoicing affordance integrates personal voice and feedback into the communication between sellers and customers and improves the interaction between customers and sellers (Dong & Wang, 2018). In live streaming shopping, based on the acquisition of product information, customers will seek information about products from sellers. Customers who have questions about the product can ask the sellers directly through live chat room (Lv et al., 2018). And they also can ask questions which are about the products they want to buy to other customers. The sellers can directly answer the customer's questions and introduce the product in the form of voice and can send videos or picture so that the customer can accept the information they searched. Thus, it reduces the perception of uncertainty and shopping resistance which have negative impacts on customer purchase. In addition, the metavoicing affordance promotes the use of interactive tools such as comment tool, rating tool and live chat room. So, there is a strong interaction between customers and sellers in live streaming shopping. The interaction plays a positive role in promoting customer purchase (Alalwan, 2018). So, we hypothesize that:

H2: Metavoicing affordance has a positive effect on customer purchase intention in live streaming shopping.

Guidance shopping affordance can help customer make purchasing decisions by providing personalized service (Dong et al., 2016). With product recommendation technology, guidance shopping affordance helps the seller to explicitly or implicitly obtain individual consumers' interests or preferences related to the product and then provide product recommendations that match the interests or preferences expressed by the consumer (Xiao & Benbasat, 2011). The sellers can directly provide customers with information about the products they need. And guidance shopping affordance helps buyers solve problems by providing personalized services (Dong & Wang, 2018). What's more, customers also can directly ask for help from sellers for product purchase and sellers can provide relevant helps based on the basis of real-time interaction and personalized needs of customers (Lv et al., 2018), which can reduce customer resistance. Based on the guidance shopping affordance and real-time interaction, sellers can provide customers with information that matches their needs, which is conducive to creating useful information for customers, and thus helping customer purchase. So, we hypothesize that:

H3: Guidance shopping affordance has a positive effect on the customer purchase intention in live streaming shopping.

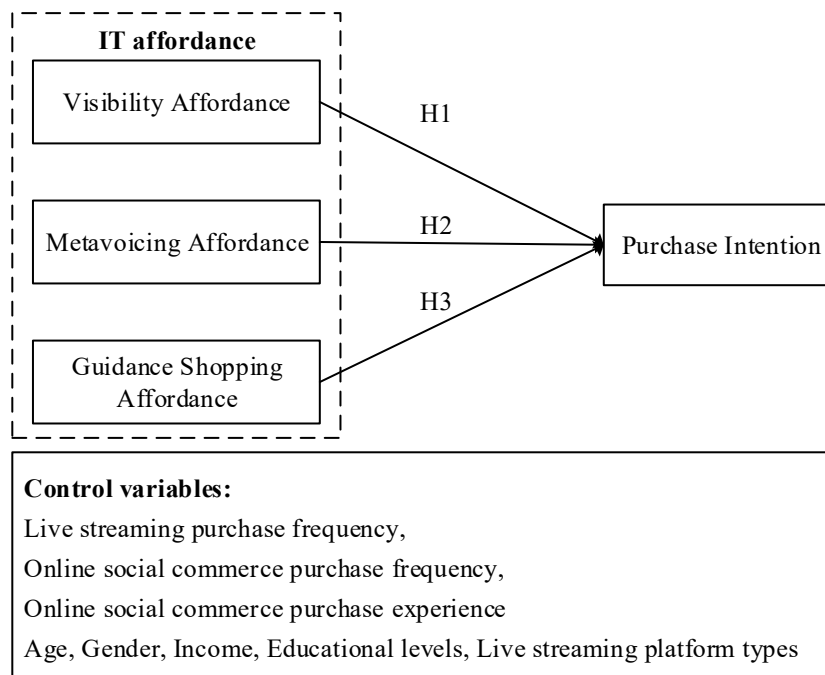


Figure 1: The Concept Model

METHODOLOGY

Measurements

By referring to existing literatures, we developed a questionnaire to measure our model. Visibility affordance, metavoicing affordance and guidance shopping affordance were adopted from Dong and Wang (2018), purchase intention was adopted from Chen et al. (2017). And we measure all the items using 7-point scales from 1 (strongly disagree) to 7 (strongly agree). Because the data was collected in China, an English questionnaire was prepared based on the existing literature, and then translated it into Chinese, followed by the guidance of relevant experts, and finally translated it into English to determine whether there was translation deviation.

Data Collection

Our questionnaire was distributed on an online survey website (<https://www.wjx.cn/>) and 510 valid questionnaires was collected. About the respondent demographics in this study, there were 313 women, which accounted for 61.37%. There were 197 men, which accounted for 38.63%. There were 198 respondents aged 30-39, which accounted for 38.82%. 357 respondents were bachelor, which accounted for 70%. About respondent experience, most respondents purchase 1-3 times a month through live streaming shopping (n=348, 68.23%). And most respondents buy 4-6 times a month in social commerce platforms (n=175, 34.31%).

DATA ANALYSIS AND RESULTS

We use the SmartPLS and SPSS to test our measurement model and structural model. The PLS and SPSS has been adopted by many researchers (Chen et al., 2017; Ou, Pavlou, & Davison, 2014), and are effective in data analysis.

Measurement Model

Before measuring the model, we first test common method bias (CMB) and multicollinearity. About the CMB, we use the Harman's single factor method to test, the result shows that 36.46% in our research, which indicates that the influence of CMB is slight. About the multicollinearity, we take the VIF as the indicator to test. Table 1 shows the VIF in our model is below 3.3, which indicates that there is not multicollinearity problems in our research (Ou et al., 2014).

Table 1: VIF, loadings and cross-loadings

Constructs	Items	VIF	GS	ME	PUI	VI
GS	GS1	1.39	0.74	0.40	0.36	0.37
	GS2	1.42	0.74	0.34	0.35	0.36
	GS3	1.50	0.79	0.38	0.42	0.39
	GS4	1.44	0.76	0.40	0.37	0.41
ME	ME1	1.57	0.36	0.70	0.24	0.43
	ME2	1.55	0.34	0.73	0.30	0.46
	ME4	1.54	0.38	0.75	0.28	0.39

	ME5	1.41	0.34	0.72	0.32	0.30
	ME6	1.49	0.43	0.77	0.35	0.40
PUI	PUI1	1.54	0.39	0.29	0.81	0.39
	PUI2	1.94	0.45	0.38	0.88	0.47
	PUI3	1.71	0.41	0.36	0.83	0.42
VI	VI1	1.83	0.42	0.49	0.44	0.84
	VI2	1.56	0.38	0.40	0.42	0.79
	VI3	1.57	0.38	0.42	0.38	0.77
	VI4	1.50	0.41	0.38	0.35	0.74

Note: VI: Visibility, ME: Metavoicing, GS: Guidance Shopping, PUI: Purchase Intention.

We adopt Cronbach's alpha and composite reliability (CR) to test the reliability. Table 2 shows the Cronbach's alphas are from 0.75 to 0.79 and composite reliability is from 0.84 to 0.88. All the reliability values exceed the recommended values 0.7 (Fornell & Larcker, 1981), which shows that the reliability of our model is satisfied.

We adopt AVE to test the convergent validity, and adopt square root of AVEs and comparing the loadings and cross loadings to test the discriminant validity. Firstly, table 2 shows the values of AVE is from 0.54 to 0.71, which indicates that the convergent validity is satisfied (MacKenzie, Podsakoff, & Podsakoff, 2011). Secondly, table 2 shows that all the values of square root of AVEs exceed the corresponding construct correlations. And table 1 shows that each variables' loadings exceed cross loadings on other variables. Both the two methods show that the discriminant validity is satisfied in our research.

Table2: Cronbach's Alpha, Composite Reliability, AVE, and correlations

Constructs	Cronbach's Alpha	Composite Reliability	AVE	GS	ME	PUI	VI
GS	0.75	0.84	0.57	0.76			
ME	0.79	0.85	0.54	0.50	0.73		
PUI	0.79	0.88	0.71	0.49	0.41	0.84	
VI	0.79	0.87	0.62	0.51	0.54	0.51	0.79

Note: VI: Visibility, ME: Metavoicing, GS: Guidance Shopping, PUI: Purchase Intention.

Structural Model

We use the PLS to estimate our structural model. we bootstrap 5000 times to obtain a stable results, and the results are shown in Figure 2. The R^2 of purchase intention is 0.39, which indicates that visibility affordance, metavoicing affordance and guidance shopping affordance can explain why customer purchase products in shopping live streaming is credible. The path of visibility affordance to purchase intention is 0.29, and is significant on the 0.001 level ($p < 0.001$), which indicates that H1 is supported. The path of metavoicing affordance to purchase intention is 0.10, and is significant on the level of 0.05 ($p < 0.05$), which indicates that H2 is supported. The path of guidance shopping affordance to purchase intention is 0.24, and is also significant on the level of 0.001 ($p < 0.001$), which shows that the H3 is supported. The results shows that IT affordance can explain why customers liking purchase products on live streaming shopping which is a new mode of social commerce.

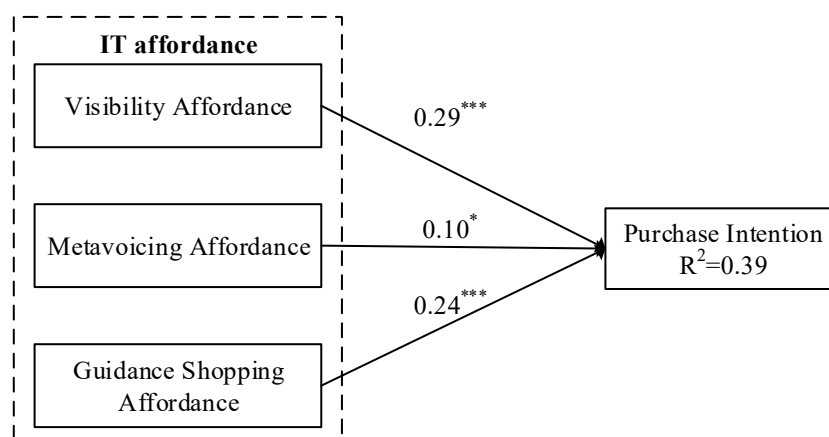


Figure 2: Hypotheses Testing Results (**p < 0.001, *p < 0.05).

DISCUSSION

Discussion of Findings

In our research, we find the visibility affordance, metavoicing affordance and guidance shopping affordance can positively impact on customer purchase. These results are in line with Dong and Wang (2018) who find visibility affordance, metavoicing

affordance and guidance shopping affordance can promote customer purchase by influencing interactivity and social ties. But different the research of Dong and Wang (2018), we find visibility affordance, metavoicing affordance and guidance shopping affordance can positively impact on customer behavior directly. In live streaming shopping, customer can see the real products based on the visibility affordance, which helps consumers perceived lower risk comparing traditional products presentations. In traditional products presentations such as pictures products presentation and words describing presentations can't show the real information of the products customers want to buy. It may pass false pictures to customers which lead to lower word-of-mouth for sellers, while the live streaming can solve the uncertainty based on the visibility affordance. Communicating tools are important in online shopping, the metavoicing affordance of live streaming shopping can help customers interact with each other and also can help customers communicate with sellers. One of the online shopping risk for customers is that they can't buy fitted products. But in live streaming shopping, sellers as streamers can guide customer purchase, which help customer buy the products fit their needs. These findings have important implications in theoretical and practical.

Theoretical Implications

Based on affordance theory, our study proposes a research model to study the factors influencing consumers' purchase intentions. The main theoretical implications include three points. First, our research is from the perspective of affordance to research, which is less used in the study of social commerce but an important in customers' purchase. Previous researches have researched social commerce based on the online social commerce platforms IT affordance (Dong & Wang, 2018; Dong et al., 2016), while our research introduce affordance theory to live streaming shopping. Future studies can further research other affordances in live streaming shopping and other types live streamings. Second, live streaming shopping promotes e-commerce to become social commerce and promote social media to become a new system combined with social factors and commerce factors. And as an new mode of social commerce, live streaming shopping has made a huge influence on social commerce. Our research pays attention to what factors impact on customer purchasing products by it, which inspires future studies research this new social commerce mode. And our research also provides some theoretical basis to future research for live streaming shopping.

Practical Implications

Our research also has some practical implications for social commerce operators. First, as a new mode in social commerce, live streaming shopping has become famous among customers. Social commerce operator should pay more attention to it and adopt this new mode in their selling. Second, our research find visibility affordance, metavoicing affordance and guidance shopping affordance are three important factors influencing customer purchasing. In social commerce practice, sellers should improve the website's ability of visibility which can reduce customer's perceived risk and uncertainty. And we find metavoicing affordance can positively impact on customer purchase. So, sellers also should improve the customers' communication efficiency on social commerce platforms. Meanwhile, Our research finds guidance shopping affordance can help customer purchase products fitted their needs and thus help them make purchase decisions. The sellers should improve their guidance ability.

RESEARCH LIMITATIONS

There are some limitations in our research. First, our research considers several platforms, but every platform is different between each other. For example, users of MoGuJie mostly are women, but other platforms are not. This difference may lead some errors to our research. Future research can pay attention to one platform or research the differences between different platforms' live streaming shopping. Second, our study only research affordance's directly impact on purchase behavior but doesn't consider customer's psychological state. SOR model holds that stimulus can impact customers response through influencing "Organism". But what is organism in our research is unknown. Future research can research the mechanism of how affordance impacts customer purchase.

ACKNOWLEDGEMENTS

This research was supported by a grant (Grant ID: 16YXYP01) from the Contemporary Business and Trade Research Center, and the Collaborative Innovation Center of Contemporary Business and Trade Circulation System Construction of Zhejiang Gongshang University, and by the National Natural Science Foundation of China under grant (Grant ID: 71772162/71302034).

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The Emerging of Smart Citizen Concept under Smart City Environment

(Work in Progress)

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ABSTRACT

This study proposed a new concept Smart Citizen under smart city environment that has not been noticed before. Smart city has introduced opportunities for improved citizen wellbeing through digitalization of many activities of our life. The information acquisition, shopping, life style tracking, and social life are all shifting from offline to online, which also creates many burdens in our life. Yet we know little about how the life process is being changed by this wave of new technology innovation. Most smart city research focused either on the technology infrastructure or the policy but neglect the most important element of the smart city is the person who lives in the city. A clear definition and examination of the role of citizens under the smart city environment would help us better cope with the technology. This study proposed a new concept smart citizen with four dimensions, followed by several relevant research questions of each dimension respectively. The four dimensions are (1) slacktivism and knowledge bubble, (2) personal digitalization, (3) virtual social relationship, and (4) digital life process burden. We expect to arouse discussions on how an individual under smart city environment shall respond to these four challenging perspectives.

Keywords: Smart city, smart citizen, knowledge bubble, personal digitalization, virtual community, consumer participation

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INTRODUCTION

Most previous studies on smart city treat the smart city as a macro system, which can be broadly classified into three streams (eg., Neirotti, *et al.* 2014; Nam and Pardo 2011), at the policy level, at the technology infrastructure level, and at the enterprise level. One stream investigated how the government develop policies of establishing smart city. The second stream focused on the technology supports of IT department. The last one paid more attention to enterprise innovation. However, limited studies were conducted on individual level, especially in the citizen's view, who are the basic elements of a city.

As we know, individual behavior has been hugely influenced by technology development, such as information technology, mobile internet, social media, electric business, wearable equipment and so on. Under the smart city environment, life of citizens is not the same as without smart devices before. We can easily get latest news of worldwide, the attendant is knowledge bubble filling up our time. We can track every action or step at all times, but sometimes feel bored with the one defined by numbers. We can contact immediately with anyone on the earth, while we might not talk with a neighbor for several years. We don't need sales people to buy everything online, yet we need to read reviews before and write reviews after consuming, that is, citizens assume responsibility for various work not belonging to themselves. Our life is not same as before, we get not only convenience but also concerns on every aspect. That is why we put forward the concept smart citizen, which should be defined, and the boundaries of smart citizens' life should be clarified.

There is a need for scientific research that explores the consuming behavior and decision mechanism of individual against the background of smart city. We brought up four dimensions of smart citizens, expecting to arouse discussion of how smart citizens' life changed and improve smart citizens' life.

SLACKTIVISM AND KNOWLEDGE BUBBLE

With the development of internet and mobile technology, we have access to the newest and widest information. We can almost "complete" everything on mobile phones: when reading a useful article on Quora, we click "favorite"; when discovering a nice event on Facebook, we click "interested"; when showing supports to a petition, we click "like" on Twitter... Actually, most people will not come back to read the article or participate in the event. After a click, the project seems to be completed. Critics suggest that participating in token support on social platforms may not necessarily lead to a higher likelihood of engaging in more substantial support for the cause in the future, which was named "slacktivism" (Morozov 2009). The moral license effect may explain that people feel they are doing something good to get a moral license, which result in undesirable impact on subsequent prosocial behavior (Khan and Dhar 2007; Kristofferson, White and Peloza 2013).

As we can see, slacktivism exists in our daily life besides prosocial behavior. We are faced not only convenience but also massive information beyond our processing ability. Cost of information seems negligible, while we cannot afford it like an overloading processor. With a click, our brain tells us we have learned the knowledge, we have done the activities, even helped others. Polanyi (1958) classified knowledge to tacit knowledge and explicit knowledge based on its transitivity and expressiveness. Knowledge can be diffused to others through two actions, transmission (more of explicit knowledge) and absorption (more of tacit knowledge)

(Davenport and Prusak 1998). Explicit knowledge can be easier to express and transmit in a large area, while tacit knowledge is formed and absorbed by oneself in specific context, more difficult to express and transmit (Dixon, 2000). Nonaka and Takeuchi (1995) proposed a dynamic theory of organizational knowledge creation including four transferring modes of tacit and explicit knowledge, that are socialization, externalization, combination and internalization. Internalization is the process from explicit knowledge to tacit knowledge, individuals internalize from system study and experience accumulation, which relates closely to action (Nonaka and Takeuchi 1995). Kakabadse *et al.* (2003) summarized a knowledge chain: data→ information→ cognition→ action→ wisdom. Without action, knowledge will not transform into wisdom. Dodd and White (1980) gave the three elements of cognition, refers information processing in certain psychology construct for certain purpose. Only with purpose, individual can make strategy and reaction based on reality, then knowledge can be activated and absorbed.

Overloading of information limits our time input to each task, the schedule is fragmented. We receive knowledge from multi resource without purpose, relevance, the explicit knowledge cannot be internalized and absorbed without action, which are facial and less efficient. We propose the learning mode is no longer through real action but only through thought, which is transmit faster and easier, but stay on surface layer. Just like speculating real estate, people create GDP through buying and selling properties without creating real value, called Real Estate Bubble. We think the underlying mechanism of slacktivism is knowledge separate from reality, that is the knowledge bubble. Across this context, a number of questions emerge:

- What is the relationship between practical action and slacktivity?
- Is slacktivism always undesirable for knowledge obtaining?
- How to solute the negative influence of knowledge bubble?
- How to define the knowledge boundary aligning with reality of smart citizens?

PERSONAL DIGITALIZATION

Increasing costs and concerns about health contributed to consumers' pursuit of healthy lifestyles, which has been supported by the quantified self-movement. With the emergence and promotion of smart Apps such as Nike +, FitBit, as well as corresponding wearable quantified equipment, more and more consumers are involved in quantifying themselves, monitoring their activities and health status (Haddadi *et al.* 2015). Digital technology and quantified equipment help consumers collect data of daily activity and physiological status, which guide them understand and improve their behavior about health, ecology, work and consume. The health apps record our steps, exercise and calories consuming (Moore and Robinson 2016). The efficiency apps record our working time and entertaining time. We can sign the location when we travel to a scenic spot or a famous restaurant. Every individual can be defined by the quantitative data of location, recordings. The age of quantified self driven by data is coming (Etkin 2016).

However, the progress of digitalization technology goes further beyond our understanding of consumer's reaction to quantified self. Almalki, Gray and Martin-Sanchez (2016) defined the concept of quantified self, individuals use quantified equipment to collect, manage, reflect themselves, so as to better understand their health condition and behavior, and better interact with environment. Self tracking may arouse self cognition of individuals and influence their attitude and behavior (Marcengo and Rapp 2014). Cadsby, Song and Tapon (2007) found external incentive promote individuals' performance in quantified activity. Spence, *et al.* (2009) further pointed out merely quantification without external incentive will stimulate better performance through highlighting value of activity. The factors of quantified self effect still need exploration and empirical research.

Based on the intrinsic motivation theory, when individuals participate in an activity for some incentive besides task accomplishment, their behavior are driven by external motivation; while participate for some characteristic of task, they are driven by internal motivation (Remedios, Ritchie and Lieberman 2005). The internal motivation higher, the more happiness and interest individuals will feel. The related ego/task involvement explored motivation from individual themselves. Decharms (1968) found that task-orientation instruction will guide participants to pay attention to task itself and more devoted, while ego-orienting instruction drags their attention to evaluation of outside world and feel less autonomy and more pressure from task. As personal digitalization will help us and others evaluate our performance, we wonder if it will externalize our internal motivation and let down the achievement. According to goal setting theory (Butler 1988), the type of goal (mastery goal vs. performance goal), clarity of goal (clear goal vs. ambiguous goal) and difficulty of goal (easy vs. challenging) of the quantified activity will influence our goal accomplishment and performance. We propose it depends on the gap between goal and reality, self efficiency and self esteem. Research questions may include the following:

- Does personal digitalization results in external or internal incentive? Will digitalization activity externalize the internal motivation and reduce happiness?
- Will personal digitalization contribute to goal completing?
- How to set appropriate goals for personal digitalization?
- Will personal digitalization result in happiness? We may find some boundary conditions such as activity type, when the activity is desirable, digitalization itself may decrease the original happiness.

VIRTUAL SOCIAL RELATIONSHIP

Instant chatting and video call applications allow us communicating anytime and anywhere. We don't have to meet each other

face to face. It seems that virtual social reduces the distance between citizens. Most researchers are of the opinion that virtual communities offer better functions and values than real communities (Li 2004). Etzioni and Etzioni (1999) argued that virtual communities provide, sometimes better, functions of real communities, particularly in social relationship building. By investigating members in a chat room, Coon (1998) was among the first to suggest that virtual communities resemble real communities and that people can form communal relationship through computer-mediated communication (CMC) on the Internet. Fox and Roberts (1999) also supported that the existence of virtual community in a medical practitioner electronic forum and further suggested that virtual communities should be the extension of real communities instead of completely replacing them. Bakardjieva (2003) pointed out that virtual communities could satisfy people's various everyday-life needs.

On the other hand, as virtual social taking more of our life, even occupying the time of talking with the people around us, the distance between citizens seems to become further. Anderson (2000) argued that virtual communities decrease people's real social interactions and are detrimental to people's relationship building in real life. We propose the link strength moderate the influence of virtual social on distance, that is the distance between weak link individuals become closer, while between strong link individuals become further. Smart citizens' social behavior in virtual and real communities ought to be discussed under smart city environment, giving rise to the following questions:

- Does the psychology distance between citizens become closer or further under smart city environment?
- What influences the psychology distance between smart citizens?
- How to balance the virtual social and practical social?
- How to break invisible walls between smart citizens in practical community?

DIGITAL LIFE PROCESS BURDEN

Smart cities make it possible for consumers to serve themselves, which are the responsibilities of officers or service people before. Citizens can deal with application online, consumers can shop and pay online, or shop offline and pay through the self check-out. Our city is getting flatter and much more efficient with consumers' participation. Consumer participation is the involvement in service producing and delivering, including passively involved in service or initiatively cooperation (Dabholkar 1990). Bettencourt (1997) supported that consumer participation was positively correlated with perceived service quality because of their own efforts.

But conflict exists in the relation of consumer participation and satisfaction, Bendapudi and Leone (2003) pointed out that self-serving bias would influence consumers' satisfaction attribution, they might attribute good result to themselves while bad results to others. In smart cities, citizens may not volunteer to participate service but have no choice with less human service. How to increase citizens' participation willingness and satisfaction is to be considered. At the same time, we have to spend more time on general affairs not belonging to us, which bring us additional burden and disturb our own duties. Many studies pay attention to alignment between IT system and business strategy (Chan and Reich 2007), however alignment between city plan and individual life process has not been discussed seriously. Research questions may include the following:

- How to increase citizens' participation willingness in city service?
- How can we increase their perceived autonomy and satisfaction?
- How to reach alignment between city plan and individual life process so as not to bring extra burden to citizens?

In the future, we are interested in the influence of individual behavior on smart city building. What kind of individual personalities or activities will contribute to smart city forming? How to promote consumers to use the facilities, products with smart attributes?

ACKNOWLEDGEMENT

This work was supported by the National Natural Science Foundation of China [grant numbers 71472104, 71772104]; Tsinghua University Initiative Scientific Research Program (20151080390).

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An Economic Analysis of Incentivized Positive Reviews

(Work in Progress)

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ABSTRACT

It becomes increasingly popular that some large online retailers such as Amazon open their platforms to allow third-party retail competitors to sell on their own platforms. We develop an analytical model to examine this retailer marketplace model and its business impact. We assume that a leading retailer has both valuation advantage that may come from its reputation and information advantage that may come from its brand awareness. We find that the availability of relatively low-cost advertising through social media or search engine can effectively reduce the leading retailer's information advantage, and thus be an important driving force for its strategic decision to open its platform. Not only does the advertising option directly make small sellers more visible to consumers, but also incentivizes the online retailer to open its platform and dramatically increases small sellers' exposure, indirectly contributing to an even more prominent long tail phenomenon in e-commerce.

Keywords: Positive reviews, electronic commerce, cash-back rebate, pricing decision.

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INTRODUCTION

Online reviews have been well documented as an important information source that affects consumers' purchase decisions (Zhu and Zhang, 2010; eMarketer, 2017). To encourage consumers to post reviews online, firms often provide various incentives. For example, after a consumer shops at Home Depot, the consumer is often invited to write reviews with the promise that he/she will have a chance to draw a lottery for some prize (e.g., an iPad). Over the last couple of years, a new approach has emerged on Taobao.com, the leading online trading platform in China: Many sellers offer consumers mail-in rebates after purchase, but the rebates can be redeemed only if the consumers post positive reviews online. This "rebate-for-positive-reviews" strategy is different from the typical "rebate-for-reviews" strategy because in some sense sellers bribe buyers for positive reviews rather than simply expanding the review pool using monetary incentives. In this paper, we aim to understand under what conditions sellers should optimally choose this "rebate-for-positive-reviews" strategy and how such a strategy affects buyers' purchase decisions and social welfare.

On the one hand, the motivation for such a strategy is rather clear. For example, prior studies show that one extra star in a Yelp review could increase revenues by 5–9% (Economist, 2015), which explains why restaurants often seek fake acclaim, offering customers discounts in exchange for positive reviews on social networking sites and other online platforms. On the other hand, offering rebate incurs cost for sellers. Therefore, it may not always be profitable to pursue such a strategy. Although poor ratings and reviews affect a seller's reputation and sales, favorable product price can mitigate these negative effects. The recent Better Business Bureau trust sentiment index report shows that roughly one in three consumers says they would still purchase from a business that has poor ratings or reviews if the price is right. Therefore, it is not immediately clear whether a strategic seller should provide monetary incentive to boost its positive reviews, increase consumers' perceived value of its product, and thus charge a price premium, or it should offer price discount to attract more consumers. This study aims to understand how a strategic seller should trade off the rebate incentive and product pricing to maximize its profit.

We develop an analytical model to study the strategic seller's rebate and pricing strategies. The seller first announces the product price and simultaneously decides whether to offer buyers a redeemable, mail-in rebate if they post positive reviews. Then, consumers make their purchase decisions based on the online review information, and buyers make their review posting decisions as well as rebate redemption decisions if they receive the mail-in rebate. Consumers have heterogeneous valuation of the product. Online reviews affect their perceived product valuation. Consumers who have purchased the product incur a cost to post online reviews. They enjoy satisfaction by sharing their true shopping experiences and suffer from a moral cost if they post fake reviews. We analyze the equilibrium rebate and price offered by the seller and the equilibrium online review volume and its effect on sales.

We find that offering rebate conditional on positive reviews plays a dual role in eliciting online reviews. It not only induces unsatisfied consumers to "lie" online, but also motivates more satisfied consumers to share their true experiences. The overall effect of reviews is an increased perceived valuation from the consumers. However, our analysis shows that the "rebate-for-positive-reviews" strategy is not always optimal. The seller's optimal rebate and pricing strategy critically depends on the cost of

posting review and the moral cost of posting fake reviews online. When the review-posting cost is low but the moral cost is high, a seller should not provide rebate to elicit positive reviews, because satisfied buyers are likely to post positive reviews anyway (due to low review-posting cost) and unsatisfied buyers are too costly to be induced to write fake reviews (due to high moral cost). The seller offers a relatively low price to attract customers. In contrast, we identify three scenarios where “rebate-for-positive-reviews” strategy is profitable. When both the review-posting cost and the moral cost are low, the seller should optimally provide a small rebate to encourage more satisfied customers to post reviews and incentivize some unsatisfied customers to provide positive reviews. The additional positive reviews increase consumers' valuation of the product and thus their willingness to pay, which enables the seller to charge a price premium from consumers. When the review-posting cost is high but the moral cost is low, the seller offers a large rebate to both compensate consumers for posting reviews and encourage them to provide positive reviews. Again, the increased positive reviews enable the seller to charge a price premium. Finally, when both the review-posting cost and the moral cost are high, the seller provides a moderate rebate, which is just enough to encourage more satisfied consumers to post positive reviews, while the unsatisfied consumers would not be interested in posting fake reviews and redeeming the rebate. In general, moral cost is more salient than the review-posting cost in determining the seller's optimal rebate and pricing decisions. The smaller the moral cost, the larger the rebate, the larger the price premium, and the higher the profit.

Not surprisingly, as the rebate increases, the online review volume increases. Its effect on sales, however, is unclear. This is because the seller can adjust its product price to influence market share, which may increase or decrease depending on the price levels. The social welfare effect of the “rebate-for-positive-reviews” strategy is also mixed. Comparing with the no-rebate benchmark, consumers who redeem the rebate are better off whereas other buyers are worse off. The overall consumer surplus and social welfare thus depend on the equilibrium rebate and price levels.

Model

We consider an online seller selling a product to a unit of potential consumers. As in (Lal and Sarvary, 1999), we distinguish two types of product attributes—digital attributes and non-digital attributes. Digital attributes refer to the attributes that can be easily communicated to and assessed by consumers via the Internet. Non-digital attributes refer to those that are difficult to evaluate online. For instance, size and color of a product are examples of digital attributes, and how well the product fits a consumer's specific setting can be an example of non-digital attributes (e.g., whether a cloth fits a consumer's figure or whether a dish caters the consumer's taste). Similar to that in (Lal and Sarvary, 1999), a consumer's valuation of the product is determined by both the digital attributes and non-digital attributes in an additive form. In particular, we denote x as the part of valuation determined by digital attributes and y as the part of valuation determined by non-digital attributes. We assume that a consumer's valuation of the product is $x + ry$, where r represents the relative importance between the two types of attributes.

Consumers are generally heterogeneous in their valuation. We assume that before purchase consumers learn their own digital-attribute valuation x , where x is drawn from a uniform distribution over $[0,1]$. In contrast, before purchase consumers do not know their non-digital attribute valuation y or its distribution, although they may have some expectation of it based on available information such as online reviews. For ease of exposition, we assume that ex post y can be either high or low—consumers derive a high value if the product can fit their needs well; otherwise, they derive a low value. We normalize the low value to 0 and high value to be 1.

As a result, consumers are either satisfied or unsatisfied after their purchase. We assume consumers are equally likely to be satisfied or unsatisfied; in other word, they are equally likely to derive high or low value from the non-digital attributes. Satisfied consumers may post positive reviews about the product, and unsatisfied consumers may post negative reviews, depending on the review-posting benefit and cost. Note that one reason for leaving reviews is that consumers have the desire to help others. We assume that, on the one hand, consumers derive value v from sharing their true opinions, where v satisfies a uniform distribution over $[0,1]$. On the other hand, posting a review takes time and effort, which incurs some cost, denoted as c . Without additional incentive, whether a consumer posts reviews depends on this sharing value and posting cost. We assume that $c < 1$ to ensure that at least some consumers post reviews.

