



**Proceedings of
The Sixteenth International Conference on
Electronic Business**

ICEB 2016

“Internet Plus”

Edited by

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Xiamen University

ISSN: 1683-0040

**4-8 December 2016
Xiamen University, China**

Preface

Welcome to the 16th International Conference on Electronic Business (ICEB) in Xiamen University, China. The theme of this year's Conference is "Internet Plus". We have received 136 submissions and 89 papers are accepted into the final program that consists of seventeen sessions. Among them, 83 papers are included in the Proceedings. The topic areas of the papers in this conference include behavior, social media, user adoption, e-business, crowdsourcing, cross border issues, trust, logistics, social commerce, Fintech, design science, e-healthcare and other e-business research issues.

We celebrate the 16th anniversary of ICEB this year, it is our great honor to welcome Professor Jianming Ye, dean of the School of Management at Xiamen University and Professor Eldon Y. Li, ICEB Honorary President, to give us opening addresses. In addition, we have scheduled five keynote speakers: Professor Kwok Kee Wei, Dean and Provost's Chair Professor in the School of Continuing and Lifelong Education (SCALE) at the National University of Singapore (NUS); Professor Qiang Ye, dean of the School of Management at Harbin Institute of Technology; Professor Bin Gu, Department of Information Systems, Arizona State University, USA; Professor Eldon Y. Li, University Chair Professor and department chair of the Department of Management Information Systems at the National Chengchi University (NCCU), Taiwan and Mr. John J.P. Li, CEO & President from HSBC Taiwan. They will present their recent research in Digital Commerce, E-Commerce, Sharing Economy, Data Analysis and Fintech.

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, reviewers, program committee members and session chairs, who all have contributed their effort and support to this conference. Special thanks go to our conference staffs who have planned and executed this conference event tirelessly.

Sincerely yours,

Lifang Peng

Lifang Peng, Ph.D.
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Gamers' Behavior Via Avatars In Online Games

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ABSTRACT

Gamers use avatars to represent themselves to interact with others in online games. However, gamers' behavior via avatars has received insufficiently attention by electronic commerce scholars, warranting further study on this issue. Positive interactions among online gamers should foster their loyalty to the game. Therefore, this study investigated how avatar design affects gamers' behavior via avatars. This study obtained responses from more than one thousand online gamers that were used for further analyses. Criteria were set to exclude some invalid responses, so as to increase data validity. Moreover, reliability and validity were checked by using six tests, demonstrating the adequate performance in psychometric properties. Structural equation modeling was conducted for analyses. This study found that avatar design has an important impact on gamers' behavior via avatars. Specifically, positive perceptions on avatar design motivate the gamers to exhibit positive behavior via avatars. Findings of this study provide feasible means for electronic commerce managers to encourage gamers' positive interactions and thus should create strong virtual communities and subsequently loyal gamers.

Keywords: Online game; avatar; avatar design; positive behavior; structural equation modeling.

INTRODUCTION

Avatars (user representations in virtual environments) have been among of the recent foci of communication studies [12]. However, gamers' behavior via avatar, especially friendly user behavior has received insufficient attention by electronic commerce scholars, indicating a research gap.

Research filling this gap should assist game providers in designing gaming elements enabling gamers to create their avatars to encourage favorable interaction among gamers, which can foster gamers' loyalty. Therefore, the purpose of this study is to fill the aforementioned gap by identifying and examining the antecedents of friendly behavior expressed through gamers' avatars.

LITERATURE REVIEW AND HYPOTHESES

Friendly Behavior in Online Games

Helping behavior is defined as an intentional action of one person that could bring the benefit to the involved person in that action [3]. In virtual environment and online gaming contexts, avatar appearance and characteristics are common elements contributing to friendly behavior [4] [5] [7] [12] [17] [21]. Specifically, avatar attractiveness impacts female users' behavior toward other users [16]; the virtual human skin color can affect frequency of help provision [5]; avatar gender influences seeking independent of physical sex [7]. In online gaming contexts, friendly behavior also plays an important role because of two reasons. First, online gamers' misbehavior (i.e., behavior that violates generally accepted norms) hinders other gamers' continuance intention [14], degrading the sustainability of game providers. Second, online gamers experience a lower level of loneliness and social anxiety when online than in the real world [9], supporting the importance of friendly behavior among online gamers.

Avatar Agreeableness

Avatar agreeableness indicates that the avatar looks agreeable (i.e., kind and warm) [18]. When the gamers use an agreeable avatar inferring that his/her behavior should be kind and warm. Such observations should fuel their motivation to actually engage in friendly behavior, creating a positive link between avatar appearance agreeableness and friendly behavior. Thus, this study hypothesizes:

H1: Avatar appearance agreeableness is positively related to friendly behavior.

Avatar Attractiveness

Avatar attractiveness indicates that the avatar is good-looking [16]. When an avatar looks good to the users, the user perceives the expectation he/she should behave in a likeable manner, encouraging them to engage in friendly behavior. Therefore, this study hypothesizes:

H2: Avatar attractiveness is positively related to friendly behavior.

Avatar Height

Avatar height has been shown to be related to overt confidence in negotiation [19] [20] and provision and acceptance of offers that strongly favor oneself [19]. Such behavior is contrary to being friendly, or being warm and kind. When a user perceives his/her avatar as tall they should perceive others' expectation that he/she should behave in an *unfriendly* manner. Therefore, this study hypothesizes:

H3: Perceived avatar height is negatively related to friendly behavior.

METHODS

Sample and Data Collection Process

This study obtained responses from more than one thousand online gamers that were used for further analyses. Criteria were set to exclude some invalid responses such as not play online games in the previous months, nominating non-existent online games, nominating non-existent avatar role/race/occupation, etc.,..., so as to increase data validity. The detail criteria were listed in table 1.

This study also collected the information on participants' gender, age, education level, and monthly income. Those data were used as control variables which increasing the analytical rigor.

The five-points Likert scale was used. Higher scores represent high levels in the measured construct.

Table 1: Criteria for Identifying and Excluding Invalid Responses

Criterion	Number
Had not played online games in the previous month	3
Had played online games where avatars were not visible	2
Had nominated non-existent online games	21
Had nominated non-existent avatar role/race/occupation	37
Had played the nominated game for zero years	1
Had played the nominated game for zero hours per week	2
Duplicative participation (submitted duplicate email addresses)	4
Total	70

Measurement

Items measuring the constructs in the study came from the literature. The four items measuring avatar appearance agreeableness were adapted from [2]; the three measuring avatar attractiveness were adapted from [3]; the three measuring avatar height were developed based on the associated descriptions by [11]; and the three measuring friendly behavior were adapted from [6].

This study used response options ranging from 1 (strongly disagreeable) to 5 (strongly agreeable). High scores represent high levels in the measured construct. Items measuring any one construct were averaged to represent the level of that construct. No items in the aforementioned were dropped during the analytical process.

Psychometric Properties

Confirmatory factor analysis was conducted to assess the psychometric properties of the study measurement. Reliability and validity were checked by using six tests, demonstrating the adequate performance in psychometric properties. Structural equation modeling was conducted for analyses.

RESULTS

Sample Profile

Table 2 summarizes the demographic distribution of the participants. To retain the information in the responses to the study items, those who provided incomplete demographic were retained as valid responses (3.3%). Therefore, the numbers in table 2 do not match the number of total valid responses. Among the participants, most of the participants were male (86.5%), age between 11 to 20 years old (63.3%). Most of them attended high school or below (48.3%) and college or university (48.2%). The monthly income is no more than US\$400 (69.1). The information about the demographic is consistent with recent online gaming literature (e.g., [10] [1] [8]).

The proportion of male participants in this study is consistent with recent online gaming literature (i.e., 80.3% male in [10]; 83.7% male in [1]). Moreover, the age range was also in line with the pertinent literature (i.e., mean age of 23.2 years old in [1]; mean age of 21 years old in [9]). Also, the substantial proportion of participants who had attended college/university was in concordance with the recent literature (e.g., [8]). Such conformance to the demographic features of online gamers in the recent literature supports the sample representativeness of the participants recruited to the present study.

Table 2: Summary of the participant profile

Variable	Category	Number	Percentage
Gender	Male	1,123	86.5
	Female	175	13.5
Age	11-20 years old	817	63.3
	21-30 years old	440	34.1

Variable	Category	Number	Percentage
Education	31-54 years old	34	2.6
	High school or below	627	48.3
	College or university	626	48.2
	Graduate institute	45	3.5
Monthly income	US\$ 400.00 or less	868	69.1
	US\$ 401.00-800.00	152	12.1
	US\$ 801.00 or more	237	18.8

Hypothesis Testing

As predicted, avatar appearance agreeableness and avatar attractiveness were positively related to friendly behavior ($\beta = .66, p < .05$; $\beta = .09, p < .05$), supporting H1 and H2. Perceived avatar height was negatively related to friendly behavior ($\beta = -.03, p < .05$), supporting H3. Table 3 summarizes the testing results.

Table 1: Sources of Friendly Behavior among Online Gamers

	β
Gender	.02
Age	.02
Education level	-.01
Monthly income	.00
User agreeableness	.14*
Avatar appearance agreeableness	.66*
Avatar attractiveness	.09*
Perceived avatar height	-.03*

Note. * denotes $p < .05$.

DISCUSSIONS

Main Findings and Contributions

Avatar agreeableness and avatar attractiveness were positively related to friendly behavior. Avatar height was negatively related to friendly behavior. This study contributes insights for game providers to encourage friendly behavior among gamers. These results should facilitate emotional cohesion among gamers, and assist game providers to form strong and tightly connected virtual communities.

This study found that avatar attractiveness is positively related to friendly behavior. Therefore, game providers are encouraged to investigate/survey/interview the gamers to seek the ways to improve the avatar attractiveness. This study also found that avatar agreeableness is positively related to friendly behavior. Thus, game providers could provide more avatars that have agreeable appearances to encourage the gamers to adopt such avatars. Avatar height is in contrast which is negatively related to friendly behavior. Therefore, game providers can add the elements that can help to alleviate the link between avatar height and friendly behavior.

Limitations and Future Research Directions

This study adopted a cross-sectional design, which is adequate since such a design deals with how current perceptions impact

current responses. This design was also found acceptable in recent literature (e.g., [13]). However, cross-sectional designs are known for their limited ability to directly confirm causality. Therefore, future studies could conduct experiments to replicate the present study, providing further and more robust evidence supporting causality among the study constructs herein. This study collected self-rated responses. Such an approach was deemed acceptable in recent communication literature (e.g., [13] [15]). However, future studies may adopt a big-data approach by using software to collect enormous amounts of behavioral data.

CONCLUSIONS

This study contributes to the literature by indentifying the antecedents of friendly behavior among gamers. Via those antecedents, the game providers can manipulate the design and applicability to retain that behavior to increase the gaming loyalty. Further research may investigate how avatars impact human communication.

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Exploring the Factors Affecting Consumers' Online Agricultural Products Purchase Behavior Based on the UTAUT Model

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ABSTRACT

The online agricultural products purchase has become a trend of consuming, but it is influenced by many factors. Based on the UTAUT (unified theory of acceptance and use of technology) model, some of the factors which include performance expectancy, effort expectancy, social influence, perceived risk, facilitating conditions, consumer innovativeness and purchase intention are chosen to build a research framework, and several hypotheses are proposed. Finally, a survey is conducted by questionnaires, and 264 valid samples are obtained. The research model is verified by using AMOS, and a modified model is built. Meanwhile, group testing is carried out to verify the correctness of each sub hypothesis.

The empirical results show as follows: effort expectancy has a significantly positive effect on consumers' online agricultural product purchase intention. Performance expectancy, facilitating conditions and purchase intention have a significantly positive effect on consumers' online agricultural products purchase behavior. The effect of social influence and perceived risk on the consumers' online agricultural product purchase intention is not significant. Some suggestions are put forward for the agricultural product online stores to meet the needs of the consumers and to improve the online agricultural products trade according to the empirical results.

KeyWords: online agricultural products purchase; purchase behavior; purchase intention; UTAUT; structural equation model

BACKGROUND

In recent years, with the increasing coverage of Chinese network, the optimizing of distribution industry and online banking, and the improving of laws and regulations of e-commerce, the environment of online shopping is gradually improved. Consequently, the scale of online shopping is developing greatly, and the consumers' habit of online shopping is fostered gradually. At the meantime, the marketing channels of agricultural products are expanded from offline to online. The online agricultural products purchase is becoming common consuming behavior of people. Compared to the traditional way of trade, the online agricultural products purchase can avoid the limitation of location and time, and it will promote the trade of agricultural products and reduce the cost of trade, and it will also stimulate the consumers' desire of consuming. In addition, the e-marketing of agricultural products helps farmers take part in setting the price of agricultural products, so that the farmers increase their incomes.

However, the e-commerce of agricultural product in our country is still in the primary stage, and many problems of it need to be researched, such as the factors affecting consumers' online agricultural products purchase. It is of great significance to know which factors will stimulate consumers to purchase agricultural products online, and which factors will hinder consumers to purchase agricultural products online. Clearing about these factors will help the storekeepers to promote the e-marketing of agricultural products.

THE OVERVIEW OF UTAUT MODEL

A new technology does not naturally get people's recognition. A large number of studies show that there are many factors affect users' intention to accept new technology in the process of development and promotion. All kinds of technology acceptance theories study the psychological and external factors which affect users' acceptance attitude of new technology from the subjective and objective view[1]. In the area of technology acceptance research, academic circles put forward many models, such as the theory of reasoned action (TRA), the theory of planned behavior (TPB), the technology acceptance model (TAM)

and its modified model (TAM2 and UTAUT)[2].

UTAUT model was raised in 2003 by Venkatesh et al[3]. It integrates more than 20 variables from eight theory models including the TRA, the TAM, the Motivational Model (MM), the Theory of Planned Behavior (TPB), the Decomposed Theory of Planned Behavior (DTPB), the Model of PC Utilization (MPCU), the Innovation Diffusion Theory (IDT), and the Social Cognitive Theory(SCT).The empirical test results show that the explanatory power of technology acceptance of UTAUT model closes to 70% [4].The main variables of UTAUT model are performance expectancy, effort expectancy, social influence and facilitating conditions. In addition, there are four moderators that will influence the effect of the determinants on behavioral intention and/or use behavior: gender, age, experience with the system and voluntariness of use. Performance expectancy defined as the degree to which an individual believes that using the system will help him or her to achieve increases in job performance. And its segmentation source variables include perceived usefulness, job fit and achievement expectancy. Effort expectancy defined as the degree of ease associated with the use of the system. And its segmentation source variables include the perceived ease of use and the complexity of the system. Social influence defined as the degree to which an individual perceives that important others believe he or she should use the new system. And its segmentation source variables include social factors and image / compatibility. Facilitating conditions defined as the degree to which an individual believes that an organizational and a technical infrastructure exists to support use of the system. And its segmentation source variables include facilitating environment and perceived behavior control. Behavioral intention and facilitating conditions determine the use behavior directly, and performance expectancy, effort expectancy, social influence affect the use behavior indirectly through affecting behavioral intention.

UTAUT model is one of the widely used, reliable and effective models to study the users' acceptance of IT technology. UTAUT model can help the strategy makers or managers understand the factors of behavioral intention of accepting new technology better. It is a measure for managers to evaluate the effectiveness of the new technology to be introduced. It helps making marketing or training decisions by using UTAUT model to predict and explain the behavior of users' technology acceptance. UTAUT model shows in Figure1:

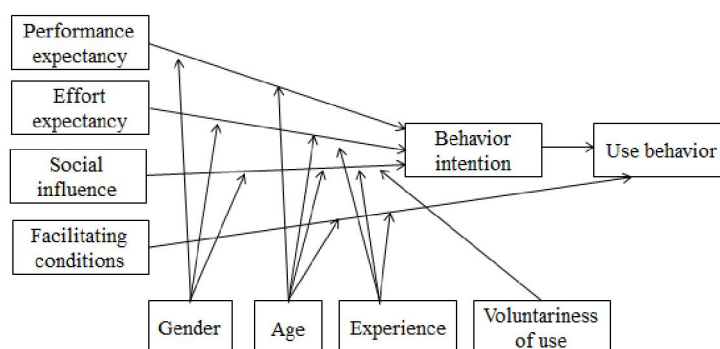


Figure 1: UTAUT Model (Venkatesh & Davis, 2003)

RESEARCH MODEL AND HYPOTHESES

Firstly, the UTAUT model is taken as the basic model of user acceptance model of online shopping.

Secondly, the user acceptance model of online shopping is supplemented based on perceived risk theory and diffusion of innovativeness theory. In addition to the “performance expectancy”, “effort expectancy”, “social influence”, “facilitating conditions”, two variables such as “perceived risk” and “consumer innovativeness” are added.

Thirdly, the moderators of the UTAUT model are modified to make the model specific. The final moderators are gender, online purchase frequency of agricultural products and consumer innovativeness.

An initial model of this paper is built. It is shown in Figure2.

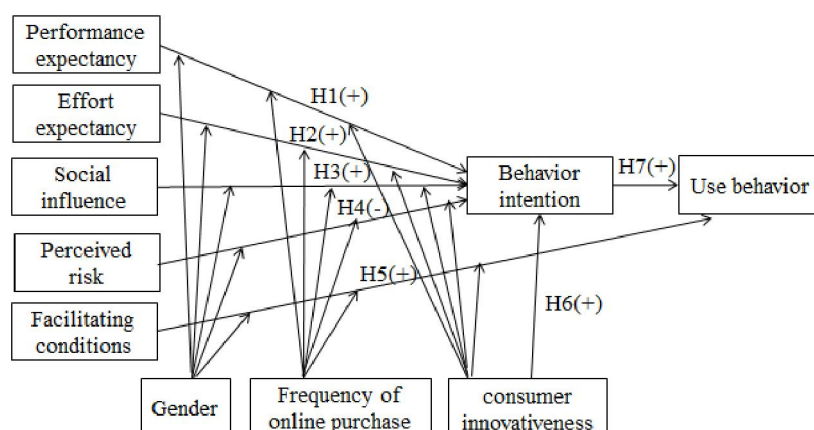


Figure 2: The research model

The following hypotheses are presented in this paper:

(1) Performance expectancy and online agricultural product purchase intension.

Performance expectancy refers to the degree to which an individual believes that online agricultural products will help him or her to get good shopping experience. Generally speaking, if the consumers have higher performance expectancy on online agricultural products purchase, their intention on online agricultural products purchase is stronger. Compared to men, women purchase agricultural products more often, and they have higher performance expectancy on online agricultural products purchase. The consumers with higher frequency of purchasing agricultural products online tend to have higher performance expectancy, because they often purchase agricultural products online, and they wish to improve their life much by it. Some scholars believe that consumer innovativeness will affect consumers' perception and decision making process, Agarwal and Prasad (1998) [5], Dabholkar and Bagozzi (2002) [6] believe that the consumers with higher innovativeness are easier to accept new things, and they have greater expectation about new things can benefit their work and life.

Based on the analysis above, we propose the following hypotheses:

H1: Performance expectancy will positively affect the consumers' online agricultural product purchase intension.

H1a: Performance expectancy will positively affect the consumers' online agricultural product purchase intension, and it affects female consumers greater.

H1b: Performance expectancy will positively affect the consumers' online agricultural product purchase intension, and it affects the consumers with higher frequency of purchasing agricultural products online greater.

H1c: Performance expectancy will positively affect the consumers' online agricultural product purchase intension, and it affects the consumers with higher innovativeness greater.

(2) Effort expectancy and online agricultural product purchase intension

Effort expectancy refers to the degree of ease associated with the use of the shopping system for purchasing agricultural products online. If consumers perceive that the shopping system for purchasing agricultural products online is easy, their intention to purchase agricultural products online is stronger. If the operating process is relatively simple and easy to master during online agricultural products purchase, the enthusiasm of consumers shopping online will grow up. Whether the online

agricultural products purchase can help consumers finish their work easily and conveniently or not is a concern when they are going to purchase agricultural products online. Generally speaking, female consumers are more likely responsible for housework, and purchasing agricultural products is one of them. If purchasing agricultural products online is convenient and quick, it will be good for women to reduce their intensity of work. The consumers with higher frequency of purchasing agricultural products online have no difficulties in operating, because they are familiar with it. The consumers with high innovativeness are initiative and capable in accepting new things, and it is easy for them to purchase agricultural products online.

Therefore, the following hypotheses are proposed:

H2: Effort expectancy will positively affect the consumers' online agricultural product purchase intention.

H2a: Effort expectancy will positively affect the consumers' online agricultural product purchase intention, and it affects female consumers greater.

H2b: Effort expectancy will positively affect the consumers' online agricultural product purchase intention, it affects the consumers with higher frequency of purchasing agricultural products online greater.

H2c: Effort expectancy will positively affect the consumers' online agricultural product purchase intention, and it affects the consumers with higher innovativeness greater.

(3) Social influence and online agricultural product purchase intention

Social influence refers to the degree to which an individual perceives that important others believe he or she should purchase agricultural products online. The consumers who purchase agricultural products online are influenced not only by surrounding community (such as colleagues, friends and relatives) but also by various information from relevant social network. When the consumers' relatives and friends always purchase agricultural products online or show positive attitude towards it, the consumers' intention to purchase agricultural products online will be strong. Especially, the women, the consumers with low frequency of purchasing agricultural products online and the consumers with low innovativeness will be affected by social influence. There are several reasons for this. First, Female consumers are more sensitive, and they will be affected by the surrounding community and environment easily. Second, consumers with low frequency of shopping online are not familiar with the operation of online shopping and the online high-quality agricultural product shops. Third, the consumers with low innovativeness are insensitive to new things, and they are not enthusiasm to care and learn new things. So, these three types of people always follow the suggestions of their relatives and friends when they are going to purchase agricultural products online.