To motivate more consumers to post reviews, the seller may provide monetary incentive. As a common practice on Taobao.com, the seller may offer a mail-in rebate s to each purchased consumer who posts positive reviews online. Note that the rebate is conditional on a consumer posting positive reviews. While the monetary incentive naturally motivates more satisfied consumers to share their opinion (i.e., providing positive reviews), the effect of this incentive on unsatisfied consumers is more nuanced. When unsatisfied consumers post positive reviews, not only do they fail to derive the value v resulting from sharing their true opinions, but also they suffer from lying. We assume that the unsatisfied consumers incur a moral cost m if they post positive reviews.

We denote p as the product price charged by the seller. Because product price p affects the total number of buyers and the rebate s affects the review-posting behavior of the purchased consumers, the numbers of consumers who post positive reviews, negative

reviews, and no reviews are functions of p and s , denote as $n \times g(p, s)$, $n \times b(p, s)$ and $n \times o(p, s)$, respectively. Since online reviews affect consumers' perceived nondigital-attribute value, we denote it as $E(y | p, s)$. Consumers whose expected utility $U(p, s) = x + rE(y | p, s) - p \geq 0$ purchase the product. The seller's expected profit is thus

$$\Pi(p, s) = (p - s)ng(p, s) + p[nb(p, s) + no(p, s)].$$

Because the rebate affects the reviews and the reviews in turn influence consumers' purchase decisions, we focus on the stationary equilibrium where the outcome of the consumers' review posting decisions is consistent with that when formulating consumers' expected valuation. The timing is as follows. First, the seller chooses its product price p and mail-in rebate s , and announces the price p (but not s , since s is unobservable at the time of purchase). Then, consumers make purchase decisions based on the perceived expected valuation. Finally, consumers make their review posting decisions, based on the rebate s and the realized value from the non-digital attributes.

Discussion and Conclusions

In general, the “rebate-for-positive-reviews” strategy results in manipulated ratings and biased online reviews, which may mislead consumers and significantly undermine the trust that consumers and the vast majority of sellers place on the retail platform. Our analysis shows that such a strategy does seem attractive for strategic sellers, at the expense of harming consumers and reducing social welfare, especially when the cost of posting review is high. Strategic sellers may purposely make it tedious and hard to post online reviews, discouraging consumers to share with others. Our finding helps explain the reason why some e-commerce platforms ban such practice. It is also worthwhile to fight against this practice using legal tools (e.g., Amazon has fought fakes with lawsuits).

However, our results also show that it is not always beneficial for the seller to pursue such a strategy. When the review-posting cost is low but the moral cost is high, the seller would be better off by offering a low product price. Since the review-posting cost is already low in the Internet era, the moral cost becomes an important factor influencing the health of the online community. The higher the moral standard of the consumers, the harder and less profitable the strategic seller would pursue such a strategy. Overall, this study helps e-commerce platforms, as well as government regulators, to better understand the business impact of the strategic online review manipulation.

ACKNOWLEDGMENT

This work is partially supported by grant NSFC No. 71371089, 71771114.

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Applying AHP to Comprehend the Factors Influencing Consumer Attention to Sponsored Ads by YouTubers

(Work in Progress)

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ABSTRACT

Several YouTubers have become an important channel for ad spending, as an influential part of the internet celebrity economy. Thus, this paper has presented a two-stage integrated hierarchical structure of evaluation for analyzing the evaluation factors of user attention to a sponsored ad by a YouTuber. That is, we use the AHP method analyze the key factors that influence the success of sponsored ads by YouTubers in attracting users. Specifically, “C1.3 Attractive Contents”, “C6.4 Curious”, and “C4.2 Personality” were the three highest key factors in the priority of evaluation factors of consumers’ attention to a sponsored ad by a YouTuber.

Keywords: social media, analytic hierarchy process, sponsored Ads, YouTube.

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INTRODUCTION

Social media has grown explosively over the last decade, and another burst of expansion is in full swing involving some digital streaming media. Social media refers to any website that provides a network of people with a virtual space to make connections. That is to say, social media is all about making a personal connection between audience and brand. YouTube is one of the most popular social media websites. According to Alexa Internet, a web traffic analysis company, one billion hours of content are watched on YouTube every day and it is currently ranked as the second most popular website in the world. Users not only want to build connections with other persons but also establish themselves as authorities on YouTube. Thus, a YouTuber is a kind of internet celebrity who has gained popularity through the video-sharing website, YouTube.

In the modern age where the volume of new information explodes every minute, we have to admit a truth: customers’ trust in ads is falling ever lower. Most people only trust recommendations from people they themselves know or trust. Hence, it is crucial to develop the strategy of influencer marketing. Several YouTubers have become an important channel for ad spending, as an influential part of the internet celebrity economy. Significantly, some YouTubers have corporate sponsors, who pay for product placement within videos instead of a separate online ad. This impacts on what audiences buy and think. Therefore, to find the key factors of sponsored ads by YouTubers that influence consumers’ attention has become a necessary and important subject of research. Existing research on social media sellout indicates that YouTubers are regarded as opinion leaders. They also cooperate with brand sponsors to advance products on YouTube (Schwemmer & Ziewiecki, 2018). On the other hand, users are indirectly and directly influenced by multiple criteria when purchasing products online. A study of users’ perceptions of YouTubers in Turkey shows that the factors of video perception, content sharing, and perceived benefit influence users’ purchase decisions (Gümüş, 2018). However, a substantial amount of research has focused on evaluating the effect of YouTube ads to discuss purchase intentions (Dehghani *et al.*, 2016). This ignores the problem and charm of the internet celebrity. Thus, it is necessary to include the specific characteristics of each YouTuber when considering the factors influencing consumer attention to sponsored ads by YouTubers.

Analytic Hierarchy Process (AHP) is a method to discover the key factors influencing a complex decision-making issue. In practice, the AHP method has been applied to numerous fields and aspects of daily life involving decision-making problems, including, for example, evaluating supply chain competitiveness, selecting appropriate software for particular engineering courses, risk management, sustainable construction in construction management, and so on (Verma & Singhal, 2018; Dorado *et al.*, 2014; Darko *et al.*, 2018). The current paper, taking account of the crucial role YouTubers play in providing entertainment and information to Millennials, seeks to focus on the key factors that influence users’ attention in viewing videos of sponsored ads on YouTube in Taiwan. That is, we use the AHP method analyze the key factors that influence the success of sponsored ads by YouTubers in attracting users. Section 2 discusses and summarizes the existing research about the AHP method and the idea of influencer marketing. Section 3 details the proposed hierarchical structure of evaluation for attention factors of consumers with regard to sponsored ads. Section 4 demonstrates the priority of key factors via the evaluation of weight. Finally, we discuss the findings and make some specific suggestions regarding sponsored ads.

LITERATURE REVIEW

Analytic Hierarchy Process

Among decision-making methods and studies, the Analytic Hierarchy Process (AHP) can be regarded as a classic decision-making method. This method can structuralize complex decision-making issues into a hierarchical evaluation model in which all elements

on each level are independent (Saaty, 1977). To ensure the consistency of various criteria, it provides goal weights, guidelines, and alternatives (Mahdavi *et al.*, 2008). The method proceeds by generating a pairwise comparison matrix through a quantitative data analysis to calculate an eigenvalue. Following this, the strength or weakness of each matrix is evaluated via the eigenvalue. This process has been widely applied in situations characterized by uncertainty such as setting priorities, predicting outcomes, risk assessment, conflict resolution, and so on. The AHP process is depicted in Figure 1.

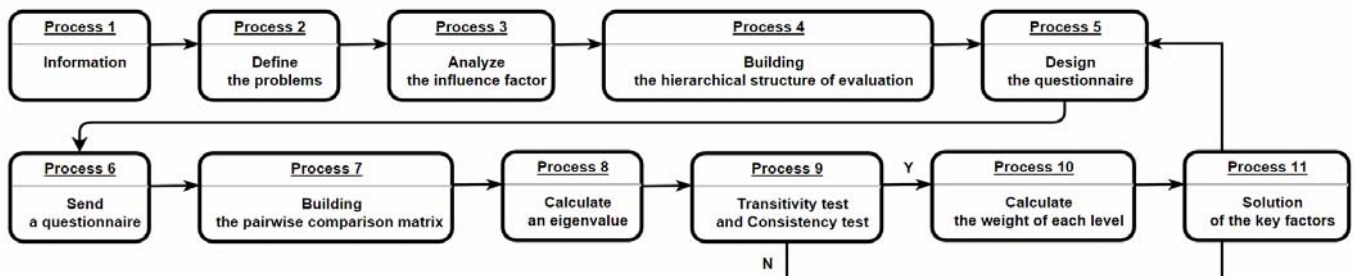


Figure 1: The AHP process

Influencer Marketing

The term “internet celebrity” could almost be called one of the most popular keywords of 2018, and influencer marketing is gradually becoming one of the most influential subjects in marketing today. The main tasks of influencer marketing are creating a relationship between a brand or product and potential customers through a key influencer (Brown & Hayes, 2008). In addition, it seeks to recommend brands and products to a wider audience through the public influence of internet celebrities. Influencer marketing has also become one of the internet marketing strategies most frequently used to promote product reputation in recent years. It goes without saying that any person with a fan base on the internet represents significant business opportunities. This is because customers prefer to trust opinions expressed on social media rather than information about the product obtained directly from a brand or company. Generally, influencer marketing consists of five steps, as shown in Figure 2.

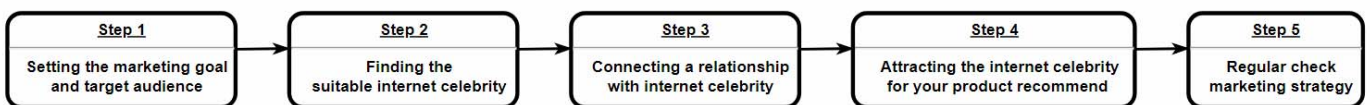


Figure 2: The Five Steps of Influencer Marketing

RESEARCH MODEL

In this section, based on related literature and the background of YouTubers, we apply AHP method to analyze the factors influencing the attention of consumers to YouTubers’ sponsored ads.

Selection of Dimensions and Factors

YouTube is a video-sharing website that offers users the opportunity to upload, view, comment on videos, subscribe to other users, and so on. Most of the content on YouTube is uploaded by individuals. In other words, YouTube caters to any form of user-generated video content, made available publicly or privately on that service. Thus, the quality of video content seems to be particularly important. On the other hand, to gain good publicity and improve product awareness, sponsors have begun to involve internet celebrities in product marketing. In view of these facts, considering the content and characteristics of videos, we classified user-concerned factors into six dimensions, namely, “D1. The Story”, “D2. Visual Experience”, “D3. Auditory Experience”, “D4. Role”, “D5. Image”, and “D6. Emotion”. Further, through expert consultation and background literature, we suggested 24 sub-factors under the 6 evaluation dimensions as shown in Table 1. As defined and explained below, the six evaluation dimensions measure how the video.

Define of Evaluation Dimensions

- D1. The Story: refers to users’ feeling a resonance with the content and plot of the video of the sponsored ad.
- D2. Visual Experience: refers to the users’ visual experience of watching video content of the sponsored ad.
- D3. Auditory Experience: refers to the users’ auditory experience of watching video content of the sponsored ad.
- D4. Role: refers to users’ feeling of resonance with the expression of characteristic roles in video content of a sponsored ad.
- D5. Image: refers to connection felt between users and brand through watching the video content of the sponsored ad.
- D6. Emotion: refers to users’ emotions generated by watching the video content of the sponsored ad.

Table 1: Definitions of Evaluation Factors and Sub-Factors

Dimension	Sub-Factors	Definition
D1. The Story	C1.1 Creative Contents	As for a customer, watching the video of the sponsored ad could redefine connections with people and promote thinking out of the box.
	C1.2 Topicality of Contents	As for a customer, watching the video of the sponsored ad could generate discussions in various areas.
	C1.3 Attractive Contents	As for a customer, watching the video of the sponsored ad could attract more users' attention.
	C1.4 Dramatic Content	As for a customer, watching the video of the sponsored ad could create the experience of a dramatic plot.
	C1.5 Novel Contents	As for a customer, watching the video of the sponsored ad could feel novel and unique.
	C1.6 Purpose of Contents	As for a customer, watching the video of the sponsored ad could express the goal of an ad.
D2. Visual Experience	C2.1 Colorful Color	As for a customer, watching the video of the sponsored ad could feel bright and full of contrast.
	C2.2 Special Effects	As for a customer, watching the video of the sponsored ad could feel true and not unexpected.
	C2.3 Textual Description	As for a customer, watching the video of the sponsored ad could express an idea or concept more clearly.
	C2.4 Length of Time	As for a customer, watching the video of the sponsored ad could successfully build in a connect to a customers' attention at a valid time.
	C2.5 Angle of Shot	As for a customer, watching the video of the sponsored ad could control a characteristic of the ad via the angle of shot.
D3. Auditory Experience	C3.1 Sound Effects	As for a customer, watching the video of the sponsored ad could give the experience of surround sound or sound of presence.
	C3.2 Special Language	As for a customer, watching the video of the sponsored ad could resonate from the heart, thanks to a special language, such as an aboriginal language.
	C3.3 Mood Music	As for a customer, watching the video of the sponsored ad could make a deeper impression via background music.
D4. Role	C4.1 Appearance	As for a customer, watching the video of the sponsored ad could showcase the appearance of a person who could attract users' attention.
	C4.2 Personality	As for a customer, watching the video of the sponsored ad could showcase a personality of role or a clear-cut stand.
	C4.3 Acting	As for a customer, watching the video of the sponsored ad could showcase natural, vivid expression, and sincerity of acting.
D5. Image	C5.1 Brand Relationship	As for a customer, watching the video of the sponsored ad could promote a connection between the brand and people.
	C5.2 Product Trust	As for a customer, watching the video of the sponsored ad could build trust towards the product.
D6. Emotion	C6.1 Pleasant	As for a customer, watching the video of the sponsored ad could create a pleasant mood.
	C6.2 Touching	As for a customer, watching the video of the sponsored ad could create a touching mood.
	C6.3 Reluctant	As for a customer, watching the video of the sponsored ad could create a reluctant mood.
	C6.4 Curious	As for a customer, watching the video of the sponsored ad could create a curious mood.
	C6.5 Surprised	As for a customer, watching the video of the sponsored ad could create a mood of surprise.

Establishment of Evaluation Hierarchical Framework

Our purpose was to analyze the priority of key factors for evaluating consumers' attention to YouTubers' sponsored ads. Therefore, based on this decision purpose, the hierarchical structure of evaluation is depicted in Figure 3.

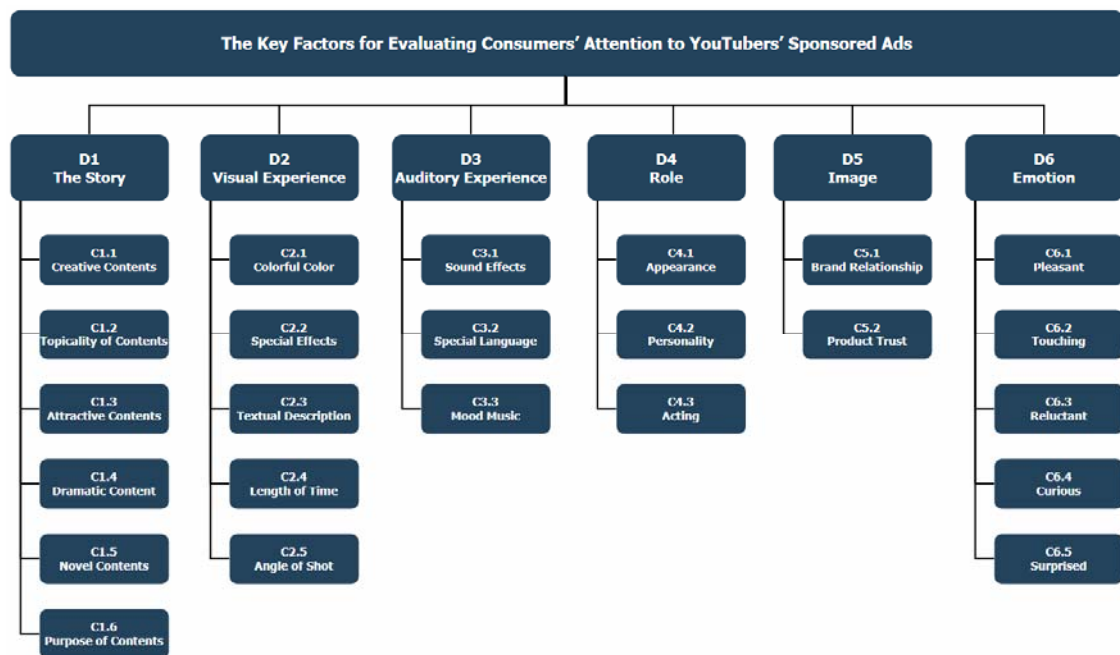


Figure 3: Hierarchical Structure of Evaluation

RESULT ANALYSIS

Descriptive Statistics Analysis

In this study, we interviewed 10 users and invited them to reply to a questionnaire regarding the factors attracting customers' attention to a sponsored ad by a YouTuber. To ensure the effectiveness of each completed questionnaire, we conducted a transitivity test and a consistency test for verifying the responses. The demographic information of questionnaire participants is depicted in Table 2.

Table 2: Demographic Information of Participants

Profiles	Sample composition	Count	Percentage
Gender	Male	5	50.0%
	Female	5	50.0%
Age	21-25	4	40.0%
	26-30	5	50.0%
	31-35	1	10.0%
Education	College	3	30.0%
	Graduate school	7	70.0%
Job	Student	2	20.0%
	Service Industry	1	10.0%
	Information Industry	4	40.0%
	Administration Industry	3	30.0%

Besides, the users' experiences in using YouTube services to watch sponsored ads were queried. Also, the three most popular YouTubers (TGOP, Tsai A-Ga, AmoGood) were queried for and included in our statistical results. The statistics results are depicted in Table 3.

Table 3: Users' Experiences of Using YouTube Services

Item	Type	Count	Percentage
The average time using YouTube for a day	Less than 1 hour	4	40.0%
	Between 1 hour to 3 hours	4	40.0%
	Between 3 hours to 5 hours	2	20.0%
The average time watching sponsored ad for a week in YouTube	Less than 1 hour	1	10.0%
	Between 1 hour to 3 hours	5	50.0%
	Between 3 hours to 5 hours	1	10.0%
	Between 7 hours to 9 hours	1	10.0%
	More than 9 hours	2	20.0%
Have you watched the sponsored ad by YouTuber	TGOPP	10	100.0%
	AmoGood	7	70.0%
	HowHow	6	60.0%
	Tsai A-Ga	6	60.0%
	Ray Du English	6	60.0%
	Saint	4	40.0%
	WawaKu	3	30.0%
	Kyon	2	20.0%
	Others	9	90.0%

Note: The others refers to the other YouTubers about ninety percent, including Dodo, Anjou, Xiaoyu, Jasper, CROWD, Louis, ILLY and LEAN, Joeman, A-han.

Evaluation of weight

Our questionnaire was designed to elicit a pair-wise comparison matrix in the 1-9 scale to obtain each question factors' priority. All the weights of the questionnaire passed the transitivity test and consistency test, with values of less than 0.1 (Saaty, 1990). In addition, questionnaire participants were requested to make a paired priority comparison for the six dimensions and 24 sub-factors. Finally, all the questionnaire scores were put through the AHP analysis to obtain the relative weights of each dimension and sub-factors. As shown in Table 4, "D1. The Story"(0.342) had the highest weight value in the dimension hierarchy.

Table 4: Weight of Dimensions and Factors

Dimension	Relative Weights	Sub-Factors	Relative Weights
D1. The Story	0.342 (1)	C1.1 Creative Contents	0.141
		C1.2 Topicality of Contents	0.141
		C1.3 Attractive Contents	0.264
		C1.4 Dramatic Content	0.160
		C1.5 Novel Contents	0.149
		C1.6 Purpose of Contents	0.144
D2. Visual Experience	0.151 (3)	C2.1 Colorful Color	0.099
		C2.2 Special Effects	0.084
		C2.3 Textual Description	0.164
		C2.4 Length of Time	0.285
		C2.5 Angle of Shot	0.367

Table 4: Weight of Dimensions and Factors (cont.)

Dimension	Relative Weights	Sub-Factors	Relative Weights
D3. Auditory Experience	0.052 (6)	C3.1 Sound Effects	0.455
		C3.2 Special Language	0.086
		C3.3 Mood Music	0.459
D4. Role	0.150 (4)	C4.1 Appearance	0.161
		C4.2 Personality	0.433
		C4.3 Acting	0.406
D5. Image	0.097 (5)	C5.1 Brand Relationship	0.360
		C5.2 Product Trust	0.640
D6. Emotion	0.209 (2)	C6.1 Pleasant	0.291
		C6.2 Touching	0.058
		C6.3 Reluctant	0.054
		C6.4 Curious	0.349
		C6.5 Surprised	0.248

Priority of Evaluation Factors

Through the pair-wise comparison matrix, we obtained the relative weights of factors in the whole hierarchical structure of evaluation. Subsequently, for the purpose of the essential ranking of all evaluation factors, we calculated the absolute weights by multiplying the relative weights of each dimension and sub-factors. This indicated that “C1.3 Attractive Contents”(0.090), “C6.4 Curious”(0.073), and “C4.2 Personality”(0.065) were the three highest key factors in the priority of evaluation factors of consumers’ attention to a sponsored ad by a YouTuber. The priority of evaluation factors are depicted in Table 5.

Table 5: The Priority of Evaluation Factors

Evaluation factors	Absolute Weights	Priority
C1.1 Creative Contents	0.048	13
C1.2 Topicality of Contents	0.048	12
C1.3 Attractive Contents	0.090	1
C1.4 Dramatic Content	0.055	8
C1.5 Novel Contents	0.051	10
C1.6 Purpose of Contents	0.049	11
C2.1 Colorful Color	0.015	20
C2.2 Special Effects	0.013	21
C2.3 Textual Description	0.025	16
C2.4 Length of Time	0.043	14
C2.5 Angle of Shot	0.055	7
C3.1 Sound Effects	0.023	19
C3.2 Special Language	0.004	24
C3.3 Mood Music	0.024	18
C4.1 Appearance	0.024	17
C4.2 Personality	0.065	3
C4.3 Acting	0.061	6

Table 5: The Priority of Evaluation Factors (cont.)

Evaluation factors	Absolute Weights	Priority
C5.1 Brand Relationship	0.035	15
C5.2 Product Trust	0.062	4
C6.1 Pleasant	0.061	5
C6.2 Touching	0.012	22
C6.3 Reluctant	0.011	23
C6.4 Curious	0.073	2
C6.5 Surprised	0.052	9

CONCLUSIONS

This paper has presented a two-stage integrated hierarchical structure of evaluation for analyzing the evaluation factors of user attention to a sponsored ad by a YouTuber. The analysis of six evaluation dimensions shows that “D1. The Story” (0.342), “D6. Emotion” (0.209), and “D2. Visual Experience” (0.151) received the highest priority among the six evaluation dimensions. It is worth mentioning that “D3. Auditory Experience” (0.052) received the lowest priority. Besides, the analysis of sub-factors through the AHP method indicated that “C1.3 Attractive Contents” (0.090), “C6.4 Curious” (0.073), and “C4.2 Personality” (0.065) were the most significant factors for attracting users’ attention to a sponsored ad. On the other hand, factor “C3.2 Special Language” (0.004) was found to be at the bottom of all the sub-factors. Specifically, people watch a video on YouTube for nothing more than relaxation and entertainment. That is why users only noticed the content and plot of the sponsored ad video, even if it used canned music. Further, according to the priority of sub-factors, in comparison with naturalness and sincerity of acting (C4.3 Acting), “C5.2 Product Trust” is what drew more user attention in the whole evaluation hierarchical model. Our results reflect the available facts. Presently, more users are choosing to trust information about products received from others on the internet instead of ads on TV or information coming from brands or companies.

In view of these facts, we suggest that YouTubers should explore more techniques for diversified photography or camera work in the future, including stills, pans, jump-cuts, montages, and so on so that users can become more absorbed in YouTubers’ sponsored ads. On the other hand, based on our hierarchical structure, YouTubers should also target specific customers and increase users’ curiosity for an ad. Finally, to create a win-win situation, YouTubers and suppliers of products should work towards the highest quality of video content and excellent service to garner users’ attention.

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Cultivating Service Diversification: A Cross-level Study

(Work in Progress)

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ABSTRACT

Positive effects of firms' service diversification on competitive advantages have been documented. However, how to achieve service diversification remains unclear. Although studies point out information technology (IT) can enhance service diversification, the effects of specific ITs need further investigation. This study proposes a conceptual model to study the effects of four specific ITs usage on service diversification from resource-based view. Moreover, we investigate the moderating effect of macro innovation environment. Firm-level data were collected from 690 logistics firms in 23 cities in China. Our results show that all four ITs contribute to service diversification. Macro innovation environment negatively moderates the relationship between emerging technologies and service diversification.

Keywords: service diversification, management information systems, internet-of-things, logistics information platform, big data, macro innovation environment.

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INTRODUCTION

Firm business diversification, in terms of entering into a related or unrelated business, is considered to be an important role for firms' long-term benefits (Hitt et al., 1997, Narasimhan and Kim, 2002) which may bring competitive advantages, where the "business" means either product or service. Specifically, as service can be regarded as special products, following the definition of product service (Wan and Hoskisson, 2003) the service diversification is defined as a firm's diversification into more than one service market. Recently, the benefits of service diversification on firm performance have drawn scholars' attention (Giachetti, 2012, Nath et al., 2010). They argue that by enlarging their service portfolio, firms can more efficiently use of their underutilized resources and capabilities, and thereby benefit from scope economics (Nayyar, 1993). Moreover, expanding the total package of services offered helps firms attract new clients or more fully serve existing clients by offering bundles of services (Hitt et al., 2006). For example, Alibaba start Ant financial to provide financial service in 2014 beyond its e-commerce business. Based on the large volume of customers on taobao.com, its financial service succeeds in producing firm performance. Such positive service diversification-performance linkage is confirmed by prior studies (Kor and Leblebici, 2005). Through the benefits of service diversification have been recognized, how firms can successfully achieve service diversification remains unclear to both academia and practitioners.

Prior studies suggest that information technology (IT) can enhance firm diversification from resource-based view (RBV), which describes firms' resources are valuable, rare, imperfect imitable, and non-substitutable (VRIN), can help firms to achieve competitive advantage (Barney, 1991). Adapting RBV into IS discipline, IT has been regarded as such kinds of resources, which may lead to firm diversification. On the one hand, IT may help firms to reduce coordination and control cost, thus to increase the scope of their business activities (Gurbaxani and Whang, 1991, Liu and Ravichandran, 2008). For example, management information systems (MIS), such as enterprise resource planning systems, can help firm integrate internal resources, and further enables firms to replicate and propagate administrative innovations across different service market (Chari et al., 2008). On the other hand, IT, such as big data and social media technology, can help firms keep in touch with their existing customers by extracting and analyzing valuable customer data (Lam et al., 2016). Firms can learn from their customers, and further fulfill their customers need with diversified service. IS scholars also suggested in order to achieve higher level of firm diversification, firms need more investment in information technology, which strengthening the important role of IT in helping firm diversification (Dewan et al., 1998, Liu and Ravichandran, 2008, Ray et al., 2013).

However, there are still some research gaps remained when linking IT with service diversification. First, prior papers suggest that the benefits of different ITs are different (Hendricks et al., 2007). For example, as the knowledge of mature technologies, such as MIS and platforms, has been well documented and explored, it is easier for firms to make use of and benefits from such ITs. However, for emerging technologies, such as big data as well as artifact intelligence, their knowledge is not well documented. Firms may enjoy the benefits of adopting emerging technologies as early movers (Huda et al., 2018), while they may also face challenges because of the limitation knowledge of such technologies (Jin and Li, 2012). Thus, the effects of different ITs are different for firms to achieve competitive advantages. In diversification researches, most researchers only consider the general IT

investment. However how specific IT, mature technologies and emerging technologies respectively, influences service diversification remains unknown. Accordingly, this study aims to further this line in the literature.

Second, prior studies mainly focus on the effects of firms' internal resources, such as IT, as well as environment within focal firms on diversification. However, several papers suggest that macro (country-level) environment plays an important role in firm diversification (Marano et al., 2016, Wan and Hoskisson, 2003). Moreover, even within a same country, different macro environment in each city is also different affect their local firms differently (Ma et al., 2013). The macro environment, such as city innovation environment, may enhance firm service diversification by providing a more creative environment, developing more service. In service diversification literature, the effects of macro level factors, such as city innovation environment, have not yet been fully investigated. Therefore, it is necessary to investigate the effect of macro environment, such as city innovation environment, on firm service diversification.

We study the problem in logistic industry, as more and more firms rely on third party logistics service (Alkhatib et al., 2015, Jharkharia and Shankar, 2007). The service diversification is important for both service providers to compete and their clients firms to enjoy. We focus on four important technologies of logistics firms: two mature technologies, management information systems (MIS) and logistics information platform (LIP), as well as two emerging technologies, internet-of-thing (IoT) and big data respectively. In this paper, we propose a cross-level conceptual research model that investigates the influence of four specific ITs usage on firms service diversification based on resource-based view. Moreover, one macro environment factor - city innovation environment is also included. The cross-level model is tested using data from 690 logistics firms within 23 major cities in China. Our results show that all four kinds of IT usage are positively related with service diversification, while mature technologies, MIS and LIP, contribute more. Furthermore, the city innovation environment positively affects firms' service diversification. The interactions between city innovation environment and two emerging technologies, IoT and big data respectively, are negative and significant. This study contributes to diversification literatures by confirming the importance of IT on service diversification. First, the study fills the research gap and limited knowledge of the effects of specific IT on service diversification. Although we use data from logistics firms, we believe that the results can be generalized to other industries. Second, this study contributes to RBV literature by considering macro environment, city innovation environment. In the study, we provides a more complete picture of how this external environment influence firms competitive advantages, rather than only looking into internal resources. We explain the results by the rareness advantages of emerging technologies.

MODEL

Based on resource-based view, we propose a conceptual model to investigate the effects of specific ITs and service diversification in logistics firms, as shown in Figure 1. This cross-level model includes firm and city levels. At the firm level, mature technologies, MIS and LIP, and emerging technologies, IoT and big data, are hypothesized to influence firm service diversification. At the city level, city innovation environment is considered as a moderator, which may influence the relationship between specific IT and service diversification. More detailed discussion of each hypothesis is as follows.

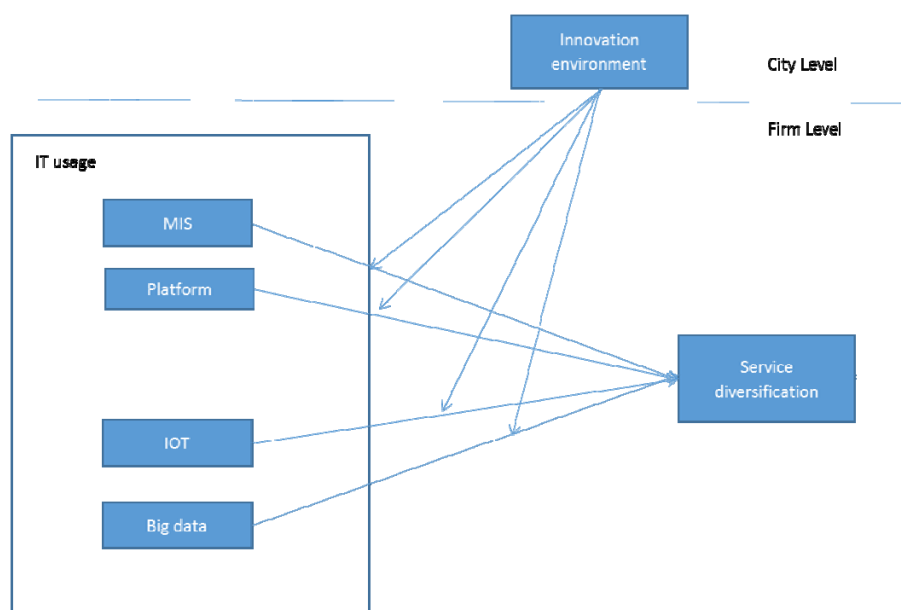


Figure 1: Research Model

Management Information System

Management information system (MIS) serves as an important technology investment for managers, which contains such as enterprise resource planning systems (ERP), warehouse management systems (WMS), supply chain systems (SCM) and so on. As one of the traditional information system, it has been widely used in many industries for many years. With abundant usage history, the usage is widely spread and the instructions are well documented. Therefore, we consider MIS as a typical mature technology. The management information technology enables firms efficiently integrating and processing a large scale of internal information which improve firms' internal process capability (Rai et al., 2006). For example, the widely used enterprise resource planning systems (ERP) facilitate integrated and real-time internal resources planning and customer response (Bradford and Florin, 2003). In the field supply chain management, warehouse management systems (WMS) automatically and constantly save the data about the products which in turn increase firms' operation efficiency (Chiang et al., 2011). Such IT-enabled information management capability is found to be critically related with firms' ability to integrate internal as well as external resources (Mithas et al., 2011). Service diversification creates internal coordination requirements, such as the sharing of related resources across multiple lines of business or organizations (Dewan et al., 1998). With the facilitation of MIS, firms could effectively coordinate their internal resources and achieve service diversification. Accordingly, we hypothesize that more usage of management information systems leads to higher firm service diversification.

H1. The usage of MIS technologies is positively related with firm service diversification.

Logistics Information Platform

Platform technology is considered as one of the critical resources for the corporates (Sedera et al., 2016, Yoo et al., 2012). With the facilitation of technologies, more and more business are moving their business into platforms (Alegre et al., 2016). Therefore, platform technology is also considered as a mature technology as it is familiar to the society nowadays. IS researchers have pointed out the emergence of platform technology impacts organizational strategies, structures and process (Sambamurthy and Zmud, 2000). The platform technology affects firms' performance in the following ways. First of all, the ability of platform technology connecting with other system facilitate firms transfer data between its suppliers (Rai and Tang, 2010). Such connection enables firms sharing and processing external resources as well as varies kind of information in time. Second, the digital platform of processes and knowledge can change information-based value propositions, forge value-chain collaborations with partners that competitors cannot easily duplicate, and rapidly exploit emerging and untapped market niches (Sambamurthy et al., 2003). Therefore, platform technology helps firms adapt the environment changes more quickly. Third, the ease development and deployment of the digital platform enables firms' argument for the existing business or provision of new services (Armbrust et al., 2010). Further, the platform technology provides easy usage experience for customers and suppliers which enhance the product adoption and diffusion (Nylén and Holmström, 2015). As a result, higher usage of platform technology increases the probability of diversification success. In logistics industry, logistics information platform provides various functions for firms to integrate cross-functional applications to create connectivity across a range of complementary applications and facilitate the exchange of complementary information between firms (Rai et al., 2006). For example, the analysis function enabled by logistics information platform provides logistics firms with the ability to predict the market need, and further develop various services to fulfill. Based on the above reasons, we hypothesize the more usage of logistic information platform (LIP) increase the level of service diversification.

H2. The usage of LIP functions is positively related with firm service diversification.

Internet of Things

Atzori et al. (2010) defined Internet of Things (IoT) from three perspectives which are internet-oriented (middleware), things-oriented (sensors) and semantic-oriented (knowledge). IoT refers to the technology for integration of the physical world information into computer-based system by embedded electronics. With a short usage history, it is regarded as an emerging technology. With the development of related technologies such as Radio Frequency Identification (RFID), Wi-Fi and sensor network technologies, IoT technologies are used in logistics industry recently (Jedermann et al., 2006, Leung et al., 2014, Mok, 2010), which make information collection and communication invisibly embedded in the environment. IoT technologies are supposed to benefit the process to firm diversification. Because firms need to accommodate more complex environment as they are operating in multiple business markets. The IoT helps firm collect data in the environment by embedded sensors. Moreover, with extra information available, firms are more likely to provide more service based on the data. For example, with the facilitation of the IoT, firms are able to extract data while customer are using product. As a result, the IoT not only helps firms improve their products but also enables them provide more new services to fulfill customers' needs (Bartolomeo, 2014). Thanks to the IoT, different market information could be effectively collected and integrated, simultaneously. Therefore, we hypothesize that IoT technologies positively affect firm service diversification.

H3. The usage of IoT technology is positively related with firm service diversification.

Big Data

Big data refers to firms' management, processing and analyzing a large scale of data sets (Wamba et al., 2015). Big data, which considered as an emerging technology becomes popular in recent years. Big data enhances firms data-driven decision making capabilities (Provost and Fawcett, 2013). Data-driven decision process makes firms proactive and forward-looking in the market, decrease firms' customer acquisition cost, and enhance firms' revenue (Liu, 2014). Deployment of customer data analytics enables firms gain meaningful customer insights, engage with customers on an appropriate level, and ultimately benefit financially (Germann et al., 2014). With the high capability of data processing, big data allows firms extracting business intelligence from petabyte-scale data in nearly real time (Tambe, 2014). Specifically, in supply chain field, predictive ability based on big data is critical to reducing cost, achieving efficiency, responding to the market timely, improving power in relationship with suppliers, as well as enhancing sales and operations planning capabilities (Schoenherr and Speier-Pero, 2015). As a result, big data and predictive analytics improves business value and firm performance (Gunasekaran et al., 2017). In summary, big data helps firms find the promising new market to enter while decreasing the new market entrance cost. Accordingly, we hypothesize that the usage of big data technologies benefits firm service diversification.

H4. The usage of big data is positively related with firm service diversification.

City Innovation Environment

Macro environment has been found to positively influence firm diversification (Wan and Hoskisson, 2003). Besides the direct effect, macro environment is also claimed to affect the relationship between IT and firm competitive advantages (Melville et al., 2004). Thus, we posit that macro environment outside firms may also influence the relationship between IT and service diversification. However, the effects of macro innovation environment may be different for specific IT. Considering the hype cycle of technologies, we divide information technologies into either mature technologies or emerging technologies (Daim et al., 2006). For example, management information systems and platform technologies are mature technologies; on the other hand, IoT technologies and big data are emerging technologies.

For mature technologies, referring to those widely adopted technologies (Agarwal and Audretsch, 2001), the knowledge of their initial faults and inherent problems, as well as how to use successfully, has been well documented. Firms are easier to access to such kinds of knowledge, and can benefits from such technologies. Moreover, in a high innovative environment, firms are provided with more resources and support, which may further develop competitive advantages although it is difficult for mature technologies, compared to firms in a lowly innovative environment.

For emerging technologies, referring to novel technologies which have radical novelty, relatively fast growth, coherence, prominent impact and uncertainty and ambiguity characteristics (Rotolo et al., 2015), the situation may be different from mature technologies. Considering these characteristics, rareness is expected to be a critical advantage for the emerging technologies. In a better innovation environment, firms are provided with more knowledge and support with emerging technologies. Through, with the knowledge, firms in a better innovation environment can adopt and use emerging technologies with less uncertainty (Alvesson 1993). This may not lead to more competitive advantages for firms in a better innovation environment as others can also enjoy the knowledge to adopt emerging technologies. In a lowly innovative environment, although knowledge is less documented about emerging technologies, firms adopting and using emerging technologies are often early birds with less competitors. The advantages of first movers have been explored a lot by prior studies (Lieberman and Montgomery, 1988, VanderWerf and Mahon, 1997). Thus, the rareness of emerging technologies is more significant for a less innovation environment than a more innovation environment. We posit that emerging technologies may benefits firms more in a less innovation environment to their competitive advantages, such as service diversification. Based on the above discussion, the hypotheses are given.

H5a. Innovation environment positively moderate the relationship between mature ITs and service diversification.

H5b. Innovation environment negatively moderate the relationship between emerging ITs and service diversification.

METHODOLOGY

A survey company helped to collect the data. First, we selected 23 major cities in China, comprising 4 independent municipalities and 19 provincial capitals. An online survey was designed, and the link was send to firms' CEO, CIO, or high-experienced managers of each firm. They were asked to fill the questionnaire. The data on demographic information, their firm's IT usage, and provided service were collected. The firm implemented strict survey quality control during the data collection process. After they finished the questionnaire, we make follow-up phone-calls to make sure that each respondent seriously took the survey. Overall, 690 samples without any missing values were finally collected, with 30 samples in each city.

Given the multilevel natures of our research model (i.e., firms nested within cities), we adopt the multilevel model to analyze the data. Multilevel model is used to deal with the non-independence of observations obtained from lower-level units nested within higher-level units (Bliese and Hanges, 2004, Huang et al., 2016, Kozlowski and Klein, 2000). In this study, aside from the

relationships at the firm level, we test the effect of upper-level (city level) moderator: the cross-level effect of city innovation environment on the within-city effect of firms IT usage on firms' service diversification.

Before multilevel analysis, we firstly examine the degree of non-independence among the lower-level (member level) observations. Following Bliese (2000), we use HLM 7 to examine whether the data justified aggregation of firms service diversification. We use the null model without any predictors to estimate the between-group variance to determine whether the hierarchical linear model is applicable: with firms' service diversification as the outcome. The variance is substantial and statistically significant (0.474, $p < 0.001$). The intra-class correlation coefficient is 0.03. This suggests there are differences between different groups: the firms nested within each city were not independent. Given these results, the multilevel model is applicable to the hypotheses testing in our study. Following Bliese (2000), we conducted multilevel analyses using random coefficient modeling (which is also referred to as hierarchical linear modeling) (Gavin and Hofmann, 2002) in the Nonlinear and Linear Mixed Effects program for HLM 7 (Raudenbush et al., 2011). We group-mean center firms different IT usage and service diversification, and then added their group-mean back to the Level 2 intercept-only model as covariates for the cross-level interactions. The Level 2 moderator, city innovation environment, was grand-mean centered to reduce multicollinearity.

RESULTS

Details of our analysis results and managerial implications will be discussed during the conference.

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Examining Consumer Mobile Money Usage Behaviour in Ghana

(Work in Progress)

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ABSTRACT

This study develops a theoretical model to examine the effects of agent credibility and service quality on customer empowerment and the consequences of such empowerment in mobile money (MM) usage in Ghana. In total, 595 valid responses were collected using a pre-tested onsite-survey instrument. The research findings suggest that a higher level of MM agent credibility increases customer empowerment, which in turn positively affects the continuous usage of MM services. A significant association between MM agent service quality and customer empowerment was also noted. The study concludes with a discussion of study implications, limitations, and future research directions.

Keywords: Mobile money, agent credibility, customer empowerment, Ghana.

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INTRODUCTION AND RESEARCH AIM

Until recently, Africa was popularly known as the unbanked continent because of its crumbling infrastructure, weak internet connectivity, low levels of financial literacy, and thin branch network, all of which have made it daunting for governments, regulators, and the banking industry to increase financial inclusion, such as by providing financial services to unbanked and rural clients. But the widespread diffusion of mobile phones, among the most widely embraced technological devices in the consumer market (Revels *et al.*, 2010), has inspired digital transformation, increased financial inclusion, replaced brick-and-mortar locations, and created a profitable business proposition for the banking, telecom, fintech, and other sub-sectors of the economy in Africa and elsewhere. Mobile money is one initiative that banking and non-banking companies alike have developed and deployed to provide the under privileged consumer segment with access to formal banking and payment products and services.

Simply put, mobile money, also referred to as branchless banking, is a tool that allows customers to make financial transactions anytime and in any location using cell phone technology (Jack & Suri, 2011). Complemented by an agent network, this mobile-based payment channel has enabled and broadened access to financial and payment services to remotely located and previously unbanked segments of the population in most of the world's developing and emerging markets. Unlike traditional delivery channels, such as bank branches and ATMs, an agent in the mobile money service channel provides everyday banking and payment-related services to consumers on behalf of the banking institute or mobile network operator (MNO). Agents are designated and contracted by financial services companies or non-banking actors such as telecom and fintech firms.

Mobile money offers numerous benefits, including convenience, usability, usefulness, and low cost. In the context of this study, however, the sustained usage of these services in Ghana has not reached a sufficiently large scale following the initial adoption of such services. This situation has become a challenge both for established players and for new entrants, such as fintech start-ups. Previous studies (e.g. Osei-Assibey, 2015; Mothobi & Grzybowski, 2017) have examined the consumer adoption of mobile money services in Africa (including Ghana), but few have delved into which factors motivate the prolonged usage of mobile money technology and services within the underbanked and unbanked consumer segment and beyond. Research on the role the agent network plays is typically limited to market reports and working and policy papers developed and published by groups such as CGAP (2018) and McKinsey and Co. (2012). To the best of our knowledge, no empirical study has contributed to this domain by specifically examining the role that mobile money agents play in reaching customers and providing financial services to the unbanked nation of Ghana. The study clearly articulates that these singularities in the mobile money domain, which are critical to the study of mobile money and the identification of antecedents and consequences, therefore require examination.

To fill this gap, the underlying purpose of this study is to contribute to the empirical literature on mobile financial services and to examine consumers' actual user behaviour rather than their behavioural intention (Choi *et al.*, 2015). Recent researchers on mobile financial services (such as mobile banking) have typically explored behavioural intention, perhaps believing that behavioural intention is generally considered as the main determinant of actual behaviour (Choi *et al.*, 2015; Hansla *et al.*, 2008). Another purpose of this study is to develop a theoretical model to examine the effect of agent credibility and agent service quality on

customer empowerment as well as the consequences of such empowerment (e.g. continuous usage and customer engagement) on mobile money technology usage in a developing country.

RESEARCH QUESTIONS

This study addresses two research questions: What is the role of mobile money agents in driving customer empowerment? How does customer empowerment increase the continuous usage of mobile money technology?

THEORETICAL MODEL

The theoretical model, which includes five latent variables (as depicted in Figure 1), proposes that mobile money agent credibility and mobile money service quality have a direct effect on customer empowerment, which is hypothesized to positively affect the continuous usage of mobile money services as well as customer engagement. The model also proposes that the continuous usage of mobile money services will directly affect customer engagement with mobile money services.

METHODOLOGY

A pre-tested survey instrument – using items on an established scale from 1 (strongly disagree) to 7 (strongly agree) – was used to collect data from consumers in Ghana. The scale items were modified to suit the mobile money context. In part to achieve a certain level of generalisability of the research findings, the dataset consists of a sample of respondents from different socio-economic, age, and gender groups across Ghana who had mobile money usage experience (>4 months). In total, 595 valid responses were collected in December 2016. The SmartPLS 3.2.7 application (Ringle *et al.*, 2015) was used to test the research model. The sample's demographic characteristics are shown in Table 1.

Table 1: Demographic Characteristics (n=595).

Demographic characteristics	Frequency	Percent
<i>Gender</i>		
Males	316	53.1
Females	279	46.9
<i>Age (years)</i>		
18 – 25	356	59.8
26 – 35	173	29.1
36 – 45	48	8.1
46 – 55	18	3.0
<i>Highest level of education</i>		
Junior High School	9	1.6
Senior High School	137	23
O' Level / A' Level	11	1.8
Polytechnic	17	2.9
Teacher training	4	0.7
Bachelor /Master	414	69.5
Ph.D.	3	0.5
<i>Current employment status</i>		
Student	346	58.2
Employee/professional	229	38.5
Unemployed	7	1.2
Entrepreneur	13	2.2
<i>Usage frequency of cell phones</i>		
< 1 year	117	19.7
1 - 3 years	159	26.7
4 - 6 years	150	25.2
7 - 9 years	74	12.4
10 - 12 years	32	5.4
13 - 15 years	17	2.9
> 15 years	46	7.7
<i>MM Usage experience</i>		
< 1 month	85	14.3
1 - 4 months	92	15.5
5 - 8 months	82	13.8

9 – 12 months	118	19.8
13 - 16 months	69	11.6
17 - 20 months	37	6.2
> 20 months	112	18.8

RESULTS, DISCUSSION, AND THEORETICAL/MANAGERIAL IMPLICATIONS

The research findings suggest that higher levels of bank agent credibility increased customer empowerment ($\beta=0.37$, $t=7.51$, $p<0.001$), which in turn positively affected the continuous usage of mobile money services ($\beta=0.27$, $t=6.19$, $p<0.001$). Figure 1 shows the results of the structural model.

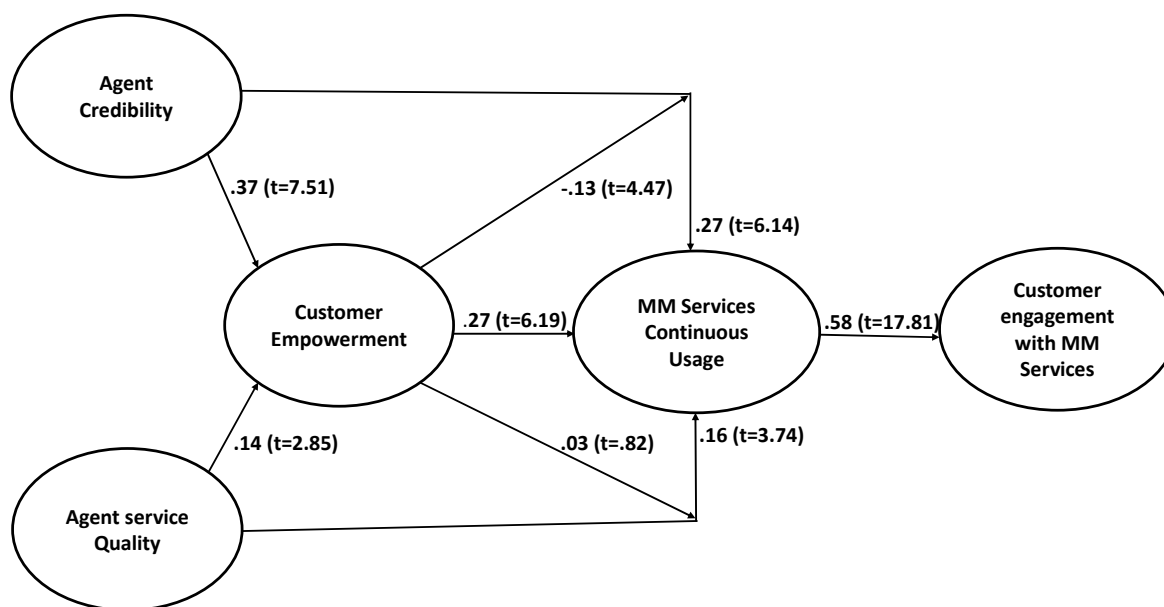


Figure 1: Structural Model Results

We found a significant association between agent service quality and customer empowerment ($\beta=0.14$, $t=2.85$, $p<0.01$). In addition, we found that the interaction between agent credibility and customer empowerment to be significant ($\beta=-0.13$, $t=4.47$, $p<0.001$), while the interaction between agent service quality and customer empowerment to be insignificant ($\beta=-0.03$, $t=0.82$, $p>0.05$). Thus, for less empowered customers, agent credibility is an important factor that enhance continuous usage of mobile money services. See Figure 2.

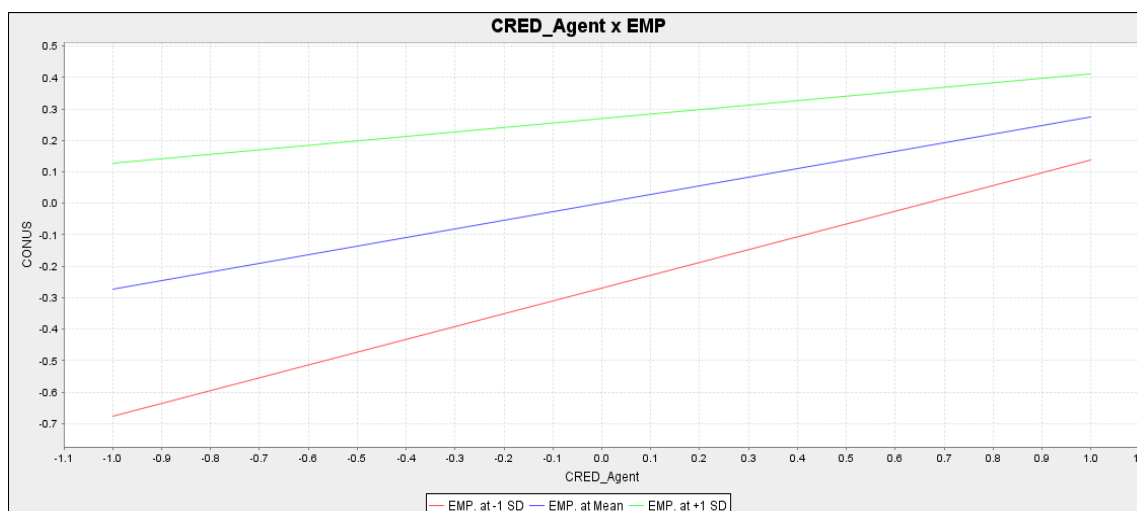


Figure 2: The Contingent Effect of Customer Empowerment

Regarding managerial implications, the findings highlighted the need for banking and non-banking companies in Africa to develop and implement strategies to increase the credibility of agents in order to ensure the reliability and confidentiality of financial transactions and the protection of individual privacy. Another relevant but interesting finding suggests that at low levels of customer empowerment, bank agent credibility increases the continuous usage of mobile money services. This finding suggests that agent credibility is one key to the sustained or prolonged use of mobile money services. This is largely because in branchless banking services, agent occupies a key position and, therefore, the branchless banking sometime refers to as the 'agent banking.'

Banking and non-banking institutions, in addition to providing a credible agent network, should also educate and train agents to provide better service quality to mobile money users. Improved services will empower customers as well as increase Africa's financial literacy, which currently falls under the sole jurisdiction of different governments and regulators. A carefully selected, contracted, trained, socially savvy, and credible agent network will thus help banking companies, MNOs, and fintech companies drive new business, increase the customer base (previously thought of as non-bankable), build brand awareness, and improve the customer experience.

This study contributes to the service marketing literature on how the service elements of quality and credibility relate to customer empowerment and outcome variables, continuous usage, and customer engagement in a validated nomological structural relationship. The paper highlights the importance of service agent characteristics in promoting customer empowerment.

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(*Full reference list is available upon request from the corresponding author.)

APPENDIX A: Survey Items

Items
Customer Engagement
<i>Activation</i>
I usually use MM services regularly.
I use MM services very often.
<i>Affection</i>
I feel very positive when I am using MM service.
Using MM service makes me happy.
I feel good when I am using MM service.
I am proud to use MM service.
<i>Cognitive</i>
Using MM gets me to think about the service.
I think about MM a lot when I'm using this service.
Using MM stimulates my interest to learn more about this service.
Continuous Usage
I intend to continue using MM rather than discontinue its use
My intentions are to continue using MM rather than use any alternative means

I would like to continue my use of MM.
Agent Credibility
Using MM agent service would not divulge my personal information
I would find the MM agent service secure in conducting my MM transactions
The MM agent is like a friend to me because of his truthfulness
The MM agent can always be relied on when doing cash transactions.
Agent Service Quality
MM agent provides on-time services
MM agent provides prompt responses
MM agent provides professional services
MM agent provides personalized services.
Customer Empowerment
Allow me to have control over my personal financial management (such as the fund transfer and the payment of utility bills).
Allow me to independently manage my personal finances (such as the fund transfer and the payment of utility bills).
Let me exercise my judgment in managing my personal finances (such as the fund transfer and the payment of utility bills).
Encourage my own initiative in managing my personal finances (such as the fund transfer and the payment of utility bills).
Provide enough information to let me manage personal finances (such as the fund transfer and the payment of utility bills) on my own.

Improving the Transfer Flow of the Taipei Metro System for Route Development: Using Open Data of the Origin and Destination Station

(Work in Progress)

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ABSTRACT

This paper has presented a decision model for optimizing route allocation with linear programming in the Taipei Metro system. The goal is to avoid centralization of a passenger in certain transfer stations, which means that some transfer stations are overloaded, whereas some transfer stations may be nearly empty. This study applies the open data of origin and destination station to solve this problem. Specifically, through a direct computational comparison of the objective function value and statistical analysis between our proposed model and the existing route development, it confirms that our route development would achieve a reduction of ridership transfer flow of approximately 15% in this case.

Keywords: Taipei Metro System, Linear Programming, Open Data Analytics.

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INTRODUCTION AND LITERATURE REVIEW

The Taipei Metro, also known as the Taipei Mass Rapid Transit (MRT), began running back in 1996. It is the most important means of public transportation serving the metropolis of Taipei, Taiwan. Currently, the Metro system comprises 108 stations (123 if transfer stations are double-counted), five main routes, and two branch lines. The Taipei Metro has developed quite well, and the MRT system has become the most convenient transportation mode in Taiwan. Further, the Taoyuan Airport MRT line is in operation as well, but we must point out that it hardly falls within the scope of the present article. There are eight terminal stations in the Taipei Metro system, as below: Tamsui, Xiangshan, Taipei Nangang Exhibition Center, Dingpu, Taipei Zoo, Songshan, Xindian, Nanshijiao, and Daqiaotou. (In this station, we make a simplification that denotes the Huilong station and Luzhou station.) There are fifteen transfer stations in the Taipei Metro system, as depicted below: Minquan W. Rd., Zhongshan, Songjiang Nanjing, Nanjing Fuxing, Ximen, Taipei Main Station, Zhongxiao Xinsheng, Zhongxiao Fuxing, C.K.S. Memorial Hall, Dongmen, Daan, Guting, Beitou, and Qizhang. However, our research does not include the transfer stations of two branch lines. It goes without saying that the system carries an average of millions of passengers per day. Hence, it is crucial to plan a reasonable route in the Taipei Metro system.

Linear Programming (LP), also called linear optimization, is a method to find the best solution in a mathematical model. It is usually applicable for the maximum profit problem or the lowest cost problem (Vanderbei, 2015). More formally, linear programming is a mathematical technique for the optimization of linear objective functions. The expression to be maximized or minimized is called the objective function. It can be expressed in the canonical form, via subject to linear inequality and linear equality constraints (Dantzig, 2016). Moreover, it can be applied to various fields of study, such as agriculture and animal husbandry. This application of linear programming aims at developing a water resource planning model that helps decision-makers increase revenue and reduce water use during the cultivation of crops (Daghighi et al., 2017). Linear Programming can even be applied to the optimization of electric vehicle charging, the optimization of cost versus life cycle assessment on drinking water production plants, the optimization of waste vehicles recycling of steel scrap and alloying, etc. (Škugor & Deur, 2018; Capitanescu et al., 2017; Ohno et al., 2017). Additionally, it can be applied to obtain an optimal framework for public transportation networks (Li et al., 2014). However, a substantial amount of research has focused on the efficiency and effectiveness of the algorithm for route planning in transportation networks. This ignores the problem of the carrying capacity (Delling et al., 2009). In accordance with this, the problem of the flow for route planning cannot be neglected.

In this paper, to consider the utility of a whole metropolitan area in Taipei, we want to avoid centralization of a passenger in certain transfer stations, which means that some transfer stations are overloaded, whereas some transfer stations may be nearly empty. Thus, we are going to apply the transportation model to the Taipei Metro system to minimize the maximum frequency of the transfer flow that may occur between terminal stations. That is, we want to minimize the maximum transfer frequency of the entire transfer station. Furthermore, to improve the quality and efficiency of the analysis and route development, we use the open data of origin and destination station to solve this problem. Section 2 summarizes and discusses the definition of the model formulation. Section 3 details the proposed model for the transfer flow algorithm and Section 4 demonstrates the solution and outcome of the proposed

model for route development in the Taipei Metro system. Finally, according to this solution, our proposed model achieved a reduction of the frequency of transfer station. It is a feasible solution for practical applications of big data analytics.

MODEL FORMULATION

This section summarizes the model formulation. Then the set of constraints is explained. Besides, the main idea of our proposed model is to maximize the number of people who can get in a station and exit that station of the Taipei Metro system on a single route while precluding transfer via transfer stations.

Define

R_{ijk} : represents the k^{th} potential routes from the i^{th} initial station to j^{th} terminal station. Moreover, an initial station is not identical to a terminal station.

S_i : The frequency a transfer station was passed, $i = 1, 2, \dots, 12$, namely, a transfer station of S_1 -Minquan W. Rd., S_2 -Zhongshan, S_3 -Songjiang Nanjing, S_4 -Nanjing Fuxing, S_5 -Ximen, S_6 -Taipei Main Station, S_7 -Zhongxiao Xinsheng, S_8 -Zhongxiao Fuxing, S_9 -C.K.S. Memorial Hall, S_{10} -Dongmen, S_{11} -Daan, and S_{12} -Guting.

L_i : The route between transfer stations on The Taipei Metro system, $i = 1, 2, \dots, 19$. For instance, a route that represents the transfer station between the Minquan W. Rd. station and Zhongshan station. A detailed description of L_i is provided below.

L_1 : from S_1 -Minquan W. Rd. station(O11/R13) to S_2 -Zhongshan station(G14/R11) via the station of Shuanglian(R12).

L_2 : from S_1 -Minquan W. Rd. station(O11/R13) to S_3 -Songjiang Nanjing station(G15/O08) via the station Zhongshan Elementary School(O10) and Xingtian Temple(O09).

L_3 : from S_2 -Zhongshan station(G14/R11) to S_5 -Ximen station(BL11/G12) via the station of Beimen(G13).

L_4 : from S_2 -Zhongshan station(G14/R11) to S_3 -Songjiang Nanjing station(G15/O08).

L_5 : from S_3 -Songjiang Nanjing station(G15/O08) to S_4 -Nanjing Fuxing station(G16/BR11).

L_6 : from S_2 -Zhongshan station(G14/R11) to S_6 -Taipei Main station(BL12/R10).

L_7 : from S_3 -Songjiang Nanjing station(G15/O08) to S_7 -Zhongxiao Xinsheng station(BL14/O07).

L_8 : from S_4 -Nanjing Fuxing station(G16/BR11) to S_8 -Zhongxiao Fuxing station(BL15/BR10).

L_9 : from S_5 -Ximen station(BL11/G12) to S_6 -Taipei Main station(BL12/R10).

L_{10} : from S_6 -Taipei Main station(BL12/R10) to S_7 -Zhongxiao Xinsheng station(BL14/O07) via the station of Shandao Temple(BL13).

L_{11} : from S_7 -Zhongxiao Xinsheng station(BL14/O07) to S_8 -Zhongxiao Fuxing station(BL15/BR10).

L_{12} : from S_5 -Ximen station(BL11/G12) to S_9 -C.K.S. Memorial Hall station(G10/R08) via the station of Xiaonanmen(G11).

L_{13} : from S_6 -Taipei Main station(BL12/R10) to S_9 -C.K.S. Memorial Hall station(G10/R08) via the station of NTU Hospital station(R09).

L_{14} : from S_7 -Zhongxiao Xinsheng station(BL14/O07) to S_{10} -Dongmen station(R07/O06).

L_{15} : from S_8 -Zhongxiao Fuxing station(BL15/BR10) to S_{11} -Daan station(R05/BR09).

L_{16} : from S_9 -C.K.S. Memorial Hall station(G10/R08) to S_{10} -Dongmen station(R07/O06).

L_{17} : from S_{10} -Dongmen station(R07/O06) to S_{11} -Daan station(R05/BR09) via the station of Daan Park(R06).

L_{18} : from S_9 -C.K.S. Memorial Hall station(G10/R08) to S_{12} -Guting station(G09/O05).

L_{19} : from S_{10} -Dongmen station(R07/O06) to S_{12} -Guting station(G09/O05).

D_i : An indicator variable (1 if set-up i used; otherwise, 0).