Therefore, the following hypotheses are proposed:

H3: Social influence will positively affect the consumers' online agricultural product purchase intention.

H3a: Social influence will positively affect the consumers' online agricultural product purchase intention, and it affects female consumers greater.

H3b: Social influence will positively affect the consumers' online agricultural product purchase intention, it affects the consumers with lower frequency of purchasing agricultural products online greater.

H3c: Social influence will positively affect the consumers' online agricultural product purchase intention, and it affects the

consumers with lower innovativeness greater.

(4) Perceived risk and online agricultural product purchase intension

For the perceived risk in the field of e-commerce, Dowhng[7], Pavlou[8] point out that online shopping is very different from traditional shopping. It is more convenient and more efficient, but there are more risks behind it. And these risks will affect the consumers' enthusiasm of online shopping. Generally speaking, if the consumers perceive more risks, they are more reluctant to purchase agricultural products online. Especially, the women, the consumers with low frequency of purchasing agricultural products online and the consumers with low innovativeness will be affected more by perceived risk. Compared with male consumers, female consumers are more sensitive, fragile, delicate, and lack of a sense of security. The consumers with low frequency of purchasing agricultural products online have strong sense of risks. The consumers with low innovativeness are suspicious and shilly-shally. So, these three types of people are always affected by perceived risk when they are going to purchase agricultural products online.

Therefore, the following hypotheses are proposed:

H4: Perceived risk will negatively affect the consumers' online agricultural product purchase intension.

H4a: Perceived risk will negatively affect the consumers' online agricultural product purchase intension, and it affects female consumers greater.

H4b: Perceived risk will negatively affect the consumers' online agricultural product purchase intension, and it affects the consumers with lower frequency of purchasing agricultural products online greater.

H4c: Perceived risk will negatively affect the consumers' online agricultural product purchase intension, and it affects the consumers with lower innovativeness greater.

(5) Facilitating conditions and the online agricultural product purchase behavior

Facilitating conditions defined as the degree to which an individual believes that an organizational and a technical infrastructure exists to support their online agricultural products purchase. Convenience, ease of operation, nutritional value, quality and price are all facilitating conditions. Typically, if the facilitating conditions are stronger, the possibility of consumers' purchasing agricultural products online will be greater. For women, purchasing agricultural products is their daily work, and they tend to purchase agricultural products online when the facilitating conditions are stronger. Consumers with high frequency of online shopping won't purchase agricultural products online without enough facilitating conditions. Consumers with low innovativeness are not enthusiasm and active to online shopping, only are there enough facilitating conditions, will they purchase agricultural products online.

Therefore, the following hypotheses are proposed:

H5: Facilitating conditions will positively affect the consumers' online agricultural product purchase behavior.

H5a: Facilitating conditions will positively affect the consumers' online agricultural product purchase behavior, and it affects female consumers greater.

H5b: Facilitating conditions will positively affect the consumers' online agricultural product purchase behavior, and it affects the consumers with higher frequency of purchasing agricultural products online greater.

H5c: Facilitating conditions will positively affect the consumers' online agricultural product purchase behavior, and it affects the consumers with lower innovativeness greater.

(6) Consumer innovativeness and online agricultural product purchase intension

In the past the studies, consumer innovativeness got much attention due to it is related to the consumer behavior of accepting and purchasing a new product.

Consumer innovativeness will stimulate consumers to learn the operation of online shopping. Consumers with high innovativeness will accept the way of purchasing agricultural products online easily. The study[9] has shown that earlier recipients will use the Internet at home and work more frequently when they perceive more usefulness of network by using it, and they will show much more intention to use online shopping than the later recipients. Consumers with high innovativeness are more easier to accept online shopping.

Based on the analysis above, the following hypothesis is proposed:

H6: Consumer innovativeness will positively affect the consumers' online agricultural product purchase intension.

(7) Online agricultural product purchase intension and online agricultural product purchase behavior

Intention governs a certain behavior, and the behavior of a person is usually produced under the control of the intention. When consumers have the intention to buy agricultural products online, they will take the actual behavior.

Therefore, the following hypothesis is proposed:

H7: Online agricultural product purchase intension will significantly affect the consumers' online agricultural product purchase behavior.

DATA ANALYSIS AND HYPOTHESIS TESTING

Variable Measurement and Data Collection

According to the model and object of this paper, there are two dependent variables (online agricultural product purchase intension, online agricultural product purchase behavior) and six independent variables (performance expectancy, effort expectancy, social influence, facilitating conditions, perceived risk, consumer innovativeness). In order to ensure the reliability and validity of the measurement, the measure indexes of each variable were modified based on the relatively mature indexes at home and abroad under the consideration of the actual situation of China. The measure indexes of initial questionnaire were modified after consulting the experts in e-commerce area. Then, questionnaire was modified according to the feedback of preliminary investigation on ten students. All of the items were modified to fit into the five-point Likert-scale format (1 =strongly disagree, 2 = slightly disagree, 3 =neither agree nor disagree, 4 =slightly agree, and 5 =strongly agree).

The data for this paper is collected by online questionnaire survey. The link address is <http://1.sojump.com/jq/3186551.aspx>. The questionnaire survey was carried out through the QQ group, Forum, Micro-blog, Wechat in May 2016. A total of 305 respondents were received. After eliminating invalid responses, a total of 264 usable questionnaires were got for data analysis and hypothesis testing.

Reliability and Validity Analysis

The reliability of measurement is higher, the scales or questionnaires are more stable. In this paper, the reliability of questionnaire is verified through the SPSS, and Cronbach's Alpha is adopted as the reliability standard which must be beyond 0.7. The result shows Cronbach's Alpha of the scales is beyond 0.7. So the reliability of variables is good. The percentage of

explained variance is beyond 60%, and the significant probability is 0.00. So the validity of the scales is good. As shown in Table1.

Table 1: The results of reliability and validity test

Construct	Number of item	Cronbach's α	KMO	percentage of explained variance (%)	Sig
performance expectancy	6	0.890	0.860	65	0.00
effort expectancy	3	0.795	0.707	71	0.00
social influence	6	0.840	0.750	60	0.00
perceived risk	5	0.801	0.729	56	0.00
facilitating conditions	4	0.777	0.500	89	0.00
consumer innovativeness	4	0.851	0.736	69	0.00
Online agricultural product purchase intension	4	0.786	0.691	62	0.00
Online agricultural product purchase behavior	2	0.780	0.500	89	0.00

Hypothesis Testing

In this paper, the structural equation model is applied to test the relationships among 8 variables. The path coefficients of the model are estimated by running AMOS, the results are shown in Table 2.

Table 2: Initial standardized structural estimates and tests of hypotheses

Hypotheses	Standardized path coefficient	Estimates	S. E.	t-value	P	Results
H1	0.126	0.114	0.107	1.068	0.285	Reject
H2	0.567	-0.550	0.147	3.745	***	Accept
H3	-0.088	-0.104	0.129	-0.801	0.423	Reject
H4	0.079	0.082	0.093	0.883	0.377	Reject
H5	0.422	0.318	0.064	4.496	***	Accept
H6	0.180	0.114	0.062	0.183	0.064	Reject
H7	0.542	0.650	0.121	5.385	***	Accept
Fit indexes: $\chi^2/df=1.997$; GFI=0.706; AGFI=0.649; NFI=0.679; IFI=0.847; CFI=0.805; RMSEA=0.087; *** ≤ 0.05						

The above table shows that the absolute value “t” of H1, H3, H4, H6 is lower than 1.96, and P are not significant at 0.05 level. The absolute value “t” of H2, H5, H7 is beyond 1.96, and P are significant at the 0.05 level. It shows that the quality of the model is not satisfying. Therefore, it is necessary to modify the model.

Model Modification

According to the analysis of structural equation model, a causal relation between performance expectancy and online agricultural product purchase behavior is established, and the causal relation between performance expectancy and online agricultural products purchase intention is cancelled. The modified model is shown in Fig.3.

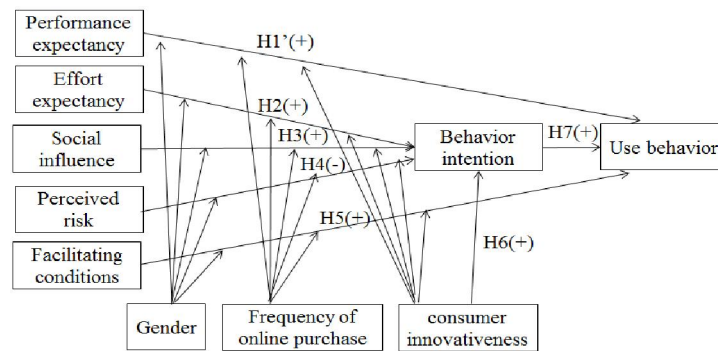


Figure 3: The modified model

The path coefficients of the model are evaluated by running software Amos. The specific results are shown in Table3:

Table 3: Modified standardized structural estimates and tests of hypotheses

Hypotheses	Standardized path coefficient	Estimates	S. E.	t-value	P	Results
H1'	0.366	0.406	0.108	3.775	***	Accept
H2	0.611	0.592	0.133	4.456	***	Accept
H3	-0.075	-0.088	0.130	-0.675	0.499	Reject
H4	0.077	0.080	0.094	0.849	0.396	Reject
H5	0.252	0.189	0.066	2.859	***	Accept
H6	0.194	0.123	0.063	1.945	0.052	Reject
H7	0.426	0.519	0.112	4.646	***	Accept
Fit indexes: $\chi^2/df=1.965$; GFI=0.710; AGFI=0.653; NFI=0.685; IFI=0.857; CFI=0.811; RMSEA=0.086; *** ≤ 0.05						

The above Table shows the absolute value “t” of H1 is beyond 1.96, and P reaches the significant level. It indicates the modified model is reasonable.

From table 3, the overall fitness of the modified model is improved compared with the meta-model, indicating that the modified model is reasonable. The P of H2 is less than 0.05 significant level and standard regression coefficient is 0.611, which means effort expectancy positively affect the consumers' online agricultural product purchase intension. The P of H1', H6 and H7 are less than 0.05 significant levels and standard regression coefficient are 0.366, 0.252 and 0.426 respectively, which means performance expectancy, facilitating conditions and online agricultural products purchase intention positively affect the consumers' online agricultural products purchase behavior.

Group Testing

In order to verify the hypotheses of moderators in the research framework, the standard regression coefficients between different groups were measured.

(1) Grouping according to the gender: The samples are divided into male group and female group. The samples of male group are 100 in total, while the samples of female group are 164 in total.

(2) Grouping according to the frequency of purchasing agricultural products online: The samples are divided into two groups, group of low frequency of purchasing agricultural products online and group of high frequency of purchasing agricultural products online. The former group is 102, while the latter group is 162.

(3) Grouping according to consumer innovativeness: The average score of consumer innovativeness in the sample is 14. Therefore, the samples are divided into two groups: consumers whose score below 14 (consumers with low innovativeness),

and consumers whose score beyond 14 (consumers with high innovativeness). The former group is 178, while the later group is 86.

Then, model fitting of these groups of samples were carried out. The result of group test is shown in Table4

Table 4 Group testing results

Causal relationship \ Effect	Gender		frequency of purchasing		innovativeness	
	male	female	low	high	low	high
performance expectancy —> purchase behavior	Significant, positive	Significant, positive	Not significant	Significant, positive	Significant, positive	Significant, positive
effort expectancy —> purchase intention	Not significant	Significant, positive	Significant, positive	Significant, positive	Significant, positive	Not significant
social influence —> purchase intention	Not significant	Not significant	Not significant	Not significant	Not significant	Significant, positive
perceived risk —> purchase intention	Not significant	Not significant	Not significant	Not significant	Not significant	Not significant
facilitating conditions —> purchase behavior	Not significant	Significant	Significant, positive	Significant, positive	Significant, positive	Not significant

We can find that H1b, H1c, H2a, H5a, H5b, H5c are gotten support.

CONCLUSION AND IMPLICATIONS

Results Discussion

Based on above research, the following main conclusions of factors affecting the consumers' online agricultural products purchase are obtained:

(1) Performance expectancy and online agricultural product purchase intension.

During the process of online agricultural products purchase, performance expectancy positively affects the consumers' behavior. That is to say when the consumers have stronger expectation on online agricultural products purchase which can benefit them a lot, they are more likely to take an actual action to purchase agricultural products online.

Performance expectancy positively and significantly affects the male or female consumers' online agricultural products purchase behavior, and it lays greater affect on male consumers because that compared to female consumers, male consumers are more decisive and resolute. When they aware that something can benefit them, they will take an action on it.

Performance expectancy positively and significantly affects the consumers with high frequency of purchasing agricultural products online. The main reason is that these consumers believe online agricultural products purchase is helpful, and they always purchase all kinds of agricultural products online, which is a part of their life. However, it weakly affects the consumers with low frequency of purchasing agricultural products online. Because online agricultural products purchase is not essential for them no matter how helpful it is, and performance expectancy doesn't affect their online agricultural products purchase significantly.

Performance expectancy positively and significantly affects the consumers' online agricultural products purchase behavior. It lays greater affect on the consumers with high innovativeness. The main reason is that consumers with high innovativeness are good at discovering and making use of new things when they aware that the new things can meet their needs.

(2) Effort expectancy and online agricultural product purchase intension

Effort expectancy positively and significantly affects the consumers' online agricultural product purchase intension. It implies that when consumer aware online agricultural purchase is easy to operate, their online agricultural purchase intention is stronger.

Effort expectancy positively affects the female consumers' online agricultural products purchase intention, and it lays weak affect on male consumers. This is because of the different characters between men and women. Generally speaking, women is delicate, their ability of dealing with complex issue pales beside men. When a new technology is easy of operating, women tend to use it, and vice versa. However, men are much stronger and curious, and they always go forward to try the new technology no matter how difficult it is.

Effort expectancy positively and significantly affects the consumers' online agricultural products purchase intention, and it lays greater affect on consumers with low frequency of purchasing agricultural products online. Effort expectancy lays greater affect on consumers with low frequency of purchasing agricultural products online. Compared with the consumers who lack experience of online agricultural products purchase, consumers who always purchase agricultural products online are familiar with the operating. So, for them, whether the online agricultural products purchase is easy or not weakly affect their purchase behavior.

Effort expectancy positively and significantly affects the online agricultural products purchase intention of consumers with low innovativeness, but it lays weak affect on consumers with high innovativeness. Consumers lack innovativeness are not good at accepting and making use of new things, and whether the new things are ease of use or not affect them greatly. Therefore, when consumers lack innovativeness aware that online agricultural products purchase is ease of use, they will choose to make use of it.

(3) Social influence and online agricultural products purchase intention

Social influence doesn't significantly affect the consumers' online agricultural products purchase intention. This is not consistent with the conclusion of UTAUT. The possible reason is that the social environment is pluralistic, people always pursue individuality, the relationship between people is relatively indifferent due to fast-paced way of life, and shopping is the behavior of the individual. So, consumers' online agricultural products purchase intention is not affected by social influence.

For the consumers with high innovativeness, social influence negatively and significantly affects consumers' online agricultural products purchase intention. That is to say, if consumers with high innovativeness are affected by social influence more greatly, their intention to purchase agricultural products online is weaker. The possible reason is that consumers with high innovativeness tend to pursue individuality and unusual things, and they are not affected by the surroundings easily.

(4) Perceived risk and online agricultural product purchase intention

The affect of perceived risk on the consumers' online agricultural product purchase intention is not significant. Nowadays, with the development of technology and the improvement of standardization of e-commerce, the risks of online shopping become weaker and weaker, and the consumers' awareness and ability to resist risk are increasing. Therefore, the consumers won't be affected by perceived risks when they purchase agricultural products online.

(5) Facilitating conditions and the online agricultural product purchase behavior

During the process of online agricultural products purchase, facilitating conditions positively affects the consumers' online agricultural products purchase behavior. It means that more facilitating conditions provide convenience for consumers' online agricultural products purchase, and consumers will tend to take an actual action on online agricultural products purchase. Because it is inevitable that people have some troubles in accepting and making use of a new things (such as online shopping of agricultural products), and enough facilitating condition will help people make use of it.

Facilitating conditions significantly affect women's online agricultural products purchase behavior. In China, most of women are responsible for housework, and they often purchase agricultural products. When there are facilitating conditions which help

them purchase agriculture products online, they will choose the way of online agricultural products online. Most of men seldom purchase agricultural products, so facilitating conditions do not affect them significantly.

Facilitating conditions positively and significantly affect consumers with high frequency of purchasing agricultural products online, because facilitating conditions provide much convenience and benefit for them to purchase agriculture products online.

Facilitating conditions positively and significantly affect the online agricultural products purchase behavior of consumers with low innovativeness. The main reason is that consumers with low innovativeness are not good at discovering and making use of new things, and only are there many facilitating conditions to provide convenience for them, will they make use of the new things.

(6) Consumer innovativeness and online agricultural product purchase intension

The affect of consumer innovativeness on the consumers' online agricultural product purchase intension is not significant. Usually, consumers' recognition and acceptance of new things are different, because their innovativeness is different. This study finds that consumer innovativeness doesn't affect the intention of consumers' online agricultural products purchase significantly.

(7) Online agricultural product purchase intension and online agricultural product purchase behavior

The affect of online agricultural product purchase intension on the consumers' online agricultural products purchase behavior is significant. When consumers have the intention to purchase agricultural products online, they will take an action.

Suggestions

It is necessary to clear which factors will affect the consumers' online agricultural products purchase. It can help enterprises set definite consumer object and make the best use of the situation to attract more and more consumers. It is meaningful to increase the power of positive factors and to eliminate the negative factors, because it will stimulate the consumers to purchase agricultural products online and promote the development of the e-commerce of agricultural products.

(1) From the perspective of improving performance expectancy, the online providers should increase the categories of agricultural products to enable the consumers to buy what they want. In order to improve the efficiency of purchasing agricultural products online, the online provider should ensure the quality of agricultural products and improve the efficiency of distribution.

(2) From the perspective of enhancing effort expectancy, the online provider should consider whether the trading system of agricultural products is easy-using or not. Simple and easy-using online shopping system will help consumers search what they want conveniently, quickly and correctly, so as to finish the online trading of agricultural products.

(3) From the perspective of increasing facilitating conditions, the online providers should try their best to ensure the agricultural products are excellent in quality and reasonable in price. Meanwhile, they should improve and ensure the quality of service, such as online consulting, after-sale service.

(4) From the perspective of satisfying different consumers, the online providers should provide diverse agricultural products and personalized service to meet the needs of consumers.

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APPENDIX

This research was financially supported by the grants from Hubei Provincial Collaborative Innovation Centre of Agricultural E-Commerce (under Construction) .

An Empirical Examination of Consumer Behavior for Search and Experience Goods in Sentiment Analysis

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ABSTRACT

With the explosive increase of user-generated content such as product reviews and social media, sentiment analysis has emerged as an area of interest. Sentiment analysis is a useful method to analyze product reviews, and product feature extraction is an important task in sentiment analysis, during which one identifies features of products from reviews. Product features are categorized by product type, such as search goods or experience goods, and their characteristics are totally different. Thus, we examine whether the classification performance differs by product type. The findings show that the optimal threshold varies by product type, and simply decreasing the threshold to cover many features does not guarantee improvement of the classification performance.

Keywords: Sentiment analysis, Experience goods, Search goods, Feature extraction, Product features

INTRODUCTION

Widespread Internet access enables users to create user-generated content such as online product reviews. Reviews about products or services provide the representative medium through which consumers express their overall opinions or feelings. Reviews are increasingly important in attracting companies' attention, because companies want to identify what consumers think about their products or services in real time. Also, individual consumers want to know the opinions of the existing purchasers. Acquiring consumer opinions is an essential factor for decision makers and marketing staff. Sentiment analysis involves the process of analyzing opinions and emotions from consumers' reviews [10]. After collecting reviews, extracting the information contained in reviews presents an enormous task due to the huge amount of data involved. Individuals face difficulty extracting and summarizing opinions manually. Thus, automated sentiment analysis tools are important to streamline the process.

Sentiment analysis can be divided by three main classification levels: document level, sentence level, and feature level [4]. Document-level sentiment analysis assumes that the document presents an author's opinion on one subject. Given the product review, the analysis determines whether the review contains an overall positive or negative opinion about a product or service [3]. Sentiment analysis at the sentence level presumes that one document offers different opinions. That is, this analysis judges whether one sentence states a positive, neutral, or negative opinion [23]. Because document-level and sentence-level analyses do not identify what consumers like or hate exactly [8], feature-level analysis is usually conducted to analyze online consumer reviews. After purchasing products or services, consumers express their opinions (good vs. bad) about many attributes of products or services. Feature-based sentiment analysis is the method based on the fact that consumer opinion is comprised of the subject of an opinion and sentiment [8]. Identifying the subject of an opinion is an important element in understanding consumers' opinions. For example, the sentence "although the battery life of this mobile phone is not good, I like this mobile phone," exhibits a positive attitude. The sentence represents a negative tone about the feature, "battery," however, the main point of feature-based analysis is to find sentiments on attributes of a product or service.

There are three characteristics of product features according to Hu and colleagues [7]. First, product features consist of noun or noun phrases. Second, features are subjects in a sentence. Lastly, features are related to opinion words or phrases. A product (Smartphone) can have many features (CPU, memory, display size, storage capacity, and so on). Each feature can be expressed in different ways, even though the meaning is same (e.g., display quality: resolution, picture quality). Extracting similar features is not an easy task. Popescu and associates [17] suggested the use of association rule mining to extract noun phrases that appeared frequently as product features. They used the feature appraiser that could evaluate each candidate noun phrase by computing the PMI scores between the noun phrases and its related phrases.

As depicted above, it is important and necessary to recognize the attributes of products or services. Several studies have proposed methods to identify product features. Mejova and Srinivasan [12] shows that frequency-based selection, one of the methods applied, exhibits different performance depending on exclusion of the terms that appear fewer than c times in the dataset. Indeed, it is difficult to extract accurate product features, and the performance depends on how one extracts the product features.

We examined whether the classification performance differs by product type, experience goods and search goods. Extracting features of search goods appears to be a more straightforward than extracting features of experience goods, in which individual preferences tend to play an important role. On the other hand, consumer reviews of experience goods use much more different words to describe the same feature and description of product features and is more subjective than consumer reviews of search

goods. Therefore, we propose a method that identifies product features and produces a dictionary depending on the product type. The approach offers better performance in feature-based sentiment analysis. We use an extensive dataset of online consumer reviews for products across various shopping sites and over a long period. Our findings show that the threshold of extracting features differs between search goods and experience goods. That is, the criteria of the threshold depends on the type of goods.

RELATED WORK

Product type

Most products available to sell online can be categorized into search goods and experience goods, according to the criteria established by Nelson [16]. Consumers find information about products before making an actual online purchase. The amount and quality of information collected through online search, such as product reviews, differ between two types. While search goods have product features that can be measured and compared more objectively, experience goods have product features which are difficult to evaluate in terms of product quality [14]. This is because consumers can evaluate the overall quality of search goods with relative ease, and they can purchase search goods online without difficulty [22]. For instance, a computer as the representative of search goods can be evaluated through memory capacity, CPU performance, and storage capacity, although experience goods such as a book do not have quantifiable features by which to evaluate the quality. Book reviews help consumers clarify information about books, but the evaluation of a book may require consumers' previous direct experience [15].

Sentiment Analysis

Sentiment analysis involves finding consumers' opinions, attitude towards a particular topic such as product reviews [20]. The analysis determines whether a consumer's opinion is positive, neutral, or negative about the topic. However, because product reviews contain objective information and subjective opinions, distinguishing both of them is important. Companies and consumers especially want to know the reasons the existing purchasers like/hate a product and finally identify consumers' overall opinions on the product. In this context, most previous studies are focused on product feature extraction [1, 19]. Still, the accuracy of feature extraction and performance of final classification is not satisfactory. To solve this problem, a new approach is required. We suggest performing sentiment analysis in terms of the two product types, experience goods and search goods, because the characteristics of product reviews depend on product type.

Product feature extraction

Consumers express positive and negative opinions through product features. The most important feature of sentiment analysis of product reviews is product feature extraction. For example, Ghani and associates [5] built a database of products through explicit and implicit features and linked the features by value. Putthividhya and Hu [18] proposed a named entity recognition (NER) system for extracting product features and combined NER with bootstrapping. Their system achieved 90.33% precision. These two approaches need manual labor for labeling process. Hu and Liu [6] utilized the association mining-based technique to extract product features in the online product reviews. This approach offers the advantage that the training process is not required. However, the drawback of this approach is that it extracted many redundant product features in spite of the feature cleansing [25]. Raju and colleagues suggested an approach which is unsupervised and domain independent. This method has 92% precision and 62% recall which is low.

DATA SET

Through crawlers, data were collected in NAVER shopping, which is one of the biggest online shopping website in Korea. This site provides consumer reviews from the other online shopping sites in Korea such as G-market, 11st, Interpark, and so on. The collected data contain product category, product name, price, review, etc. We chose two products, external battery charger for mobile phone and cream for women, as a representative of both search goods and experience goods. The total number of acquired reviews is 16,083,512. After gathering, we performed actions such as spelling check and grammar correction, not to correct all the errors but to eliminate as much of the noise of reviews as possible.

FRAMEWORK OF SENTIMENT ANALYSIS

The process of sentiment analysis includes feature extraction, opinion extraction, sentiment classification, and performance evaluation (Figure 1). When consumers write product reviews online, they may make errors such as inadvertent misspellings, which undermines the overall performance of the sentiment analysis. Part-of-speech (POS) tagging [11] can be greatly influenced by these errors. Thus, cleansing work is required prior to performing sentiment analysis.

Feature extraction

Part-of-Speech (POS) tagging

An online review consists of more than one sentence and includes opinions on aspects such as a shopping site, a product, or delivery. After splitting reviews into sentences, each sentence is parsed by a linguistic parser, which is widely used in natural language processing (NLP). The linguistic parser reads text and assigns parts of speech to each word, such as noun ('N') and verb ('V'), which is called part-of-speech (POS) tagging. For example, the POS tagger transforms a review "This cream product is good for oily skin" into "This (DT) cream (NN) product (NN) is (VBZ) good (JJ) for (IN) oily (JJ) skin (NN)". This task is consequential to the outcome of the sentiment analysis. As a proven tool for POS tagging, the Kokoma Korean morpheme

analyzer (<http://kkma.snu.ac.kr>) was used.

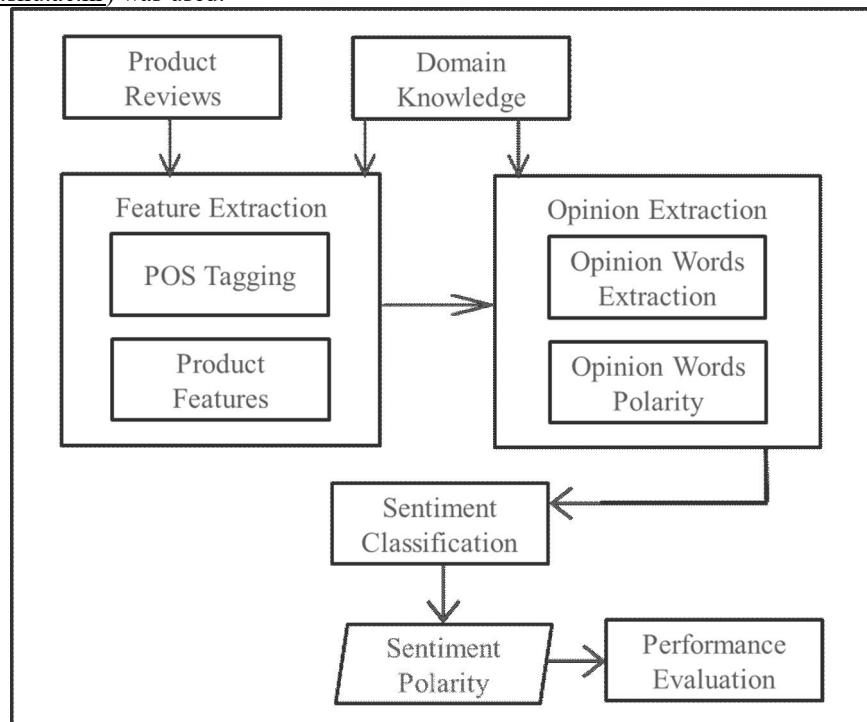


Figure 1: The Process of Sentiment Analysis

Product features

Product features exist in the form of nouns or noun phrases in online reviews [7, 19]. Proper selection of a product feature plays an important role for increasing classification accuracy [9]. The methods of feature extraction are divided into heuristic, statistical, clustering, and hybrid approaches [1, 7, 19, 24, 26]. The performance of some approaches depends on frequency thresholds [24], because features extraction faces the issue that primary features can be extracted, but it is difficult to extract minor features. These issues arise differently by product type. As mentioned in related works, the characteristics of product features that consumers mention are different. Thus, even though the same threshold is applied, the performance of sentiment analysis can be differentiated by product type. Table 1 shows the product feature list extracted from our data. Based on the naïve approach, if the threshold of frequency ratio (frequency/total number of sentence) is adjusted, the extracted product features varies with product type.

Table 1: Product Feature List based on Frequency

Cream (Experience goods) # of reviews: 1,039,653			Battery (Search goods) # of reviews: 150,261		
	Features	Frequency		Features	Frequency
1	Features	74589	1	charge	16353
2	moisture	23910	2	design	4645
3	droughtiness	20887	3	capacity	4567
4	dry skin	11452	4	genuine	4055
5	trouble	11000	5	size	2697
6	humectant	10472	6	weight	2202
7	absorption	9073	7	performance	2199
8	oily skin	6630	8	mobility	1545
9	applying	5312	9	color	926
10	smell	5109	10		
11	nutrition	5058	11		
12	pimple	3990	12		
13	elasticity	3390	13		
14	wrinkle	2607	14		
15	sensitivity	2565	15		
16	texture	2164	16		
17	irritation	2150	17		
18	whitening	1915	18		
19	scent		19		

20	absorbing ability	1695	20		
21	rash	1633	21		

Opinion extraction

Opinion words extraction

We limit our study to sentences containing product features from entire reviews, because we are interested in consumers' opinion on the product itself. To find opinion words, fundamental principles in natural language processing are used effectively. The first criterion is that opinion words are near product features [6]. Second, subjective sentences are related to the existence of adjectives positively [2]. In other words, adjectives and verbs which are close to product features act as opinion words.

Opinion words polarity

The Semantic Orientation from Point-wise Mutual Information (SO-PMI) algorithm, which estimates the semantic orientation by measuring the similarity of pairs of words, was used to identify the polarity of opinion words [21]. For example, when the reference words are "good" and "bad", the assumption of the algorithm is that a phrase is defined as a positive semantic orientation when a phrase is more strongly associated with good regard for the product. That is, determining proper reference words is critical when utilizing the SO-PMI algorithm. Although WordNet [13] is a good reference dictionary, it does not provide polarity information in Korean. Instead, OpenHangul (www.openhangul.com), the Korean sentiment dictionary based on collective intelligence, was used as a reference dictionary. Because OpenHangul is not a dictionary that judges based on domain knowledge, four people who have domain knowledge about e-commerce were hired to help reference the words chosen. With SO-PMI algorithm and the reference words, the polarity of adjectives and verbs is determined.

RESULTS

Table 2 and Table 3 show feature lists, which are extracted from the product feature in Table 1 based on the threshold. In the case of the battery product, all product features in Table 1 were extracted within the 0.5 percent threshold (Table 3). On the other hand, for the cream product, nine features out of twenty-one features in Table 1 were obtained (Table 2). While consumers need only a few features to express their opinion on a product in search goods, the lower threshold is required to utilize more feature words for experience goods. When choosing the threshold that is as low as possible to cover more features, irrelevant features can be included, that ultimately results in low performance of classification. We identify that applying different criteria by product type is necessary in spite of the use of the same algorithm.

Table 2:(Cream) Feature List based on Threshold

Cream	Threshold	Frequency	Features									
	2.5%	25991	moisture									
	2.0%	20793	moisture	dry								
	1.5%	15595	moisture	dry	dry skin							
	1.0%	10397	moisture	dry	dry skin	trouble	humectant					
	0.5%	5198	moisture	dry	dry skin	trouble	humectant	absorption	oily skin	applying	smell	1

Table 3:(Battery) Feature List based on Threshold

Battery	Threshold	Frequency	Features									
	2.5%	3757	charge	design	capacity	genuine						
	2.0%	3005	charge	design	capacity	genuine						
	1.5%	2254	charge	design	capacity	genuine	size					
	1.0%	1503	charge	design	capacity	genuine	size	weight	performance			
	0.5%	751	charge	design	capacity	genuine	size	weight	performance	mobility	color	

To evaluate the classification results, we used 2,000 product reviews, with 1,000 reviews for each product type, as the test set. The performance metrics commonly used to evaluate the classification results are accuracy, precision, recall, and F1-score. Computation of these measures is as follows.

True positive (a) represents the number of messages correctly classified as positive, False positive (b) denoted the number of negative messages classified as positive, False negative (c) denotes the number of positive messages classified as negative, and True negative (d) represents the number of messages correctly classified as negative (Table 4).

Table 4:A Confusion Table

		Machine	
		Positive	Negative
Human	Positive	a	b
	Negative	c	d

$$Precision = a / (a + b)$$

(1)

$$Recall = a / (a + c)$$

(2)

$$Accuracy = (a + d) / (a + b + c + d)$$

(3)

$$F1-score = 2 \cdot (P \cdot R) / (P + R)$$

(4)

While decreasing the threshold to bring a significant improvement in the classification accuracy in experience goods from 95% to 98% (Figure 2), the accuracy for search goods declines, and the decrease in precision and recall is negligible (Table 5). This means that search goods include major features, even in the high threshold, which leads to high classification accuracy. Decreasing the threshold regardless of product type, it is not efficient in terms of performance. From these results, we concluded that the optimal threshold should differ by product type.

Table 5:Performance Evaluation

Cream	Threshold	Accuracy	Precision	Recall	F1-score
	2.5%	0.96	1.00	0.96	0.98
	2.0%	0.98	1.00	0.98	0.99
	1.5%	0.98	1.00	0.98	0.99
	1.0%	0.98	1.00	0.98	0.99
	0.5%	0.98	0.99	0.98	0.99
Battery	Threshold	Accuracy	Precision	Recall	F1score
	2.5%	0.94	0.96	0.98	0.97
	2.0%	0.94	0.96	0.98	0.97
	1.5%	0.94	0.96	0.96	0.96
	1.0%	0.93	0.95	0.97	0.96
	0.5%	0.93	0.95	0.97	0.96

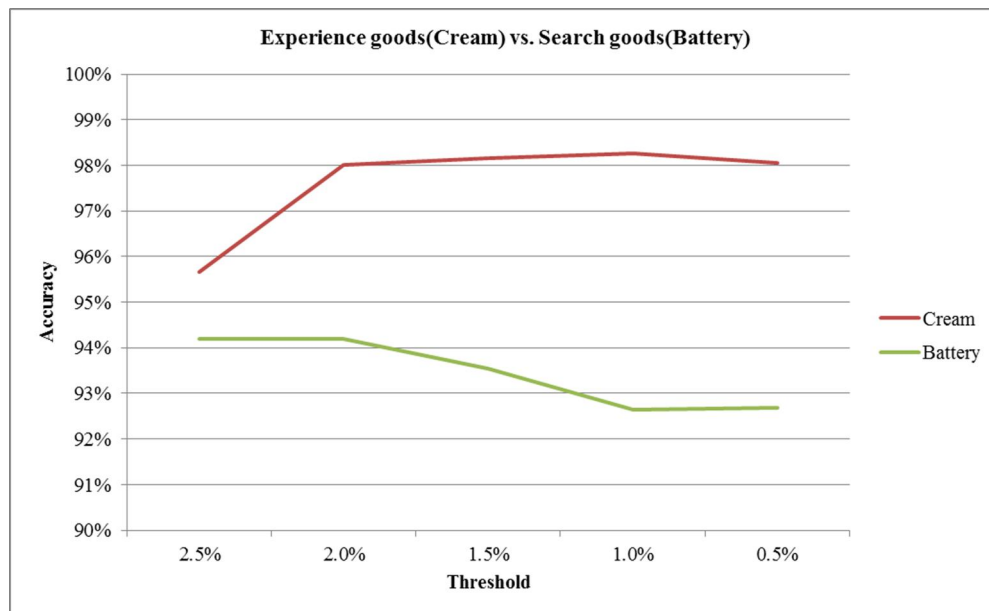


Figure 2: Accuracy Results

CONCLUSION AND FUTURE RESEARCH

With the explosively increasing use of user-generated contents such as product reviews and social media, sentiment analysis is becoming an important area of study. It is utilized in a wide variety of applications, such as product review analytics. Sentiment analysis is an especially important method in that through this method, companies can determine purchasers' opinions on a certain product. Feature extraction in sentiment analysis is a critical element, because it can impact classification performance. Previous studies examined various feature extraction techniques without considering product type. Our research confirmed that the results of classification performance differ by product type, experience goods and search goods. These findings mean that the optimal threshold according to product type may differ, and simply decreasing the threshold does not guarantee improvement of classification performance without product type.

We examined only one product by product type, so the results can be biased. To generalize our findings, we need to analyze at least two more products by product type. Our data are derived from the reviews collected from a Korean shopping site. Our findings must be scrutinized to determine whether they can be applied to reviews written in other languages, because the findings might be typical to the Korean context.

ACKNOWLEDGEMENT

This research was financially supported by Hansung University.

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Investigation of the Service Innovation of an Industry: Using iBeacon as an Example

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ABSTRACT

Service quality and service innovation may not only reflect consumers' satisfaction but also their revisit intention. Studies have focused on improving products or old services on electronic commerce. However, this study focused on enterprises' service innovation on mobile commerce. We developed a model that examined the impact of using iBeacon service on consumers' satisfaction and revisit intention. The pretest questionnaire was issued on the Internet, and the results revealed that the questionnaire was reliable. We evaluated whether services provided by an enterprise using the iBeacon system satisfies consumers and affects their revisit intention.

Keywords: Mobile commerce, iBeacon, Service innovation.

INTRODUCTION

Research Background

Since the release of the iPhone 4 the world has entered into an era overrun with mobile devices, which are changing the lifestyle and purchase behavior of people. An eMarketer survey indicated that the number of people using smartphones reached 1.639 billion in 2014, and that that number was expected to reach 1.914 billion in 2015 and more than a quarter of the global population by 2016 [1].

According to a study conducted by Forrester Research Inc., online retail sales in the United States reached \$294 billion in 2014, of which 29% (\$87 billion) were conducted on mobile devices, including smartphones, tablets, and laptops. Approximately \$28 billion of those sales comprised device application purchases. Furthermore, 114 billion transactions were conducted using smartphones and tablets on electronic commerce (e-commerce) and mobile commerce (m-commerce) in 2014 [2].

A mobile shopping survey and analysis of Taiwanese people who use smartphones conducted by MIC in 2014 indicated that 62.5% of the users employed smartphones to make purchases on m-commerce sites [3]. In addition, the survey revealed that the consumers' browsing time on smartphones is increasing and that online shopping is gradually growing. Industries have used this opportunity to provide limited-time exclusive promotion offers and other sale programs, that shorten consumers' browsing time and provide additional discounts. This has led to the development of m-commerce, which also exerts external effects on the Internet. M-commerce is rapidly growing with an increase in the number of smartphones users. Therefore, we selected mobile devices as the research foundation for this study.

Research Motivation

Studies have reported that enterprises increase consumer satisfaction by improving service quality and service innovation; in particular, the innovation and improvement of the marketing strategy and service quality can help consumers feel satisfied and thus be more willing to revisit these enterprises [6] [16]. Notably, consumer satisfaction depends heavily on their subjective attitude, and their perception of service quality is the difference between the expectation they have of an enterprise and the service that the enterprise actually provides [27].

The service innovation behavior of an enterprise is also an index of consumer satisfaction. Moreover, consumers consider the feelings they experienced while shopping and how effectively an enterprise presents its products to them; therefore, the service quality and service innovation of an enterprise are integral components of consumers' shopping experience, and influence consumers' shopping intention and revisit intention.

Traditional service innovation research has mostly focused on improving products or old services. During the period of e-commerce development, the marketing strategy of e-commerce greatly differed from that of offline commerce. Therefore, to keep pace with the time and satisfy consumers, companies should innovate their services. Companies evaluated changes that occurred in service innovation from offline commerce sites to e-commerce and m-commerce sites (e.g., online-to-online [O2O] service). The focus on service innovation has gradually increased. However, irrespective of traditional, e-commerce, or m-commerce environments, improving the service innovation of an enterprise is crucial for increasing consumers' satisfaction and their revisit intentions

Several studies have discussed service innovation; however, most of them focused on product improvement. By contrast, in this study we examined service innovation as a marketing strategy, an enterprise's technological service innovation on m-commerce. For example, many consumers use applications developed by enterprises that provide the iBeacon technological service through mobile devices in physical stores. We determined whether the iBeacon technological service influences consumers' satisfaction and increases their shopping and revisit intention. Furthermore, this study investigated whether service quality and service innovation influence consumers' revisit intention and satisfaction.

Research Purpose

On the basis of the research background and motive, we observed that mobile devices are indispensable to consumers during shopping. Most scholars have focused on service innovation in traditional and e-commerce environments, and there is a dearth of research on m-commerce environments. Thus, we investigated the relationship among service innovation, service quality, and revisit intention according to the following research questions:

1. Does a company's service innovation directly affect customer satisfaction in an m-commerce environment?
2. Does a company's service quality directly affect customer satisfaction in an m-commerce environment?
3. Does a company's service innovation indirectly affect customer satisfaction through service quality in an m-commerce environment?
4. Does customer satisfaction affects revisit intention in an m-commerce environment?

LITERATURE REVIEW

Mobile Commerce

Modern wireless communication devices combine portability and wireless Internet, which are two key technologies that promote the growth of m-commerce. M-commerce is considered crucial for enterprises and consumers. Furthermore, devices such as personal digital assistants (PDAs) and smartphones [4] influence the work and consumption patterns of people, who use mobile devices rather than personal computers to trade or purchase items on the Internet. Although mobile devices are already widely used in m-commerce, increasing consumers' awareness and acceptance of m-commerce is vital. Moreover, the usefulness of new technology and whether it affects a user's acceptance of m-commerce remains unclear [7] [38]. In the past, researchers have considered m-commerce to be difficult and have explained it in various ways. Broadly speaking, m-commerce integrates values, transactions, and business processes. Overall, the use of mobile applications to perform transactions of goods and services through wireless Internet can be termed m-commerce [31].