M : A small, integral constant. Given this, the model is expressed:

$$\min [\max \{S_1, S_2, S_3, S_4, S_5, S_6, S_7, S_8, S_9, S_{10}, S_{11}, S_{12}\}]$$

subject to

$$\sum_k R_{ijk} = 5, \forall k$$

$$\sum_i L_i = 1, \forall i$$

$$\sum_i N_i \geq 2, \forall i$$

$$D_i \in \{0, 1\}, \forall i$$

In the above formulation, the objective function is to minimize the total transfer flow, defined as the sum of the transfer station for the largest flow in the Taipei Metro system. The set-up routes are transferred according to the flow. For example, transfer stations with different transfer flows will have different set-up routes. In order to make a decision result meeting the actual circumstances better, more external and easier to be understood, the first set of constraints (1) ensures the route of five only; whereas, the second set of constraints (2) assures that the route segment can only be passed between transfer stations once at most. Moreover, for the third constraints (3), all the transfer stations will connect to at least two route segments. Finally, the fourth set of constraints (4)

imposes a fixed route-chosen indicator, D_i , associated with the potential route variable, R_{ijk} . In this paper, we limit our study to the application of the formulation to decrease the transfer flow of the Taipei Metro system, ruling out the problem of regionals. The definition of our model formulation is depicted in Figure 1.



Figure 1: Model Formulation

THE TRANSFER FLOW ALGORITHM

The complete algorithm for the transfer flow model presented herein comprises three steps: (i) data preprocess; (ii) the generation of transfer flow routes and an initial feasible solution to the transfer flow model; and (iii) the application of simulated transfer flow to the solution of the Taipei Metro system. Moreover, to promote the proposed model efficiency and effectiveness, open datasets of origin and destination station were adopted to verify the actual transfer station flow of the Taipei Metro system. A detailed description of these four steps and datasets is provided next.

Description of datasets

The datasets of origin and destination station include the statistics of time division flow for each station in the Taipei Metro system. To decrease the frequency of the transfer station, appropriate datasets were selected based on the ridership statistics per day from the Taipei Rapid Transit Corporation. As shown in Table 1, we find the highest average ridership per day in December 2017. On the other hand, we find the largest amount of ridership, in statistical terms, at 6 p.m., as shown in Figure 2. Therefore, our proposed model has selected the datasets of origin and destination station at 6 p.m. on December 2017.

Table 1: Summary Statistics of Average Ridership per Month

Time	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
2018	2,080,677	1,953,907	2,172,866	2,022,173	2,096,107	2,050,134	-	-	-	-	-	-
	+7.44%	-4.53%	+2.37%	-0.61%	+4.25%	+1.49%	-	-	-	-	-	-
2017	1,936,615	2,046,706	2,122,548	2,034,486	2,010,690	2,020,000	1,962,774	2,043,185	2,008,376	1,993,600	2,101,132	2,247,974
	-3.93%	+6.21%	+1.08%	+2.03%	-0.49%	+2.81%	+0.05%	+0.37%	+7.15%	-1.59%	+0.38%	+0.45%
2016	2,015,843	1,926,929	2,099,816	1,993,945	2,020,689	1,964,780	1,961,747	2,035,594	1,874,315	2,025,883	2,093,201	2,237,913
	+4.69%	+2.71%	+3.57%	+2.55%	+3.09%	+2.39%	+1.37%	+7.14%	-1.59%	+0.81%	+3.10%	+4.26%
2015	1,925,543	1,876,165	2,027,365	1,944,422	1,960,053	1,918,947	1,935,314	1,899,873	1,904,606	2,009,554	2,030,302	2,146,519
	+6.89%	+0.64%	+5.48%	+5.36%	+7.22%	+8.77%	+7.88%	+4.23%	+6.62%	+7.55%	+4.60%	+2.29%
2014	1,801,374	1,864,298	1,922,074	1,845,525	1,828,124	1,764,291	1,793,885	1,822,855	1,786,273	1,868,494	1,941,074	2,098,393
	+5.86%	+14.00%	+9.63%	+10.14%	+6.81%	+4.87%	+5.02%	+6.65%	+6.17%	+5.99%	+5.02%	+5.30%
2013	1,701,595	1,635,239	1,753,202	1,675,666	1,711,563	1,682,217	1,708,057	1,709,166	1,682,400	1,762,973	1,848,253	1,992,743
	+12.45%	-1.66%	+5.00%	+4.12%	+5.84%	+5.89%	+4.94%	+6.71%	+3.44%	+2.69%	+7.34%	+11.39%
2012	1,513,243	1,662,837	1,669,706	1,609,292	1,617,133	1,588,700	1,627,631	1,601,655	1,626,521	1,716,723	1,721,808	1,788,973
	+0.30%	+10.28%	+6.03%	+2.27%	+7.45%	+7.25%	+4.67%	+3.86%	+5.07%	+9.47%	+8.43%	+7.47%
2011	1,508,687	1,507,771	1,574,786	1,573,507	1,504,946	1,481,293	1,554,978	1,542,135	1,548,007	1,568,150	1,587,907	1,664,559
	+14.30%	+21.18%	+14.09%	+17.27%	+12.49%	+12.56%	+13.45%	+13.71%	+16.80%	+11.17%	+0.76%	+4.04%
2010	1,319,886	1,244,220	1,380,331	1,341,728	1,337,869	1,315,997	1,370,680	1,356,201	1,325,350	1,410,568	1,575,920	1,626,351
	+17.67%	-3.86%	+10.26%	+7.60%	+9.85%	+8.01%	+3.33%	+10.94%	+4.00%	+8.17%	+19.54%	+15.33%
2009	1,121,652	1,294,176	1,251,877	1,247,014	1,217,863	1,218,395	1,326,558	1,222,445	1,274,332	1,304,073	1,318,288	1,410,195
	-5.58%	+12.96%	+0.98%	+2.57%	-0.90%	-	+6.42%	-4.80%	+9.40%	+2.17%	+5.44%	+9.43%

Note: the growth rate is the number of ridership statistics of this month minus the ridership statistics of that same month last year, divided by the ridership statistics of that same month last year.

The Average Ridership per Day in December 2017

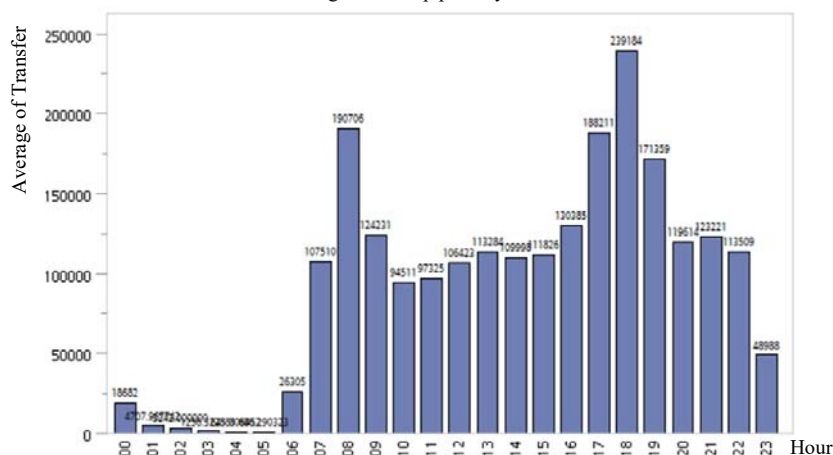


Figure 2: The Average Ridership per Day in December 2017

Step 1: data preprocessing

Data preprocessing is one of the most essential steps in data mining (Famili et al., 1997; García et al., 2015). To ensure the quality of the data, we follow data preprocessing methods such as data cleaning, data integration, data transformation, and data reduction. First of all, we ignore the tuple (transfer station), when the class label is missing. Then, we remove noisy data (containing errors) and identify outliers. Second, as in data warehousing, we combine multiple tuples from open sources into a coherent data store. Third, concerning data normalization, we replace and add the columns inferred by existing attributes. Besides, we scaled the attribute values to fall within a specified range. That is, the occurrences of getting in the transfer station and exiting the transfer station are divided into the occurrences of getting in the transfer station 1, getting in the transfer station 2, exiting the transfer station 1, and exiting the transfer station 2. Moreover, we fill in the number of the two ends of the station. Finally, in order to reduce the number of attributes, if the origin station coincides with the destination station, both are excluded for the analysis. The procedure of data preprocessing is depicted in Figure 3.

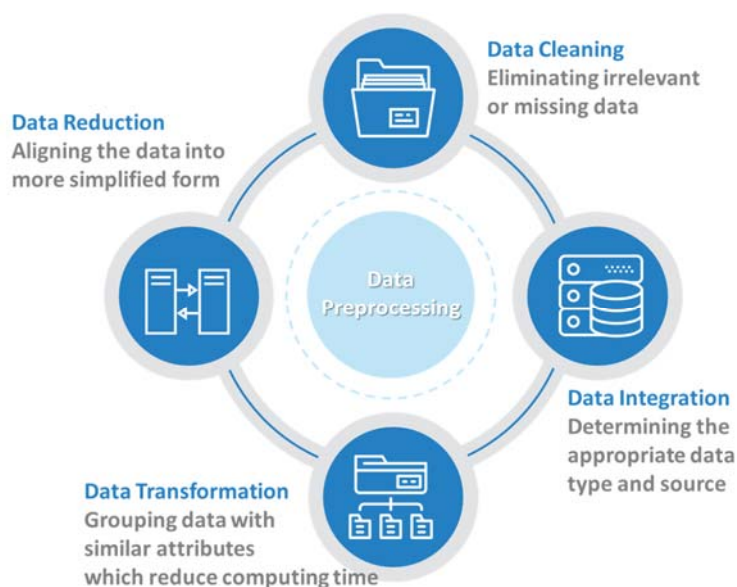


Figure 3: The Data Preprocessing Methods

Step 2: the generation of transfer flow routes and an initial feasible solution to the transfer flow model

We are using an enumerative search technique to identify all possible routes (R_{ijk} in the model). As shown in Table 2, for example, the route from Taipei Zoo(BR01) to Nanshijiao(O01) via six ways. The first route through L_{17} and L_{19} . The second route through L_{17} , L_{16} , and L_{18} . The third route through L_{15} , L_8 , L_5 , L_4 , L_6 , L_{13} , and L_{18} , and so on. The purpose of generating an initial feasible solution is to provide a starting solution in the transfer flow of the Taipei Metro System for route development. The initial feasible solution for our algorithm was provided by the first incumbent solution of a linear programming procedure. For this step, we query the selected routes (the set-up variables, R_{ijk}), also matching getting in and exiting stations of the dataset in this case. Then, record the transfer flow of this case if the passenger could get in and exit the station while precluding transfer via the transfer station on the Taipei Metro system. Finally, we obtain the objective value, which is sum of the transfer flows for each recorded case (routes).

Table 2: The Route of Transfer Station in Taipei Metro

Route	L_1	L_2	L_3	L_4	L_5	L_6	L_7	L_8	L_9	L_{10}	L_{11}	L_{12}	L_{13}	L_{14}	L_{15}	L_{16}	L_{17}	L_{18}	L_{19}
BR01 to O01																	1		1
																1	1	1	
				1	1	1		1					1		1			1	
										1	1		1		1			1	
											1			1	1				1
					1		1	1						1	1				1

Step 3: the application of simulated transfer flow to the solution of the Taipei Metro system

The steps of our final implementation of the transfer flow are outlined below on the Taipei Metro system for route development. The algorithm was implemented through linear programming using software solutions (Microsoft Excel and Lindo). Furthermore, we need to only consider the effect of those decision variables that were altered in the trial solution (with respect to the objective function). Finally, the solver found an integer solution within tolerance. All constraints are satisfied.

THE SOLUTION AND RESULT

Linear programming was applied to obtain the solution of our proposed model. This solution from linear programming has proven that the proposed model can be implemented on the Taipei Metro system for route development. Additionally, the objective function compares the original route version and the new route development version of the Taipei Metro system. The results suggest that the objective function of the original route version is equal to 383,481 values, whereas the objective function of new route development version is equal to 335,055 values (the frequency of transporting without transferring). Apparently, the new route development achieves a reduction of ridership transfer flow of approximately 15% in the Taipei Metro system. On the other hand, the results of ridership statistics per station show that the Tamsui (R28) station and the Taipei City Hall (BL18) station are most crowded at rush hour. The new route development shows that a single route has a large amount of ridership station to decrease the transfer flow of the Taipei Metro system. The route development of the Taipei Metro system is depicted in Figure 4. The description of solution as shown in Table 3.



Figure 4: The Route Development of the Taipei Metro System

Table 3: The Description of Solution (Route Development)

	Route (Before)	Route (After)
Brown Line	from <i>Taipei Zoo</i> to <i>Taipei Nangang Exhibition Center</i>	from Nanshijiao to Taipei Nangang Exhibition Center
Red Line	from <i>Xiangshan</i> to <i>Tamsui</i>	from Taipei Nangang Exhibition Center to Tamsui
Green Line	from <i>Xindian</i> to <i>Songshan</i>	from Taipei Zoo to Xiangshan
Orange Line	from <i>Nanshijiao</i> to <i>Huilong or Luzhou</i>	from Xindian to Huilong or Luzhou
Blue Line	from <i>Dingpu</i> to <i>Taipei Nangang Exhibition Center</i>	from Dingpu to Songshan

CONCLUSIONS

This paper has presented a decision model for optimizing route allocation with linear programming in the Taipei Metro system. A linear programming model of the transfer flow problem has been developed and employed to illustrate the superior performance of our model over existing route development. Specifically, a direct computational comparison of the objective function value and statistical analysis between our proposed model and the existing route development indicates that our proposed model can provide better solutions. Further research should be conducted to analyze the maximum load of each station, especially the transfer station limit on the number of people, to determine the applicability of the route planning to other linear programming problems with decision variables.

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Influence of Online Consumer Reviews on Brand Choice

(Work in Progress)

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ABSTRACT

Social interaction encourages consumers to share information in the digital age. Many consumers use online reviews of products and services to support their brand choice. The concept of reference group explains how peers can influence consumer purchase decisions. Peers can exert influence on consumers in the forms of informational, utilitarian and value-expressive influences. This proposed study aims at examining how these three forms of reference group influence would affect consumers in using online consumer reviews when making a brand choice decision. It also explores the role of brand trust on the brand choice. This paper serves the purpose of providing a conceptual framework for developing further research.

Keywords: Reference group influence, informational influence, utilitarian influence, value-expressive influence, online consumer reviews, brand trust, brand choice

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INTRODUCTION

The growth of online communications has facilitated the reference group influence on the use of online consumer reviews of products and services in purchase decisions. Consumers use online review platforms to communicate and exchange opinions with other peer consumers who have similar purchase experiences (Cheung & Thadani 2012; Olbrich & Holsing, 2011). Peer consumer reviews are the source of information used by consumers to support their purchasing decisions. The peer consumers of these online social communities offer informational, utilitarian and value-expressive signals for their fellow consumers to follow. Previous research has shown that online consumer reviews affect a consumer's purchase decision (e.g. Huang & Chen, 2006; Park, Lee, & Han, 2007).

Consumers are engaged in sharing and listening to online consumer reviews in the buying decision-making process. These peer generated reviews, which are generally opinion-based by nature, may exert a positive or negative influence on consumers' purchase decisions as these reviews provide information that influences the extent to which consumers trust the brands, and subsequently affects the consumers' brand choice decisions. This paper intends to develop a conceptual framework to examine how the informational, utilitarian and value-expressive influences would affect the influential power of the online consumer reviews, and specifically, how the informational influence would influence consumers' trust in brands. It also intends to evaluate if online consumer reviews would affect consumers' level of trust in brands and their brand choice decisions. Finally, it examines whether brand trust and online consumer reviews are related.

CONCEPTUAL FRAMEWORK

Reference group influence

Reference group influence affects a consumer's buyer behaviour, including brand choice. Bearden and Etzel (1982) define a reference group as a group of people that influences an individual's behaviour significantly. Reference group influence shapes an individual's purchase decision (Childers & Rao, 1992) and the foundation of an individual's behaviour (Schiffman & Kanuk, 2015). Previous research has examined the reference group influence in brand and product choice (e.g. Hsu, Kang & Lam, 2006; Leguizamon, 2010; Tang & Fam, 2005). However, limited research was conducted to examine the independent effect of the informational, utilitarian, and value-expressive reference group influences in brand choice, in particular, utilitarian and value-expressive reference group influences (Kallgren, Reno, & Cialdini, 2000).

Previous research has divided the types of reference group influences in different categories. Burnkrant and Cousineau (1975) classified the reference group influence as informational and normative influences. Childers and Rao (1992) suggested that the reference group influence should be divided into informative and comparative influences. Park and Lessig's (1977) approach to examine the reference group influence including the informational, utilitarian, and value-expressive influences is commonly adopted in the study of buyer behaviour (e.g. Bearden & Etzel, 1982; Mangleburg, Doney, & Bristol, 2004; Rook, & Fisher, 1995).

Informational Influence

Informational influence is defined as the acceptance of information from another as credible evidence of reality (Mangleburg, Doney & Bristol, 2004). Consumers use friends, salespersons and publications as the source of information (Price, Feick & Higie, 1989). The source of information is further divided as a personal and an impersonal source (Ansari, Essegiaier & Kohli, 2000; Senecal & Nantel, 2004). Consumers can refer to the information provided directly from others, such as their peer consumers' online reviews, or indirectly by observing other people's behaviour. In the circumstances of online consumer reviews, consumers learn from the

experiences of their peer consumers through their reviews. When consumers accept the information from either the personal or impersonal sources and subsequently use the information to support their brand choice, it indicates that they believe the content as it reflects their value system. Consumers tend to seek information from available sources when they are faced with risk or uncertainty (Batra, Homer & Kahle, 2001; Childers & Rao, 1992), and it is expected that informational influence is related to brand trust. Therefore, the proposed hypotheses are:

H1: When consumers are more susceptible to informational influence, they will have a higher level of trust in brands which are reviewed positively by other peer consumers.

H2: When consumers are more susceptible to informational influence, they are more likely to accept online consumer reviews.

Utilitarian Influence

Bearden and Etzel (1982) define utilitarian influence as an individual's attempt to comply with others' expectation to avoid punishments or achieve rewards. A consumer will find it useful to meet the expectations of the others when he feels that he is likely to receive punishments or rewards from these significant others (Bearden & Rose, 1990; Mangleburg, Doney, & Bristol, 2004; Massara, Liu & Melara, 2010; Park & Lessig, 1977). For example, consumers might comply with other peer consumers' expectations when making a purchase decision if they feel that their peer consumers are aware of their choice. It can happen when consumers are part of the online communities. They are motivated to achieve rewards such as being praised by other online members for making a "right" brand choice. However, they may listen to the others to avoid sanctions such as being disagreed or disapproved by their peers in their corresponding reviews. Therefore, the proposed hypothesis is:

H3: When consumers are more susceptible to utilitarian influence, they are more likely to accept online consumer reviews.

Value-expressive Influence

Bearden and Etzel (1982) define value-expressive influence as an individual's attempt to conform to others' influence to support his self-image by associating himself with the significant others or by trying to be different from others. A consumer will respond to his reference group as he feels a need for psychological associations. Consumers need cues for possessions and use brands to develop their psychological connection with their peers. Previous research has suggested that consumers are motivated to maintain or enhance their self-concept about who they are, what they want to become and what they do want to be associated with (Markus and Nurius, 1986). They are deeply affected by their need to maintain and enhance their self-concept and self-esteem (Escalas and Bettman, 2003). The brands they choose and use is a way to create and express their self-concept (Bearden and Rose, 1990; Belk, 1988; Fournier, 1998). They take into account their peers' brand choice because these are signals of whether the self-concept associated with the brands would be accepted by the group (Muniz & O'Guinn, 2001). Consumers tend to seek information through online consumer reviews as they can be more certain about the brand choice. Therefore, the proposed hypothesis is:

H4: When consumers are more susceptible to value-expressive influence, they are more likely to accept online consumer reviews.

Online Consumer Reviews

Online consumer reviews can influence consumers' purchase decisions (Zhu & Zhang, 2010). Many consumers visit online social communities to read online consumer reviews before making a purchase decision. Previous research has indicated that reference group influence affects a consumer's brand decision (Orth 2005; Ratner & Kahn, 2002; Roper & Niece, 2009). Consumers are more aware of a brand when they observe their peer consumers' recommendations (Solomon, Bamossy, Askegaard & Hogg, 2016), which can be obtained from online consumer reviews. These peer consumers are regarded as members of aspirational reference group who offer a positive connection between the consumers and the brand (Escalas & Bettman, 2003), resulting in the influence on others' perception of the brand image. Hanna, Rohm and Crittenden (2011) suggested that peer consumers within an online social network accumulate their influential power over time when the frequency of using the online social network increases. Consumers are empowered through participation online and as such are more conscious about a brand choice by others (e.g. Bush, Martin & Bush, 2004; Muñoz Jr & Schau, 2005; Schouten, McAlexander & Koenig, 2007).

Previous research findings have supported that online consumer reviews have impacts on consumers' purchase decisions. Consumers make purchase decisions based on online recommendations and information they have reviewed (e.g. Dellarocas, Zhang & Awad, 2007; Liu, 2006). Senecal and Nantel's (2004) research findings suggested that consumers who received product reviews have a higher tendency to choose these products recommended by their peer consumers. However, the extent to which online consumer reviews would affect consumers' purchase decisions can be moderated by product and consumer characteristics (Zhu & Zhang, 2010). Online consumer reviews reveal peer consumers' reputations when they post either their positive and negative comments. Hence, it is likely that online consumer reviews will positively relate to brand trust. The extent to which consumers trust the brand will positively relate to their brand choice decisions. Therefore, the proposed hypotheses are:

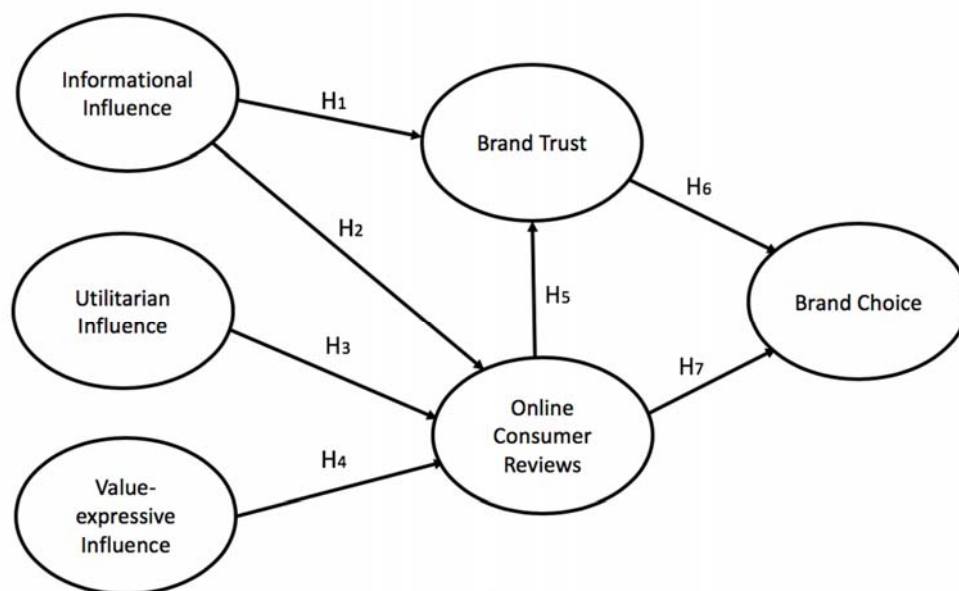
H5: When consumers are more susceptible to online consumer reviews, they will have a higher level of trust in brands which are reviewed positively by other peer consumers.

H6: When consumers are more susceptible to online consumer reviews, they are more likely to choose the brand recommended by their peer consumers.

Brand Trust

Brand trust is defined as the extent to which an individual is willing to rely on the ability of a brand to perform its function, despite the uncertainty or risk related to the brand (Becerra & Korgaonkar, 2011). Doney and Cannon (1997) suggested that trust reduces uncertainty when consumers feel unsure and vulnerable. They found that beliefs about reliability, safety, and honesty are factors consumers consider. The extent to which consumers believe in a brand is divided into cognitive trust beliefs and affective perception about the brand. Cognitive trust beliefs involve reliability, consistency, competence, and predictability of performance (e.g. Becerra & Badrinarayanan, 2013; Becerra & Korgaonkar, 2011; Chaudhuri & Holbrook, 2002). The affective perception about the brand drives consumers to view the brand focusing on the expectations of brand integrity, honesty, and benevolence (e.g. Becerra & Badrinarayanan, 2013; Becerra and Korgaonkar, 2011; Delgado-Ballester Munuera-Aleman, & Yague-Guillen 2003). Previous research has identified that brand trust affects brand-related behaviour including attitudes towards the brand, perception of brand value, purchase decisions and brand referrals (e.g. Delgado-Ballester et al., 2003; Elliott & Yannopoulou, 2007). Becerra and Korgaonkar (2001) concluded in their study that a high brand trust level leads to an increase in the intention to purchase the airline tickets. They also found that the interaction of the influence of the brand trust beliefs and product trust beliefs was significant for the intention to purchase teeth whitener (Becerra and Korgaonkar, 2001). Similarly, consumers are more susceptible to accept brands which are referred by others (Reichheld, 2003). Therefore, the proposed hypothesis is:

H7: When consumers have a higher level of trust in brands, they are more likely to choose the brand recommended by their peer consumers.



Source: This study

Figure 1 The proposed conceptual framework

PROPOSED DATA ANALYSIS APPROACH

Structural equation modelling will be used to test the suggested model in Figure 1. The proposed plan of analysis involves a preliminary examination of the data before the multivariate analysis. A set of measures with good measurement properties that will allow the assessment of the suggested model in Figure 1 will be developed. Following this, the analysis includes the estimation of the measurement model, and finally, it involves the estimation of the structural model, including assessing model fit and testing the seven hypotheses by examining the various path coefficients.

CONCLUSION

The proposed conceptual model focuses on the extent to which informational, utilitarian, and value-expressive reference group influences impact on consumers' response to online consumer reviews posted by their peer consumers. It is expected that informational reference group influence is likely related to brand trust. When the consumers are more susceptible to informational influence, they will have more trust in brands. The more consumers feel positive about their peer consumers' online consumer reviews, the more they will trust those brands reviewed by their peer consumers. Consequently, brand choice is affected by brand

trust and online consumer reviews. The proposed research aims at identifying the relationships among the variables. It is expected that the findings will provide relevant information to support online marketing strategies.

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Kansei-Engineering-Based Method for Improvement of Cross-border E-commerce Service: From the Perspective of Customers' Emotional Perceptions

(Work in Progress)

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ABSTRACT

With the rapid development of the Internet, cross-border e-commerce has become an important channel for promoting international trade. Simultaneously, more and more customers express their views and comments on cross-border e-commerce services on the Internet. To understand and satisfy customers' requirements, it is required to find out helpful information from consumer feedback and make an improvement as soon as possible. The relevant firms will provide a more friendly and satisfactory service for customers by this way. Cross-border e-commerce will also achieve a better development. Therefore, this study proposes a method which combines text mining and Kansei engineering to analyze cross-border e-commerce service. Kansei engineering (KE) is a kind of approach to design the elements which transforms customers' affective and emotional perceptions into products and services. Therefore, this study applies a KE-based approach to analyze the associations between service elements (property space) of cross-border e-commerce and customers' emotional perceptions (semantic space), and provides a new idea for further improvement of cross-border e-commerce service.

Keywords: Cross-border e-commerce service, consumer feedback, Kansei engineering.

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INTRODUCTION

With the progress of the Internet technology, e-commerce has become an important driving force to world economy in the 21st century, especially cross-border e-commerce. Consumers are able to purchase products and services directly which may be unavailable or expensive in their home countries from online marketplace, despite of the difference in languages and currencies between consumers and merchants (Hsiao, Chen, & Liao, 2017). This business activity is called cross-border e-commerce and has been growing in recent years because of the advances in international payment security, payment methods and logistics, language barriers, and so on. Nowadays, cross-border e-commerce has become an important channel for promoting international trade. Therefore, it is an important issue to understand how cross-border e-commerce customer feedback and satisfaction are jointly influenced by customers' emotional perceptions and cross-border e-commerce service elements. Because the success of cross-border e-commerce depends on the degree of consumers' satisfaction and the number of potential buyers, thus a better service is required for meeting consumers' high requirements and expectations for cross-border e-commerce service such as good service quality and attitude, fast logistics and more choice, etc. (Mou, Shin, & Cohen, 2016).

For better service improvement, some researchers collected data from a leading cross-border e-commerce firm in China to explore the topics of feedback posted directly by their customers. Then, the Latent Dirichlet Allocation (LDA) model was employed to explore the potential topics focused on most by consumers (Mou, Ren, Qin, & Kurcz, 2018). This paper plans to collect consumer feedback from cross-border e-commerce platform. Through collecting, reading and analyzing consumer feedback, consumers can make a better purchase decision, and cross-border e-commerce firms may have a good understanding of consumer' needs. Therefore, service quality of cross-border e-commerce will be improved. Kansei engineering (KE) is an approach to transform the elements which satisfy customers' affective and emotional perceptions into products and services (Schütte*, Eklund, Axelsson, & Nagamachi, 2004). Therefore, the main purpose of this study is to use KE approach to analyze consumer feedback and the associations between service design elements of cross-border e-commerce and customers' emotional perceptions. It will provide a new idea of transforming the elements of customers' affective and emotional perceptions into cross-border e-commerce service. Meanwhile, this study provides reference for firms to develop cross-border e-commerce service strategies and designs, and it can also help them understand the key factors which facilitate such commerce.

The rest of this paper is constructed as follows. In Section 2, we review the cross-border e-commerce, consumer feedback and Kansei engineering. Section 3 illustrates the study framework and methodology. In Section 4, conclusions are made, and the limitations and suggestions for future research are described.

LITERATURE REVIEW

Cross-border e-commerce and related work

In recent years, as a hot field of Chinese e-commerce, cross-border e-commerce has become the fastest growing sector of the whole Chinese e-commerce (Xue, Li, & Pei, 2016). Cross-border e-commerce is a new mode of international trade utilizing the Internet and the e-commerce platform as its medium (Jiao, 2016). It can shorten the distance between products and markets in time and space, through information and capital flow and logistics efficient integration. Therefore, cross-border e-commerce will become the main method of promoting trade facilitation and upgrade trade development mode (Xue, et al., 2016). In general, cross-border e-commerce occurs when multiple parties in different consumers' areas conclude a transaction involving cross-border logistics via cross-border e-commerce platforms. Typical parties involved include two subjects (buyer and seller), e-commerce platform (cross-border online platform), and other third-party service firms (cross-border logistics provider and payment provider). The seller utilizes the online e-commerce platform to sell products; the international buyer utilizes the online e-commerce platform to order the products; and the third parties (e.g. logistics firms or payment firms) conclude the cross-border transactions (Mou, Cohen, Dou, & Zhang, 2017). The characteristics of cross-border e-commerce are multilateral, direct, small-amount and high-frequency (Wang, Chai, Liu, & Xu, 2015). Currently, China's e-commerce is in a period of great development. As the main body of e-commerce in China, cross-border e-commerce platform is developing well with its strong vitality (Xue, et al., 2016).

Extant researches on cross-border e-commerce are mainly focusing on the different determinants of successful transaction between buyers and sellers, such as reputation, word of mouth and so forth which lack the reasons in depth for the success of cross-border e-commerce from seller's perspective (Cui, Mou, Cohen, & Liu, 2018). Some researchers suggest that the main motivation for cross-border e-commerce is economic advantages of product price, product quality, service provided by sales person, store facilities and variety of product selections in cross-border region (Wang, 2004). However, from views of sellers and consumers, it is generally recognized that cross-border commerce has more complexities and risks compared with domestic e-commerce (Lesma & Okada, 2012; Guo, Bao, Stuart, & Le-Nguyen, 2017). In cross-border e-commerce, buyers, sellers, the platform and third parties show more complicated interaction processes and there may be greater uncertainties for consumers (Mou, et al., 2017). Consumers will face uncertainties such as increasing information asymmetry, private information misuse, and trust on sellers. Thus, this has been emphasized as an important factor to the success of cross-border e-commerce (Guo, Le-Nguyen, Jia, & Li, 2015). Anyway, whether to provide a satisfactory service and product or not is the most important question that consumers concern about. It is also a vital factor for cross-border e-commerce to grow rapidly (Lesma & Okada, 2012).