Because e-commerce continuously affects the global commerce environment, the application of mobile computing and modern wireless Internet technologies [35] and the development of m-commerce are crucial. The true value of m-commerce is that it can provide substantial business opportunities; moreover, people can efficiently use m-commerce while trading. Therefore, m-commerce is considered to be the mobile version of e-commerce [37]. Ngai and Gunasekaran argued that m-commerce can be considered a subset of e-commerce, and that m-commerce inherits numerous functions from e-commerce [24]. Notably, any currency transaction that occurs through the mobile Internet is considered an m-commerce transaction.

Clarke [12] indicated that the benefits of m-commerce include ubiquity, convenience, localization, and personalization, which are defined as follows:

1. Ubiquity: Users can receive messages and transactions anywhere with mobile devices; thus, the use of m-commerce can occur everywhere.
2. Convenience: Mobile users are not limited by time or space, and can instantly send and receive messages and execute trades anytime and anywhere. Convenience is one of the primary differences between e-commerce and m-commerce because some things cannot be processed in e-commerce until users have free time on a wired device.
3. Localization: No particular location is necessary to perform m-commerce tasks. This is one of the crucial characteristics of mobile devices and is one of the reasons why m-commerce is more advantageous than e-commerce. In addition, location-based service is one of the popular services in m-commerce. For example, Walgreens, the largest chain of pharmacies in the United States, partnered with Foursquare to detect a user's current location and then automatically send electronic coupons to the user's mobile phone when they entered Walgreens [8].
4. Personalization: Compared with e-commerce, m-commerce is more personalized and only one user can use a single mobile device. Data mining analysis is performed to understand users' needs and habits, and accordingly send advertisements to interested users at the right time.

E-commerce and m-commerce also have several common features; for example, business transactions can be performed using the Internet in both formats. However, the communication mode and Internet access devices required in e-commerce differ from those required in m-commerce. For example, communication in e-commerce is carried out using wired equipment, whereas communication in m-commerce is conducted through a wireless network connection. With regard to types of Internet access devices, desktop and notebook computers linked to the Internet are used in e-commerce, whereas PDAs and smartphones are used in m-commerce.

Service Innovation

The concept of innovation was first proposed by the economist Schumpeter [32], who believed that innovation is the driving force of economic growth. He also argued that innovation is the effective use of resources as well as new processes or production methods to meet the needs of the market.

Service innovation can be used in a new service, to improve an existing service, or to enhance organizational benefits [34]. In addition, service innovation can promote performance and provide adequate benefits to customers, enhancing their perceived value. Two constructs make up service innovation. The first is the type of benefit offered, which provides a new core benefit and provides a core benefit as a new path of transmission; the second is the degree of service separability, which indicates the services that can be used at different times and places, and considers service innovation to be incremental [5].

Overall, service innovation is the result of improved service response to customers with a diversification of needs, which thereby increases the value of an enterprise's products and services [36]. Enterprises can launch exclusive applications and request that consumers download them from application stores such as Google Play; subsequently, consumers can browse a company's products in their free time and easily purchase desired products online. However, companies also attempt to attract these online shopping customers to their physical stores. Thus, they use O2O services to inform consumers about product promotions that are only in the physical stores to encourage consumers to visit.

Enterprises are also concerned about timely informing the customers who browse in their physical stores about their discounts on products, because if a company sends an employee on a one-to-one service, labor costs can increase. Since the invention of the iBeacon technology, many companies have applied it to develop new services.

iBeacon is the one of the service innovation technologies currently used in the retail industry. The iBeacon technology uses low-power Bluetooth technology to create a radius signal area on the iBeacon device. Once a customer enters the set area with a mobile device they can receive a range of information provided by the company, including discounts and limited-time promotions.

For example, the leading U.S. retailer Macy's has started deploying iBeacon sensors; customers were satisfied with the new technology and its convenience because they could receive information instantly, irrespective of the floor they were on or the shop they were in. In short, iBeacon provides more possibilities for enhancing retail services. Because mobile devices are personal products, iBeacon could provide a more personalized retail service experience in the future.

Most retailers are well aware of their old service deficiencies and are willing to improve the quality of their services. Thus, retailers strive to improve their service processes to not only provide a wealth of experience and value to target and potential consumers but also understand their ideas and core needs in order to provide perceived valuable services.

When retailers focus on service innovation, they not only gain a competitive advantage but also enjoy sustainable development [39]. Service innovation is initially based on consumers' thoughts. Therefore, retailers aim to understand consumers' demands and accordingly provide them the information they require by using advanced technology. Consumer satisfaction increases when they realize the effort being exerted by retailers; hence, the value of retailers' efforts is equivalent to customer satisfaction. Therefore, we proposed the following hypothesis:

H1: Service innovation positively influences consumer satisfaction in the m-commerce environment.

The emphasis on service innovation can help the industry gain a competitive advantage, upgrade its service quality, and maintain positive customer relations [13]. Stauss, B., et al. emphasized the importance of technological innovation, and proposed that the service innovation model contains six types of dimensions and uses a dynamic capabilities view (DCV) to manage the service innovation of an industry [33]. Their results revealed that service innovation can improve service quality. If an industry improves the way they serve their customers and provides more creative ideas, customers can judge the service quality of an industry and thus develop a positive attitude toward that industry. This can reduce the difference between the expectations of consumers from an industry and the services actually provided by the industry [27]. Therefore, we proposed the following hypothesis:

H2: Service innovation positively influences service quality in the m-commerce environment.

Service Quality

Levitt contended that service quality is the result of services provided by an industry, and that it should effectively conform with the standards expected by consumers [22]. Furthermore, Olshavsky indicated that service quality is an overall assessment of that services provided by an industry and regarded it as an attitude of enterprises [26]. In 1985, Parasuraman evaluated four service industries and conducted an in-depth focus group interview with the staff of credit card companies, banks, securities brokers, and product maintenance companies. He reported that service quality is the gap between the expectations of consumers from an enterprise, and the services actually provided by the enterprise. In addition, he developed a conceptual

model of service quality called the PZB model. This model was named after three scholars, and includes the following ten service quality determinants: reliability, responsiveness, competence, access, courtesy, communication, credibility, security, understanding, and tangibility [27].

Parasuraman compiled the results of service quality research and developed the SERVQUAL service quality scale [28]. This scale has been widely cited and recommended by numerous scholars and can be used to solve various practical problems. Parasuraman used the 10 determinants of the PZB model to develop the SERVQUAL scale. This scale can effectively measure service quality and has established a reference pattern for follow-up scholars. In contrast to the PZB model, the SERVQUAL scale includes only the following five service quality determinants: reliability, tangibility, responsiveness, assurance, and empathy.

The SERVQUAL scale has been verified and cited in studies on the traditional service industry. With the widespread prevalence of the Internet in the late 1990s, the focus of consumers has shifted from the traditional offline service industry to the online e-commerce industry because of the advantages of the e-commerce industry over the traditional service industry. Services provided by the e-commerce industry were not considered in the SERVQUAL scale. Therefore, many researchers have attempted to improve the scale.

In 2005, on the basis of studies using the SERVQUAL scale, Parasuraman conducted an empirical study and used Amazon and Walmart to establish two service quality-related scales for e-commerce websites: the multiple-item e-service quality (E-S-QUAL) scale and the e-recovery service quality (E-RecS-QUAL) scale. The E-S-QUAL scale evaluates e-commerce quality using four constructs: efficiency, fulfillment, system availability, and privacy. By contrast, the E-RecS-QUAL scale examines emergency situations not frequently encountered by consumers, such as technical difficulties experienced on e-commerce websites or responding to the delivery of defective products that need to be replaced and where customers require compensation [29].

Kuo et al. indicated that Telecom service providers' content quality, system quality, and visual design of mobile value-added services can affect users' satisfaction and purchase intention [20]. In the above situation conforms to this study want to understand industry using iBeacon service. Service quality positively affects consumers' experiences and expectations of mobile services, and further increases their satisfaction [21] [40]. Thus, we proposed the following hypothesis:

H3: Service quality positively influences satisfaction in the m-commerce environment.

Satisfaction

Consumer satisfaction is the difference between consumers' shopping experiences and expectations, and its overall assessment includes service system, effectiveness, service personnel behavior, and professional knowledge provided by an industry [11]. Satisfaction depends on whether a product conforms to consumers' demands [9]. As Koltler and Armstrong reported, satisfaction is consumers' expectation of and psychological awareness regarding a product [19]; this awareness is the difference between consumer expectation and the actual service provided by an industry [25].

Churchill Jr. and Surprenant evaluated the perspectives of different scholars and concluded that the following four factors influence consumer satisfaction [11]:

1. **Expectation:** The expectation consumers have about a product before purchase; consumers already have expectations of a product and then determine whether the product conforms to their expectations.
2. **Performance:** The quality of the product after purchase; this perception is often compared with expectations before purchase.
3. **Disconfirmation:** The difference between consumers' expectations and experiences after purchase. This difference has three possible outcomes: experience and expectation matches, the experience is worse than the expectation; or the experience is better than the expectation.
4. **Satisfaction:** The overall attitude of consumers to the product after purchase. If the experience is higher than the expectation, consumer satisfaction is high; however, if the experience is lower than the expectation, consumer satisfaction is low.

Revisit Intention

Revisit intention is considered the result of satisfaction [6]. In this study, revisit intention refers to customers' desire to visit a particular store again. Several studies have similarly expressed revisit intention as customer loyalty. The effective strategy to make a customer visit again is to maintain a high degree of customer expectation or provide more than expected customer services [17]. Jang and Feng [16] conducted a study on tourism to examine whether revisit intention is related to satisfaction. They confirmed that customer satisfaction affects their short-term, but not mid- or long-term, revisit intention. Several other studies have reported that customer satisfaction positively affects revisit intention [14] [18] [30].

For an industry, retaining old customers is more cost effective than developing new customers. An innovative service can be used to inform customers about a retailer's effort. Moreover, high consumer satisfaction can increase revisit intention. Therefore, we proposed the following hypothesis:

H4: Satisfaction positively influences revisit intention in the m-commerce environment.

RESEARCH METHODOLOGY

In this study, a research framework on the basis of the literature review is proposed. The operational definition of the research framework and hypotheses is as follows:

Research Framework

The effect of service innovation and service quality on consumer satisfaction and revisit intention were investigated in this study, as outlined in Figure 1.

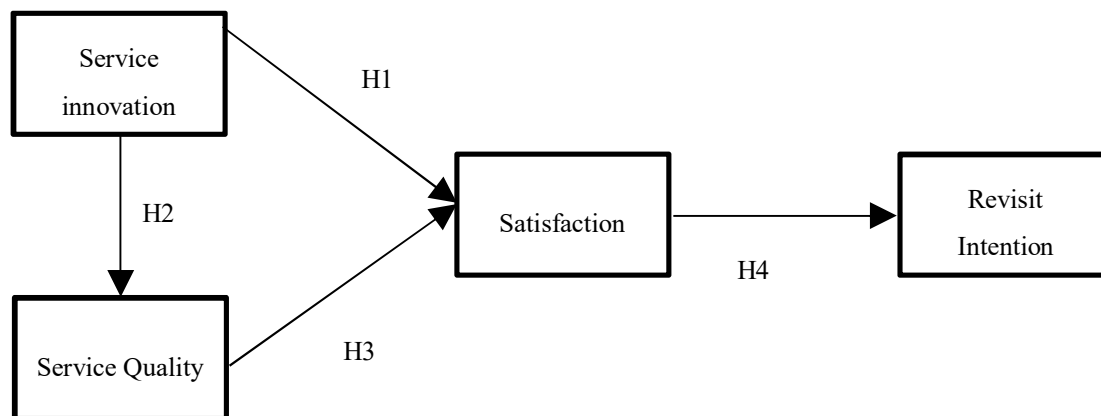


Figure 1: Research framework

Operational Definitions of Study Variables

A multiple-choice questionnaire containing five study variables (i.e., service innovation, service quality, satisfaction, revisit intention, and personal information) was used. The responses of the questionnaire were measured on a 5-point Likert scale, with scores ranging from 1 (strongly disagree) to 5 (strongly agree).

Service Innovation

Sundbo's views of service innovation were adopted for this study [34]. For retailers, using a one-to-one service requires many employees and is thus not cost effective. Therefore, the iBeacon technology can be used to improve existing services, increase retailers' revenues, and improve operational performance. Therefore, service innovation was operationally defined as the use of a new service or improvement in an existing service to increase organizational benefits.

To measure consumers' perception of service innovation, four items used by Hinnant [15] were adopted for our questionnaire and modified to conform to our study objectives.

Service Quality

Parasuraman's views of service quality were adopted for this study [29]. If a retailer makes an effort in managing the application of service and diligently interacts with consumers, consumers feel a positive attitude toward the service of the retailer. Therefore, service quality was operationally defined as In addition to infrastructure on m-commerce website, the additional cognitive of services to customer on m-commerce.

The service quality of the iBeacon technology provided by retailers was explored in our questionnaire using the E-S-QUAL scale developed by Parasuraman [29] in 2005. Although the iBeacon service is related to Bluetooth technology, whereas the Parasuraman scale is related to the context of e-commerce, the E-S-QUAL scale (which includes four constructs, namely efficiency, fulfillment, system availability, and privacy) explored the situations similarly to the iBeacon service.

By contrast, the service quality of customer contact service personnel for return of goods, compensation, and other services was evaluated by the E-RecS-QUAL scale. The iBeacon service does not include return- and compensation-related concerns, and only recommends contacting service personnel in case of problems.

Thus, the four constructs of the E-S-QUAL scale and the single construct of the E-RecS-QUAL scale (contact) were adopted for the present study.

Satisfaction

Churchill Jr. and Surprenant's views of satisfaction were adopted for this study [11]. For consumers, the actual experience retailers' service innovation and service quality. Consumers have expectations about a service provided by a particular retailer depending on their previous practical experience; therefore, consumer satisfaction can be operationally defined as the difference between the shopping expectation of consumers and the services actually provided by enterprises, including service systems, efficiency, service attitude, and professional knowledge.

Items used by three researchers were included in our questionnaire following modification to conform with our study to measure consumers' perception of satisfaction [10] [23] [40].

Revisit Intention

Finally, Kim's views on revisit intention were adopted for this study [18]. Consumers are willing to patronize a store again because their prior service equals or exceeds consumer expectations. Therefore, revisit intention can be operationally defined as customers' willingness to revisit.

In addition, questionnaire items used by Jang and Feng [16] to evaluate whether consumers are willing to visit a company again in the future were adopted here; specifically, the revisit intention items were divided into short-, mid-, and long-term revisit intentions.

The operational definitions of the constructs are presented in Table 1.

Table 1: Operational definition of variables.

Construct	Operational definition
Service Innovation	The use of a new service or improvement in an existing service to increase organizational benefits.
Service Quality	In addition to infrastructure on mobile commerce website, the additional Cognitive of services to customer on mobile commerce.
Satisfaction	The difference between the shopping expectation of consumers and the services actually provided by enterprises, including service systems, efficiency, service attitude, and professional knowledge.
Revisit Intention	Customer's willingness to revisit.

DATA ANALYSIS

Pretesting

We included items in the questionnaire according to the literature review and research framework (see Appendix), and these items were measured quantitatively. Specifically, items that have demonstrated reliability and validity in previous studies were used, although we appropriately adjusted the content of the items according to our research purposes. For example, we adjusted the number of questions on the basis of participants' tolerable range to reduce their displeasure. Additionally, a pretest before the release of the formal questionnaire was conducted to determine the appropriate adjustment for the items. Because we included civilians as participants, the survey was conducted by posting a link to the web questionnaire on the PTT Bulletin Board System and on social media. After the questionnaires were returned, inappropriate samples, which included questionnaires that had low standard scores and the questionnaires of users who never used the iBeacon service, were excluded. In total, 77 respondents completed the questionnaire and 60 (77.9%) questionnaires were used. Following exclusion, the responses of the questionnaires were quantitatively analyzed using SPSS software (version 18) to confirm the structure of the measurement scale. The Kaiser–Meyer–Olkin (KMO) test provided a KMO score of > 0.7 , and Bartlett's sphericity test results were significant. In addition, factors were extracted using the principal component analysis, and varimax rotation was used as the rotation method. Finally, the factor structure of each construct was established and the factor loadings that were less than 0.4 or greater than 0.4 on two or more factors were deleted.

Sampling Data

As noted, pretest questionnaires were collected from 77 respondents. After screening and exclusion, 60 valid questionnaires were included in our research. Of the respondents, 24 (40%) were men and 36 (60%) were women. Nearly 45% and 30% of the respondents were aged between 21 and 25 years, and between 26 and 30 years, respectively, and approximately half of the respondents were students. Table 2 presents a summary of the demographic descriptive statistics of the participants.

Table 2: Demographic descriptive statistics

Measure	Option	Frequency	Rate (%)
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Gender	Male	24	40%
	Female	36	60%
Age	Under 25 years old	9	15%
	21–25 years old	27	45%
	26–30 years old	17	28.3%
	31–35 years old	1	1.7%
	36–40 years old	5	8.3%
	41–45 years old	1	1.7%
	Senior high school	1	1.7%
Education level	Bachelor	51	85%
	Master	8	13.3%
	Student	32	53.3%
	Service industry	10	16.7%
Occupation	Administrative personnel	6	10%
	Computer/ engineering	2	3.3%
	Academic/ education	3	5%
	Sales/ marketing	2	3.3%
	Trade	1	1.7%
	Household industry	1	1.7%
	Unemployed	3	5%

RESULT

The KMO score of service quality was 0.828, and the Bartlett's sphericity test results were significant (Table 3). We also performed exploratory factor analysis (EFA) on the pretest questionnaires and extracted two factors, and calculated a cumulative variance of 59.66% for service quality. As listed in Table 4, service quality extracted two factor separated. Efficiency and fulfillment constructs were extracted into the same factor, and contact and privacy constructs were extracted into the same factor. Thus, we speculated that the iBeacon can be applied in physical stores in the retail industry. Notably, efficiency and fulfillment was quite similar for consumers.

The KMO score of service innovation was 0.651, the Bartlett's sphericity test results were significant (Table 3), and the cumulative variance was 52.72%. Because the KMO score was almost 0.7 and was based on fewer samples; We still performed exploratory factor analysis (EFA) on the service innovation construct. The factor loadings of service innovation constructs are listed in Table 4.

The KMO score of satisfaction and revisit intention was >0.7 , and Bartlett's sphericity test results for these two constructs were significant (Table 3). Furthermore, the cumulative variance of satisfaction and revisit intention was 62.53% and 70.76%, respectively. Our data indicate that satisfaction and revisit intention constructs are suitable for performing exploratory factor analysis. The factor loadings of all the constructs are listed in Table 4.

Table 3: Kaiser–Meyer–Olkin scores and Bartlett's sphericity test results

Construct	KMO	Bartlett	Cronbach's alpha
Service Innovation	.651	.000	.698
Service Quality	.828	.000	.903
Satisfaction	.757	.000	.846
Revisit Intention	.837	.000	.916

Table 4: Factor Loadings of Constructs

Construct	Items	Factor Loadings
Service Innovation	SI2	.832
	SI1	.787
	SI3	.694

	SI4	.562	
		Factor1	Factor2
Service Quality	EFF6	.808	
	EFF1	.804	
	EFF4	.761	
	FUL3	.758	.373
	FUL2	.716	.373
	SYS2	.643	.311
	FUL4	.595	
	SYS3	.489	
	PRI2		.840
	PRI1		.785
	CON3		.773
	CON2	.314	.694
	PRI3		.666
Satisfaction	SAT2	.869	
	SAT4	.817	
	SAT1	.802	
	SAT3	.729	
	SAT5	.726	
Revisit Intention	RI3	.900	
	RI6	.861	
	RI4	.842	
	RI5	.835	
	RI1	.816	
	RI2	.789	

EXPECTED CONTRIBUTION

In recent years, technology has changed the way people use electronic products. Because of the transition from desktops to mobile devices, and from simply browsing on websites to browsing on mobile websites, as well as the convenience of mobile devices, retailers have been encouraged to develop various innovative services. On the basis of the literature review, this study evaluated whether service innovation and service quality affects satisfaction and revisit intention among consumers using the iBeacon service.

We investigated whether consumers are satisfied with services provided by industries using the iBeacon system and whether their revisit intention is dependent on the degree of satisfaction. Mobile service providers can use our study results to change the manner in which they operate on m-commerce for fulfilling consumer expectations and improving the overall performance.

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APPENDIX

Construct		Item	Measurement
Service Innovation		SI1	In recent years, our company has improved already-existing service development processes with the iBeacon service.
		SI2	In recent years, our company has improved the efficiency and effectiveness of its service delivery according to organizational demand with the iBeacon service.
		SI3	In recent years, our company has improved the efficiency and effectiveness of service delivery based on the customer demand with the iBeacon service.
		SI4	In recent years, our company has facilitated new service development processes with the iBeacon service.
Service Quality	Efficiency	EFF1	The iBeacon service makes it easy to find what I need.
		EFF2	The iBeacon service enables me to complete a transaction quickly.
		EFF3	The promotional information provided through the iBeacon service is well organized.
		EFF4	The iBeacon service rapidly loads its promotes information.
		EFF5	The iBeacon service is simple to use.
		EFF6	The iBeacon service enables me to get on to it quickly.
System Availability	System	SYS1	The iBeacon service is always available for business.
		SYS2	The iBeacon service launches and runs right away.
		SYS3	The iBeacon service does not crash.
		SYS4	The information promoted on the iBeacon service does not freeze.

Construct (continuous)		Item	Measurement
Service Quality	Fulfillment	FUL1	The iBeacon service delivers promotes information when promised.
		FUL2	The iBeacon service makes promotes information available for delivery within a suitable time frame.
		FUL3	The iBeacon service rapidly delivers promotional information.
		FUL4	The iBeacon service sends out promotional information.
		FUL5	The iBeacon service is truthful about its promotional information.
		FUL6	The iBeacon service accurately provides product about promotes information.
	Privacy	PRI1	The iBeacon service protects information regarding my browsing behavior.
		PRI2	The iBeacon service does not share my personal information with other companies.
		PRI3	The iBeacon service protects my credit card information.
	Contact	CON1	The iBeacon service provides a telephone number to reach the company.
		CON2	The iBeacon service has customer service representatives available online.
		CON3	The iBeacon service offers the chance to speak live to a person in case of a problem.
Satisfaction		SAT1	I am satisfied with the value-added iBeacon service provided by this company.
		SAT2	I think this company has successfully provided the value-added iBeacon service.
		SAT3	This value-added iBeacon service is better than expected.
		SAT4	Using the iBeacon service has been a good experience.
		SAT5	I have truly enjoyed using the iBeacon service.
Revisit Intention	Short-term Revisit Intention	RI1	Revisit interest within 12 months.
		RI2	Revisit likelihood within 12 months.
	Mid-term Revisit Intention	RI3	Revisit interest within 3 years.
		RI4	Revisit likelihood within 3 years.
	Long-term Revisit Intention	RI5	Revisit interest within 5 years.
		RI6	Revisit likelihood within 5 years.

To Study Effects of Using Human Presenter in Product Image: Applying an Eye-tracker VS Facial Expression Translation

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ABSTRACT

Eye tracking is the process of measuring either the point of gaze or the motion of an eye relative to the head. An eye tracker is a device for measuring eye positions and eye movement. Eye trackers are used in research on the visual system, in psychology, in psycholinguistics, marketing, as an input device for human-computer interaction, and in product design. Previous study applies an eye-tracker to investigate effects of using human presenter in product images and conclude that eye-tracker data can be used for eye-gaze data collection and analyzed for further statistical conclusion [8]. The result indicates that product image with positive emotion female presenter gets the highest fixation duration, however, not significantly higher than fixation duration of other types of product images.

However, Eye tracking by professional eye-tracker is not an affordable research method for most researches. Facial expression translation is a new function comes from “Youdao translate officer” which can be downloaded from apple APP store for free; It can indicate human facial expression in eight dimensions (i.e., happiness, angry, fear, contempt, disgust, calm, surprise, sad) with values. We are proposed to use this free technical to investigate effects of using human present in product images and compare the results with studies applies eye-tracker previously. A fresh accepted research method could be discovered by this study, and give an optional research method in relative field.

Keywords: Human Presenter, Product Image, E-commerce, Eye-tracking, Facial Expression Translation, Fixation duration.

INTRODUCTION

Nowadays, technology has played an important role in medical, education, communication, and especially in marketing. If organizations use technology effectively; they will be able to create advantages over their competitors. Researchers use many tools for collecting data such as questionnaires and interviews. However, questionnaires and interviews may not be the most suitable tools for collecting eye-gaze data. On the other hand, Facial expression translation APP which installed in smart phone is an acceptable and affordable way for the researches to get eye-gaze data for further study purpose. Many studies have been done in laboratory for collecting eye-gaze data by expensive eye tracker. In this study, we are try to redo a group of experiments which have been done by eye trackers, collecting facial expression data and calculate attitude value to compare with eye tracking results.

RESEARCH OBJECTIVES

This paper has three objectives which are:

1. To study how facial expression translation technology can collect data from visitors of ecommerce webpages.
2. To use the collected facial expression data to calculate “attitude value”
3. To compare collected facial expression data of five different product images on e-commerce webpages which are:

Using no human presenter in product image.

Using male presenter with positive emotion (smiling face) in product image.

Using male presenter with neutral emotion in product image.

Using female presenter with positive emotion (smiling face) in product image.

Using female presenter with neutral emotion in product image.

4. To compare the results with the previous study applies eye-tracker

RESEARCH METHODOLOGY

Research Tools

There are three research tools in this study.

1. A smart phone with “Youdao translate officer” APP installed, software interface as shown in Figure 1.



Figure 1: Software interface

2. Five e-commerce webpages, with five different product images as mentioned earlier, but same design and content in each page, as shown in Figure 2, 3, 4, 5, and 6.



Figure 2: Webpage using no human presenter in product



c.

Figure 3: Webpage using male presenter with positive emotion (smiling face) in product image.

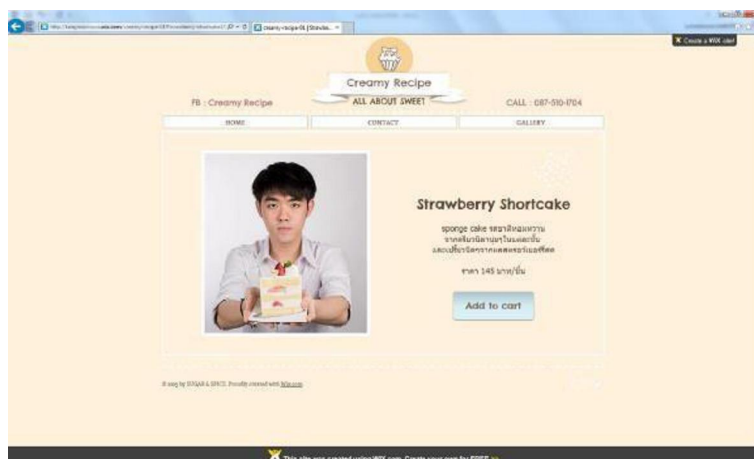


Figure 4: Webpage using male presenter with neutral emotion in product image.

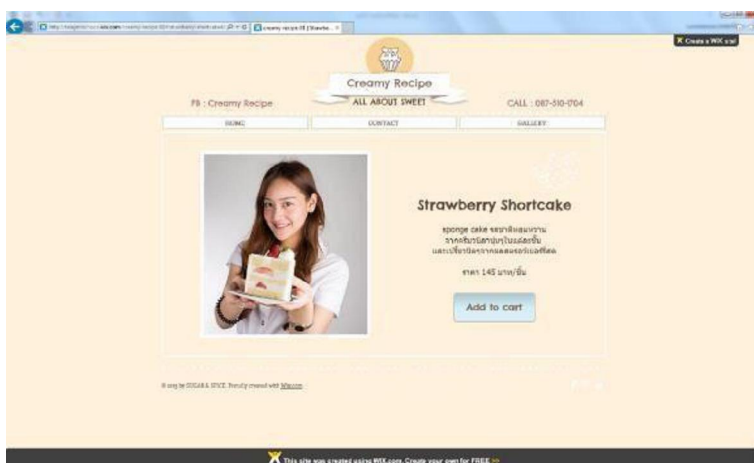


Figure 5: Webpage using female presenter with positive emotion (smiling face) in product image.



Figure 6: Webpage using female presenter with neutral emotion in product image.

3. Questionnaire for collecting participants' data. This questionnaire is divided into four parts. The first part is used to collect demographic data such as gender, age, and experiences with Internet shopping. The second part collects participants' vision condition, usual or unusual (such as Myopia, Hyperopia, or Astigmatism). The third part is to double check if each participant really looks at the webpage or not (by asking something specific about the product on webpages). And the final part is to ask participants about product (cake) purchase behavior such as how often he/she buys the product, reasons why he/she buys the product, his/her opinions about using human presenter in product image, and so on.

Procedure

Nielson (2006) suggested using about 20 subjects when collecting usability data. Since we have five different product images to compare in this study, we collect data from 100 participants (20 subjects x 5 different product images). We conducted this study in these following steps:

1. The information about this research was announced to students. Each volunteer participant made appointment with his/her convenient date and time. For the data collection process, data can be collected from one person at a time.
2. Each participant came to his/her appointment.
3. Participant listened to an explanation about the study and steps of data collection before starting the data collection process. Then, if the participant agreed, he/she signed the consent form allowing us to use his/her data in the study.
4. Participant adjusted his/her seat in front of the computer. Then, we set smart phone position in accordance with participant's seat for reducing error in data collection.
5. Then, we asked each participant to view an e-commerce webpage. Facial expression image will be captured during the participant to view the website.
6. Lastly, participant was asked to fill in the questionnaire to collect participant's demographic data, as well as other data and opinions for the study.

Measurements

In this study, participants were asked to view e-commerce webpages. Website conditions (see table 1) as below. We were interested in participants' facial expression translation data when they looked at product images on our experiment webpages. After data collection from smart phone was finished, we filtered participants' facial expression translation data in tables to calculate viewer attitude value of each participant for product image.

Table 1: website conditions

Website Conditions	Using Human Images in Product Presentation				
	Image with Positive Facial Expression		Image with Neutral Facial Expression		Product Presentation without Human Image
	Female	Male	Female	Male	
A	●				
B			●		
C		●			
D				●	
E					●

Participants

One hundred volunteer participants who were undergraduate students from Xiamen University participated in this study. A summary of demographic information of 100 participants will show in the Table. The participants content female and male, Average age will be counted and they are expected had internet shopping experience.

EXPECTING RESULTS

As mentioned earlier, there are five e-commerce webpages, with five different product images in this study, one product image on one webpage. The 100 volunteer participants were divided into 5 groups, one group for one product image (or one webpage). So, 20 participants (5 males, 15 females) were assigned to one product image. In group 1, participants viewed the e-commerce webpage using no human presenter in product image. In group 2, participants viewed the e-commerce webpage using male presenter with positive emotion (smiling face) in product image. In group 3, participants viewed the e-commerce webpage using male presenter with neutral emotion in product image. In group 4, participants viewed the e-commerce webpage using female presenter with positive emotion (smiling face) in product image. And group 5, participants viewed the e-commerce webpage using female presenter with neutral emotion in product image.

In experimental study with eye tracker device, the results from eye tracking data shows that product image with female presenter expressing positive emotion (smiling face) gets the highest fixation duration, but not significantly higher than fixation duration of other types of product images. When grouping by gender of the presenter, the result suggests that product image with female presenter gets the highest fixation duration. When grouping by emotion expression of presenter, the result indicates that product image with human presenter expressing neutral emotion gets higher average fixation duration than other groups. Product image with female presenter expressing positive emotion gets the highest fixation duration, product image with male presenter expressing positive emotion gets the lowest fixation duration. The average fixation duration of product images

with human presenters expressing positive emotion is less than the average fixation duration of product images with human presenters expressing neutral emotion. And finally, when grouping by human presenter usage, the result suggests that product image with human presenter gets higher fixation duration than product image without human presenter. Results from ANOVA and t-test all indicate that there is no significant differences between different groups of product images. This can be because the product image position on the experiment webpage is in the center of the page and the size of product images are quite large. Hence, participants in the study would look at the product images no matter what types of product images they are. However, most participants suggest in the questionnaire that they prefer product image with female presenter expressing positive emotion (smiling face).

Data is still in processing, more details and data will be come out in presentation. We are expect that the results from facial expression translation collecting shows similar result with eye tracking, i.e. Attitude value could shows that product image with female presenter expressing positive emotion (smiling face) gets the highest attitude value, but not significantly higher than attitude value of other types of product images. When grouping by gender of the presenter, the result could suggest that product image with female presenter gets the highest attitude values.

CONCLUSION AND LIMITATIONS

From this study, we could conclude that facial expression image data can be used for eye-gaze data collection and data collected from the study can be analyzed for further statistical conclusion. A fresh accepted research method could be discovered by this study, and give an optional research mothed in relative field.

However, there are some limitations using Facial expression image data for collecting data as follow:

1. We found problems when participants wore eyeglasses. Facial expression image data detected some reflective points of eyeglasses, instead of participants' eyes.
2. We found that sometimes facial expression image data crashed during collecting data due to unstable smart phone or conditions in the test room.

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Different Individual's Impact on Learning Performance in Virtual Reality

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ABSTRACT

Motivation

This study cooperated with National Palace Museum and the aim is to determinate the difference between various personal characteristics on learning performance in virtual reality (VR), to find out what kind of personality can have a better impact on performance and also want to raise people's interests in learning by using virtual reality. According to the current application on VR, it has been widely utilized in surgery simulation, aircraft simulation training and as we can see now, VR is getting more and more popular in gaming filed. Also, there already have many studies discussed about the VR, for example, many studies ([1]Witmer & Singer, 1998; [2]Steuer, 1992; [3] Rafaeli , 1988) discussed the factors which may influence user's experience in virtual environment and also there already have been lots of literatures ([4] Heeter, 1992; [5] Sanchez-Vives & Slater., 2005; [1] Witmer & Singer, 1998) talked over the indicator which can measure user's experience, the indicator we call it 'presence' and will talk about it later. In addition, there has another literatures proposed another indicator to measure user's experience, it's called 'engagement'. In this study we will talk about them and use them to measure how much subjects involve in the virtual environment.

But as we can see now, there are not so much application on educational field in VR. Otherwise, most of the literatures talked about what kind of usage in technology can have better presence to user or what kind of presence user would have when they experienced VR, also as we mentioned above, the application of VR in surgery simulation or aircraft stimulation training etc. With the chance if cooperating with the National Palace Museum, it's a good opportunity to do a research on it, National Palace Museum provide virtual reality equipment and the educational content to us, we dedicated to find out the different individual's impact on the usage of VR and also explore what kind of channels can have better presence or engagement to users and find the suitable content usage in different channel. After all, our aim is to let the application of VR can have more possibility in different field such as education and make people have more interests in learning the history of antiquities by using the virtual reality equipment which is supplied by National Palace Museum.

Research objective

In order to find the difference between various individuals, we can compare user's experience by measuring the presence and the engagement as the indicator we mentioned in the last paragraph. According to the past literatures, we can see that there are different methods can measure how much involvement user have in virtual environment, but the presence is the commonest one, in addition to this, we also take the engagement as one of our indicators, which can let us know how much enjoyment users have when they experience in the virtual environment, because if user have more enjoyment in VR, it will arouse their interests in learning things, this is one of our objective too. Also, because there were not so much essays discussed the usage of VR in the field of education. By the opportunity to cooperate with National Palace Museum, we will focus on the application on it and find out whether different personal characteristics can perform different learning performance when they are learning something in virtual environment.

In today, the VR is becoming more and more common and popular, there are many news talked about it and also many company are doing research and developing the equipment of VR, such as the famous virtual reality headset, HTC vive, which is developed by HTC and Valve Corporation, released on 5 April 2016. It is a first-of-its-kind virtual reality system. Aside from this, the Oculus Rift which is developed by Oculus VR, released on March 28 2016 is also one of the well-known virtual reality equipment. As to this world trend we hope to have a contribution to the application of VR in education, make the VR have more usage in different field.

Literature review

For evaluating user's experience, as mentioned before, we use presence and engagement as our indicators. Refer to the past literatures, there had many definition about presence, in this study we categorized it in three types, *environmental presence*, 'The extent to which the environment itself appears to know that you are there and to react to you' ([4]Heeter, C., 1992), *personal presence*, 'A measure of the extent to which and the reasons why you feel like you are in a virtual world' ([4]Heeter, C., 1992), *social presence*, "as individuals' perception of the medium to connect them to each other and create sociable, warm, and intimate interaction"([6]Lombard, M., & Ditton, T., 1997). In this study, because of restricting to the equipment and the content of VR which are provided by National Palace Museum, we will focus on discussing *environmental presence* and *personal presence*. And also as we mentioned, *engagement*, 'which reflects an individual's subjective enjoyment in a holistic experience with technology' ([7] Yi, Jiang, & Benbasat, 2015).

By using this indicators, we designed a questionnaire to measures them, after reviewing several literatures about presence questionnaire ([8]Witmer, Jerome, & Singer, 2005; [9]Slater, & Steed, 2000; [10]siter, Freeman, Keogh, & Davidoff, 2001). we

have picked some items from them to make it suitable to our experiment. As to appendix, there has several items, different items belongs to different indicators, and for the personality we used the big five personality trait to analysis, but the questionnaire is still on designing, so the items including in this abstract is the example from the recent finding, it's not the final vision of our questionnaire.

Research framework

For the purpose of measuring presence, we have reviewed many literatures and found out several factors that may impact the presence, in here, we summarize the elements into two parts, *individual differences* and *technology*. *Individual differences*, refer to [1] Witmer & Singer, (1998), they noted that the distraction factors and the realism factor may have impact on presence, these two factors are both related to personal difference. So according to these two factors, we expect personality, previous experience, attention and personal interests as the important elements of the presence. Also, according to [2] Steuer (1992), we knew that technology is one of the important factors may influence presence, for example, the resolution in virtual environment. Moreover, presence will impact user's learning performance. So by the means of measuring presence, we can find out the important factors which can have a better impact on performance.

For another indicator, engagement, we have found that we can measure it and know how much enjoyment user will have after they experience virtual environment. Because one of our objective is arousing people's interests in learning by using VR, it's important for us to know whether they engage in the virtual environment or not. If they have better performance in engagement it means that people really enjoy the experience in VR. If they enjoy it, it means that they may like the content which they experience and will let them have more interests in it. On the contrary, if they don't enjoy it, there are two main reason, one is that they may not really like the content and another is the equipment is not comfortable to them. According to this, people may not want to learn more about the things they see or listen in the virtual environment, because they don't have good experience. By measuring engagement, it will help us know whether the content is attractable to users. We hope to help National Palace Museum find the suitable content and arouse people's interest in learning more about the cultural relics.

Research plan and expected contribution

As to the framework we mentioned in the last paragraph, one of our purpose is finding out the important factor that may impact user's learning performance in VR, so we need to evaluate different user's presence. For example, users have experience in using VR may have better learning performance than those who never use it before, or the users who have interest in the virtual reality's content may have different presence to those who don't have, and whether user have experience in visiting museum or not will also have difference between them. Our another objective is attracting people's interests, we will design a questionnaire to measure engagement as we mentioned before, by measuring this we can know the content is attractable and also can help National Palace Museum to design their future content in VR.

Regarding to the experiment, because we want to find out the difference individual's impact, we will give them prerequisite questionnaire and separate the subjects into two groups by the result. The two groups are treatment group and control group, let the subjects have task in virtual environment which is supplied by National Palace Museum and we may give them some task, after the experiment, we will observe the task performance (in here it means learning performance) and give them questionnaire which is design by us, then we can measure the presence and engagement.

Our experiment's content and equipment is provided by National Palace Museum, the equipment is HTC Vive head-mounted display, with a camera near the bottom rim, two wireless handheld controllers and two 'lighthouse' base stations. Regarding to the content, there are some of the famous antiquities being stimulated in VR, such as the most famous one, jadeite cabbage with insects, one hundred stallions and some crafts, all of them are arrange in a place which looks like a room in the museum, user can walk around the room and watch the exhibits or interact with some of them. For the two controllers, one is a stimulated hand for people to interact with object, another one is a stimulated flashlight, by this we can turn on it in VR in order to let us observe the relics much more clearly. During the time experiencing the content which is provided by National Palace Museum, people can pick up some of the cultural relics, rotate it or take a look of it, but some of them people can only zoom them. For all of the antiquities, when people interact with them, the virtual environment will play the introducing track about the relic you interact with automatically.

By this experiment, we hope to prove that various individuals can have different impact on learning performance and find out which characteristics can have a better impact. Aside from this, by evaluating engagement, we can also know the content which is provided by National Palace Museum can make the user feel enjoyable or not and give some advice to them, we hope the advice can make them improve their content design in VR. And also let the educational application of VR can focus on the features we found, then use these features to design the content, make the VR can not only use in gaming or training field, but also be widely utilized in more fields.

Keywords: presence, virtual reality, education, personal characteristic, personal presence, environmental presence

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APPENDIX

Measuring Items Sample (Using a Seven-Point Likert Scale)

Personal Presence

- (1) I was aware of the world.
- (2) I felt I knew what was going to happen next
- (3) How involved were you in the virtual environment experience?
- (4) When you think back about your experience, do you think of the field more as images that you saw, or more as somewhere that you visited?
- (5) During the time of the experience, did you often think to yourself that you were actually just standing in an office wearing a helmet or did the field overwhelm you?

Environmental Presence

- (1) How well could you move or manipulate objects in the virtual environment?
- (2) How responsive was the environment to actions that you initiated (or performed)?
- (3) The temperature of the real world distracted me.
- (4) I wanted to see more of the space in the displayed environment than I was able to.
- (5) I could not do some of the things I needed to do in the virtual environment.

Engagement

- (1) The content was attractive.
- (2) Experiencing the museum in the virtual environment was worthwhile.
- (3) I would recommend experiencing the virtual reality with this content to my friends and family.
- (4) I was really drawn into my gaming task.
- (5) This gaming experience did not work out the way I had planned.

Big Five Personality Trait

- (1) Do not have a good imagination
- (2) Have a rich vocabulary

- (3) Make a mess of things
 - (4) Am quick to understand things
 - (5) Have difficulty understanding abstract ideas
 - (6) Feel little concern for others
 - (7) Seldom feel blue
-

The item is quote from [8]Witmer, Jerome, & Singer, 2005; [9]Slater, & Steed, 2000; [10]siter, Freeman, Keogh, & Davidoff, 2001; [11]Wiebe, Lamb, Hardy & Sharek, 2014) and the big five personality test. Note that this the sample item from the recent finding, still not the final vision of our questionnaire.