To summary, consumers' satisfaction is closely related to the success of the cross-border e-commerce. Although cross-border e-commerce brings numerous benefits, consumers may still have worries and concerns about it such as uncertainties, private information misuse and trust on sellers. Previous studies have showed that cross-border e-commerce satisfies consumers' needs and provides them with benefits sought, including value, relaxation, pleasure, variety seeking, sensation seeking or a learned experience (Sullivan, Bonn, Bhardwaj, & DuPont, 2012). However, consumers still have a variety of dissatisfaction (e.g. terrible service attitude, poor product quality, slow logistics, etc.) with cross-border e-commerce service. At present, there are few researches on how to improve cross-border e-commerce service from the perspective of customers' emotional perceptions and satisfaction. So this topic should get more attention.

Consumer feedback and related work

With the surge of information and communication technologies, consumers are able to express their feedback even complains more easily and quickly through the Internet than traditional media. Its effect is becoming enormous in consumers' daily lives (Wu & Huang, 2015).

Consumer feedback includes positive feedback and negative feedback. Positive feedback can provide various positive implications behavior, including guidance to develop innovative products or services and opportunities to redress consumers' problems (Wu & Huang, 2015). However, when consumers encounter service failures or product dissatisfaction, they are more likely to engage in complaining behaviors to resolve the problems (Bach & Kim, 2012). Therefore, negative feedback could be more attention grabbing in general and be more useful, which ultimately has a stronger effect on consumers' evaluations than positive feedback (Homer & Yoon, 1992; Park & Nicolau, 2015).

Consumer feedback is the critical sources of product/service feedback. Firms cannot acquire the crucial information regarding the sales losses if consumers do not provide feedback. By collecting and analyzing the consumer feedback, firms can have a good understanding of consumers' needs and make some improvements according to consumers' needs. Therefore, consumer feedback is essential for the development of cross-border e-commerce (Sparks & Browning, 2010).

Consumer feedback can offer indirect experiences about products and their dominant attributes. It plays an important role as an informant and a recommender of products (Bae & Lee, 2011). Consumer feedback enables people to obtain detailed information with high trustworthiness and credibility compared with the information provided by marketers (Park & Nicolau, 2015). According to prior research, it is found that consumers are more likely to be influenced by other consumers' opinions. People often refer to others' opinions or experiences before spending on some products about which the quality they are uncertain. The feedback from other users can serve as a quality index for a product of interest. Thus it can potentially reduce the quality uncertainty faced by a potential customer and confer a higher degree of confidence to the consumer's purchasing decision (Schubert & Ginsburg, 2000). As a result, there are some reasons to believe that positive consumer feedback may reduce quality uncertainty and increase product sales, and thus promote the development of cross-border e-commerce (Chen, Wu, & Yoon, 2004).

In summary, for cross-border e-commerce, service quality gradually becomes a critical factor determining customers' satisfaction and emotional perception. Previous studies showed that consumer feedback can reflect customers' satisfaction and emotional perceptions with cross-border e-commerce services (Wu & Huang, 2015). For example, consumers will give negative feedback if they are dissatisfied with the products or logistics. However, these studies mentioned above are mostly focused on the relationship of consumer feedback and satisfaction. This study will, from the perspective of customers' emotional perceptions feedback, analyze the relationship between consumer satisfaction and cross-border e-commerce service using KE method, in order to promote the improvement of cross-border e-commerce service.

Kansei engineering

Kansei is a Japanese word. When translated into English it might mean 'consumer's psychological feeling and image' (Hsiao, et al., 2017). Kansei engineering is a proactive product development methodology which translates customers' impressions, feelings and demands on existing products or concepts into design solutions and concrete design parameters. This approach was developed in the early 70s at the University of Hiroshima, through the work of Mitsuo Nagamachi. Since then many companies and universities in Japan have adopted the methodology (Schütte*, et al., 2004). It is a customer-oriented product development method, and it does not focus on the manufacturer's intention of the product, but rather on the customer's feeling and needs.

Kansei engineering is mainly a catalyst for a systematical development of new and innovative solutions, but can also be used as an improvement tool for existing products and concepts (Schütte*, et al., 2004). Kansei engineering can provide some help for product designers by establishing and analyzing relationships between customers' feelings and corresponding designs. It also supports the consumer in choosing a product that fits his/her feeling among various products (Chen, Hsu, Chang, & Chou, 2015). Kansei engineering is based on subjective estimations of product and concept properties. It gives expression to the demands on the products which customers are not aware of, by using semantic tools developed by Osgood (Hsiao, et al., 2017).

METHODOLOGY

This study proposes a KE-based approach to analyze the associations between service design elements of cross-border e-commerce service and customers' emotional perceptions, then to provide a new idea of designing the elements of consumers' affective and emotional perceptions into cross-border e-commerce service, shown in Fig. 1. According to the KE method, this approach consists of four phases: Phase 1 is to choose the product domain. Phase 2 is to span the semantic space and property space of the cross-border e-commerce service. Phase 3 aims to build the relationship between semantic space and property space, and test the validity of semantic space and property space. Phase 4 is model building. The factors that influence consumers' emotional perception can be found out by analyzing the model.

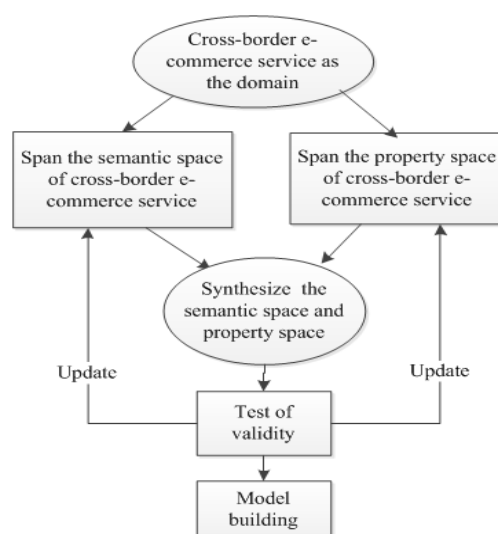
The four phases of the proposed KE-based approach are detailed as follows.

Choose the product domain

Selecting the domain includes the selection of a target group and the specifications of the new product. Based on this information, product samples which represent the domain will be collected. The Kansei domain can be understood as the perfect idea behind a certain product (Schütte*, et al., 2004). Kansei engineering method in this work will be used to study the whole service of the cross-border e-commerce, including platform, products, logistics, customer service, etc.

Span the semantic space and property space

The purpose of this stage is to span the emotional semantic space and the space of the cross-border e-commerce service elements. Text-mining-based analysis will be employed as the first screening methods, which are followed by secondary screening based on expert knowledge.



Source: This study.

Figure 1: Kansei engineering method.

Span the semantic space

A Kansei word is a word used to describe the selected domain. In this step, the Kansei words which are generally used to express the emotional perceptions of cross-border e-commerce service are extracted to establish the semantic space (Schütte*, et al., 2004).

(1) Text-mining-based analysis

The part of text-mining-based analysis includes two steps:

The first step is: Filter by the Part Of Speech (POS). The POS is the first filtering consideration, because Kansei words are always adjectives. For example, adjectives will be used like quick and slow when describing the logistics of cross-border e-commerce service. The POS will be conducted on all text feedback, and the tagging adjectives will be screened out.

The second step is: Frequency statistics of words. The frequency of the marked adjectives will be counted, and the higher-frequency words (the top 200) will be extracted (i.e. 'good', 'different', 'expensive', 'multiple', etc.). The higher the frequency is, the more frequently words are used.

(2) Secondary screening

In secondary screening, expert knowledge will be employed in a supporting role to optimize the set of Kansei words. There are six experts to do the secondary screening, three experts with the background of Kansei engineering and three experts with the background of cross-border e-commerce. The steps of the secondary screening are as follows:

Step 1: The words and terms that are close in meaning or less important or incorrect will be eliminated (e.g. these words, like 'good', 'nice', 'great' and 'fine' are close in meaning, and 'such', 'able' and so on are considered less important or incorrect.). Then the Kansei words that are not extracted by the text mining method will be added.

Step 2: An affinity diagram technique, also known as the KJ method, will be used to group the semantically-identical words and terms (e.g. 'horrible', 'terrible', 'frustrating' and 'disappointed'). According to their affinity, one relevant word or term is chose to represent the others in the group.

Step 3: The final identified Kansei words which form the semantic space will be discussed with and confirmed by professional senior managers and experts in the cross-border e-commerce domain (Hsiao, et al., 2017).

Span the property space

Span the property space has the same procedure as spanning the semantic space. The service elements (e.g. website design, product quality, logistics speed, payment method, and so on) presented in online feedback texts are mostly nouns. Filtering by POS and frequency statistics of service elements will be also used to extract the top 200 nouns. Then experts' knowledge will be employed to revise and optimize service elements. The similar, incorrect and less important service elements will be eliminated (e.g.

'account' and 'number' are similar, 'i', 'm', '/', and so on are incorrect, 'work', 'anything', 'example', and so on are less important words.). Finally, professional senior managers and experts will discuss and confirm the final service elements.

Build the relationship of semantic space and property space

By questionnaire and the statistical method of Partial Least Squares (PLS), the relationship between Kansei words (semantic space) and cross-border e-commerce service elements (the space of properties) will be established. Then, testing the validity of the relationship and building model will be conducted.

Synthesize the semantic space and property space

In the synthesis step, the semantic space and property space will be linked to understand the relationship between service elements and Kansei words. For this purpose, it is required to collect customers' Kansei evaluations of the stimuli by questionnaire survey (A stimulus is a service sample presented by the combination of one selected attribute in each service element of the property space, which is a possible outcome of service design (Hsiao, et al., 2017)). Then the relationship between the semantic and property space may be clear by analyzing collected data.

(1) Questionnaire design

This study will employ a web-based questionnaire survey to protect respondents' anonymity and overcome time and place constraints. A web-based survey helps to reach respondents more easily than with other survey methods such as interviews and other self-administered survey techniques. The questionnaire survey will be conducted by asking respondents to evaluate the predefined cross-border e-commerce service system samples (stimuli). It will use each of the Kansei words in the semantic space to obtain consumers' kansei responses. The respondents in this questionnaire survey are the sellers of cross-border e-commerce service. Each respondent will spend about ten minutes completing the questionnaire, and the incomplete questionnaire responses will be eliminated. The questionnaire consists of three parts. The part 1 is relevant information of respondents including gender, age, education level, annual sales, experiences of selling online, etc. As suggested by Nagamachi, it is appropriate to have 10-20 stimuli including the one for benchmarking to implement questionnaire survey (The only one attribute adopted in each service element is randomly determined except the stimulus S1 which is designed as a benchmark service.) (Schütte*, et al., 2004). Thus this study will use 12 stimuli to serve as the service sample and pick out 2 randomly. The first one of the selected two stimuli will represent the first cross-border e-commerce service example. It will be assigned to the part 2 of the survey questionnaire in text description for respondents to evaluate their emotions and Kansei perceptions regarding Kansei words in five-point Likert scale, anchored by 1 = strongly disagree and 5 = strongly agree. The second one of the selected two stimuli will be assigned to the part 3 of the survey questionnaire for the same purpose.

(2) Data collection and analysis

In this part, descriptive analysis will be conducted on the data collected from the part 1 of the questionnaire, which can be summarized as tables for statistics. The data collected from the part 2 and part 3 will be statistically analyzed by SPSS software. Then, the relationship of the service elements and Kansei words can be obtained by data analysis above. For every Kansei word, a number of service elements in cross-border e-commerce will be found, affecting the Kansei word. For example, the Kansei word 'friendly' may arise because of good service attitude.

Test of validity

This validity test will be done to check if the synthesis is reliable. It is necessary to update the property space and the semantic space if the validity fails. A factor analysis will be conducted from the gathered customers' evaluation data to spot the words which have no effect on the Kansei. Conventionally, variables that have a factor loading of 0.4 or greater within a particular factor are considered to be its major components. This will be then fed back to the semantic space and property space if validation fails. Additionally, Cronbach's α will be used to perform the reliability analysis. It is greater than 0.70, which indicates a high reliability for the synthesis above (Chen, et al., 2015; Hsiao, et al., 2017).

Model of building

The model is a function depending on the service elements and the Kansei score for a certain word:

$$y_{\text{kansei}} = f(\text{service elements}) \quad (\text{Schütte*}, \text{et al.}, 2004) \quad (1)$$

For example, one of the results in this study shows that the score of the Kansei word 'satisfied' is affected by five service elements, of which the product quality, the speed of logistics and service attitude are the most significant. Once the validity tests give a sufficient result, the data gathered from the synthesis step will be presented as models to investigate the relationship between Kansei words and service elements. By analyzing the models, new idea for the design and improvement of cross-border e-commerce service will be obtained.

CONCLUSION

The service quality of cross-border e-commerce is likely to be a critical factor in determining consumers' emotional perceptions and satisfaction. For a cross-border e-commerce service provider, how to improve the level of cross-border e-commerce service

and attract further new consumers is an urgent issue. This study explores the implementation of Kansei engineering to analyze the associations between service design elements of cross-border e-commerce and consumers' emotional perceptions. It integrates text-mining-based online content analysis into the conventional expert-knowledge-based approach to improve overly subjective expert opinions. The findings of this study will provide significant implications for the design of cross-border e-commerce service.

The future work will be conducted as follows. First of all, text mining method will be used to analyze consumer feedback and extract Kansei words and service elements related to cross-border e-commerce service. Furthermore, we will eliminate Kansei words and service elements that are similar in meaning or considered incorrect and add the words that are not covered in text mining method. Then, the questionnaire survey will be carried out. Finally, we will analyze the results based on the collected results and build model of the relationship of Kansei words and service elements.

However, some limitations still need to be addressed in the future. Firstly, the materials of this study have a limited application scope such as experts, online contents, test subjects, etc. Therefore, the results may not be fully applicable to all cross-border e-commerce services in the world. Secondly, the Kansei words and service elements (attributes) might not be completely identified in this study. Further improvement is still required. Thirdly, consumers' feedback on cross-border e-commerce service may not fully represent all consumers. Future study should be conducted in a more comprehensive way.

ACKNOWLEDGEMENT

This research was supported by the National Natural Science Foundation of China under Grant 71573199, as well as the Fundamental Research Funds for the Central Universities of No.JBX180604, 20103176477.

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On the Potential of Socioeconomic Characteristics to Understand the Adoption of Information Technology

(Work in Progress)

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ABSTRACT

We suggest to use publicly available large-scale socioeconomic data to examine the utility of demographic and social characteristics as proxies for constructs of technology adoption models. Such characteristics can be sourced from socioeconomic surveys in several countries. We suggest a model associating constructs of a technology adoption model with proxies available in socioeconomic surveys. It is discussed that managers and policymakers assessing scenarios for new technology introductions may be given easier to handle indicators in form of demographic and social characteristics to understand important drivers of technology acceptance.

Keywords: Technology adoption, socioeconomic surveys, publicly available data

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INTRODUCTION

The developments of consumer information and communication technologies (ICT) have created a multibillion dollar industry that enables consumers to use a diverse set of ICT such as smart mobile devices, mobile apps and services (e.g., cloud storage). ICT advancement and the growth of affiliated industries have been accompanied by research targeted at understanding how individuals accept and adopt ICT.

Existing research models and empirical analyses on technology adoption research generally use research instruments which demand significant resources to gather data because of their complexity (e.g., Davis 1989, Davis *et al.* 1989, Elie-Dit-Cosaque *et al.* 2011, Neufeld *et al.* 2007, Venkatesh *et al.* 2003, Venkatesh *et al.* 2012). This complexity is necessary to further our knowledge in the area of technology adoption. Yet, for practical application complex instruments may be suboptimal. A manager who needs to select employees to use new systems may not have the time or expertise to run elaborate questionnaires in order to best match employees with technology.

This study investigates the potential of socioeconomic information to draw inferences about technology adoption. Our investigation does not suggest that socioeconomic factors can replace technology adoption models (TAMs) that are based on precise measures and have facilitated an in-depth understanding of human behaviour. Socioeconomic factors can, however, provide an additional view on associations regarding technology adoption that could help practitioners. An example of the use of such data to further our understanding in the context of financial risk-willingness constitutes Schneider, Fehrenbacher & Weber (2017).

In this paper, we use Venkatesh *et al.*'s (2012) technology adoption model (unified theory of acceptance and use of new technology model; UTAUT2) as the underlying theoretical lens. The UTAUT2 can be used to determine consumer's technology adoption in a wider social context. We suggest that several demographic and social characteristics can be used as proxies for the UTAUT2 constructs. Consequently, managers assessing scenarios for new ICT introductions may be given "easier to handle" indicators to understand the drivers of ICT acceptance. This may assist managers in proactively designing interventions (e.g., employee training and marketing) targeted at populations of users or consumers that may be less likely to adopt and use new systems.

In order to identify ICT-use related questions in socioeconomic panels, twelve panels from the LWS Database (Luxembourg Wealth Study Database 2015) are reviewed. Importantly, some of the reviewed panels provide explicit opportunities for researchers to add questions to an upcoming panel wave. The data on online banking in Italy and Austria constitutes the most comprehensive collection in our review and should be used in future research to test our model's predictions.

This paper is structured as follows. First, a brief overview of technology adoption models is given and the UTAUT2 is introduced. Subsequently, some background on socioeconomic panels is provided. Then, potential demographic and social characteristics for approximating the latent constructs of UTAUT2 are discussed and the UTAUT2 proxy model is presented. Finally, the study is concluded and future research avenues are suggested.

BACKGROUND ON TECHNOLOGY ADOPTION MODELS

The technology acceptance model (TAM) (Davis 1989, Davis *et al.* 1989), one of the most widely employed models of IT usage (Venkatesh 2003), is derived from the theory of reasoned action (TRA) and theory of planned behaviour (TPB) (Ajzen 1991, Fishbein & Ajzen 1975). TAM measures perceived usefulness and perceived ease of use as predictors of a user's intent to use IT, and their actual usage on the job. The model focuses on organizational users and has received considerable empirical support. It has undergone a variety of adaptations and extensions.

They can be broadly classified into two types: new *constructs* (endogenous or exogenous predictors) and new *contexts*.

First, a variety of new *constructs* have been proposed to explain technology adoption. The focus has been in testing endogenous constructs. For instance, Venkatesh *et al.* (2003) introduce and empirically test performance expectancy, effort expectancy, social influence and facilitating conditions as main predictors and gender, age, experience and voluntariness of use as moderating predictors for *users' intent* to use IT and for their *actual usage* on the job. Taylor and Todd (1995) show that the endogenous variable perceived behavioural control is a determinant of technology usage. Elie-Dit-Cosaque *et al.* (2011) focus on the perceived behavioural control variable and describe internal forces (computer anxiety and personal innovativeness with IT), external forces (managerial support, quantitative overload, qualitative overload and managerial support) as well as several individual differences (age, gender, education, ICT experience and work status) as determinants of perceived behavioural control. Neufeld *et al.* (2007) demonstrated the influence of the exogenous variable 'project champion charisma' on technology adoption.

Second, technology acceptance has been investigated in various organizational and non-organizational *contexts*. The TAM or extended TAM models have been put into new contexts, such as new user populations (e.g., physicians: Yi *et al.* 2006), new technologies (e.g., e-commerce perspective: Grandon *et al.* 2011; corporate web services: Kim & Olfman 2011; online games: Zhu *et al.* 2012), or new cultural settings (e.g., Sub-Saharan Africa: Musa *et al.* 2005; India: Gupta *et al.* 2008; Thailand: Lertwongsatien & Wongpinunwatana 2003).

These constructs and context extensions have been valuable in enhancing our understanding of ICT adoption. However, there have been limited and inconclusive findings on the influences of individual differences in technology adoption. One reason may be that in TAMs, individual differences are subsumed along with situational constraints and managerial interventions into external and control variables and are not further discussed. Venkatesh *et al.* (2003) were one of the first to draw their attention to individual differences (gender, age, experience) by modelling them as moderating variables. Venkatesh *et al.* (2003) find influences of age, gender and experience on usage behaviour in organizational contexts of several industries (entertainment, telecommunication, banking and public administration). In contrast, Gupta *et al.* (2008) do not find an influence of gender on the adoption of technology in eGovernment.

If one were able to establish individual differences as apparent predictors for behavioural intention and system usage, managers controlling their employees within organizations or targeting consumer markets could be given more straightforward guidelines. In this paper, we use Venkatesh *et al.*'s (2012) *unified theory of acceptance and use of new technology model for consumers* (UTAUT2) as the underlying model because it examines technology adoption in a wider social context. UTAUT2 is based on the unified theory of acceptance and use of new technology (UTAUT) (Venkatesh *et al.* 2003).

BACKGROUND ON SOCIOECONOMIC PANELS

The data reviewed is from the *Luxembourg Wealth Study Database (LWS)*, which provides harmonised socioeconomic data from twelve countries. At the time of review twelve countries were included in the database: Austria, Canada, Cyprus, Finland, Germany, Italy, Japan, Luxemburg, Norway, Sweden, UK and the USA. From the socioeconomic surveys of the twelve countries (see Table 1), two surveys – the Italian and Austrian surveys – have administered questions on the use of ICT. Both surveys ask questions regarding the use of online banking.

The Italian data originates from the Survey of Household Income and Wealth (SHIW) administered by the Bank of Italy. The data was collected in the subsequent years of the reference period, i.e. for 2002 between February and July 2003, and for 2004 between February and July 2005. It is a cross-sectional and partly longitudinal interview survey. By means of a structured questionnaire, the interviewers asked questions and assessed answers. The focus of the survey is to provide information on household microeconomic behaviour within Italy. Information includes demographic characteristics, income, wealth and expenditure. In 2002 and 2004, approximately 8,000 households were sampled with a two-stage stratified sampling, with the stratification of the municipalities by region and demographic size. The unit and item non-response rates were reported to be 50% and 5% respectively, although it is

higher for the online banking question. The interviewed individuals are household heads (an individual who is primarily responsible for the household budget).

The Austrian survey is called the Survey of Household Financial Wealth and is administered by the Oesterreichische Nationalbank (National Bank of Austria). Data collected includes income, household composition, assets, debt, wealth and use of online banking. In 2004 2,556 households were interviewed in a multistage, stratified sampling design.

Table 1: Research Design

Step	Technology Adoption Model Review (1)	Socioeconomic Survey Review for IT related Questions (2)	Classification of Proxies (3)	Future Research Directions (4)
Input	TRA (Fishbein & Ajzen, 1975) TAM (Davis <i>et al.</i> , 1989) TPB (Ajzen, 1991) UTAUT (Venkatesh <i>et al.</i> , 2003) HIS (van Heijden, 2004) UTAUT2 (Venkatesh <i>et al.</i> , 2012)	Austria Canada Cyprus Finland Germany Italy Japan Luxemburg Norway Sweden UK US	UTAUT2 Demographic and social characteristics of Socioeconomic Surveys	Request that panels incorporate other IT-related questions (e.g., the socio-economic panel Germany ‘SOEP’ allows requests) Longitudinal Study on Italy Cultural Comparison of Italy 2002/2004 and Austria 2004
Outcome	UTAUT2 (Venkatesh <i>et al.</i> , 2012)	Austria Italy	UTAUT2 Proxies Model	

UTAUT2 PROXIES MODEL

There are nine *constructs* in UTAUT2. Figure 1 shows the constructs of UTAUT2 and potential socioeconomic proxies of those constructs available in public surveys. In the context of online banking the suitability of potential proxies for UTAUT2 constructs is discussed.

Performance expectancy is defined as the extent to which using a technology will provide benefits to a consumer in performing activities. Once technology is implemented, it may facilitate and often speed-up transactions (Laudon and Laudon 2013). In the context of online banking, users who possess their own business activities are likely to be in need of more transactions, which is why they may expect higher performance results of the system overall.

Effort Expectancy refers to the degree of ease associated with consumers’ usage of technology. Age has been known to influence attentional demands or the ease of learning new things (Anderson *et al.* 1998, Smyth & Shanks 2011). One reason is that the perceived effort of learning increases with age. Thus, in the underlying context, age may have a general effect on online banking usage.

Social influence refers to consumers’ perceptions of important related individuals. Related individuals may influence particular technology adoption. Also children may exert such a peer-pressure. Individuals with children may be more likely to adopt contemporary ICT.

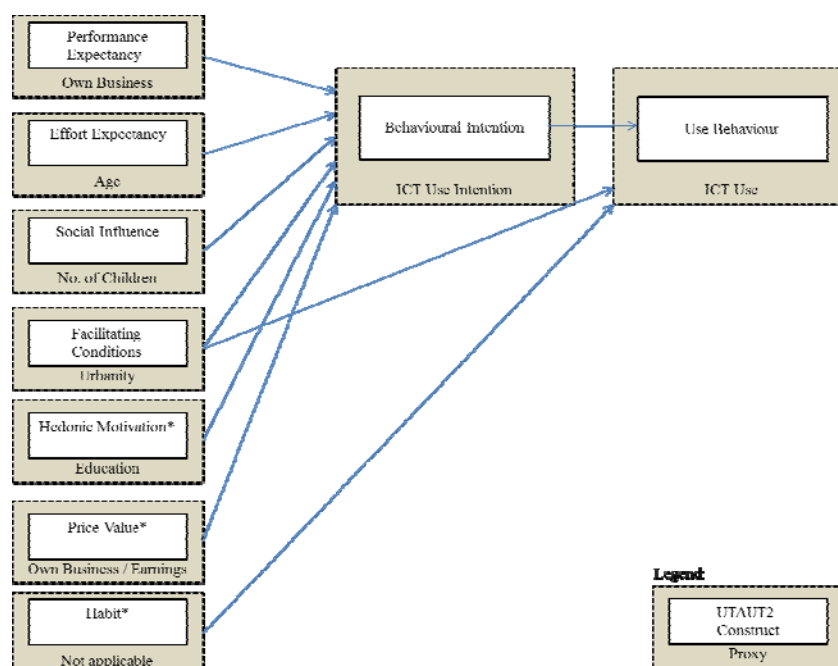
Facilitating conditions are the extent to which consumers perceive the availability of resources and support to perform actions. For this setting and ICT in general, more support can be expected in urban areas. For example, branches of banks from which technological support can be obtained may be closer or general courses which teach IT usage may be more readily available.

In the online banking setting, *hedonic motivation* refers to the pleasure derived from using ICT and is likely to play a minor role as the goal of the technology is oriented towards managing private financial circumstances. Nevertheless, to a certain extent, individuals who engage in formal education can be expected to find pleasure in acquiring new skills and knowledge. Thus, they may be more likely to adopt contemporary ICT just for the sake of acquiring new skills and experiencing pleasure.

Price Value refers to consumers' cognitive trade-off between perceived benefits and monetary costs of applications. ICT often benefit from economies of scale (Laudon & Laudon 2013). Once ICT are implemented, the marginal cost per additional transaction is close to zero. Thus, individuals who expect more transactions may perceive a more favourable cost/benefit ratio. It seems likely that people engaging in their own business activities do more bank transactions and thus, are more likely to adopt online banking. Another line of thought may be that individuals with higher earnings tend not to perceive as much disutility from costs as individuals with lower earnings; thus, leading to a more favourable cost/benefit ratio for higher incomes and a higher probability for IT adoption. Price value is also one major difference in technology adoption consideration between consumers and organizational users. Consumers, unlike employees, are responsible for costs incurred in the adoption of technology. Cost considerations can influence consumers' product decisions and hence technology adoption (Coulter & Coulter 2007).

Habit captures the degree to which individuals perform certain behaviour automatically and may reflect the results of prior *experience*. Experience refers to prior technology usage. The idea is that past technology use influences future technology use and adoption. These constructs are not applicable in this context as only the actual use of technology is taken as an outcome measure.

It needs to be noted, that the linking of UTAUT2 constructs to socioeconomic data is not mutually exclusive. It is, for example, conceivable that urban individuals have a stronger peer-pressure to use certain systems because of city trends. This may link the urban/rural indicator to UTAUT2's social influence construct. Another rational may be that children can influence the perception of the availability of support and may be seen as facilitators in the adoption of technology. Thus, the associations between the UTAUT2 constructs and the socioeconomic proxies are tentative and should be empirically examined.



Notes: Asterisks highlight the constructs which are relatively more important in consumer contexts than in organizational contexts and thus appear in the UTAUT2 (Venkatesh *et al.* 2012), but not in the UTAUT (Venkatesh *et al.* 2003).

Figure 1: UTAUT2 Proxies Model: unified theory of acceptance and use of technology in a consumer context (UTAUT2, Venkatesh *et al.* 2012) and demographic proxies for the theory's constructs

DISCUSSION

Our study suggests that the use of publicly available socioeconomic surveys is a potentially fruitful way to study technology adoption at a national and cross-national level. Our discussion suggests that several socioeconomic characteristics can be used as proxies in the UTAUT2 model.

While socioeconomic proxies might be more readily available than proxies based on survey instruments, they are not able to target precise psychological processes. Our investigation does not suggest that socioeconomic factors can replace TAMs that are based on precise measures and have helped us to understand human behaviour in more detail, but aims at adding an additional perspective

that could help practitioners and researchers understanding technology adoption within organizations, societies and also across countries.

In providing more readily observable proxies, managers and policymakers assessing scenarios for new technology introductions may use these indicators to understand the drivers of technology acceptance. We suggest some potentially useful proxies and provide a review on data sources. Information systems researchers can use these publicly available data sources to study ICT adoption on a cross-national and cross-cultural level. This, for instance, may eventually assist in proactively designing interventions (e.g., employee training, marketing, government initiatives) targeted at sections of the population that may be less likely to adopt and use potentially beneficial ICT.

Future research needs to empirically examine the validity of the suggested proxies. Researchers should also make requests that panels incorporate other IT-related questions. For instance, the socio-economic panel in Germany ‘SOEP’ considers requests.

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Proposing a New Research Framework for Loan Allocation Strategies in P2P Lending

(Work in Progress)

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ABSTRACT

One of the frontier Web 2.0 applications is online peer-to-peer (P2P) lending marketplace, where individual lenders and borrowers can virtually meet for loan transactions. From a lender's perspective, she not only wants to lower investment risk but also to gain as much return as possible. However, P2P lenders possess the inherent problem of information asymmetry that they don't really know if a borrower has capability to pay the loan or is truthfully willing to pay it in due time, leading them to a disadvantaged situation when making the decision of lending money to the borrower. This study intends to consider the loan allocation as an optimization research problem using the research framework based upon modern portfolio theory with the aim of helping lenders achieve the two goals of gaining high return and lowering risk at the same time.

The expected results of this research are twofold: 1) compared to a logistic regression based credit scoring method, we expect to make more profits for lenders with risk level unchanged, and 2) compared to a linear regression based profit scoring method, we expect to lower risk without lowering return. Our proposed new model could offer insights into how individual lenders can optimize their loan allocation strategies when considering return and risk simultaneously.

Keywords: Peer-to-peer lending, Loan allocation, Credit scoring, Profit scoring, Modern portfolio theory.

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INTRODUCTION

The arrival of Web 2.0 has brought us the incoming of online peer-to-peer (P2P) lending marketplace, which is a virtual place for individual lenders and borrowers to conduct loan transactions directly without intermediaries (Berger & Gleisner, 2009; Emekter et al., 2015). Since the foundation of the first online peer-to-peer lending platform Zopa in 2006 (Dorfleitner et al., 2016), an increasing number of similar platforms have grown and evolved (Feller et al., 2016), such as Lending Club in American and PPDai.com in China. Specifically, Lending Club, as one of the largest P2P lending platforms in U.S., has attracted more than 2 million customers and funded more than 24 billion due to the end of 2017. As a result of the elimination of a traditional financial intermediary, P2P lending is supposed to lower the transaction cost and increase market efficiency compared to traditional bank loans (Guo et al., 2016; Serrano-Cinca et al., 2015).