The Effectiveness of Applying Virtual Reality to Educational Purpose

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ABSTRACT

Research Motivation

The purpose of this thesis is to build a model to examine the impacts of subjects who experienced the virtual reality system made by Taiwan's National Palace Museum and make a proof that apply virtual reality on museum exhibition will achieve the expected benefits. The beginning of research on virtual reality is starting from psychological therapy. For the purpose of knowing what effects virtual reality has and why virtual reality is effective, many researchers devoted to this subject related to the concept of presence [1].

In the past decades, the researches on presence are adequate and covers many dimensions: the cause of presence, the category of presence, measuring presence, the outcome of presence, experimental design about understanding or measuring the presence, questionnaire design. However, what other fields that virtual reality can be applied in? what are the details about actual utilizing virtual reality in a specific field? The researches on this subjects are insufficient. For example, there was a research talking about applying virtual reality to learning purpose is potential if the system can generate a high presence virtual environment, but it did not actually prove it for real world. This paper, with Taiwan's National Palace Museum's virtual reality system, we will develop a model to examine the impacts of technical and task factors on presence in virtual reality museum exhibitions and through the questionnaire to evaluate the subject's performances.

For knowing using virtual reality in museum exhibitions was valuable or not, we listed the three main targets. These targets means after subjects experienced the virtual reality, it would be achieved at least one of the following benefits. the first one, enhance the subjects' willingness of joining the exhibitions, the second, increase the interests of the exhibitions and the last, improve the knowledge of artifacts in the exhibitions. Overall, we would know whether the virtual reality of museum exhibitions could produce the expected outcomes. If not, how to adjust the technical and task factors and improve the system is the question we try to answer.

Research Objective

Based on the past experiences, the visitors of museums could be divided into two types. The persons have been very interested in the artifacts or the experts had related professional background knowledge. Another type was the persons who just went for fun or felt curiosity but did not really interested in the contents. For giving the first type visitors a better experience and enhancing the interests of second type visitors, Taiwan's National Palace Museum had been starting its digital plan. The plan has been executed for several years and there have been many positive results and feedbacks. In recent years, the potential of virtual reality took the museum's fancy and the museum tried to develop a museum exhibition virtual reality.

Taiwan's National Palace Museum developed a virtual reality system for its digital plan. The virtual environment includes artifacts like jade cabbage, paintings and script of ancient poetry. The subjects wear head-mounted display(HMD), hands with the controllers and broadcast the introduction of artifacts continuously. There is a little space subjects can walk around and the scenes in the virtual environment is just like visiting an exhibition in the museum. In the virtual environment with the viewpoint of the subject, the subject can see that their right hand with white gloves and left hand with a flashlight. There are two ways that the subject can control the virtual environment and every action represents the different interactions. Controller on the right hand corresponds to the virtual environment is the right hand wearing the white gloves. The controller has a button, when press the button direct to the specific artifacts, it means "grab" the artifacts if the thing can be picked up. If the artifacts in the virtual environment cannot be picked up, such as painting and script of poetry, pressing the button will not give any response. A subject can use right hand to pick up the jade cabbage and watch it in full view. The controller on the left hand corresponds to the virtual environment is the left hand with the flashlight. A subject can use the flashlight to scan the paintings or scripts, and it represents the subject press the button on the left hand controller. The artifacts scanned will become full-screen in front of the subjects, so subject can see the details.

In order to know the outcomes of the museum exhibition virtual reality, we are going to build a model to figure it out. Therefore, we are going to find out the key factors that contributed to the presence and relationship between these variables and presence. Through the decades, the researches on finding out the factors that affects to presence was sufficient and many researchers tried to categorize these factors. Thus, there were so many taxonomies but some of them still had commonality. We use the Sheridan's (1992) taxonomy to categorized these variables into three groups, technological, task- or context-based and user characteristics or individual. Technological and task-based view are focus on the system level. Technological view focus on how the virtual reality design affects the presence. Task-based view emphasize what contexts or tasks will contribute to presence. Except the technological and task-based variables mentioned above, individual differences are important to presence. The variances between individuals are huge and complex, including differences of personal characteristics, attitude toward to the technology, tendencies of paying attention or engaging in the virtual environment. it is difficult to take these views all. Thus, this paper will concentrate on system level, point in technological and task-based factors and examine the impacts of these factors.

Presence is classified into personal presence, environmental presence, and social presence [2]. For the contexts of Taiwan's National Palace Museum virtual reality, there did not include the element of social presence. For the reason that this paper just separated the presence into personal and environmental presence.

We have three expected outcomes of this museum exhibition virtual reality, increasing the visitors' interests, improving the experience and learn more about the artifacts than before. Through the model, we want to know whether the system achieve these targets. The measurement is according to questionnaires fulfilled by subjects after they experienced the virtual reality. The measurement not only valid the model but also evaluate subjects' performance and the virtual reality can fulfill the expected outcomes or not. The details of the model will discuss in research framework paragraph. Model see the following Figure 1.

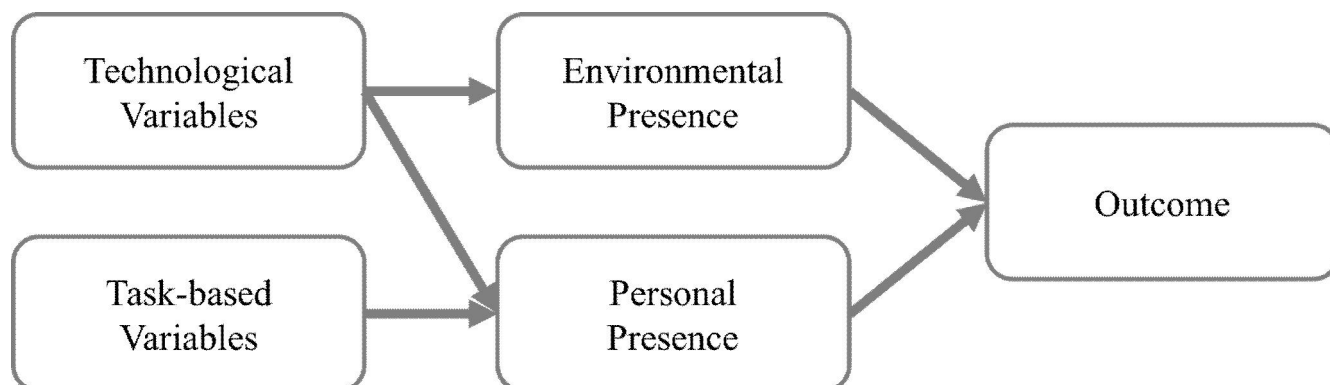


Figure 1

Literature Review

In the past researches, there were so many factors contribute to presence, and many researchers try to categorize these factors. Sheridan (1992) identifies five factors contribute to presence [3]. Steuer, J. (1992) categorized three of them as technological factors: the extent of sensory information, control of sensors relative to environment, and the ability to modify the physical environment [4]. The other two are task-, or context-based: task difficulty, and degree of automation [3]. Zeltner (1992) also provides three technological variables: autonomy (a qualitative measure of the ability of a computational model to act and react to simulated events and stimuli), interaction (the degree of access to model parameters at runtime), and presence (bandwidth of sensation) [5]. Naimark (1992) provides a six-category factors for realspace imaging and the taxonomy also from a technological view [6].

The definition of term "presence" is related to wide fields of researches. Lombard and Ditton identified six different explanations of presence: social richness, realism, transportation, immersion, social actor within medium, medium as actor [7]. Schloerb separated the presence into subjective presence and objective presence [8]. Heeter distinguishes between three different types of presence: personal presence, a measure of the extent to which the person feels like he or she is part of the virtual environment; social presence, refers to the extent to which other beings (living or synthetic) also exist in the virtual environment; environmental presence, refers to the extent to which the environment itself acknowledges and reacts to the person in the virtual environment [2]. There are still existing other researches about defining the nature of presence. Although these theories do not conflict, we have to pick one or converge approach some theories together when it is necessary to measuring presence. This paper uses the Heeter's definition, differentiate personal presence, social presence and environmental presence.

The measurement of presence in this paper is questionnaire. The presence questionnaire has been developed for several years and many of them were passed the validity test. So far we sort out the presence questionnaire and classified the questions to personal or environmental presence. The following are the presence questions we are going to use it to our questionnaire [12] [13] [14].

- | | |
|------------------------|---|
| Personal Presence | (1) I was aware of the world.
(2) I felt I knew what was going to happen next
(3) How involved were you in the virtual environment experience?
(4) When you think back about your experience, do you think of the field more as images that you saw, or more as somewhere that you visited?
(5) During the time of the experience, did you often think to yourself that you were actually just standing in an office wearing a helmet or did the field overwhelm you? |
| Environmental Presence | (1) How well could you move or manipulate objects in the virtual environment? |

- (2) How responsive was the environment to actions that you initiated (or performed)?
- (3) The temperature of the real world distracted me.
- (4) I wanted to see more of the space in the displayed environment than I was able to.
- (5) I could not do some of the things I needed to do in the virtual environment.

The questionnaire of antecedents is also developing. There is a limitation of space and the final questions are not confirmed, thus we do not list all the questions we sorted up until now here.

Research Framework

Based on the model (Figure 1), There are two groups of antecedents which affect the presence. The technological and task-based groups. The technological variables refer to the variables related to the system design. All factors which will affect the presence and the factors relate to the virtual reality system design are the technological variables. For examples, how the virtual environment interacts and reacts with the subjects, what subjects can do in the virtual environment and how many sensory of the subjects used when experiencing. These questions are technical factors' issues. Giving the last question as instance, in the museum virtual reality, the subjects can grab the jade cabbage to watch all details and zoom in the paintings on the wall. The sensory breadth of this system is covered the visual, auditory, and basic orienting system.

The factors in the technical group also have three subgroups: interaction, vividness and realism. These factors were defined by many researchers. In the paper, the fundamental definitions of interactivity and vividness we chose the Steuer, J. (1992) definitions and used the definition to extent to other similar concepts. Interactivity refers to the degree to which users of a medium can influence the form or content of the mediated environment [4]. Vividness refers to The ability of a technology to produce a sensorially rich mediate environment [4]. Vividness is stimulus driven, depending entirely upon technical characteristics of a medium. Media artist Michael Naimark (1990) refers to these same properties as realness and interactivity [9]. Besides the interactivity and vividness factors, the last factor of technological is realism. The realism refers to a person can be fooled into believing that the experienced situation is real if his mind cannot detect any discrepancy between the expected and the mediated outcome of their actions [11]. In a review of the concept of presence in virtual environments and associated literature (Sanchez-Vives & Slater, 2005) it was reported that experimental studies have found that factors that contribute to high reported presence are mainly concerned with the form of: how data is displayed to participants and how they are able to interact, rather than with the level of realism of the displays [10]. The realism discussed in this paper emphasizes the level of realism, and images in the virtual environment must be statistically plausible in relation to the probability distribution of images over natural scenes [10]. A constraint on this plausibility is the level of immersion not the level of realism. Thus, the realism is also a factor contributes to the presence and it belongs to the technological variables. The technological variables will affect both personal and environmental presence.

The task-based variables group refer to any factor which related to the context of the virtual reality. The differentiation of tasks difficulty is the main factors we will discuss. In the museum virtual reality, the different types of the artifacts mean the different tasks. The different tasks have its task difficulty. For an example, the artifacts in the virtual reality can be separated in to three type: the utensils like jade cabbage, the paintings and the words in manuscript. Each type of task will lead to different degree of presence. For the reason that the factor tends to the individual, the task-based variables only affect the personal presence.

The higher no matter the personal presence or the environmental presence, higher the total presence. The degree of the total presence represents the performance of this virtual reality. We make an assumption that the better performance can have more chance to achieve the outcomes we defined at the first.

Research Plan and Expected Contribution

With the virtual reality of Taiwan's National Palace Museum, we will design the experiments to verify the relationships in the model and further valid it. For measuring all the factors, the presence and outcome, we will develop a questionnaire to measure all the factors. We designed the questionnaire based on the past literatures. In the last, we want to know is the virtual reality of Taiwan's National Palace Museum can achieve the outcomes we expected including enhancing the subjects' willingness of joining the exhibitions, increasing the interests of the exhibitions and improving the knowledge of artifacts in the exhibitions when the subjects experienced the exhibition in simulated environment rather than being in the actually museum. If the final answer is positive, there is a big encouragement to museum to keep working on its digital plan and utilizing the virtual reality to more artifacts. It will give visitors a better experience when visiting the museum.

Through this paper, we build a model and verify it then we prove that using virtual reality in museum exhibition will give the visitors a better experience or not. For the future, we hope the model will not only use on this case. The case is just an instance and the model can be used in another case and on the other situation according to this model can give others advices to design the virtual reality across the technological and task-based view.

Keywords: Presence, virtual reality, virtual environment, presence measurement, user experiences, exhibition, museum.

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An Irrationally Rational Game Model

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ABSTRACT

In the application of game theory into the scenario of selling and buying a product in real life, sellers and buyers concern not only the acquisition utility of the good but also the transaction utility. To this end, in this paper we develop a game model with payoff matrix of aggregating transaction utility and acquisition utility, where we set the perceived transaction utility of a customer according to prospect theory. Moreover, we also study how the equilibrium of a game of this kind is influenced by some irrational factors that can be reflected by transaction utility. Finally, we use our model explain why online promotion selling in Tmall.com on Singles' Day is so successful in China.

Keywords: Game theory, transaction utility, prospect theory, price discount, electronic commerce.

INTRODUCTION

Game theory [17] is an effective tool to help the players in a game rationally choose strategies that can maximize their individual utilities. In particular, in a trading game a buyer pays for a good just because buying can bring more profits to the buyer than not buying. However, situations often differ in real life. Impulsive buying often happens to almost everyone when they are offered tremendous discount in a sale promotion, which can be loosely defined as "special offer", essentially aiming to stimulate demands during a certain period of time [16]. For example, a lady might not be able to resist the temptation of buying a lovely gown when it is 50% off, even though she would regret that it costs her one month's salary. It is irrational if we still think the utility of a good is simply the acquisition utility of the good, which depends only on the value of the gown received compared with the price. Actually, this kind of impulsive buying takes up the majority purchases in shopping mall and supermarkets, and in some situation, it even covers 80% of sales [27]. Then why does it often happen?

To answer the question, this paper will develop a new game model that can put such an irrational factor into account. More specifically, we will build a game model based on transaction utility theory [23] and prospect theory [8]. The transaction utility theory reveals that the utility of a good should be an aggregation of its acquisition and transaction utilities. The former one depends only on the value of the good received compared to the outlay, which is similar to the concept of consumer surplus; while the latter one depends solely on the perceived merits of the deal. Ann and Yuri [1] evidence the existence of transaction utility by an on-line auction experiment, which shows that people bid more for an item with a higher posted "buy now" price than for an identical item with a lower posted "buy later" price. Another experiment of psychology [27] also shows that the bigger the transaction utility is, the more purchases the subjects tend to make. Therefore, in our model the payoff that a player takes a strategy is the aggregation of the perceived transaction utility and acquisition utility. Moreover, for the individual customers during a transaction, according to prospect theory [8] they perceived utility in a special non-linear way. Accordingly, we set the buyer's transaction utility in the fashion of the value function model of prospect theory [8]. In addition, using our model we discuss how some rational and irrational factors influence the equilibrium of a game of this kind, so that the marketing manager of an online company can better understand that for each kind of customers, how much discount is enough for stimulating them to buy.

With our new irrational rational game model, we can better understand why online shopping is so popular. That is, people see a price of a good when they are on high streets; but when they browse the Internet, they often find the same product but in a lower price. Thus, the price difference turns into a perceived transaction utility, which makes them buy the good impulsively. The success of "Tmall.com Singles' Day Festival" is a very convincing piece of evidence for the effect of transaction utility (we will discuss in details in the illustration section). Another evidence is that one of the main reasons why university students in China shopping online is low-price [28].

The rest of this paper is organized as follows. Firstly, we recap and discuss relevant concepts and notations in transaction theory and prospect theory. Secondly, we define our game model. Thirdly, we reveal some properties of the model. Fourthly, we employ the model to explain the success of Tmall.com on Singles' Day Festival in China. Fifthly, we discuss some related work to show clearly how our work advances the state-of-art. Finally, we conclude the paper with some future research directions.

PRELIMINARY

This section will recap and discuss the relevant concepts and notations in transaction theory [23] and prospect theory [8], which we need to build up our game model.

Buyer Side

We first discuss different situations for individual customers. The transaction utility of a good mainly comes from the customer's

personal experience of buying it and its reference price perceived from the environment [12], including the original price label, the salesman's verbal cues, the price presented in the official website, and so on. The acquisition utility of a good is determined mainly by the reservation price and the selling price of the good. Behavior experiments [9] suggests that subjects who played the role of buyers in a price negotiation adopted their reservation price as a reference point. And during the purchasing period, it would be perceived as gains or losses by the buyer depending on whether the selling price is lower or higher than the reference point.

To allow different weights, in [23] a buyer's total utility function of a good z is defined as follows:

$$w_b(z, p_b, p_b^*) = v(\bar{p}_b, -p_b) + \beta_b v(-p_b; -p_b^*). \quad (1)$$

where p_b is the price the buyer paid for good z ; p_b^* is the reference price for z , which is an expected or "just" price for z ; \bar{p}_b is the value equivalent to z , the amount of money which would leave the individual indifferent between \bar{p}_b or z as a gift; β_b represents how much the buyer weights the transaction utility; $v(\bar{p}_b, -p_b)$ represents the buyer's acquisition utility; and $v(-p_b; -p_b^*)$ represents the buyer's transaction utility. Actually, β_b is the degree to which a buyer cares about money (see the fourth section for detailed discussion); and \bar{p} can be understood as the reservation price in microeconomics [5] (i.e., it is the highest price that a buyer is willing to pay).

The transaction utility is gained by a customer only if the good is on sale, and the acquisition utility is gained by the customer only if the deal is made. So, we still need to differentiate the following situations: 1) For an individual customer, if one good is on sale and he bought it, then the customer gets both its transaction utility and acquisition utility. 2) If one good is not on sale and he does not buy it, then he gets neither of these two utilities. 3) If one good is not on sale and the customer bought it, he gets its acquisition utility but no transaction utility. 4) If one good is on sale but the customer has not bought it, then the customer gets no acquisition utility as he does not gain the product and cannot enjoy it. However, he did get a negative transaction utility because the good is on sale but he missed it. It is something like that at the moment when he made the decision, he missed a chance to save some money. It could cause pain in the customer's heart because he might regret even after a long time. Therefore, in this case, the transaction utility is negative. The four situations above can be summarized in Table 1, which is helpful when we calculate the utility of an individual buyer.

Table 1: The Utilities of Buyer

Situation	Utilities
Sale & Buy	Acquisition utility + Transaction utility
Sale & Not buy	-Transaction utility
No sale & Buy	Acquisition utility
No sale & Not Buy	0

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Situation	Utilities
Sale & Buy	Acquisition utility + Transaction utility
Sale & Not buy	-Transaction utility
No sale & Buy	Acquisition utility
No sale & Not Buy	0

Further, prospect theory reveals that the utility perceived is not a linear, but non-linear, more specifically, S-shaped curve, in which the marginal gain decrease and the pain of losing an amount of money is larger than the happiness of gaining the same amount of money. So for individual buyers, a more realistic representation of utility should be figured out. In [24], Tversky and Kahneman advocated a form of value function. Accordingly, we define the following perceived transaction utility function of a customer with the value function.

Definition 1.

The perceived transaction utility t_b^p of buyer is the transaction utility a buyer perceived. It is defined as follows:

$$t_b^p = \begin{cases} (t_b)^\alpha & \text{if } t_b \geq 0 \\ -\lambda(-t_b)^{\alpha'} & \text{if } t_b < 0 \end{cases} \quad (2)$$

where $t_b = \beta_b v(-p_b; -p_b^*)$ is the actual transaction utility when a consumer purchases good in a sale, $\alpha \in (0, 1)$ and $\alpha' \in (0, 1)$ are risk attitude coefficient, and $\lambda \in (1, \infty)$ is loss aversion coefficient.

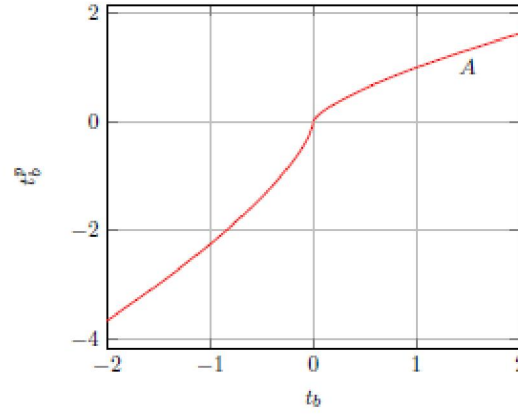


Figure 1: The relationship between t_b^p and t_b

The reference point of the perceived transaction utility function is the p_b^* . We can make a simple example to see the relationship between t_b^p and t_b . In Fig. 1, line A represents t_b^p , whose $\alpha = \alpha' = 0.7$, $\lambda = 2.25$. From the Fig. 1, we clearly see that for the customer, the increased speed of perceived transaction utility become smaller when the total amount of transaction utility increased. Meanwhile, gaining the same amount of transaction utility causes less perceived transaction utility than losing the same amount of transaction utility. Thus we defined the buyer's utility function with acquisition utility and perceived transaction utility as:

$$u_b(z, p_b, p_b^*) = v(\bar{p}_b, -p_b) + t_b^p. \quad (3)$$

Seller Side

Now we turn to discuss the seller side. Inspired by Thales's total utility function for the customers we mentioned above, we define the total utility of a seller as follows:

$$u_s(z, p_s, p_s^*) = v(-\underline{p}_s, p_s) + \beta_s v(-p_s^*, -p_s), \quad (4)$$

where p_s is the price the buyer paid for good z ; p_s^* is the seller's reference price of the good, for example, its price before discount; \underline{p}_s is the cost of good z for the seller; β_s indicates how much the seller weights the transaction utility; $v(-\underline{p}_s, p_s)$ is the acquisition utility; and $v(-p_s^*, -p_s)$ is the seller's transaction utility.

Sometimes it is reasonable to put the transaction utility into account of a seller. For example, Raghubir and Corfman's experiments [20] showed that under some specific conditions price promotions affect pretrial brand evaluation and do so unfavorably. They also found that consumers tend to perceive negatively when promotions are uncommon in the industry. Moreover, frequent or large price promotion will damage brand equity by bringing bad influence to consumer's loyalty and perceived value [15, 18]. On the contrary, when a company prices a good increasingly, it often delivers the message that its products are of high quality and thus makes the company's reputation higher. So, by means of formula (4), we define that transaction utility is negative when lowering the price, while the transaction utility is positive when increasing. However, for the sake of space, in this paper, we focus on the situation of price decreasing situation.

Specifically, we have: 1) If their good is on sale and a customer buys it, the company gets both transaction utility and acquisition utility. 2) If their good is not on sale and no customers buy it, their acquisition utility value is negative for the company has invested money to produce the good but gets no return. However, as they have not yet offered discount, so the value of transaction utility is zero. 3) If their good is not on sale and a customer bought it, they get the same acquisition utility but no transaction utility. 4) If their good is on sale but no customers have bought it, they get both acquisition utility and transaction utility. It gets acquisition utility because producing the good causes them some cost but gets no return, and they gain a transaction utility because they indeed offered discount, which influences its reputation. The above four situations are summarized in Table2.

GAME MODEL DEFINITION

This section will define our game model of discount trading.

Definition 2.

A discount trading game is a 4-tuple of (N, S, U, M) , where:

- $N = \{1, 2\}$, where 1 represents a seller and 2 represents a buyer.

- $S = S_1 \times S_2$, where $S_i = \{s_{i,1}, s_{i,2}\}$ is the strategy set of player $i \in N$. And $s_{1,1}$ is "Sale" and $s_{1,2}$ is "No Sale"; $s_{2,1}$ is "Buy" and $s_{2,2}$ is "Not Buy".

- $U = \{u_i(s_{1,j}, s_{2,j'}) | i \in N\}$, where $u_i(s_{1,j}, s_{2,j'})$ represents the utility of player i when player 1 chooses $s_{1,j} \in S_1$ and then the player 2 chooses $s_{2,j'} \in S_2$, and $u_1(s_{1,j}, s_{2,j'})$ is given by formula (4), and $u_2(s_{1,j}, s_{2,j'})$ is given by formula (3).

- $M = (s_{1,j}, s_{2,j'})$ indicates this game proceeds as follows: firstly seller 1 takes strategy $s_{1,j} \in S_1$ and then buyer 2 takes strategy $s_{2,j'} \in S_2$.

We will use $(s_{1,m}, (s_{2,m'_1}, s_{2,m'_2}))$ to represent that player 2's strategy is decided by player 1's choice $s_{1,m}$. That is, when player 1 chooses $s_{1,1}$, player 2 will choose s_{2,m'_1} , and when player 1 chooses $s_{1,2}$, player 2 will choose s_{2,m'_2} , as shown in Fig. 2. From the game tree, we can see clearly how player 2's moves connects to player 1's.

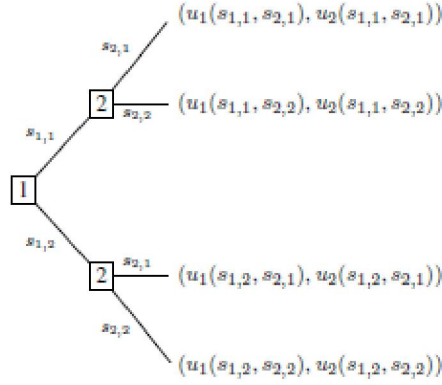


Figure 2: The game tree of our model

From Fig. 2, we can see that the game defined above is a perfect information dynamic game [26]. The seller first decides to offer a discount or not, and then the customer decides to buy or not. Before making a decision, the customers clearly know what discount they were offered and how much money they should pay. Each player in the game will choose the optimal strategy according to the utility that they can gain. Formally, we have:

Definition 3.

An acquisition-transaction equilibrium ζ to discount trading game G is (s_1^*, s_2^*) , where $s_1^* \in S_1$, $s_2^* \in S_2$ satisfying:

$$\forall s'_1 \in S_1, s'_1 \neq s_1^*, u_1(s_1^*, s_2^*) \geq u_1(s'_1, s'_2) \quad (5)$$

$$\forall s''_2 \in S_2, u_2(s'_1, s_2^*) \geq u_2(s'_1, s''_2), u_2(s_1^*, s_2^*) \geq u_1(s_1^*, s''_2) \quad (6)$$

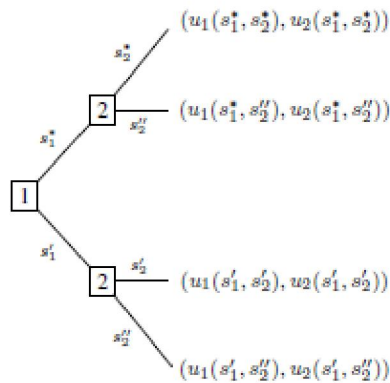


Figure 3: Backward induction for finding the Nash equilibrium

From Fig. 3, we can understand Definition 3 better. In every sub game of the discount trading game G , for the buyer, s_2' is the better choice. Then the seller can choose his better choice s_1^* according to the pay-off. In the sub game where the s_1^* leads to, the dominant choice s_1 of the buyer is s_1^* .

Using our game model with utility functions (3) and (4), we can explain some phenomena well in real life. If acquisition utility is concerned, it just can reflect material payoff. This makes the game model not be able to explain the situation of impulsive buying something due to discount but still not worth that price, such as some luxury goods because it is known to almost everyone that a luxury good's material pay-off is not that much but owning a luxury good can symbolize a buyer's status and taste. For example, Chinese people pay tremendous money aboard to buy luxury goods with discount they cannot get in domestic markets, because the discounts stimulate them to buy those luxury goods that can symbolize their richness. It is the transaction utility, instead of the acquisition utility, that triggers them to do crazy shopping overseas.

Theorem 1.

For the buyer, let $v(-p_b: -p_b^*) = p_b^* - p_b$, and let $v(\bar{p}_b, -p_b) = \bar{p}_b - p_b$. Then the buyer's utility u_b of strategy profile $(s_{1,i}, s_{2,i})$ can be positive even its corresponding acquisition utility is negative.

Proof. By formula (3), we have $u_b = v(\bar{p}_b, -p_b) + t_b^p$, and according to the premise, we have $v(\bar{p}_b, -p_b) < 0$. Now we should prove $t_b^p > -v(\bar{p}_b, -p_b)$ is possible. Since this paper focuses on price decreasing situation, we have $p_b^* - p_b > 0$. If $\beta_b > 0$, then $t_b^p = \beta_b(p_b^* - p_b) > 0$, so we have $t_b^p = (\beta_b(p_b^* - p_b))^\alpha$. We have:

$$\begin{aligned} v(\bar{p}_b, -p_b) + t_b^p > 0 &\Leftrightarrow (\beta_b(p_b^* - p_b))^\alpha > -(\bar{p}_b - p_b) \\ &\Leftrightarrow \beta_b > \frac{(\bar{p}_b - p_b)^{\frac{1}{\alpha}}}{p_b^* - p_b}. \end{aligned}$$

It means when $\beta_b > \frac{(\bar{p}_b - p_b)^{\frac{1}{\alpha}}}{p_b^* - p_b}$, the gain of the perceived transaction utility is able to compensate the loss of the acquisition utility.

But when $\beta_b < 0$, $\beta_b(p_b^* - p_b) < 0$, so $t_b^p = -\lambda(\beta_b(p_b^* - p_b))^{\alpha'} < 0$. And we have $t_b^p + v(\bar{p}_b, -p_b) < 0$. In this case, the gain of the perceived transaction utility is unable to compensate the loss of the acquisition utility.

The following is straightforward by Definition 3.

Theorem 2.

For any game with transaction utility and acquisition utility, there exists an acquisition-transaction equilibrium.

PROPERTIES

This session will discuss how the outcome of our game is influenced by various factors. The result can tell a marketing manager that for what kind of customers, how much discount they should make to attract them to buy.

Now we discuss the different situation of β . For all the players in a game, the values of parameter β in their utility functions can fall into the following 3 categories: 1) $0 \leq \beta \leq 1$; 2) $\beta > 1$; and 3) $\beta < 0$. We first discuss the customers. For the customers in category 1), they care about not only money they may pay but also the value of the good itself equally or even more. This kind of customers tend to estimate the value of the good according to both its acquisition utility and its transaction utility. For the customers in category 2), they care about money so much that we can call them bargain hunters. That is, whatever they buy, they tend to choose the one that they can take advantage of. For the customers in category 3), they gain negative (instead of positive) transaction utility when the price is lower. Maybe these are vain customers who want to buy expensive good to manifest their taste or show off themselves to others, or they just simply take price changing as an important message of good's quality and hate lowering the quality, even though they can save some money.

The three categories of β can also be applied to the seller, depending on who is the one suffering from price changing. For the sellers in category 1), they may sell general consumers goods, and if lowering the price, their reputations will be damaged, but the acquisition utility is more or equally important. For the sellers in category 2), they produce goods, which values depend desperately on the company's reputation instead of the goods' functions. We can take luxury goods as an example. If a company tries to trigger the massive shopping by a huge price discount, their luxurious image will be ruined and none will believe that their product is highly valuable any longer. Category 3) means declining price will increase the company's reputation. This sort of companies

might be completely new in a market and so try to use market penetration pricing strategy (i.e., setting low level of price to quickly build market share [25]). Thus, with the increasingly growing market share, they have a chance to make themselves known to more new customers and manifest a strong brand image.

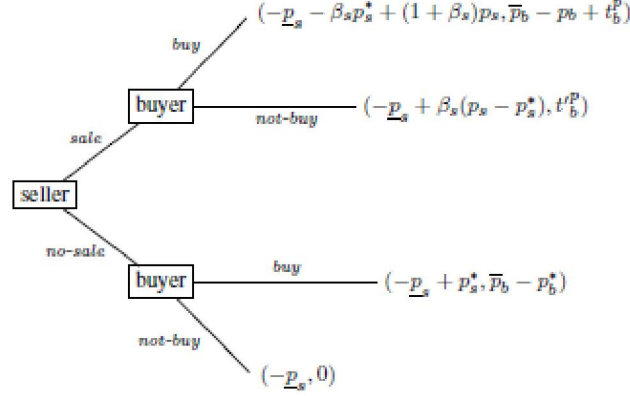


Figure 4: The game tree for property analysis

Now we examine the above discussion more accurately according to the game tree as shown in Fig. 4. Notice that the perceived transaction utilities of the buyer when buying or not buying are denoted as t_b^p and t_b^p respectively, where formula (2) should be applied. Since we focus on price decreased situation and $t_b = \beta_b(p_b^* - p_b)$, $t_b' = -\beta_b(p_b^* - p_b)$. We have $t_b^p = (\beta_b(p_b^* - p_b))^a$ if $\beta_b \geq 0$, $t_b^p = -\lambda(-\beta_b(p_b^* - p_b))^{a'}$ if $\beta_b < 0$; and $t_b^p = -\lambda(\beta_b(p_b^* - p_b))^{a'}$ if $\beta_b \geq 0$ and $t_b^p = (-\beta_b(p_b^* - p_b))^{a'}$ if $\beta_b < 0$.

Theorem 3.

Under all the three conditions, the payoff of the seller is always bigger when a customer chooses Buy than Not Buy.

Proof.

Firstly we compare the payoff of the seller between $(s_{1,1}, s_{2,1})$ and $(s_{1,1}, s_{2,2})$, and then we compare the payoff of the seller between $(s_{1,1}, s_{2,1})$ and $(s_{1,1}, s_{2,2})$.

If the seller chooses $s_{1,1}$, the seller's utility difference when the buyer chooses "Buy" or "Not-buy" is:

$$u_1(s_{1,1}, s_{2,1}) - u_1(s_{1,1}, s_{2,2}) = (-\underline{p}_s - \beta_s p_s^* + (1 + \beta_s)p_s) - (-\underline{p}_s + \beta_s(p_s - p_s^*)) = p_s.$$

Since $p_s > 0$, when the seller chooses the strategy of sale, the seller's payoff will be bigger if the buyer chooses to buy.

If the seller chooses $s_{1,2}$, the seller's utility difference when the buyer chooses "Buy" or "Not-buy" is:

$$u_1(s_{1,2}, s_{2,1}) - u_1(s_{1,2}, s_{2,2}) = (-\underline{p}_s + p_s^*) - (-\underline{p}_s) = p_s^*.$$

Since $p_s^* > 0$, when the seller chooses not to sale, the payoff will be bigger if the buyer chooses to buy.

Theorem 4. When a customer decides to buy,

if $0 \leq \beta_s \leq 1$ or $\beta_s > 1$ or $-1 < \beta_s < 0$, then it is better for the seller to choose no sale; and if $\beta_s < -1$, then it is better for the seller to choose sale.

Proof.

We can see the difference between $u_1(s_{1,1}, s_{2,1})$ and $u_1(s_{1,2}, s_{2,1})$ as follows:

$$\begin{aligned} u_1(s_{1,1}, s_{2,1}) - u_1(s_{1,2}, s_{2,1}) &= (-\underline{p}_s - \beta_s p_s^* + (1 + \beta_s)p_s) - (-\underline{p}_s + p_s^*) \\ &= (1 + \beta_s)(p_s - p_s^*). \end{aligned}$$

Since we focus on the situation of price decreasing, we have $p_s - p_s^* < 0$. So, when $\beta_s > -1$, $(1 + \beta_s)(p_s - p_s^*) < 0$. Thus,

$u_1(s_{1,1}, s_{2,1}) - u_1(s_{1,2}, s_{2,1}) < 0$. Then it is better for the seller not to choose sale. When $\beta_s < -1$, $(1 + \beta_s)(p_s - p_s^*) > 0$. Thus, $u_1(s_{1,1}, s_{2,1}) - u_1(s_{1,2}, s_{2,1}) > 0$. Then it is better for the seller to choose sale.

Theorem 5.

Table 3: The Equilibriums under Different Conditions

IF			THEN
\bar{p}_b and p_b^*	β_b guarantees	β_s satisfies	Equilibrium
$\bar{p}_b > p_b^*$	$\bar{p}_b - p_b + t_b^p > t_b'^p$	$\beta_s > -1$	(No Sale, Buy)
		$\beta_s < -1$	(Sale, Buy)
	$\bar{p}_b - p_b + t_b^p \leq t_b'^p$	$\beta_s > \frac{p_s^*}{p_s - p_s^*}$	(No Sale, Buy)
		$\beta_s < \frac{p_s^*}{p_s - p_s^*}$	(Sale, Not Buy)
$\bar{p}_b < p_b^*$	$\bar{p}_b - p_b + t_b^p > t_b'^p$	$\beta_s > -\frac{p_s^*}{p_s - p_s^*}$	(No Sale, Not Buy)
		$\beta_s < -\frac{p_s^*}{p_s - p_s^*}$	(Sale, Buy)
	$\bar{p}_b - p_b + t_b^p \leq t_b'^p$	$\beta_s > 0$	(No Sale, Not Buy)
		$\beta_s < 0$	(Sale, Not Buy)

The general equilibrium conclusion is presented in Table 3.

Proof. We use the backward induction method to prove it. During the whole proving procession, we should remember $p_s < p_s^*$ and $p_b < p_b^*$, since this paper focuses on the price decreasing situation. The proof method is similar to those of Theorem 3 and 4. We first consider the buyer's utility when the good is not on sale. We have:

1) When $\bar{p}_b - p_b^* > 0$, which means $\bar{p}_b > p_b^*$, for the buyer, it holds $u_2(s_{1,2}, s_{2,1}) > u_2(s_{1,1}, s_{2,2})$, which means if the good is not on sale, the buyer gets a higher utility if choosing to buy. Then the seller should consider when the good is on sale, what strategy the buyer will choose, so that the seller can figure out their own utility.

When the good is on sale, we can assume that when choosing to buy, the buyer got a bigger amount of total utility. If $\beta_b > 0$, then we have:

$$\begin{aligned} u_2(s_{1,1}, s_{2,1}) > u_2(s_{1,1}, s_{2,2}) &\Leftrightarrow \bar{p}_b - p_b + t_b^p > t_b'^p \\ &\Leftrightarrow \bar{p}_b - p_b + (\beta_b(p_b^* - p_b))^\alpha > -\lambda(\beta_b(p_b^* - p_b))^{\alpha'} \end{aligned} \quad (7)$$

If $\beta_b < 0$, then we have:

$$\begin{aligned} u_2(s_{1,1}, s_{2,1}) > u_2(s_{1,1}, s_{2,2}) &\Leftrightarrow \bar{p}_b - p_b + t_b^p > t_b'^p \\ &\Leftrightarrow \bar{p}_b - p_b - \lambda(\beta_b(p_b^* - p_b))^{\alpha'} > -\beta_b(p_b^* - p_b)^\alpha. \end{aligned} \quad (8)$$

So, the buyer will choose to buy when the good is on sale if β_b satisfies $\bar{p}_b - p_b + t_b^p > t_b'^p$, while he will choose not to buy when the good is on sale if β_b does not satisfy $\bar{p}_b - p_b + t_b^p > t_b'^p$.

Now we discuss the situation where β_b satisfies $\bar{p}_b - p_b + t_b^p > t_b'^p$. Since the seller knows the buyer will choose to buy when the good is on sale or not on sale, as we just discussed, he can compare his own utility when the good is on sale or not. Then we have $(s_{1,m}, (s_{2,1}, s_{2,1}))$. We first assume that when choosing sale, the seller can get a higher utility. Then we have:

$$u_1(s_{1,1}, s_{2,1}) > u_1(s_{1,2}, s_{2,1}) \Leftrightarrow -\underline{p}_s - \beta_s p_s^* + (1 + \beta_s)p_s > -\underline{p}_s + p_s^* \Leftrightarrow \beta_s < -1.$$

So, we can see that when $\beta_s < -1$, the seller should choose to sale. So, the equilibrium becomes (Sale, Buy). When $\beta_s > -1$, the seller would choose not for sale, the equilibrium will fall in (No Sale, Buy).

We then discuss the situation where β_b does not satisfy $\bar{p}_b - p_b + t_b^p > t_b'^p$. Under this condition, the buyer will choose not to buy when the good is on sale, but the buyer will still choose to buy when the good is not on sale as $\bar{p}_b - p_b^* > 0$. Thus, $(s_{1,m}, (s_{2,2}, s_{2,1}))$. This may sound odd, but it often happens to people who want to manifest their status by the high price, especially in a developing country like China. Now the seller should consider his total utility between sale and no sale. If the utility of choosing sale is bigger, we have:

$$u_1(s_{1,1}, s_{2,2}) > u_1(s_{1,2}, s_{2,1}) \Leftrightarrow -p_s + \beta_s(p_s - p_s^*) > -p_s + p_s^* \Leftrightarrow \beta_s < \frac{p_s^*}{p_s - p_s^*}.$$

So, we can see that when $\beta_s < \frac{p_s^*}{p_s - p_s^*}$, the seller will choose sale, and then the equilibrium becomes (Sale, Not Buy); and when $\beta_s > \frac{p_s^*}{p_s - p_s^*}$, the seller will choose no sale, the equilibrium becomes (No Sale, Buy).

2) We then discuss the situation where $\bar{p}_b - p_b^* < 0$, which means $\bar{p}_b < p_b^*$, then for the buyer, if the good is not on sale, the utility will be bigger when he chooses not to buy. That is, $u_2(s_{1,2}, s_{2,1}) < u_2(s_{1,2}, s_{2,2})$. Then the seller should consider when the good is on sale, what strategy the buyer will choose to maximize his total utility, too. Formula (7) is applied again and the result can be quote: the buyer will choose to buy when the good is on sale if β_b satisfies $\bar{p}_b - p_b + t_b^p > t_b'^p$, while the buyer will choose not to buy when the good is on sale if β_b does not satisfy $\bar{p}_b - p_b + t_b^p > t_b'^p$.

If β_b satisfies $\bar{p}_b - p_b + t_b^p > t_b'^p$, then we have $(s_{1,m}, (s_{2,1}, s_{2,2}))$. The seller should compare his own utility between sale and no sale. If sale is better than no sale, then we have:

$$u_1(s_{1,1}, s_{2,1}) > u_1(s_{1,2}, s_{2,2}) \Leftrightarrow -p_s - \beta_s p_s^* + (1 + \beta_s)p_s > -p_s \Leftrightarrow \beta_s < \frac{p_s}{p_s^* - p_s}.$$

We can see that if $\beta_s < \frac{p_s}{p_s^* - p_s}$, the seller will choose sale, and then the equilibrium will be (Sale, Buy); when $\beta_s > \frac{p_s}{p_s^* - p_s}$, the seller will choose no sale, and thus the equilibrium becomes (No Sale, Not Buy).