However, as lenders and borrowers perform their transactions in a virtual environment (Lin et al., 2013) without the involvement of financial intermediaries, they have insufficient information about each other. Particularly, as borrowers are better informed than lenders of their ability and willingness to repay, information asymmetries (Akerlof, 1970) arises, leading lenders to a disadvantage situation when making decisions. This subsequently results in adverse selection (Spence, 2002) and moral hazard (Petersen & Rajan, 2002) problems. As information asymmetry has become a severe problem for lenders in P2P lending, platforms always provide basic evaluation of loan risk for lenders to make investment decisions, which is often credit-rating based. For example, Lending Club has set up a 7-grade credit-rating system (Xia et al., 2017), and each grade contains 5 sub-grades.

Similarly, traditional credit scoring is usually a dichotomous classification problem and assigns "0" to default loans and "1" to non-default loans (Serrano-Cinca & Gutiérrez-Nieto, 2016). The goal of such methods is to distinguish good (i.e., those supposed to be fully paid) from bad (i.e., those supposed to default) loan applicants or to estimate the probability of default (Verbraken et al., 2014), and then those that the model predicts have a low likelihood of default are accepted, while those with a high likelihood are rejected (Finlay, 2010). As a result, loans with high default probability are always discarded, although some of them are actually with high profitability. However, besides seeking to minimize the percentage of consumers who default, P2P lending platforms also hope to know who are the most profitable (Thomas, 2000; Crook, Edelman & Thomas, 2007), as well as lenders in this market. Thus, there should be a trade-off between risk and return considering the effectiveness of a loan portfolio.

As Markowitz (1952) proposed, investors should consider expected return and risk simultaneously when making investment decisions, the hypothesis (or maxim) that the investor does (or should) maximize discounted return must be rejected. Similarly, rating-based credit risk assessment models, which are practical and have been widely utilized by financial institutions for issuing loans (Guo et al., 2016) should be considered more carefully. These models do not concern about the high profitability of some high-risk loans. In this paper, we are trying to formulate loan allocation as a portfolio optimization problem in the framework of modern portfolio theory, which combines return and risk simultaneously for decision making.

This paper intends to compare linear programming method based on modern portfolio theory with logistic regression based credit scoring and linear regression based profit scoring methods. Our study, therefore, extends the growing research on peer-to-peer lending. More specifically, our work contributes to the research literatures on investment recommendation based on modern portfolio theory in the context of online peer-to-peer lending. For instance, Guo et al. (2016) compared linear programming based on modern portfolio theory with rating-based models, whereas Xia et al. (2017) compared it with credit score and rating-based models. Compared to the methods in Serrano-Cinca and Gutiérrez-Nieto (2016), we try to show that 1) for logistic regression based credit scoring method, our framework derives more profits for investors without improving the risk level, and 2) for linear regression based profit scoring method, our framework lowers risk for investors with the profit unchanged. Given the rapid increasing in the prevalence of online peer-to-peer lending, this study may have important implications not only for researchers, but also for lenders and P2P platforms in marketplace.

The remainder of this paper is organized as follows. The next section describes the research framework of this study, mainly the variables used. We show in Section 3 how to develop the model. Section 4 presents the expected results in twofold, and discusses the possible implications and limitations of this research.

RESEARCH FRAMEWORK

Independent variables of our proposed new research framework are divided into five categories, including borrower assessment, loan characteristics, borrower characteristics, credit history, and borrower indebtedness. Borrower assessment category includes borrower's credit information related variables. Loan characteristics category contains interest rate, loan amount and loan purpose. Borrower characteristics category describes the basic information of the borrower, including annual income, home ownership and employment length. Borrower's past credit history information is included in credit history category, like number of derogatory public records, the number of inquiries in past 6 months, etc. Moreover, borrower indebtedness is mainly depicted by three ratios, which evaluate the ability of the borrower to pay back the loan, included variables are loan amount to annual income ratio, annual installment to annual income ratio, and debt to income ratio.

As we consider both credit scoring and profit scoring, this study contains two dependent variables. For credit scoring, we calculate the probability of default of each loan by a logistic regression. Among the many models, logistic regression has been the most widely used in the literature (Guo et al., 2016). For profit scoring, we estimate the rank of internal rate of return by a multivariate regression, which is a suitable variable for capturing the profitability of a P2P lending loan (Serrano-Cinca and Gutiérrez-Nieto, 2016).

RESEARCH DESIGN

Following Serrano-Cinca and Gutiérrez-Nieto (2016), this study applies regression analysis to calculate the probability of default and the rank of the internal rate of return (IRR) of funded loans. We estimate the following two specifications:

$$\text{probability}(\text{default}=1|x)=\alpha_0+a\text{BorrowerAssessment}+\beta\text{LoanCharacteristics} \\ +\chi\text{BorrowerIndebtedness}+\delta\text{BorrowerCharacteristics}+\phi\text{CreditHistory}+\varepsilon \quad (1)$$

$$E(r\text{IRR}|x)=\gamma_0+\gamma\text{BorrowerAssessment}+\eta\text{LoanCharacteristics} \\ +\kappa\text{BorrowerIndebtedness}+\lambda\text{BorrowerCharacteristics}+\omega\text{CreditHistory}+\varepsilon \quad (2)$$

where default and rIRR are the dependent variables which measure the default status and profitability of the funded loan, respectively. As default is a binary variable, we use probit regression to estimate the default probability of a funded loan; whereas rIRR is continuous, we use multivariate regression to estimate Eq. (2). In either equation, all five categories of variables that determine the default probability and profitability of a funded loan are included.

Moreover, for predicting risk of each loan, we find all the loans within the same rating sub-grade in the training set as the target loan and calculate the standard deviation of the internal rate of return within that sub-grade as the predicted risk of the target loan, as Eq. (3) shows:

$$\sigma_i^2=\frac{1}{n-1}\sum_{k=1}^n(\text{IRR}_k-\overline{\text{IRR}})^2 \quad (3)$$

where σ_i^2 represents the risk of loan i , n is the number of loans within the sub-grade, IRR_k is the internal rate of return of each loan within the sub-grade, and $\overline{\text{IRR}}$ is the mean internal rate of return of that sub-grade.

Now that we have predicted the default probability, expected return and risk of each loan, we will formulate the portfolio selection problem in the framework of Markowitz's (1952) work in our next step of research.

In order to show the effectiveness of our proposed model, we will compare it with two traditional baseline models: 1) a logistic regression based credit scoring model, and 2) a linear regression based profit scoring method.

RESEARCH DATA COLLECTION AND EXPECTED RESEARCH FINDINGS

The dataset used in this empirical study is officially provided by one of the state-of-the-art P2P lending platforms, Lending Club in the United States. All borrower information and loan information are available on the Lending Club website, as well as payments made during the loan period, which make it easy for us to measure the internal rate of return (IRR) of each loan.

For this paper, we are trying to compare the proposed loan allocation framework with logistic regression based credit scoring method and linear regression based profit scoring method, which are used in Serrano-Cinca and Gutiérrez-Nieto (2016). The expected results are twofold: 1) the proposed method outperforms credit scoring method in that it derives more profits without improving risk, and 2) it outperforms profit scoring method as it lowers the risk with profits unchanged.

Our study could not only provide suggestions for investors on how to allocate their portfolios, but also for P2P lending platforms and financial banks running lending and investment business.

However, there are limitations in this study. For example, more accurate risk prediction of each loan is needed, as we assumed that loans within the same sub-grade had equal risk for lenders; secondly, future research could improve IRR prediction by considering late fees and loss recovery.

ACKNOWLEDGMENT

This work is partially supported by grants 71731009, 71742005, 71331005 and 71628103 of the National Natural Science Foundation of China.

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Research on Dynamic Distribution and Prediction of Inbound Tourists in China

(Work-in-progress)

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ABSTRACT

Based on the 1997-2016 inbound tourism data, this paper establishes a second exponential smoothing prediction model, predicts the number of inbound tourists in the next five years, and explores the dynamic changes and trends of inbound tourists in China, and analyzes this trend. The study found that the distribution of inbound tourists in the six regions of China has shown a relatively stable trend.

Keywords: inbound tourists, second exponential smoothing prediction, tourist number forecast.

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INTRODUCTION

Inbound tourism is an important part of China's tourism industry. In 2017, China received 1,984. 24 million inbound tourists, a year-on-year increase of 0. 80%, and the total volume reached a record high. China has a vast territory and abundant tourism resources. However, the tourism environment, tourism culture and tourism services in different regions are different. The number of inbound tourists in each region is also very different. Understand and grasp the spatial distribution pattern of inbound tourists in China, explore the dynamic changes and trends of inbound tourists in China, and have important reference significance for formulating targeted regional tourism development strategies and promoting coordinated development of regional tourism.

Inbound tourist flow is one of the most important subjects involved in inbound tourism activities. Domestic and foreign research is mainly based on inbound tourist flow. The research content mainly focuses on the spatial distribution of inbound tourism flow (Jin-Feng et al., 2010; Xing-Zhu et al., 2014,2011; Jing-Feng et al., 2015,2010; Yong-Ming et al., 2011), and agglomeration (You-Yin et al., 2009, 2011; Hongying, L et al., 2008). Liu Fajian and others combined network analysis with tourism flow to obtain: China's inbound tourism scale is strong in the east, the west and northeast are strong, and the central part is weak. The overall structure is loose and uneven, and there is a certain cluster phenomenon in the spatial structure (LIU, F et al., 2010). Chen Gangqiang and Li Yinghui used spatial analysis techniques to explore the spatial structure and changes of regional tourism scale in China. The results show that the spatial differences between the eastern, central and western regions are obvious, but the spatial gap between regions and within them is shrinking (CHEN, G et al., 2011). Shen Jinghong et al. used the Gini coefficient and its decomposition method to calculate the income difference of China's inbound tourism regions, and also found that the income difference in inbound tourism regions is shrinking (Jing-Hong et al., 2013). Shi Zhuoyi selected Canada as the research object, based on the statistics of Canadian inbound tourists from 31 provinces and cities and some major cities in the mainland, using standard deviation, coefficient of variation, Gini coefficient, Herfindahl index and other methods to enter Canada's mainland China tourism flow. Analysis of spatial distribution characteristics and differences, and found that Canada's inbound tourism flows have obvious regional differences. The above research explores the spatial structure and dynamic changes of China's inbound tourism regional differences from a macro level.

In order to more accurately grasp the changing trend of inbound tourists, this paper starts from the six major regions and establishes a second exponential smoothing prediction model to predict the number of inbound tourists in China and the proportion of inbound tourists in different regions in the next five years, so as to explore the distribution of inbound tourists in China. Dynamic changes and trends.

DATA SOURCE AND DESCRIPTION

The data comes from the 1997-2016 China Tourism Statistics Yearbook. The data includes the number of overnight visitors from international tourists to China's six major regions and provincial regions. The "inbound overnight visitors" refers to the total number of foreign tourists, Hong Kong and Macao tourists and Taiwanese tourists.

This paper uses China's geographical division criteria to divide the Chinese mainland into six regions: North China, East China, Central South, Southwest, Northwest, and Northeast, as shown in Table 1.

Table 1: Six major regional divisions

Region	Province	Region	Province
Northern China	Beijing	Central	Henan
	Tianjin	Southern	Hubei

	Hebei	China	Hunan
	Shanxi		Guangdong
	Inner Mongolia		Guangxi
Northeast China	Liaoning	Westsouth China	Hainan
	Jilin		Chongqing
	Heilongjiang		Sichuan
Eastern China	Shanghai	Westnorth China	Guizhou
	Jiangsu		Yunnan
	Zhejiang		Tibet
	Anhui	Westnorth China	Shaanxi
	Fujian		Gansu
	Jiangxi		Qinghai
	Shandong		Ningxia
			Xinjiang

PREDICTION MODEL

The distribution of inbound tourists in the Chinese region is measured by the proportion. the ratio of the inbound tourists of region i is A_i :

$$A_i = N_i / \sum_{i=1}^7 N_i, \quad i = 1, 2, \dots, 7 \quad (1)$$

N_i is the number of inbound tourists received by the region i .

This paper will establish an exponential smoothing prediction model to predict the inbound tourists. Exponential smoothing is a common method used for trend analysis and prediction. The method can weaken the influence of short-term random fluctuations on time series, show the variation law of sequence, and has the advantages of simple calculation, less sample quantity, strong adaptability and stable prediction results. The exponential smoothing method is a weighted moving average method. In the moving average method, all historical observations are given the same importance, and in actual random events, recent results have a greater impact on the present. Therefore, in the exponential smoothing method, the weight of the observations in each period is exponentially attenuated with the increase of the time interval, and the earlier the observation weight is smaller, so as to reflect this feature.

Taking a region as an example, a simple exponential smoothing method is expressed as follows:

$$\tilde{x}_t = \alpha x_t + \alpha(1-\alpha)x_{t-1} + \alpha(1-\alpha)^2 x_{t-2} + \dots + \alpha(1-\alpha)^{t-1} x_1 + (1-\alpha)^t \tilde{x}_0 \quad (2)$$

\tilde{x}_t is the smoothing value of t period; α represents the smoothing coefficient that provides the weight, which satisfies $0 < \alpha < 1$; \tilde{x}_0 is the initial smoothing value, which is generally the mean of the first three samples, because:

$$\tilde{x}_{t-1} = \alpha x_{t-1} + \alpha(1-\alpha)x_{t-2} + \alpha(1-\alpha)^2 x_{t-3} + \dots + \alpha(1-\alpha)^{t-2} x_1 + (1-\alpha)^{t-1} \tilde{x}_0 \quad (3)$$

So, \tilde{x}_t equals,

$$\tilde{x}_t = \alpha x_t + (1-\alpha)\tilde{x}_{t-1} \quad (4)$$

\tilde{x}_t is the predicted value of the inbound passenger flow for the $t+1$ period; x_t is the actual value of the inbound passenger flow for the t period.

The overall prediction error is expressed by the mean square error, and the smoothing coefficient α takes the value of the minimum mean square error. The overall mean square error λ_{MSE} of the t -stage sample can be calculated from the following equation.

$$\lambda_{MSE} = \frac{1}{t} \sum_{i=1}^t (\tilde{x}_{i-1} - x_i)^2 \quad (5)$$

The obvious shortcoming of the one-time smoothing index method is the hysteresis of the prediction, and it is more suitable for the stationary time series. It is impossible to predict the time series of the trend, and the purpose of the inbound passenger flow forecast is whether it has a rising or falling trend. Here, the Holt two-parameter exponential smoothing method in the second exponential smoothing method is used.

The quadratic exponential smoothing increases the parameters reflecting the trend compared to the one exponential smoothing, and performs better in the short- and medium-term forecasting. Its formula is:

$$s_t = \alpha x_t + (1 - \alpha)(s_{t-1} + b_{t-1}) \quad (6)$$

s_t is the second exponential smoothing value, and is also the predicted value of the inbound passenger flow in the t period. x_t is the actual value of the inbound passenger flow in the t period. α is the smoothing coefficient, which satisfies $0 < \alpha < 1$. b_{t-1} is the trend of the $t-1$ period. The initial value s_0 is the average value of the inbound passenger flow in the first three periods. Under the influence of random factors, the increment or decrement value of each period in the time series will also fluctuate with time, so the trend sequence is a random sequence, and it is smoothed once, then the formula of b_t is:

$$b_t = \gamma(s_t - s_{t-1}) + (1 - \gamma)b_{t-1} \quad (7)$$

γ is the trend smoothing coefficient and satisfies $0 < \gamma < 1$. The initial value is $b_0 = \frac{x_t - x_1}{t-1}$. In the quadratic exponential smoothing algorithm, the influence weights of recent data are represented by two smoothing coefficients α and γ . And the method of taking the smoothing coefficients also takes the value when the mean square error is the smallest. Here, the trial algorithm is adopted, taking the initial value $\alpha = 0.5$, $\gamma = 0.5$, taking the step length 0.05 to calculate the increment and decrement respectively, and calculating the mean square error λ_{MSE} no longer decreases, so as to obtain the parameter value of α and γ (Saputra et al., 2017).

Using Holt's two-parameter exponential smoothing method, the predicted model of the forward l -stage predicted value is expressed as follows:

$$\hat{A}_{t+l} = s_t + lb_t \quad (8)$$

\hat{A}_{t+l} indicates the predicted value of inbound passenger traffic for the $t + l$ period.

FORECAST RESULTS OF INBOUND TOURISTS

Based on the annual data of inbound tourists received in the unit area from 1997 to 2016, this paper first establishes an exponential smoothing prediction model, predicts the number of inbound tourists received in the unit area from 2017 to 2023, and then calculates and predicts the ratio of tourists to each region and province. The results are shown in Figure 1 and Figure 2. Figure 1 shows the number of inbound tourists and the predicted results. The red color is the predicted value. Figure 2 shows the proportion of inbound tourists and the forecast results. The red mark is the predicted value, and the forecast error is 0.0526-0.0911.

As can be seen from Figure 1, after 2014, the Central and South China region has the largest number of inbound tourists, followed by Central South, East China, Southwest China, North China, Northeast China and Northwest China. Overall, the number of inbound tourists in China is on the rise. Except for the inflowing tourists in North China and Northeast China, the trend of decline is stable after 2012. The rest of the regions have shown a trend of decline after the first decline. As can be seen from Figure 2, the inbound tourists are in a trend of decreasing proportion in Central, Northeast and North China. They have been in a stable trend in the northwest, rising in East China and Southwest China, and the most influx of inbound tourists in East China, and tourists in the Southwest. The increase in the proportion is second, thanks to the development of the western region and the positive promotion of inbound tourism to the west. It can be seen that the distribution of inbound tourists in the six major regions of China has shown a relatively stable trend.

The analysis shows that the changing trend of Chinese inbound tourists has the following characteristics: First, the implementation of a series of facilitation policies such as transit visa exemption and departure tax rebate, it is expected to continue to expand the development space of China's inbound tourism and improve the quality of development; Visitors will get more convenient travel services and higher travel experience, which will become the focus of China's inbound tourism in the next stage of full participation in international competition. Third, the current development model of China's inbound tourism has changed from the closed mode of the past team reception to more Diversified and more open.

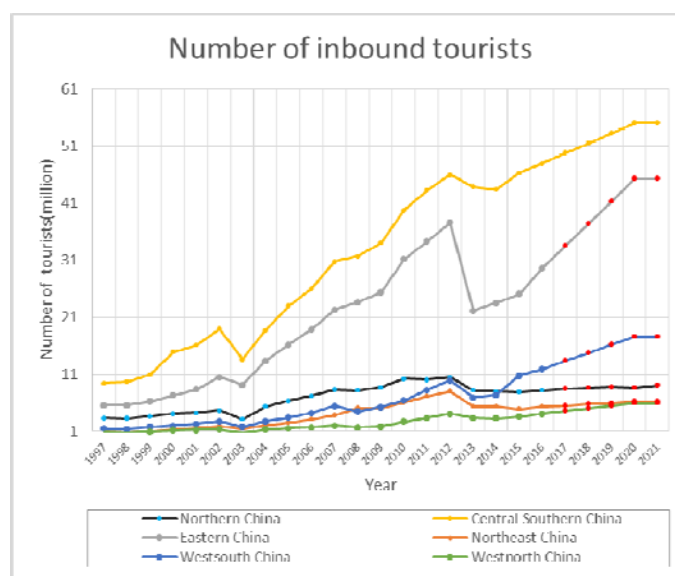


Figure 1: Number of inbound tourists and forecast results

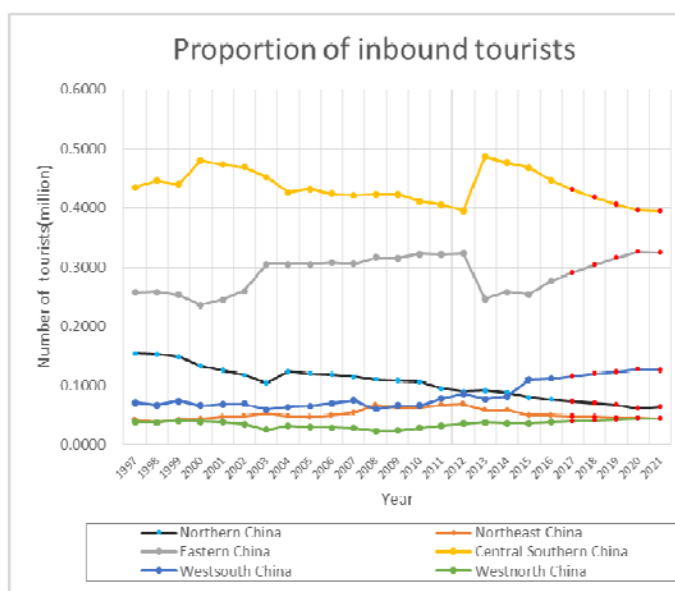


Figure 2: Proportion of Inbound Tourists and Forecast Results

CONCLUSION

China has a vast territory and rich tourism resources. Geographical zoning divides the Chinese region into six regions with certain characteristics of tourism flow. According to the research results of this paper, the distribution of overseas tourists in China's six major regions has shown a relatively stable trend. The proportion of East China and Southwest China is increasing, while the proportion of northern regions is decreasing. It is recommended that the northern region improve inbound tourism. The attraction effect, while the state can consider implementing an integrated development strategy for inbound tourism regions, and coordinate the development of inbound tourism in various regions, with a view to the long-term sustainable development of China's inbound tourism industry.

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The application of Bounded Online Gradient Descent Algorithms for Kernel Based Online Learning in Tourist Number Forecasting

(Work in Progress)

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ABSTRACT

With the upgrade of tourism informationization and the rise of intelligent city construction, the Internet of Things, Cloud Computing and other information technologies have been widely used in the tourism industry, making the development model and technical framework of intelligent tourism become a hot issue. Aiming at the problems of insufficient preparation and inadequate reception capacity of scenic spots in recent years, this paper proposes to apply machine learning algorithm to predict the number of tourists, so as to make an early response. In this paper, the characteristics of the application of the number of tourists are analyzed. The fixed buffer kernel online gradient descent algorithm is used to predict the number of tourists, and the actual number of tourists is brought into the algorithm for experiments. Finally, the rationality of the experimental process and results is analyzed.

Keywords: Smart tourism, online learning, kernel gradient decline, tourist number forecast;

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INTRODUCTION

With the improvement of living conditions, the number of people who choose to travel has continued to rise in recent years, accompanied by a large number of tourists is the scenic spot far beyond the expected number of tourists prepared inadequate reception capacity. In this case, accurately predicting the number of tourists and making a good plan in advance according to the predicted results is the key to the above problems, and is also a key issue in the study of intelligent tourism. (Guan, 2016).

According to the modeling theory, there are two kinds of tourist quantity prediction: one is the traditional tourist quantity prediction model based on the statistical principle, which is based on the linear theory. But because the change of tourist quantity is a nonlinear dynamic system, it is affected by many factors, such as climate, advertisement and so on. As a result, the prediction accuracy is low and the application scope is limited (Kim, 2003; Huang, 2013; Ma, Liang & Lu, 2016). Another kind of machine learning prediction model is represented by neural network, which has good approximation ability to nonlinear, and the prediction accuracy of the number of tourists has been greatly improved (Deng & Lu, 2006; Dun, Zhang, Liu & Zhang, 2017; Chang & Tsai, 2017; Li & Zhang, 2010; Gjylapi, Durmishi & Musaraj, 2014). However, the traditional neural network training process needs to modify the weights of the network repeatedly, which requires a large amount of calculation, and there are some problems such as over-fitting and dimension disaster (Huang, Zhu & Siew, 2006). Extreme Learning Machine (ELM) is a new kind of feed forward neural network. According to Moore-Penrose generalized inverse matrix theory, the training iteration is transformed into solving linear equations, and the network training can be completed at one time. Compared with the traditional neural network, it needs many iterations to determine the network output weights. ELM greatly improves the network prediction modeling efficiency (Xia, Zhang, Weng & Ye, 2012).

However, most of the previous methods used fixed data to establish the tourist number prediction model, which belongs to the typical off-line prediction model. However, the number of tourists has the characteristics of time series, real-time change, stochastic and strong time-varying. It is difficult to predict the number of tourists accurately by using offline model (Feng, Huang, Lin & Gay, 2009). Combining with the time series characteristics of the number of tourists, this paper adopts the Bounded online gradient descent algorithm for scalable kernel based online learning (BOGD) to predict the number of tourists, and uses the actual number of tourists to calculate and predict, according to the experimental results. The effectiveness and defects of BOGD algorithm in the application of tourist volume prediction are discussed.

BOGD ALGORITHM

BOGD algorithm is an on-line algorithm proposed by Zhao, Wang, Wu, Jin, and Hoi (2012). Its kernel function is used to realize nonlinear classification and regression. Gradient descent method is used to optimize the classifier. The core idea of the algorithm is as follows:

Let the collected time series data be $\{(x_t, y_t), t \in [T]\}$, among them $x_t \in R^d$, $y_t \in R$, $[T] = \{1, \dots, T\}$.

The online learning model of BOGD algorithm is:

$$L(f) = \min_{f \in \mathcal{H}} l(f(x_t), y_t) + \frac{\gamma}{2} \|f\|_H^2 \quad (1)$$

γ is the regularization parameter. When a new set of samples (x_t, y_t) arrives, the online gradient descent method is used to update the classifier, and the updating rules are as follows:

$$f_{t+1} = f_t - \theta \partial_f L(f) | f = f_t \quad (2)$$

θ is the learning rate constant, which can also be understood as falling step size. According to the regeneration characteristic of kernel function $K(\cdot, \cdot)$:

$$\langle f, K(x, \cdot) \rangle_H = f(x), \text{ for } x \in X \quad (3)$$

And

$$\partial_f l(y_t f(x_t)) = y_t^H (y_t f(x_t)) K(x_t, \cdot) \quad (4)$$

Bringing (4) into the update expression (2) can be obtained:

$$f_{t+1} = (1 - \theta \gamma) f_t - \theta y_t^H (y_t f(x_t)) K(x_t, \cdot) \quad (5)$$

Let $f_1 = 0$, f_t can be written as a form of kernel expansion:

$$f_t(x) = \sum_{i=1}^{t-1} \alpha_i y_i K(x_t, x), x \in X \quad (6)$$

The coefficient of step t is updated to:

$$\alpha_t = -\theta y_t^H (y_t f_t(x_t)), \quad t = t_1 \quad (7)$$

$$\alpha_t = (1 - \theta \gamma) \alpha_t, \quad t < t_1 \quad (8)$$

In the above updating process, with the deepening of the calculation, support vector will be generated continuously. If the amount of data is infinite, then an infinite number of support vectors will be generated. The calculation of support vector weight α_t will occupy a large amount of memory and computing resources. To solve this problem, the number of support vectors N_{SV} is limited in the BOGD algorithm. The upper limit of the number of support vectors is B , which is called intercept parameter. When $N_{SV} < B$ is satisfied in the above calculation process, iterative calculation is carried out according to the above steps. As each iteration process, the coefficient $\alpha_t (t \neq t_1)$ will be reduced by $(1 - \theta \gamma)$. After R times iteration, it will be reduced to $(1 - \theta \gamma)^R \alpha_t$. Therefore, when $N_{SV} > B$ is used, the support vector with small coefficients can be discarded, which only leads to very small errors.

The input and initialization of the BOGD algorithm are as follows:

Input: sample sequence is $(x_t, y_t)_{t \in N} \in (X \times Y)^\infty$, regularization parameter is $\gamma > 0$, intercept parameters satisfies $B \in N$, learning rate is $\theta \in (0, \frac{1}{\gamma})$, loss function is $l: R \times Y \rightarrow R, H$, space reproducing kernel is $K(\cdot, \cdot)$;

Initialize: number of support vectors is $S_t = 0$, $f_t = 0$;

The calculation process of the BOGD algorithm is as shown in Figure 1.

THE APPLICATION OF BOGD ALGORITHM TO PREDICT THE NUMBER OF TOURISTS

The number of tourists is a typical unstable time series forecasting problem. Although the number of tourists changes from time to time, it has obvious time series. Therefore, BOGD algorithm is used to predict the number of tourists. The online characteristics of the algorithm can meet the requirements of real-time processing of the number of tourists. At the same time, the fixed buffer kernel gradient descent method ensures that the calculation process will not take up unlimited resources, which guarantees the efficiency of the algorithm.

Composition of Time Series

The training data in this paper are based on the original number of tourists and the number of tourists in Jiuzhaigou from 06/01/2012 to 06/01/2017.

Data details are shown in Table 1.

```

for  $t = 0, 1, \dots, T$  do
  Receive  $x_t$ ;
  Predict  $\hat{y}_t = f_t(x_t)$ ;
  Receive  $y_t$  and suffer loss  $l(y_t f(x_t))$ ;
  If  $l(y_t f(x_t)) = 0$  then
     $f_{t+1} = (1 - \eta\lambda)f_t$  and  $S_{t+1} = S_t$ ;
  Else
    If  $|S_t| < B$  then
       $f_{t+1} = (1 - \eta\lambda)f_t - \eta y_t l'(y_t f(x_t))K(x_t, \bullet)$ 
    And  $S_{t+1} = S_t \cup \{t\}$ 
    Else
       $f_{t+1} = \sum (1 - \eta\lambda)\alpha_i y_i K(x_i, \bullet) - \eta y_t l'(y_t f(x_t))K(x_t, \bullet)$ 
       $S_{t+1} = S_t \cup \{t\} / \{1\}$ 
    End if
  End if
End for

```

Figure 1: The Calculation Process of BOGD Algorithm

Table 1 Details of Tourist Quantity for Training

Spot name	Start time	End time	Data quantity	Owed Country
Jiuzhaigou	06/01/2012	06/01/2017	1827	China

As shown in Table 1, the experimental data are from Jiuzhaigou Scenic Area in China, with a total of 11 data items. The online access address of the data is <https://www.jiuzhai.com/news/number-of-tourists>.

Data Preprocessing

In order to improve the training efficiency and the generalization ability of calculation, it is necessary to compress the range of actual input data. For this reason, we normalized the original data of the number of tourists.

Let x_{ti} be the i th component of the data arriving at t time. The maximum value of all data is MAX and the minimum value is MIN . The data are normalized by Equation (9):

$$x_{ti}^f = \frac{x_{ti} - MIN}{MAX - MIN} \quad (9)$$

The normalized data are brought into the algorithm for calculation.

Forecast of Tourists and Result Analysis

The normalized data are brought into the algorithm for calculation. The actual and predicted numbers of tourists for the day are shown in Figure 2.

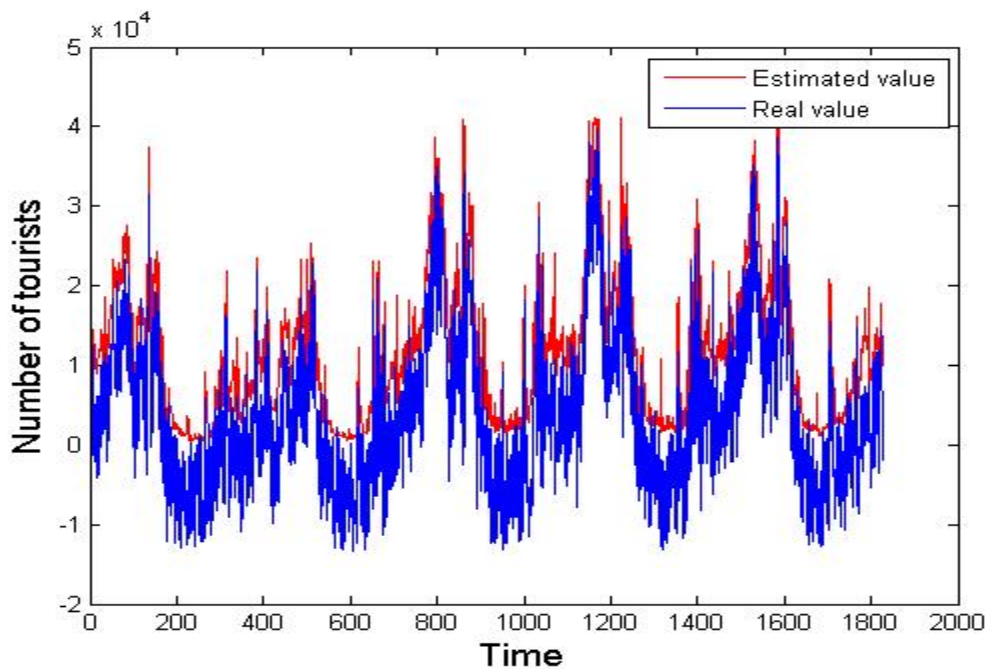


Figure 2: Comparison of Actual and Predicted Tourist Numbers

As can be seen from the above figure, the number of tourists in this scenic spot shows obvious fluctuations. This is due to the obvious increase in the number of tourists in holidays, while winter is the off-season for tourism. A careful observation of the actual and predicted number of tourists reveals that the predicted overall trend is in good agreement with the actual value by using BOGD algorithm to calculate the number of tourists. However, in the single-day data, the accuracy of BOGD algorithm in predicting the number of tourists is not high.

CONCLUSION

This paper proposes to apply BOGD algorithm to study and predict the number of tourists. From the experimental results, it can be seen that the overall trend of the predicted data is similar to the actual data, so it can be used to predict the general trend of the number of tourists. However, it can be seen from the enlarged detail chart that the predicted data value of each day is still quite different in accuracy from the actual data.

After analysis, this result may occur for the following reasons. The BOGD algorithm used in this paper needs to preprocess the data and normalize all data to $[0, 1]$. However, for the online algorithm, we do not know the sample population before the regression calculation. Therefore, this method of calculating the maximum and minimum values of samples in the normalization process is not appropriate. In addition, the number of tourist changes in real time, and the accuracy of the experimental design method of predicting the number of tourists in days may not be guaranteed.

Although the above problems still exist in the experiment itself, this research process is a preliminary attempt to predict the number of tourists using the classic online algorithm and lays a good foundation for future research.

ACKNOWLEDGMENT

This work is supported by the Department of Military Logistics, Army Logistics University of PLA.

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The Impact of Sharing Economy on Local Employment: Evidence from Airbnb

(Work in Progress)

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ABSTRACT

A growing literature has documented the impact of home sharing. We study a new externality in which local people can enjoy more job opportunities because of the entry of home sharing. Using data from Airbnb and employing a quasi-experimental design, we find the following evidences. We find that home sharing provides more employment options to locals especially for less-education and low-income population. As home sharing becomes an incentive for local employment, our study provides important understanding of home sharing and its implications to local welfare, Airbnb hosts, and policy makers.

Keywords: Home-sharing, local employment, Airbnb, education, income.

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INTRODUCTION

Airbnb, a pioneer of the sharing economy, provides a handy platform for individuals to rent their spare space (Xie & Kwok, 2017). Starting from renting out three air mattresses in 2008, Airbnb now supplies 4.5 million properties in over 81,000 cities of more than 191 countries (Airbnb 2018). A key benefit of sharing economy like Airbnb is that it maintains low barriers to entry and enables flexible working arrangements and low transaction cost (Cheng, 2016).

Airbnb is closely associated with local employment. On the one hand, Zervas et al. (2017) found that a 1% increase in Airbnb listings in Texas results in a 0.05% decrease in quarterly hotel revenues, especially for the lower-priced hotels. Therefore, the entry of Airbnb may cause unemployment because of the revenue shrinkage of lower-priced hotels. On the other hand, the entry of Airbnb can benefit the local tourism industry by generating new job opportunities serving travelers (e.g., restaurants, guided tours, stores, and cleaning) as low accommodation cost of Airbnb generates more tourists and longer stays (Fang et al., 2016).

Although studies such as Fang et al. (2016) found a positive correlation between Airbnb supply and local employment in the tourism industry using 220 (44 counties \times 5 years) observations from Idaho. The question “whether the entry of Airbnb benefits local employment” remains an open question. Because the research samples of current studies are very limited and their empirical settings are subject to endogeneity issues that may bias the effect of Airbnb on local employment. Moreover, the literature investigating the impact of Airbnb on local employment lags in answering “who benefits (or not) from home sharing.” According to the trickle-down effect (Aghion & Bolton 1997), resources and support such as tax cut to the businesses can serve as a means to stimulate business investment in the short term and benefit society at large in the long term. The emergence of home sharing is similar to such support because it allows homeowners (i.e., the hosts) to invest on Airbnb businesses and hire affiliated workers to provide ancillary services for listing operation, which may essentially generate local welfare. An investigation of how Airbnb affects the employment of demographically heterogeneous local groups will help us extend the understanding of trickle-down effect and guide policymaking.

To add evidence to the literature, we attempt to examine (1) the impact of the entry of Airbnb on local employment and (2) which demographic groups (in terms of education and income) of the locals benefit from home sharing. To answer these questions, we collect data of 320,243 Airbnb listings from the top ten metro areas in the U.S. over six years and employ a difference in difference (DID) design with time and zip code fixed effects included to eliminate macroeconomic fluctuations over time and economic disparities across areas. Our findings offer direct implications for Airbnb hosts and policymakers to identify opportunities for local employment stimulation.

DATA AND METHODOLOGY

Data and Variable

We collect the home sharing data from Airbnb and the employment and census data from the Bureau of Labor Statistics (BLS). The top ten metro areas in the U.S. are our empirical setting, which covers 535 zip codes and 320,243 Airbnb listings (see Table 1).

We then exclude zip codes without employment statistics and construct a panel dataset of 2,886 observations (481 zip codes \times 6 years).

Table 1. Description of Airbnb listings

Rank	Metro Areas	Zip Codes	Listings
1	New York-Newark-Jersey City, NY-NJ-PA Metro Area	204	148,113
2	Los Angeles-Long Beach-Anaheim, CA Metro Area	65	48,358
3	San Francisco-Oakland-Hayward, CA Metro Area	28	30,025
4	San Diego-Carlsbad, CA Metro Area	35	19,466
5	Washington-Arlington-Alexandria, DC-VA-MD-WV Metro Area	40	19,844
6	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD Metro Area	48	15,900
7	Seattle-Tacoma-Bellevue, WA Metro Area	37	14,626
8	Portland-Vancouver-Hillsboro, OR-WA Metro Area	34	10,228
9	Boston-Cambridge-Newton, MA-NH Metro Area	16	7,457
10	San Jose-Sunnyvale-Santa Clara, CA Metro Area	28	6,226
Total		535	320,243

We first examine whether the entry of Airbnb affects local employment. The dependent variable is *Employment*, measured by the actual employment rate. The independent variable of interest is the supply of Airbnb listings, which is measured by *Cum.Supply* (the cumulative amount of local Airbnb listings before a given year) and *Inst.Supply* (the net growth of local Airbnb listings in a given year). The first review of the property marks the entry time of an Airbnb to each zip code.

We then explore who benefits from the entry of Airbnb. Three demographic characteristics of locals serve as moderators, including (1) *Education*, which is calculated by the percentage of individuals with a bachelor degree or above; and (2) *Income*, which is the median household income. Lastly, we control the zip code and year fixed effects to account for annual variation in employment rate across zip codes. Table 2 presents the definition and summary statistics of variables in our study.

Table 2. Data Description

Variable	Description	Obs	Mean	Std. Dev.	Min	Max
Dependent Variable						
<i>Employment</i>	Employment rate (in %) for a zip code in a given year	2,886	58.814	10.466	0.1	89.1
Independent Variable						
<i>Cum.Supply</i> (in 100)	Scaled cumulative entries of home-sharing of a zip code by a given year	2,886	2.086	5.003	0	79.47
<i>Inst.Supply</i> (in 100)	Scaled instantaneous entries of home-sharing of a zip code in a given year	2,886	0.919	1.967	0	24.61
Moderators						
<i>Education</i>	Percentage of bachelor's degree or higher of a zip code in a given year	2,886	0.275	0.222	0	1
<i>Income</i>	Logged household median income of a zip code in a given year	2,886	10.792	1.384	0	12.411
Control Variable						
<i>Population</i>	Logged population of a zip code in a given year	2,886	10.017	0.988	3.401	11.364

Model specification

The staggered entry (across different zip codes and time) of home sharing on Airbnb provides a quasi-experimental difference-in-differences (DID) setting for estimating the causality between the entry of Airbnb and local employment (Zervas et al., 2017; Angrist & Pischke, 2008). Our DID strategy identifies the Airbnb treatment effect by comparing differences in the employment rate for zip codes affected by Airbnb before and after its entry with a benchmark of differences in the employment rate for zip codes unaffected by Airbnb during the same period. Table 3 illustrates the DID empirical strategy. That is, zip codes without Airbnb entry are the control group, and those with at least one Airbnb entry are the treatment group. Hence the entry of home sharing in a given month can be a treatment stimulus. Through the lens of a quasi-experiment, the DID design is effective in mitigating endogeneity issues when estimating the causal influence of home sharing on local employment.

Table 3. The Difference-in-differences (DID) Design

	Before entry	After entry
Zip codes with Airbnb entry	O	X
Zip codes without Airbnb entry	O	O

For each zip code i in year t , the impact of Airbnb entry on local employment is specified as

$$Employment_{it} = \beta \cdot Cum.Supply_{it} + \gamma \cdot Cum.Supply_{it} \times Z_{it} + \delta \cdot Z_{it} + \mu_i + v_t + \varepsilon_{it} \quad (1)$$

where $Employment_{it}$ is the employment rate of zip code i in year t . $Cum.Supply_{it}$ is the cumulative entries of home sharing on Airbnb of zip code i in year t . Z_{it} is a vector of moderators, including $Education_{it}$, and $Income_{it}$. μ_i is zip code fixed effect, and v_t is year fixed effect. ε_{it} is the idiosyncratic error. β identifies the impact of the entry of Airbnb on local employment, and γ captures the moderating effect of the moderators.

RESULTS

The DID regression results are reported in Table 4. Column (1) presents the main effect of the entry of Airbnb on local employment. The coefficient of $Cum.Supply$ is positive and significant at the 0.01 level, indicating that the entry of Airbnb benefits local employment: a 100 increase in home sharing leads to a 0.07% increase in the local employment rate. Considering the average entries (yearly: 2011~2016) of home sharing on Airbnb in each zip code is over 90 in our research samples, the magnitude of 0.07% is economically significant. Columns (2~3) report the moderating effect of three sets of moderators: (1) The coefficient of $Cum.Supply \times Education$ is negative and significant (-0.222***), suggesting that the entry of Airbnb benefits the less-educated population more. This finding is consistent with the “low barriers to entry” feature of Airbnb. (2) The negative and significant (-0.107***) coefficient of $Cum.Supply \times Income$ indicates that the low-income population benefits more from the entry and expansion of Airbnb because they have low transaction cost when switching into Airbnb.

Table 4. Effect of entry of Airbnb on local employment

D.V.: Employment (in 100)	(1)	(2)	(3)
$Cum.Supply$ (in 100)	0.070*** (0.014)	0.200*** (0.035)	1.255*** (0.362)
$Cum.Supply$ (in 100) \times Education		-0.222*** (0.053)	
Education		0.355 (0.846)	
$Cum.Supply$ (in 100) \times Income			-0.107*** (0.032)
Income			0.213 (0.214)
Zip code FE	YES	YES	YES
Year FE	YES	YES	YES
Control Variable	YES	YES	YES
F (p)	31.27***	29.98***	29.19***
R ²	0.103	0.111	0.112
Obs.	2,886	2,886	2,886
Groups (Zip codes)	481	481	481

Notes. Robust standard errors clustered at the zip code level are reported in parentheses. The *, **, and *** represent significance at the levels of 10%, 5%, and 1%, respectively.

To further check the robustness of the above results, we first replicate the results in Table 3 using the alternative measure of the instantaneous entries ($Inst.Supply$). As Table 5 shows, the estimated effects are robust and consistent with those reported in Table 4.

Table 5. Effect of entry of Airbnb on local employment (Robustness check: $Inst.Supply$)

D.V.: Employment (in 100)	(1)	(2)	(3)
$Inst.Supply$ (in 100)	0.209*** (0.036)	0.460*** (0.074)	2.558*** (0.932)
$Inst.Supply$ (in 100) \times Education		-0.448*** (0.123)	

<i>Education</i>		0.329	
		(0.850)	
<i>Inst.Supply</i> (in 100) \times <i>Income</i>			-0.213**
			(0.084)
<i>Income</i>			0.210
			(0.222)
Zip code FE	YES	YES	YES
Year FE	YES	YES	YES
Control Variable	YES	YES	YES
F (<i>p</i>)	39.09***	34.83***	32.51***
R ²	0.106	0.112	0.113
Obs.	2,886	2,886	2,886
Groups (Zip codes)	481	481	481

Notes. Robust standard errors clustered at the zip code level are reported in parentheses. The *, **, and *** represent significance at the levels of 10%, 5%, and 1%, respectively

CONCLUSIONS AND IMPLICATIONS

We investigate the impact of the entry of Airbnb on local employment. Two main findings are drawn from our DID analyses. First, the entry of Airbnb improves local employment. Second, the employment effect of Airbnb is non-uniform: its entry benefits the less-educated, and low-income population more. As sharing economy like Airbnb is overwhelming, our work contributes to the literature and practice in many aspects.

Theoretically, this study fills two major research gaps. First, we add evidence to the debate about the impact of home sharing on local employment. We disclose an increased employment rate after the entry of Airbnb. Using large-scale field evidence and a causal inference approach, we add rigor to the investigation of Airbnb and local employment. Second, this study is among the first to explore which demographic groups of the population can benefit from the entry of Airbnb. Our work contributes to the literature by advocating the welfare effect of home sharing to locals, especially those are less educated or lower-income.

Practically, our findings yield important implications for Airbnb hosts and policymakers. First, Airbnb hosts can outsource the ancillary guest services to local labor markets for amplified welfare to the locals. Particularly, hosts can target the less-educated and low-income population in the local labor markets because these local groups are mostly affected by home sharing. Second, targeted advertising for hiring can be delivered on social media platforms like Facebook and Twitter with considerations of the education, income, and gender of the local audience, which can improve the efficiency and precision of Airbnb online advertising. Lastly, Airbnb is found to be an effective instrument to drive local employment. Policymakers should support the growth of Airbnb in neighborhoods that have less-educated and low-income population.

LIMITATIONS AND FUTURE DIRECTIONS

There are several limitations to this research that need to be acknowledged. First, the dataset represents the entry of Airbnb in USA from 2011 to 2016. The research results may differ with geographic, economic, and cultural conditions. Hence, the findings of this study may not be generalizable to other countries. Future studies may expand to other countries and consider moderation effects of economic development and cultural conditions. Second, we don't have actual industry employment data in zip code level due to data unavailability. Although we introduce moderators to explain the mechanism of the positive effect of entry of Airbnb on local employment and conduct robustness check using instantaneous supply of home-sharing instead of cumulative supply, the specific influencing mechanism is still insufficiently comprehensive. Future studies using more detailed employment data and host data of Airbnb are strongly encouraged and expected. Finally, some variables that may affect local employment have not been included in this study due to the unavailability of data such as the number of tourists which may have an impact on local employment. Future studies may expand this research with more variables. Overall, we encourage future scholars to explore the external impact of sharing economy in a broader dataset with different perspectives.

ACKNOWLEDGMENT

This research has been supported by the National Science Foundation of China (71532004, 71490720, 71601038) and the National Social Science Foundation of China (14CXW045).

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Understanding Baby Boomers' Intention to Use Online Travel Agencies (Work in Progress)

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ABSTRACT

There is an increasing trend where travellers are making most of their travel purchases through online channels. More and more travellers use online travel agencies for their travel purchases. While this is popular among the millennial generation, it would be interesting to study how the baby boomer generation has been influenced by this trend. This paper is a preliminary study based on Azjen's theory of planned behaviour. It provides a comprehensive review of the literature on the theory in relation to purchase behaviour involving online shopping. It examines how attitudes, subjective norms, and perceived behavioural control can be used to understand and explain behavioural intention, which can predict actual behaviour in the context of baby boomers using online travel agencies. This study provides some valuable insights and serves as the initial part of further research on identifying the possible factors affecting baby boomers in Singapore purchasing travel products and services via online travel agencies.

Keywords: Attitudes, subjective norms, perceived behavioral control, behavioral intention, the theory of planned behaviour, online travel agency, baby boomers

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INTRODUCTION

E-commerce businesses continue to grow over time. Pew Research Centre conducted a survey in the United States of America in 2015 and the results indicated that roughly eight-in-ten Americans shop online with around 15% buy online weekly (Smith & Anderson, 2016). According to a survey conducted by Allied Market Research (2018), the global online travel market will reach an estimated sales of US\$1,091 billion by 2022. The global online travel market is likely to be dominated by hotels, airlines and car rental companies. The online travel agencies (OTAs) are expected to experience higher growth rate over the next five years due to its growing popularity among travellers (Allied Market Research, 2018). Previous research indicated that more Generation Xers and millennials engage in online travel purchase than baby boomers (Marketing Charts, 2017). However, little is known about baby boomers' usage of the online travel agencies' services.

Generation is a predictor of travel consumption behavior (Moscardo & Benchendorff, 2010). It is therefore important to address how baby boomers respond to the shift from buying travel product and services at the traditional physical travel agencies to using online travel agencies. This study attempts to identify the specific factors of using online travel agencies in the purchase of travel products and services through the theory of planned behavior. It aims at filling the gap to add depth to the understanding of how the baby boomers respond to the rapid growth of the online purchase channel. A conceptual model is proposed for data collection and data analysis at a later stage. The findings will provide insights into the design of relevant marketing strategies to motivate the baby boomers to use the online purchase channel. The paper is organised to explain the aim of this study including the reviews of the literature relevant to travellers buying travel products and services online, the growing baby boomer market, and the conceptual model based on the theory of planned behavior including attitudes, subjective norms, perceived behavioural control, behavioral intentions and behavior.

GROWING TREND USING ONLINE TRAVEL AGENCIES

The usage of online resources for travel planning includes searching for relevant information to facilitate travel decision making (Gretzel, Fesenmaier, & O'Leary, 2007). Previous research focused on areas such as the travel planning process, information sources, search strategies, and the factors affecting search behavior (e.g. Gretzel, Hwang, & Fesenmaier, 2012; Pan & Fesenmaier, 2006). For example, Pan and Fesenmaier (2006) studied how travellers searched information for holiday planning and online travel product and services purchase. Kah, Vogt, & MacKay (2008) examined how travel information search influenced travellers' travel experiences. Past research focused on how search engines and social media influenced travel planning (e.g. Gretzel & Yoo, 2008; Fesenmaier, Xiang, Pan, & Law, 2011; Xiang & Gretzel, 2010; Xiang, Wöber, & Fesenmaier, 2008). Some researchers focused on web-based e-commerce (e.g. Baloglu & Pekcan, 2006; Cao & Yang, 2016; Chung & Law, 2003; Musante, Bojanic, & Zhang, 2009); while others researched on the online travel website contents (e.g. Bai, Hu, & Jang, 2006; Law, Qi, & Buhalis, 2010; Salavati & Hashim, 2015; Schmidt, Cantallos, & dos Santos, 2008; Standing, Tang-Taye, & Boyer, 2014)).

In the context of purchasing travel online, more travellers have indicated their intention to book travel online (Sahli & Legohérel, 2016). Past research found that travellers' intention to purchase travel products and services online was affected by their attitude towards online shopping (e.g., Agag & El-Masry, 2016; Amaro & Duarte, 2015; Bigné, Sanz, Ruiz, & Aldás, 2010; Dedek, 2016). Amaro and Duarte (2015) found that the travellers' perceived behavioral control influenced their intention to purchase travel online.

With the growing demand for e-commerce, future research should further explore the specific factors that would affect travellers using the online travel agency.

BABY BOOMER CONSUMERS

Previous research showed that demographic characteristics of travellers have an impact on the behaviour of using the Internet for travel (e.g. Ip, Lee, & Law, 2012; Luo, Feng, & Cai, 2004; Weber & Roehl, 1999). These demographic characteristics include gender (e.g. Kim, Lehto, & Morrison, 2007; Okazaki & Hirose, 2009) and age (e.g. Mitchell, 1995; Roberts & Manolis, 2000). Roberts & Manolis (2000) pointed out that age is the most important factor affecting one's purchase of goods and services. Age determines consumer behavior (Mitchell, 1995) as customers from different age cohorts tend to have certain attitudes and behaviors different from others (Cleaver, Green, & Muller, 2000; Parment, 2013; Schewe & Meredith, 2006). It is evident that recent research has focused on the younger age cohorts (Kim, Xiang, & Fesenmaier, 2015). Hence this proposed study intends to focus on the baby boomers to identify and better understand the distinctive patterns of their attitudes and behaviors.

Baby boomers were born between 1946 and 1964 (Colby & Ortman, 2014; Hewlett, Sherbin, & Sumberg, 2009; Williams & Page, 2011). They are aged between 54 and 72 years in 2018. The number of baby boomers living in the United States was estimated at 77 million in 2011 (Colby & Ortman, 2014). Although millennials are generally savvier in technology, more baby boomers have adopted infocomm technology in recent years. According to a Pew Research Centre survey conducted in January 2018 (Jiang, 2018), 67% of American baby boomers own smartphones in 2018 while only 25% had the smartphone in 2011. In addition, 52% of American baby boomers own a tablet and 57% use social media (Jiang, 2018).

With higher discretionary income and the accumulated wealth over time, baby boomers are considered as the most lucrative travel market as compared to the Generation X and Millennials (Li, Li, & Hudson, 2013; Roberts & Manolis, 2000). The American baby boomers made the most domestic trips in the United States (Li, Li, & Hudson, 2013). Baby boomers also travelled a greater distance than the other generational cohorts (Horneman, Carter, Wei, & Ruys, 2002). In the context of online travel search, Beldona (2005) studied the use of the Internet to search travel information online and to make an online travel purchase. The findings indicated that baby boomers had a greater increase in travel information searches online than Generation Xers. Beldona, Nusair, & Demicco's, (2009) follow-up study confirmed that baby boomers had the greatest increase in the likelihood of online travel purchases. Previous research focused on the American baby boomers, and as such, it is important to expand the study to baby boomers outside the United States. Hence, the proposed research will attempt to use a sample from Singapore.

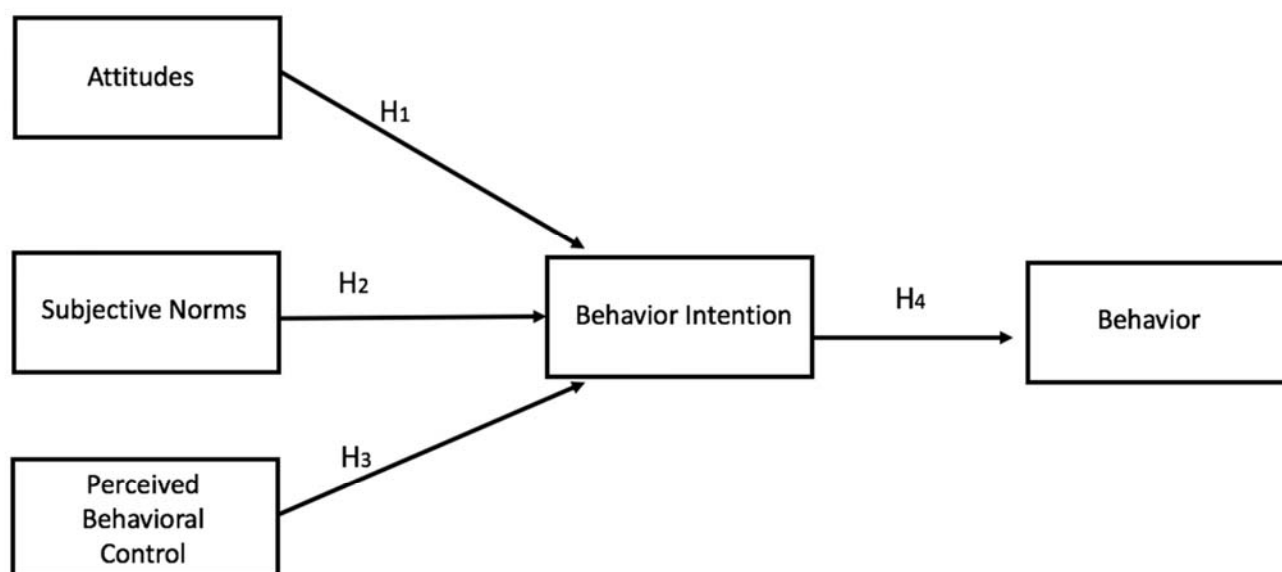
THEORY OF PLANNED BEHAVIOR

Icek Ajzen (1985) developed the theory of planned behavior model (TPB). It was evolved from the theory of reasoned action (TRA) developed by Martin Fishbein and Icek Ajzen in 1967. The theory of reasoned action focuses on the relationship between attitudes and behaviors within human action. The components of the theory of reasoned action model consist of behavioral intention, attitudes, subjective norms, belief strength, evaluation, normative belief, and motivation to comply. It is a causal model of the cognitive processes leading to the prediction of an individual's conscious decision making. The theory of planned behavior added perceived behavioral control to improve the predictive power of the theory of reasoned action (Ajzen, 1991).

The theory of planned behaviour proposes that an individual's behavioral intention and behaviors are influenced by one's attitudes toward behavior, subjective norms and perceived behavioral control (Figure 1). Attitudes refer to the individual's favourable or unfavorable evaluation of the target behavior (Ajzen, 1991). Subjective norms explain how the views of the individual's social reference group on whether he should engage in a specific behavior would influence the individual's behavioral intention (Ajzen, 1991). Perceived behavioral control was added to link an individual's beliefs and behavior, and is defined as 'people's perception of the ease or difficulty of performing the behavior of interest' (Ajzen, 1991, p.183). Perceived behavioral control indicates how the individual perceives the ease or difficulty of performing the specific behavior. When the individual has the ability, resource, and opportunities to perform a specific behavior, he will perceive himself as being more able to be in control, and therefore his behavioral intention will increase. The attitudes about the likelihood that one's behavior will have an expected outcome and the subjective evaluation of the positive and negative results of the specific expected outcome would impact one's behavioral intentions (Ajzen, 2011).

The theory of planned behavior has been widely applied in many research fields, including healthcare, education, tourism and many others, to predict human behavior. In recent years, some researchers have used the theory of planned behavior to study online behavior. Wu (2006) studied the behavioral intentions towards making a purchase from online bookstores among different consumer groups. His study showed that the opinions of reference groups influenced the consumers' behavioral intentions. Subjective norms and perceived behavioral control were the two key factors affecting the decisions on buying from online bookstores. Liang and Lim (2011) adopted the theory of planned behavior to compare the behavioral intention toward online shopping of two groups of consumers – traditionalist consumers and adventurist consumers. The findings indicated that the behavioral intention toward online shopping was positively affected by subjective norms and perceived behavioral control. This proposed research aims at exploring

how the theory of planned behavior can be applied to study how these factors affect the baby boomers' behavior of using online travel agencies.



Source: This study.

Figure 1 Main variables of the theory of planned behavior.

A few studies have adopted the theory of planned behavior to study users' intention to use e-commerce websites. For example, Morosan & Jeong (2008) found that the intention of using e-commerce website positively influenced booking hotels online. Similar findings were also evident in buying airline tickets online (Bigné et al., 2010; Kim, Kim, & Shin, 2009), and tourism-related products and services (Usoro, Shoyelu, & Kuofie, 2010). In the context of using the online travel agency, this proposed research will adopt the theory of planned behavior to examine if attitudes, subjective norms and perceived behavioral control will influence behavioral intention, and subsequently affect the behavior of using the online travel agency. It is expected that the findings will help marketers develop relevant strategies that encourage baby boomers to use online travel agencies.

ATTITUDES

Attitudes are "the individual's positive or negative evaluation of performing the particular behavior of interest" (Ajzen, 1991, p.188). It suggests that the individual may have different levels of positive or negative evaluation of a specific behavior. Ajzen (1991) explains attitudes as the extent to which an individual has a favourable evaluation of the behavior. The individual's intention to perform a specific behavior tends to be strong when he holds a more favourable attitude toward the given behavior (Armitage & Conner, 2010). On the contrary, the individual's negative evaluation of a specific behavior leads to a negative relationship with the intention to engage in that specific behavior (Ajzen, 1991). Previous research supported that the significant relationship between attitudes and intention was evident (e.g. Knowles, Hyde, & White, 2012; Lee, Shi, Cheung, Lim, & Sia, 2011; Linden, 2011; Quintal, Lee, & Soutar, 2010; Truong, 2014; Yazdanpanah & Forouzani, 2015).

Online travel shopping has grown in the past few years. Understanding consumers' online travel shopping behavior requires an examination of previous research in the field of online shopping. In the context of online shopping behavior, consumer's attitudes are defined as the positive or negative feelings when making an online purchase decision (Chiu, Lin, & Tang, 2005), which is consistent with Ajzen's theory of planned behavior. Previous research found that attitudes had a significant direct impact on online shopping behavior (e.g. Cheah, Phau, & Liang, 2015; Cheng & Huang, 2013; Cho, 2004; George, 2004; Pavlou & Chai, 2002). The online shopping behavior includes online information search, selection and purchase of goods and services online (Ariff, Sylvester, Rahim, & Zahuan, 2014). It suggests that consumers who have a positive attitude toward online shopping will have a higher tendency to purchase online. Based on the theory of planned behavior, Primabud & Samopa (2017) found that consumers would have higher behavioral intention to make online purchases when they had a more positive attitude toward online purchasing. When the individual shows the behavioral intention to use an online channel, he is more likely to make an online purchase (Pavlou and Fygenson, 2006). Some researchers found that attitudes were the strongest predictor of behavioral intention to shopping online (e.g. George, 2004; Pavlou & Fygenson, 2006).

In the context of online travel shopping, several studies found that consumers' attitudes toward online shopping were significantly related to their intentions to use online travel shopping (e.g. Bigne et al., 2010; Lee, Shi, Cheung, Lim, & Sia, 2011; Morosan & Jeong, 2008; Sahli & Legohe'el, 2016). Bigne et al. (2010) conducted a study to identify the determinant factors affecting the purchase of airline tickets online. The results showed that attitudes had a direct influence on airline ticket purchase intention among those people who had never purchased an airline ticket online. Amaro and Durate (2015) developed an integrative model to examine factors affecting intentions to purchase travel online. The research findings further supported that attitudes had a strong influence on the purchase of travel products and services online. Similarly, the results of Agag and El-Masry's (2016) study on consumers' drivers and outcomes of consumer trust toward online travel websites acknowledged that consumers' attitude toward online travel websites was the most relevant predictor of their intentions to purchase travel services online, which was consistent with Amaro and Durate's (2015) research. Agag and El-Masry (2016) further confirmed the positive impact of attitude towards an online hotel booking on the intentions to book a hotel online. Therefore, the proposed research will hypothesize that individuals' attitudes toward using the online travel agencies are positively related to the intention to purchase travel services online.

SUBJECTIVE NORMS

Subjective norms are beliefs about how an individual responds to whether those people the individual cares about (referents) would approve or disapprove a specific behavior (Ajzen, 1991). The individual will perform a specific behavior when he feels that his referents believe that he should do so. Conversely, if he believes that his referents would not approve his act, he will comply with the referents' expectations and avoid performing that specific act (Ajzen, 1985). Subjective norms indicate how the individual is affected by the perception of significant referents, such as friends and family members, of his behavior (Schofield, 1975). Some previous studies suggested that subjective norms are an important predictor of the individual's behavioral intention (e.g. Crespo & Bosque, 2008; Kim, Kim, & Shin, 2009; Quintal, Lee, & Soutar, 2010; Taylor & Todd, 1995). However, subjective norms were evidenced as the weakest predictor of intentions to act (Armitage & Conner, 2001).

Past research showed mixed results in the relationship between subjective norms and online purchase behavior. A few previous studies found that subjective norms were not significant in the prediction of one's intentions to purchase online (e.g. Lin, 2007; Pavlou and Fygenon, 2006; Wang, Chen, Chang, & Yang, 2007). Their findings were consistent with George's (2004) study that subjective norms were not significant in predicting actual online purchases. However, it was evident in other studies that subjective norms were related to the intention to purchase online (e.g. Al-Gahtani, Hubona, & Wang, 2007; Limayem, Khalifa, & Frini, 2000; Wang et al., 2007). When applying subjective norms in online purchasing behavior, the individual is more likely to comply with the specific norms in the group he belongs (Yu & Wu, 20017). They found that the stronger subjective norms' in favour of online shopping, the higher the intention that an individual would have to shop online. Interestingly, another research focused on the intention to participate in firm-hosted online travel communities, and effects on consumer behavioral intentions found that subjective norms had a negative effect on the intention to participate in a firm-hosted online travel community (Casaló, Flavián, & Guinaliú, 2000).

In the context of online travel shopping, the research findings showed that the impact of subjective norms on one's intention to purchase travel services online was mixed. Previous research found that subjective norms had a significant direct impact on consumers' intention to purchase travel products and services online (e.g. Bigné et al., 2010; Lee, Qu, & Kim, 2007; Sahli & Legohe'el, 2016). Kim, Kim and Shin (2009) conducted a study on the roles of subjective norms and eTrust in customers' acceptance of an airline B2C eCommerce website. The results supported that subjective norms exerted a positive impact on the perceived usefulness of the airline B2C eCommerce website. Similarly, Bigne, Andreu, Hernandez and Ruiz (2018) did a study of the impact of social media and offline influences based on an analysis of the low-cost airline industry. The findings showed that interpersonal influence as a component of subjective norms had a positive effect on consumers' repurchase of low-cost airline services, and their willingness to engage in positive word-of-mouth about online purchase of low-cost airline services. On the contrary, San Martín and Herrero's (2012) study concluded that subjective norms did not have a direct impact on the intention to purchase through the rural accommodation websites. Therefore, in the proposed study, based on the mixed findings, it is proposed that subjective norms are positively related to intention to purchase travel services online through the online travel agencies.

PERCEIVED BEHAVIOR CONTROL

Ajzen (1991) added perceived behavioral control to the theory of planned behavior model and defined perceived behavioral control as "people's perception of the ease or difficulty of performing the behavior of interest" (Ajzen, 1991, p.183). Perceived behavioral control contributes to both the individual's intentions and the actual behavior (Ajzen, 1991). Ajzen (2002) recognized that not all behaviors are volitional and so perceived behavioral control was included in the theory of planned behavior. Ajzen (1985) pointed out that an individual's performance of behavior may be furthered or hindered by either the internal or external control factors. The internal factors, such as the lack of specific skills to perform the task and emotions; and the external factors, such as opportunity, time and dependence on others would affect how the individual perceives his ability to perform (Ajzen. & Fishbein, 1980). The addition of perceived behavior control focuses on the internal factors. It suggests that the individual may have the intention to perform

a specific act but may not be able to put through the intention. The presence of some other factors may further or hinder the individual's behavioral performance, which is guided by control beliefs (Ajzen, 2002).

Ajzen further argued that perceived behavioral control is compatible with Bandura's self-efficacy theory (Ajzen, 2002). Armitage & Conner (2001) suggested that self-efficacy reflects how the individual perceives cognitive control or the level of difficulty in performing a task based on his internal factors. Taylor & Todd (1995) decomposed perceived behavioral control into self-efficacy and facilitating conditions based on Ajzen's work. Facilitating conditions were further divided into resources and technology compatibility. Resources such as time and money affected perceived behavioral control. Shih & Fang, (2004) adopted Taylor and Todd's (1995) decomposition of perceived behavioral control in the context of Internet banking. Their research findings indicated that perceived behavioral control was not affected by facilitating conditions.

Armitage & Conner's (1999) decomposed perceived behavioral control is different from Taylor and Todd's (1995). Perceived behavioral control was divided into perceived difficulty (i.e. self-efficacy) and perceived control. Perceived control is the extent to which the individual perceives the behavioral performance is under his voluntary control. Research results showed the difference between perceived difficulty and perceived control. Perceived behavioral intentions and actual behavior were better predicted by perceived difficulty (i.e. self-efficacy) than perceived control.

Following the development of the research on the decomposition of perceived behavioral control, Ajzen (2002) re-classified perceived behavioral control into self-efficacy and perceived controllability. Perceived behavioral control was defined as "people's expectations regarding the degree to which they have requisite resources and believe they can overcome whatever obstacles they may encounter" (Ajzen, 2002, p.676). Self-efficacy relates to whether the individual perceives the performance of a behavior as easy or difficult or whether he/she is confident with his/her ability to perform the task (Ajzen, 2002). Controllability relates to the extent to which the individual believes that he has the ability to control over his behavior (Ajzen, 2002). Hsu and Chiu (2004) applied both self-efficacy and perceived controllability in their research and found that both components explained the perceived behavioral control in electronic service acceptance.

Past research found that the addition of perceived behavioral control is relevant in explaining online shopping behavior (e.g. George, 2004; Hsu, Yen, Chiu, & Chang, 2006; Limayem, Khalifa, & Frini, 2000). Perceived behavioral control was found to have impact on intentions to buy online. A positive relationship between perceived behavioral control and behavioral intention was identified in a study of online brokerages and purchase intention (Bhattacharjee, 2000). Similarly, Pavlou and Chai (2002) found a positive relationship between perceived behavioral control and online transaction intention. Pavlou and Fygenson (2006) further confirmed that perceived behavioral control over getting information online and over product purchase online positively influenced people's intention regarding online transactions.

In the context of using online travel agencies, an individual may have the intention to book an air ticket online, but he may perceive that he lacks the skills to purchase on his own, and as such he will not execute the purchase behavior. Amaro and Duarte (2015) conducted a study on travellers' intention to purchase travel online. The findings showed that the traveller's perceived behavioral control over purchasing travel online had a positive impact on his intention to purchase travel online. Similarly, Sahli & Legohe'el's (2016) research on the tourism web acceptance model also found that perceived behavioral control positively influenced people's intention to book online. Following this, in this proposed study, it is proposed that perceived behavioral control over booking online has a positive influence on the intention to use the online travel agencies.

BEHAVIORAL INTENTION AND ACTUAL BEHAVIOR

Ajzen (1985) emphasized that intention can be considered as an individual's subjective inclination to perform a certain action and it is a variable for the predication of a specific behavior. Cheng & Huang (2013) suggested that when consumers have strong online group buying intention, they are more likely to buy online. Intention had a positive influence on the online purchase behavior. This proposed research attempts to investigate the baby boomers' intention to use the online travel agencies to book and purchase related travel products and services. Hence, the proposed study hypothesizes that the intention to use the online travel agencies positively influences the behavior of using online travel agencies.

To summarize, the proposed framework includes the hypotheses to examine the impact of attitudes, subjective norms perceived behavioral control, behavioral intention on the actual behavior in the context of baby boomers using the online travel agencies.

- H1: Attitudes toward using the online travel agencies are positively related to the intention to purchase travel services online.*
- H2: Subjective norms are positively related to intention to purchase travel services online through the online travel agencies.*
- H3: Perceived behavioral control over booking online is positively related to the intention to use the online travel agencies.*
- H4: Intention to use the online travel agencies positively influences the behavior of using online travel agencies.*

CONCLUSION

With the growing demand for using online travel agency services, it is worthwhile to examine the baby boomers' intention to buy through online travel agencies and to predict their actual online purchase behavior. This proposed research intends to offer a number of important implications for both the online travel agencies and related tourism marketers. The results will add to the body of knowledge based on the theory of planned behavior in the area of online travel purchase behaviour. More importantly, it will gain a better understanding of baby boomers' online travel usage behaviour, and thus, help tourism marketers to develop much more relevant digital marketing strategies to promote and encourage older generation customers to be actively involved in online travel related activities (Moscardo & Benchendorff, 2010).

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Ambiguity Aversion Effect on Sharing Economy Participation: Evidence from Transactions of Sharing Platform

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ABSTRACT

Despite that sharing economy is developing in various industries, more hidden concerns have spread and impeded its way ahead. In many countries, sharing businesses are banned and people are also wandering the participation for sharing their property. One important enlightenment point is whether the ambiguity aversion of the entity is high or low. Because when people participate sharing activities, the side with assets face the risk such as asset being damaged while the side without assets also have risk of safety or bad experience, that is the participants are ambiguity averse. By measuring sharing market participation using the transaction data on sharing platform and ambiguity with the insurance paid for the sharing. Besides, we can also measure ambiguity aversion with custom-designed questions based on Ellsberg urns, using a large representative survey on sharing platform. Our expected results will show that how the change in ambiguity influence the sharing behavior. The results provide hint for the sharing platform to establish effective mechanism to reduce the ambiguity for both sharing sides to motive the sharing participation.

Keywords: Ambiguity aversion, sharing economy, sharing platform

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Li, Y.R., Guo, Y. & Jing, Z. (2018). Does order takeaway contribute more opportunities? An empirical analysis of the impact of Meituan Waimai on local labor market. In *Proceedings of The 18th International Conference on Electronic Business* (p. 820). ICEB, Guilin, China, December 2-6.

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Does Order Takeaway Contribute More Job Opportunities? An Empirical Analysis of the Impact of Meituan Waimai on Local Labor Market

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ABSTRACT

This study intends to examine the impact of Meituan Waimai, a leading Chinese online takeaway platform on local labor market. On the one hand, online takeaway platform may attract more labor due to its flexible job opportunities compared to the traditional industry. On the other hand, to compete with platform, the advance of wages by traditional industry may attract more unemployment and underemployment. Our research plan to replay on an event study (i.e., the entry of Meituan Waimai on different cities in China) using a difference in difference method.

Keywords: online labor market, difference in difference method, empirical analysis

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Examining the Mediating Role of Commitment on Brand Herding: An Empirical Study in a Virtual Community of Consumption

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ABSTRACT

Consumer social interaction is one of the most influential factors affecting people's consumption-related decision making (Y. Chen, Wang, & Xie, 2011). When making product choice, particularly, consumers apt to follow the action of the crowd in many circumstances (Bonabeau, 2004). Referred to as *herding* in literature, such behavior-based social influence among market participants has long been studied (Banerjee, 1992; Hirshleifer & Hong Teoh, 2003; Raafat, Chater, & Frith, 2009). With the rise of online social platforms, other people's actions are getting increasingly more observable, as consumers usually share with each other their product-related use experiences, opinions, and purchase decisions (Liu, Brass, Lu, & Chen, 2015). As such, behavior-based social influence plays a critical role in shaping and affecting consumers' choice (Duan, Gu, & Whinston, 2009). Meanwhile, research on herd behavior has grown significantly and continues to grow. Empirical research examines herd behavior in a wide range of contexts, including online purchase (C. M. K. Cheung, Xiao, & Liu, 2014; Huang & Chen, 2006), technology adoption (Sun, 2013; Walden & Browne, 2009), online auction (Simonsohn & Ariely, 2008), contribution to open source projects (Oh & Jeon, 2007), etc. While it is generally held that no single reason can explain the behavioral convergence of consumers, literature in economics, marketing, and IS (information systems) disciplines primarily highlight two utility-based mechanisms behind herding (Bikhchandani, Hirshleifer, & Welch, 1992; Y.-F. Chen, 2008; Duan *et al.*, 2009; Huang & Chen, 2006; Langley, Hoeve, Ortt, Pals, & van der Vecht, 2014; Zhang & Liu, 2012). These mechanisms are informational cascades (i.e., ignore one's own information and make a choice based on other's choice due to uncertainty when making decision, see (Bikhchandani *et al.*, 1992) and positive network externalities (i.e., additional users of a good increase the value of that good, (Kauffman, McAndrews, & Wang, 2000).

Despite a wealth of literature on herd behavior, there has been little work discusses the convergent behavior occurs among customers who are already the patrons of certain brands. This setting is unique in that, available choices in the market (i.e., current brand vs. alternatives) are not in the same position from the standpoint of consumers. Empirical studies do show that the popularity of a brand, per se, positively impacts its customers' loyalty (Raj, 1985) and favorable cost-benefit evaluation (Deval, Mantel, Kardes, & Posavac, 2013; He & Oppewal, 2018; Li, 2004). These key components, in turn, encourage the existing customers of the brand continue their patronage (Aaker, 2009). By this process, a product's popularity establishes a hinderance to its customers' attrition by cementing brand-customer relationship (Aaker, 2009). However, it remains uncertain how and to what extent that customers' continuance intention (as opposed to migrating to alternative brands) is affected by the crowd's choice. Note: in some occasions, indeed, brand popularity is negatively associated with one's brand choice. Need for uniqueness (Tian, Bearden, & Hunter, 2001) and negative network externalities (Hellofs & Jacobson, 1999) are two common mechanisms. The former occurs primarily in the market of self-expressive products, such as luxury goods, apparels, and the like (Steinhart, Kamins, Mazursky, & Noy, 2014); whereas a typical context of the latter is that the quality of certain services being worsen off due to high service popularity (Hellofs & Jacobson, 1999).

Obviously, the understanding of brand patrons' behavioral convergence has significant implications on both theory and managerial practice. However, none of the aforementioned utility-based mechanisms of herding (i.e., informational cascades and positive network externalities) provides a satisfactory explanation in this context. One reason for this theoretical lacuna is related to the implicit assumption in the herding literature (i.e., available choices in the market are of the same position), which is not the case in the research context of business retention/switching. A second reason deals with the overwhelming emphasis on the economic utility as the underlying mechanisms. As pointed out by Bikhchandani *et al.* (1992), herding could also be induced by non-economic factors, such as the decision-maker's conformity with others (Jones, 1984), avoiding sanctions due to disobedience (Bendor & Mookherjee, 1987), and so on.

Building upon the prior research on customer retention, we introduce customer commitment — the key construct in business relationship literature, into the understanding of brand patrons' behavioral convergence. It is widely held that commitment plays the central role in people's persistence of behavior (Newman & Sabherwal, 1996). Particularly, customer commitment involves not only the state of mind that binds a customer with the present business relationship (Kelley & Davis, 1994), but also the structural conditions that prevent her from making a change (Becker, 1960). Therefore, we contend that the perspective of commitment offers an integrative understanding of the behavioral convergence induced by both psychological and utility-based mechanisms.

This research adopts the three-component commitment model (TCM) — a widely used conceptualization of commitment (Meyer, Stanley, Herscovitch, & Topolnytsky, 2002). According to TCM, people choose to maintain the current business relationship

because they feel they want to (affective commitment), ought to (normative commitment), or need to (calculative commitment) (Meyer, Allen, & Smith, 1993). By introducing TCM into the study of herding phenomenon, this research takes a holistic and novel view for understanding the interplay between product popularity and consumers' continuance. In particular, we ask, *how do affective commitment, normative commitment, and calculative commitment mediate the effects of product popularity on customers' intention of brand continuance?*

In this research, we attempt to answer the research question in the settings of virtual communities of consumption (VCC), which are online groups explicitly centered on consumption-related interests (De Valck, 2005). VCCs provide plentiful of informative cues about brands' relative popularity and consumers' choices (C. M. K. Cheung *et al.*, 2014), hence constitute an ideal research environment of our study.

This study potentially contributes to the literature at the following perspectives. First, despite the voluminous research on herding, it remains uncertain how group mimicking behavior affect customer retention or migration. The current research adds to the literature by expanding research on herding to a domain in which, to the best of our knowledge, very little scholarly effort has been devoted. Second and more importantly, this research theorizes and empirically tests the central role of commitment components underlying the herd behavior of brand patrons. This perspective provides insights into an alternative mechanism of how herding takes effect in the context of customer migration, thus adds to both the herding and customer retention literature. In addition, our exploration of the heterogeneous roles of various popularity cues in customer retention sheds lights on marketing practice about the most effective way to retain patrons and attract potential customers.

Keywords: Brand herding, brand continuance, normative commitment, affective commitment, calculative commitment, virtual community of consumption

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ACKNOWLEDGEMENTS

This research was fully supported by research grant numbered MYRG2017-00020-FBA, University of Macau.

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Li, Y.L. (2018). Human-machine negotiation system based on psychological factors. In *Proceedings of The 18th International Conference on Electronic Business* (p. 824). ICEB, Guilin, China, December 2-6.

Li

Human-machine Negotiation System Based on Psychological Factors

(Abstract Only)

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ABSTRACT

In order to solve the problem of negotiator's psychological representation in the negotiation system, a negotiation system based on psychological factors was designed. Firstly, a description model based on human psychological factors is established. According to the actual negotiation situation, the influence of the negotiator's psychological factors is added to the model, which makes the outcome of the negotiation model more realistic. Then, the negotiating process of the model is analyzed. The system can conduct a new round of negotiation according to the dynamically determined negotiation strategy and the psychological factors of the other parties in the negotiation process to help the user make the optimal decision and automatically select the appropriate strategy. Finally, the design implements a tourism-oriented e-commerce negotiation system. The system combines the actual needs of the Guilin tourism market and applies the negotiation model designed in the text to the system. Through experiments, the results show that the user satisfaction of using the system is high.

Keywords: Automated negotiation; psychological factors; e-business; tourism strategy

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Investigating on Determinants of Cross-Border E-Commerce Purchase Intention

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ABSTRACT

Research Background and Motivation

In recent years, cross-border e-commerce has risen and developed to be an important model in the rapidly expanding e-commerce market. According to Accenture's predictive report, the global market of cross-border e-commerce will increase in size to \$1 trillion in 2020, and obtain more than 900 million online consumers around the world (Feng et al., 2017). Due to the information asymmetry between online customers and retailers, reducing customers' uncertainty and building their trust become critical issues for e-commerce. Comparing with traditional e-commerce, cross-border e-commerce suffers more from customers' uncertainty, because of their limited knowledge and unfamiliarity of other countries, various image on the products and their original countries, and different attitude to cross-border e-commerce platform. These factors lead to the perceived risk in process of cross-border purchasing, and increase uncertainties which negatively affect their purchase intention. It is important to find out the mechanism of consumers' psychology and behavior under cross-border e-commerce context, and explain the influencing factors of customers' uncertainty and purchase intention.

Theoretical Foundation and Model Development

The country-of-origin image (COO) is considered as an important factor on reducing uncertainty and complexity of making purchase decisions in international business and cross-border commerce. COO can be described as a snapshot and a representation which business people and consumers link to the products of a particular country (Cervin~o et al. 2005). Authors such as Lantz (1998) and Ahmed et al. (2005) introduce the concept of COO as the result of the country's stereotypes. Stereotypes affect consumers on categorizing information (Tat et al. 2012). The way consumers tend to categorize knowledge can be used to explain the relationship between COO and the product (Lee and Ganesh, 1999). Product category image (PCATI) means the image of products in a particular category form a country (Adamantios et al. 2011). Better country image lead to higher evaluation of the country's performance on the product category, then we make a hypothesis that COO will positively influence PCATI. Both COO and specific product category level (PCATI) are drivers of product image, and have positive impact on PCATI.

Trust plays an important role in all business relationships, especially cross-border e-commerce. The separation in both time and space in cross-border e-commerce brings information asymmetry to buyer which raises risks and uncertainty. Meanwhile it highlights the importance of trust. Trust is defined as the buyers have positive expectations of supplier' behavior and intention and are willing to accepting vulnerability in the process of purchasing (Rousseau et al. 1998, p. 295) . Buyers are concerned with platform-level trustworthiness, which is divided into parts: ability, benevolence, and integrity (Mayer et al. 1995). Consumers really care about whether platform has the ability to satisfy their needs, show benevolence and integrity towards the buyer for their benefits. Trust in platform is measured as the trustworthiness of the cross-border e-commerce platform. However, in cross-border transactions, buyers are also concerned with country-level and product category-level characteristics. Consumers' trust in platform provides cues on the institutional assurance on the quality of product, and reduces their dependence on the characteristics of products like COO and PCATI. In other words, trust in platform negatively moderates the relationship between COO (PCATI) and product image.

Consumers' knowledge can change their perceptions of product image. Subjective knowledge highly influences consumers' decisions on choosing products according to their attributes (Phillips et al. 2013). Subjective knowledge is defined and measured as the amount of product related information which a consumer perceived as storing in their memory (Flynn and Goldsmith 1999). The consumers with subjective knowledge can clearly identify the product attributes they need, so they place a higher value on PCATI rather than COO when they perceive the product image. For example, an electronics enthusiast would be more concerned with the level of electronics in a given country than with the overall image of COO. Namely the more subjective knowledge consumers have, the less they will refer to COO to perceive product image. On the contrary, the more subjective knowledge consumers have, the more attention they will pay to PCATI to assess product image. We make hypothesis on the moderation effect of subjective knowledge on relationship of COO (PCATI) and product image: Subjective knowledge negatively moderates the relationship between COO and product image. Subjective knowledge positively moderates the relationship between PCATI and product image.

Uncertainty has always been an important issue for e-commerce purchase behavior. It comes from the unpredictable changes and information asymmetry due to nondisclosure or distortion of information (Devaraj et al. 2002). Consumers' willingness or reluctance to acquire products is mainly affected by the degree of consumers' familiarity with a product (Souiden et al. 2011).

Uncertainty is negatively associated to possibility of consumers' purchase decision. However, uncertainty can be reduced by subjective knowledge, product image and trust in the platform. The higher consumers' perceived products image (product image / trust in platform) is, the lower their uncertainty towards those products.

Fishbein and Ajzen (1975) defined purchase intentions as decisions to act, or psychological states which represent the individual's perception to engage in a purchase behavior (Wang and Yang, 2008). Consumers' purchase intention constitutes a long cognitive process (Haubl, 1996). The higher consumers' uncertainty to acquire high a product is, the lower is their purchase intention of this product.

Intended Contribution

The objective of our study is to gain insights into the determinants of cross-border e-commerce purchase intention, and in particular to investigate the influencing factors of uncertainty in the cross-border purchasing. Base on the cross-border context, we study the effect of country image on building product image by consumers. We further classified the general concept of country image into COO and PCATI. We think COO is a cue that consumer utilized to build the image of a cross-border product. Additional consideration is given to the influence of PCATI on product image in this study, indicating PCATI is positively associated with product image.

Trust in platform and subjective knowledge are defined as moderators in the model. This study innovatively investigates their moderating effect on the relationships between COO/ PCATI and product image, and their negative impact on uncertainty.

In addition, this study further clarified the influencing factors of uncertainty, namely trust in platform, subjective knowledge and product image. All of these variables have negative effects on uncertainty. And both consumers and platform managers can benefit from our study and take actions to encourage purchase intention by reducing uncertainty in the cross-border e-commerce purchase process.

Keywords: Cross-border, e-commerce, country image

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ACKNOWLEDGEMENTS

The work described in this study was partially supported by the Natural Science Foundation of Liaoning Province (No. 20180550433), Philosophy and Social Sciences Planning Fund of Liaoning Province (No. L18CGL015) and the Fundamental Research Funds for the Central Universities (No. DUT17RC(3)12).

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Media Richness and User Continuance to Instant Messaging

(Abstract Only)

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ABSTRACT

Media richness determines adoption of information systems. Insufficient research was done for investigating its influence on user continuance of using instant messaging applications. This study used classic IS and psychological theories to construct a research framework. This study gathered more than 200 responses by using an online form. LISREL software was used to conduct structural equation modeling technique to test the research framework. The findings indicated that various but not all dimensions of media richness positively contribute to users' continuance to use instant messaging applications. Specific dimensions provide insights for managers to design their applications to effectively retain their users.

Keywords: Media richness, instant messaging, user, continuance, structural equation modeling.

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Perceived Speaking Up as a Stressor for Coworkers in a Social Network Context: A Dual Process Examination

(Abstract Only)

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ABSTRACT

This research proposal will explore the coworker-related outcomes of perceived employee speaking up which can be viewed as a stressor for coworkers in workplace. Within a team, voice behavior can make changes for the status quo and even upset others (LePine & Van Dyne, 1998). We want to examine how voicing may influence coworkers' job attitude and behavior in a social network context. Specifically, this study introduces the dual process model of coping theory to employee voice behavior literature to construct longitudinal mediational mechanism underlying the relationship between perceived speaking up toward supervisor and coworker outcomes like job performance and satisfaction. Integrating with social exchange theory, this study adds coworker exchange as a moderator for the mediating effects. This quality of coworker exchange may influence coworkers to adopt different coping strategies (problem solving focused coping vs. emotion focused coping) to respond perceived speaking up toward supervisor.

Keywords: Perceived speaking up, voice behavior, social network and influence, stress.

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INTRODUCTION

Research questions

Voice behavior or speaking up is defined as the verbal communication of suggestions, problems, or concerns about work-related issues intended to improve organizational procedures or unit effectiveness (LePine & Van Dyne, 1998; Morrison, 2011). Even though voice behavior is a kind of discretionary behavior that highlights expression of promotive and constructive intentions to obtain the improvement in organizational functioning, it is logical to suppose that speaking up toward supervisor is likely to upset interpersonal relationships and indeed create coworker great workplace stress. Voicing a challenging suggestion can send a ripple of implicit or explicit change across a whole team or unit just like stone dropping in the water.

The main research question is about when and why speaking up toward supervisor influence coworkers' outcomes. The specific research questions are as follows.

Research question 1: In a team interactional process, do employees' speaking up toward supervisor positively or negatively affect coworkers' job performance and satisfaction.

Research question 2: If the answer to RQ 1 is yes, then is such a positive effect explained by a problem-solving focused coping process (i.e., via coworkers' personal control)?

Research question 3: If the answer to RQ 2 is yes, then is such a negative effect explained by an emotion focused coping process (i.e., via coworkers' role overload)?

Research question 4: If the answer to RQ 2 is yes, then is such a dual-process coping mechanism moderated by coworker exchange.

Constructs and theoretical framework

Voice behavior in our study refers to speaking up toward supervisors or upward voice that emphasizes focal employees' expression of constructive suggestions to team leaders (Liang, Farh, & Farh, 2012; Liu, Song, Li, & Liao, 2017).

This study proposes a dual-process model of coping as a theoretical framework to describe coworkers' response process toward focal employee's upward voice. This model consists of problem solving focused and emotion focused coping strategies (Folkman & Moskowitz, 2004). Problem solving focused coping refers to "attempts to identify a stressor and taking action to eliminate or circumvent the source of the stress", and personal control is used to represent such coping process; whereas emotion focused coping refers to "attempts to reduce or eliminate the emotional distress associated with a stressful situation", and role overload is used here to outline the emotion focused coping process.

We use coworker exchange relationship as the moderator of the first stage of the dual-process mediating effect of personal control and role overload. Coworker exchange is defined as the exchange relationship among coworkers who are supervised by a same leader (Sherony & Green, 2002). We believe that coworker exchange influences the way that coworkers think about focal employees' upward voice. Coworkers' outcomes as dependent variables are expressed by job performance and job satisfaction.

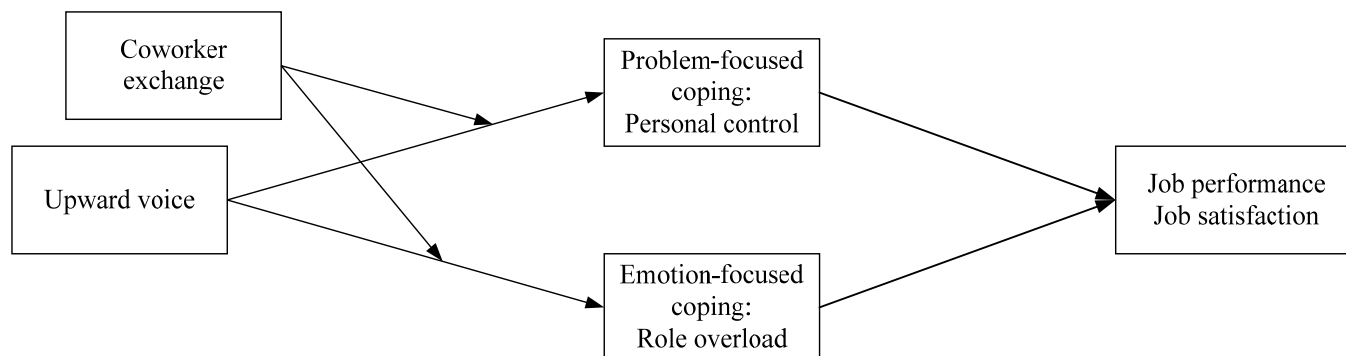


Figure 1 Theoretical Framework

Research design

We will adopt longitudinal field research design to explore the coping process mechanism of the interactive effect of upward voice and coworker exchange on coworkers' job performance and satisfaction. All the measurements of the variables can be obtained in the previous research that has been published in top-tier journals. Upward voice can be measured with the scale developed by Liang et al. (2012) and Liu et al. (2017). The scale of coworker exchange is obtained from Sherony and Green (2002). Personal control and role overload can be measured by the scales from (Aryee, Walumbwa, Mondejar, & Chu, 2014) and (Eissa & Lester, 2017), respectively. The scales of coworkers' and job satisfaction comes from the research of Wyland, Lester, Ehrhardt, and Standifer (2016).

Data collection

We will collect data from some corporates with three-wave survey methodology in China. The predictors, mediators and outcome variables all will be measured separately at three-time point. And they will be reported by a multisource way.

Analytical strategy

First of all, a descriptive statistic method will be used to analyze the central tendency and correlation coefficients of all variables. And then we will employ latent growth modeling analysis to testify the hypothesized relationships in our model.

ACKNOWLEDGMENT

This work is supported by grant of The Natural Science Foundation of China (Project no. 71502048), and "Fundamental Research Funds for the Central Universities" (Projects no. 2018B20714).

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The Design of an Online Roommate Finding System for Property Management Portals—the Virtual Community Perspective

(Abstract)

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ABSTRACT

With the evolution and diffusion of the internet at the society level, various business sectors have been transformed and redesigned with the new technologies such as enterprise systems, social media, virtual communities, social commerce, and business intelligence. For example, most fortune 500 companies have installed ERP system by 1998 (Magal & Word, 2012), resulting in major manufacturing and traditional businesses to re-design their business processes. The travel industry has been disrupted by the online booking system such as booking.com and TripAdvisor.com (Mellinas, Martínez María-Dolores, & Bernal García, 2015). Many bookshops have been closed because of the operations of online booking stores such as Amazon (Pitt, Berthon, & Berthon, 1999). The emerging smart city research also implies that the transformation by the digital technology is at the national and city level into all sectors including transportation, energy, water etc (Paroutis, Bennett, & Heracleous, 2014). In the property management sector, various property management portals have been established to facilitate the estate agencies to manage properties and the customers to find suitable properties. The typical examples are zoopla.com and rightmove.com, both of which are specialized in one-stop property renting and selling in the United Kingdom. At the same time, there are also many small property management agencies who operate the independent property management platforms.

The traditional property management portal normally consists of three key functions, property listing and management for agencies; property browsing and appointment booking for customers; and the property information integration including neighbourhood, billing, local tax etc. While the traditional property management system has satisfied the great needs for estate agencies and focus heavily on the information of the properties themselves, the customer experience has mainly ignored from the traditional design of the website. Practically, there is a need to bring the most recent knowledge of improving online shopping experience into the property management system design. This paper proposed a new business model for property management portals by designing an online roommate finding system with the virtual community theory. Specifically, the virtual community concept is used to design the online roommate system from the interpersonal relationship perspective.

The proposed online roommate finding system is designed based on the interpersonal relationship framework (Li & Lee, 2013) and borrowed the concept and algorithm of the online recommendation system (Jiang, Shang, & Liu, 2010). Specifically, the following functions are implemented for the online roommate finding system so that a renting community emerges from the rental portal, the profile information of each tenant, the desired roommate features including personality, age, country, native language, etc, and the inside communication channels. The proposed online roommate finding system is going to be integrated into the existing online property management portal in UK. The action research method will be used to test the effectiveness of the online roommate finding system from 3 stages for 3 years, stage one is for the system testing, stage 2 is for community member recruitment, stage 3 is for operations of the system for profit generation. The current project is in the early phase of stage 1 and the requirements analysis is finished.

Keywords: Property management portal, virtual communities, e-business, recommendation system, roommate finding.

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ACKNOWLEDGMENT

This work is partially supported by Innovation Voucher Fund of Northumbria University in UK.

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