If β_b does not satisfy $\bar{p}_b - p_b + t_b^p > t_b'^p$, then we have $(s_{1,m}, (s_{2,2}, s_{2,2}))$. The buyer will choose not to buy when the good is on sale. So, if we assume the seller's utility is bigger when he chooses sale, then we have:

$$u_1(s_{1,1}, s_{2,2}) > u_1(s_{1,2}, s_{2,2}) \Leftrightarrow -p_s + \beta_s(p_s - p_s^*) > -p_s \Leftrightarrow \beta_s < 0.$$

So, we can see that when $\beta_s < 0$, the seller should choose sale, and thus the equilibrium is (Sale, Not Buy); when $\beta_s > 0$, the seller should choose no sale, and thus the equilibrium becomes (No Sale, Not Buy).

According to Table 3, we can forecast the equilibrium of the game when a price strategy was taken. For example, if a good was often perceived too expensive without discount, i.e., $\bar{p}_b < p_b^*$, and its target customers' β satisfies $\bar{p}_b - p_b + t_b^p > t_b'^p$, and the company's β_s is less than $\frac{p_s}{p_s^* - p_s}$, then we can forecast the equilibrium is (Sale, Buy), which means that the company will choose sale, and the customer will choose to buy. In the next section, we present an example of this circumstance.

SINGLES' DAY SHOPPING FESTIVAL

With the new game model we developed, we can explain the amazing success of the Tmall.com (the biggest online shopping website in China) on Singles' Day Shopping Festival. On the Singles' Day of 2015 (i.e., 11 November 2015), the total sales were 91,200 million Chinese Yuan, or say 143 billion USA dollars. This sales broke the Guinness World Records [4]. It was reported that during the first hour on that day, the sales surpassed the sum sales of "Black Friday" and "Cyber Monday" in America in 2014. Now suppose there is a silk shirt that a customer has been longed for but too expensive to afford. More specifically, it is priced at 300 RMB but a customer can just pay 240 RMB for it. The shirt's company usually offers no discounts except on Singles' Day Festival of Tmall.com. That is, on Singles' Day, customers just need to pay 250 RMB for it. However, for the company, the total cost of this shirt is 150 RMB and so there are still profits for the company. Suppose the company is famous for its brand management and high quality, so doing price promotion can actually harm its brand reputation. Thus, we can assume $\beta_s = 1$. Suppose a customer is a student having little money, so he likes to save money and thus we can assign 1 to β_b as well. Based on function (2), we assign 0.7 to α and α' , and assign 2.25 to λ .

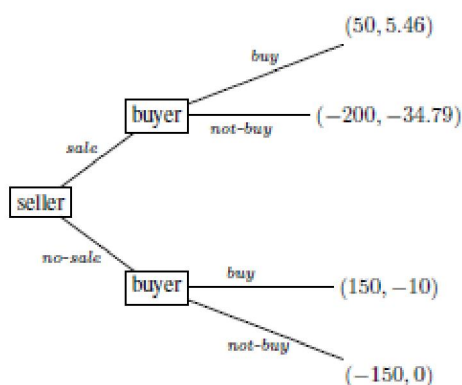


Figure 5: The game tree of trading a shirt in Singles' Day

If we only use acquisition utility to measure the utility of the customer, the customer will not buy the shirt whether the seller chooses sale or not, since the value of the acquisition utility is negative when buying, less than the value of the utility when not buying. However, when considering transaction utility in game model, the outcome is different. The game tree between the company and the customer is shown in Fig. 5.

We use backward induction to find out the equilibrium. That is, the seller chooses $s_{1,m}$, then two choices are left for the buyer in the sub game, i.e., *Buy* or *Not-Buy* in the sub track of the tree in Fig. 5. The buyer will choose the one that brings him a bigger utility. If the company offers discount, the customer will buy the silk shirt because $5.46 > -34.79$; otherwise, the customer will not buy the silk shirt because $-10 < 0$. So we have $(s_{1,m}, (\text{Buy}, \text{Not-buy}))$. Now the seller can predict that if he chooses $s_{1,1} = \text{Sale}$, the outcome of this game is (Sale, Buy), and if he chooses $s_{1,2} = \text{No-Sale}$, the outcome of this game is (No-sale, Not-buy). Accordingly, he can compare the outcomes of these two choices and take the better one, $s_1^* = \text{Sale}$, which brings him a bigger utility. Once $s_{1,m}$ is settled, player 2's choice is settled, i.e., $s_2^* = \text{Buy}$. Then we have equilibrium $(s_1^*, s_2^*) = (s_{1,1}, s_{2,1})$.

Therefore, by putting the perceived transaction utility into account of a game, we can see that if a good is discounted appropriately, it will be sold out. Even if the seller earns less in one deal, but it can maximize its total material revenue by selling more.

RELATED WORK

In [22], the authors views a company and residential consumers as two players in a dynamic game, in which the latter's strategy chosen will be the consequence of the former's, and try to find out the optimal pricing strategy. The work in [21] analyses consumer's utilities with different promotion strategies of supermarket retailers. The work in [13] considered the influences of unit marketing expenditure and the unit price charged by the buyer in the end demand of the product in both cooperative and non-cooperative games. In [3], the authors managed to figure out the optimal pricing strategy for a new product in dynamic oligopolies by considering price effect and adoption effect. However, all the above studies concern little about the transaction utility attached to promotion, which makes them less capable to explain impulsive buying behavior in real life. Rather, in this paper, we did put the transaction utility into account, so our model can explain and predict impulsive shopping behavior more accurately.

On the other hand, pricing promotion strategy has been a very active topic in marketing research. In [30], a two-period pricing model is built up for a supply chain to utilize group-buying program to promote its products and derive the equilibrium decisions of the two supply chain members in three different scenarios. Nonetheless, their research neglected the responses of the consumer, thus it is hard to apply the result of the pricing model to markets in real world. In [11][19], a quantities discount pricing model is developed to evaluate the pricing schedule to win the heart of the customer, but none of them considers the psychological influences of the pricing promotion strategy. In [6], the authors presented that different kinds of promotion method influence consumers' choices, but the model cannot be used to estimate the influences to the company's reputation and the consumers' perceived utility. Although in [29] the transaction utility is used to explain why consumers like price promotion so much with a lot of vivid examples, unlike us they did not do any quantities analysis in the framework of game theory.

CONCLUSION

In this paper, we develop a game model with transaction utility, which makes three important theoretical contributions: 1) The rationality in game theory is no longer evaluated simply by material pay-off of the good, but also by the money saved, the reputation of the company that was influenced, and so on. These are important aspects that rational people often consider irrationally in their daily life. So, our model can better explain irrational rationality in human interaction. 2) In game theory,

utilities are generic, lacking of clear semantics, so too ambiguous. In our work, utility values are not just some simple numbers without specific semantics, rather they have clear semantics, which can make the outcome more persuasive and practical, reflecting well the situations about price and cost in real trading. 3) The original transaction utility function is applied to the consumers only. However, according to our new definition, this utility function can be applied to not only buyers but also sellers.

Moreover, using our model marketing managers of some online shops can design various sale promotion strategies to attract various customers. Also, after they set a new promotion strategy, they can check it with our model and see whether or not it can stimulate customer to buy. This will bound to help making smart decisions. More specifically, since the parameters in our model are already set in a market and the only variable is the new price after discount, the market manager can use Table 3 to set discount carefully so as to attract more customers to buy.

However, there are still some limitations in our work, which are worthy being removed in future. Firstly, according to framing effect [7], framing price promotion in different ways leads to different consumer perceptions. For example, Chinese subjects are more satisfied with the possibility of refunding than combining offers and percentage effect [16]. Thus, some parameters in our model should be different for not only different types of consumers but also different forms of price promotion. Moreover, among various forms of value function in prospect theory [2], it is worth studying which one is the most suitable for a specific problem discussed in this paper. Finally, since consumer's experience of explosion to promotion activity (including pricing promotion) can change the reference price [10], it requires a facility for automated updating their sale data in time for a discount game we proposed in this paper.

ACKNOWLEDGMENT

This work was supported by the Bairen Plan of Sun Yat-sen University and the Natural Science Foundation of Guangdong Province, China (No.2016A030313231).

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Herd Behavior In Global Online Shopping Carnival

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ABSTRACT

We have witnessed the magnificent power of herd behavior exhibited by the frantic crowd during the Alibaba's global online shopping carnival (OSC) which has made 9 Guinness world's records within 24 hours. This study explores the cognitive herding process and the critical factors facilitating herd behavior in OSC. Meanwhile, applying the theory of carnival, this study identifies three OSC behaviors which spread through the OSC herd. Using 473 samples from OSC participants, the hypotheses are supported by the empirical results. Information incentive (e.g. promotion motivation and review information) and social influence (e.g. peer mimicry and endorsement influence) are two crucial preconditions for herd behavior; participation, interaction and playfulness capture the essence of OSC behavior. The results provide insights to: (1). the cognitive process of herd behavior; (2). the critical factors facilitating herd behavior in OSC; (3) the important OSC behavior imitated during the herding process.

Keywords: Online Shopping Carnival, Herd Behavior, Electronic Commerce

INTRODUCTION

The rapid growth and advantages of electronic commerce (EC) present a new paradigm for conducting business worldwide [43]. Especially, the massive sales volume from the EC market in China is pushing Asia-Pacific's growth forward, making it become the largest regional EC market in the world (eMarketer 2014a). Alibaba Group known as the global EC giant has focused on the Chinese market with global perspective [32]. In 2016, Alibaba's retail platforms in China surpassed RMB 3 trillion in gross merchandise volume (GMV), equivalent to 476 billion USD [3].

Alibaba's annual global online shopping carnival on November 11, simply called "OSC", is well known as the most successful online promotion campaign since its debut in 2009. The OSC event begins in early November each year and lasts through the end of November 11 shopping day. Prior to November 11, participants could accumulate discount coupons and gift cards by playing shopping games and attending live shows. These coupons and gift cards can be used on the shopping day to offset the prices of the products. For the few years, the OSC have witnessed steady growth in the sales volume [73]. During the most recent event in 2015, it generated 14.3 billion USD GMV and made 9 Guinness world's records [4]. This intriguing phenomenon featured with online technologies and carnival excitement has attracted the OSC participants from 232 countries and regions worldwide [2]. Such an event has demonstrated the magnificent power of herd behavior exhibited by the frantic crowd, which created the final success of the OSC. As the OSC contains complex and voluminous information, it often exacerbates uncertainty of the potential participant's decision and entices the participants' herd behaviors. Therefore, it is important to understand the critical factors and cognitive process behind the herd behavior in the OSC. A clear understanding of these issues could improve strategy, technology, and marketing decisions for the organizers and vendors in the OSC.

The herd behavior has been reported in financial investment (Bikhchandani & Sharma, 2001), marketing [14], and political arenas [68]. Recently it has been applied to the usage of Internet technologies [39][40][24] and information systems [65]. However, few have discussed the cognitive process of herd behavior [65]. In our opinion, the process of herding begins with the uncertainty of decision due to the lack of information. Thus, additional information from other sources is likely to cause discounting of own information, adjusting the initial beliefs, and imitating others' behaviors [12][65]. This additional information triggers the herding process and information cascade in which the information is passed throughout the herd from one to another [18]. To improve the quality of decision making, one needs the information to maximize the values and minimize the risk of the decision. In the context of OSC, the promotion information promises the values [58]; while the prior review information reduces the risk [54]. Moreover, the observation of predecessors' behaviors could reinforce the belief of imitating others' behaviors [59]. In the OSC context, such an observation focuses on three elements of carnival behavior: participation, interaction, and playfulness, as prescribed in Bakhtin's TOC [47]. Since the OSC behavior determines the success of the event, it is critical to examine whether the TOC can plausibly explain the dynamics of the behavior. Scholars have suggested that the examination of certain construct (in this case, the OSC behavior) in the new context may bring novel understanding and the generalization of a theory [70]. This study aims to achieve this purpose and examine the herd behavior in the OSC. Specifically, there are two research questions:

RQ1. How to measure the herd behavior in the OSC?

RQ2. What are the factors influencing the herd behavior in the OSC?

The remaining sections are organized as follows. In the next section, we present the literature review, elaborate the TOC and the herding process, and develop a research model and related hypotheses. Next, a description of research method and research results are presented, including the research instrument development, data collection, data analysis, and research findings. Then, we discuss the research findings and highlight the implications for theories and practices. Finally directions for future research as well as the limitations of the current study are discussed.

LITERATURE REVIEW AND MODEL DEVELOPMENT

The Theory of Carnival and the OSC

Carnival by definition is a social sphere that busts open and transforms traditional closed discourses to embrace freedom and equality, and create possibilities for learning and positive change [9][10][47]. It has been known as an important festival during the European history. The work of Russian philosopher Bakhtin [10] explores the role and the features of carnival during the Middle Ages and Renaissance, which is later regarded by researchers as the TOC. During that period, people's daily life is regulated with powerful social hierarchy and conservative medieval ecclesiastical and feudal culture. Bakhtin [10] characterizes carnival as a 'second life' of the people, and as a folk culture embracing freedom and equality, and creating new social relationships with positive changes [47]. The scenery of carnival is mirrored in the OSC. The playful spirit and festival atmosphere of the OSC relieve people from their routine life. It is open to all; each participant can jointly indulge in this online event with shopping, sharing, playing, and laughing. Specifically, the OSC possesses three prominent features as prescribed in the TOC [47]. The description of each feature follows.

Participation

The first feature is the active participation of all in the event. In a carnival, the line between spectator and performer is blurred; participants can move in and out of processions [9]. Behavior, gesture, and discourse are temporarily freed. Exaggerated mock battles and mock official businesses are reenacted. With the suspension of social hierarchies and conventions, a joyful 'disorderly conduct' flourishes. The participants live by its laws as long as those laws are in effect; that is, they live a carnivalistic life with new rules and a new mode of life [9, p. 122].

During the OSC, celebrities, fashion leaders, endorsers, sellers, and consumers are all welcome to actively and positively participate in a variety of carnival activities not available during the normal shopping day (e.g., browsing personalized OSC homepages, engaging in carnival games, watching TV shows, or hunting for gifts and bargains, etc.). Thus, this study defines participation as the active and positive behaviors of taking part in a variety of OSC activities, such as browsing, searching, shopping, and gaming.

Interaction

A second important feature of carnival is free contact and interaction among people [47]. During the carnival, physical and social distances between people are suspended. In a carnival, life is turned inside out and upside down. This disruption of life's routine, and especially the temporary abolition of powerful social hierarchies, allows participants to experience new relations with each other and the world that are unavailable to them in everyday life. New connections are made; ideas and objects are seen in a new light [9, p. 123].

In the modern society, Internet has become one of the main spaces for experiencing carnival for many people, a space where attitudes and ideas flourish with no intervention of social and physical restrictions [28]. It offers numerous channels and ways for participant to express themselves freely, such as reviewing, rating, and recommending certain products [5]. As an online marketplace, the OSC enables its participants to send and receive messages from friends/buyers/sellers via the instant messaging app or many other channels. New relations can be built, such as developing contacts and interacting with friends, fashion leaders, or other net-friends sharing the similar interests. Sharing the OSC experience, collaborating in gifts and bargains hunting, and exchanging the excitement of OSC are among the topics of interaction. Thus, this study defines interaction as the extent to which people use OSC as a social environment to freely interact with others, even if only temporarily, to share the experience or conduct collaborative activities.

Playfulness

The third feature of carnival is the playful manipulation of the everyday world for enjoyment of life [47]. The playful stance has been seen as the signal of carnival in which a play with objects and concepts "pursues a distant prophetic goal" and dispels "the atmosphere of gloomy and false seriousness" [10, p. 38]. Sarcastic role playing is embraced in which "normal constraints and conventions are thrown off, democracy reigns while commoner and aristocrat rub shoulders, the crude and the vulgar are enshrined, the fool reigns" [62, p. 179].

Numerous studies in IS confirm the positive effect of hedonic factors in online shopping and technology usage [55][70]. A high enjoyment associated with experiential behavior often engenders a more positive mood and greater shopping satisfaction [72]. Thereby, in order to entertain the participants, Alibaba Group designs many kinds of playful elements and activities for OSC participants (e.g., shopping games, gifts and bargain hunting, gala TV show, and live shows, etc.) to gain experienced distinguished from the everyday world. Alibaba Group executive chairman Jack Ma has interpreted OSC in China as an entertainment festival, a chance to share the happiness, rather than a mere commercial promotion campaign. Thus, this study defines playfulness as the fun and pleasure derived from the playful experienced distinguished from the everyday world.

during the OSC through gathering, shopping, gift and bargain hunting, show watching, and game playing. Table 1 summarizes the similarities between a traditional carnival and the OSC of Alibaba Group.

Table 1: A comparison of traditional carnival and the global OSC provided by Alibaba Group in China

Attribute	Traditional Carnival [47]	Alibaba Group's Global OSC
Participation	Active participation of all.	During the OSC, celebrities, fashion leaders, endorsers, sellers, and consumers are all welcome to actively and positively participate in a variety of OSC activities, such as browsing, searching, shopping, and gaming.
Interaction	Free contact and interrelation among all.	People can use OSC as a social environment to freely interact with others, such as sharing the OSC experience, collaborating in gifts and bargains hunting, and exchanging the excitement of OSC.
Playfulness	Playful manipulation of the everyday world for enjoyment of life	Playful experienced distinguished from the everyday world is engineered by Alibaba Group in order for the OSC participants to jointly indulge watching live shows and the evening gala TV show, in addition to gathering, shopping, gift and bargain hunting, and game playing.

In this study, we define the OSC behavior as a reflective construct because it meets the attribute of being reflective, in which any change in one indicator is not likely to cause a change in the latent construct [57][51]. Therefore, we model the construct of OSC behavior as a latent construct with three reflective indicators, namely, participation, interaction, and playfulness.

Herding Behavior Process

It has been widely acknowledged that people have the tendency to mimic each other resulting in herd behavior [24]. For example, people often choose the restaurant with more customers to dine. In other words, people's decision is influenced significantly by decisions of others around them [12]. The concept of herd behavior has been widely used to explain the mimicry of investors and fund managers among themselves in financial market [17]. Similar phenomenon has occurred among marketers who apply herd behavior to entice potential consumers to purchase [14]. Recently, herd behavior has been observed in a variety of contexts in Internet and IT technologies. For example, Chen (2008) reveals that online herd behavior occurs when people are purchasing book at the Internet bookstore. Sun elaborates the herd behavior in technology adoption and further confirms its effect on post-adoptive system use [65]. Several other similar effects are identified in the context of digital auction [29][63], software download [39], among others. Since the effect of herd behavior has been confirmed in a number of prior studies, the discussion of the cognitive process and the antecedents of it might add more knowledge to the understanding of herd behavior [65].

Herding process generally begins from the uncertainty of a decision. The uncertainty of decision is mainly due to the situation of having imperfect information or lacking information, and people perceive his/her inability to predict the correctness and accuracy of the consequences by making certain decision [52]. The situation can be very common in OSC, since the OSC usually contains much complex information and sophisticated functions. Actually, unlike the traditional face-to-face retail environment where products can be seen and touched, information asymmetry and ambiguity is more severe in the online platform [20][24]. For example, millions of online stores with different promotion campaigns, shop features, and service standards, and billions of products with different quality, price, and attributes are presented on the OSC online platform. A large number of features and activities people have limited prior experience are also, such as new bargain hunting activities, gift games, and live shows during the OSC period. It requires extensive knowledge, experience, time, effort, and even money to accurately evaluate the value of the information, which often makes people uncertain about whether they should conduct certain behavior in the OSC (e.g. participation, interaction, and play).

Not surprisingly, under the situation of decision uncertainty, people are more likely to herd by following the lead of additional information sources considered as useful and by imitating others' behaviors, discounting their own information and beliefs which are considered insufficient and incomplete [12][18][65]. The herd behavior emerges, even when people receive a slightly more information than what they already have from other information sources, enticing the individual following the action the additional suggestion, mimicking the predecessors' behavior, and adjusting their initial beliefs [65]. When such imitation behavior occurs in a large number, an information cascade is formed, in which the information is spread throughout the herd [12]. As the online environment, such as OSC, requires participants to infer product/service/activity information based on choices of others and additional information sources, rendering the prevalence of information cascades in OSC, and triggering herd behavior of the OSC participants. Therefore, the influence of valuable information and others' behaviors are highly related to one's herd behavior.

Information incentive and the OSC behavior

Due to the decision uncertainty caused by imperfect information an individual have, the information provided via other channels can engender herd behaviors. In order to improve the correctness and accuracy of the decision, one commonly

requires information to maximizing the values and minimizing the risk of the decision. In the context of OSC, the promotion information promises the values [58], e.g. large scale sale, while the prior review information reduces the risk [54], e.g. quality store and product recommendation after actual usage. Hence, we refer information incentive as the information the potential OSC participants received from two sources: OSC promotion information and review information, which can facilitate their OSC behavior.

The promotion information often contains price discount which will entice more consumers to purchase the discounted products [43]. Scholars further argue that if potential buyers anticipate a price drop in the near future, they will be motivated to join the shopping activity [42]. During the promotion of OSC, it is claimed that the price offered on that day is the lowest in the whole year. Moreover, the promotion of OSC also campaigns the personalized products recommendation to entice purchase, bargaining hunting activities, and shopping / gift games for potential participants to play solely or cooperate with others for better offer or just for fun. Alibaba engineered the promotion information to foster the participants' beliefs that OSC is the best online marketplace to indulge in. It serves as a reliable and useful information source, compensates the potential participants' initially imperfect information regarding OSC, and eventually facilitates their decision to herd in OSC behaviors. In the promotion information, the OSC participants are suggested to participate in the OSC to acquiring better offer through active information browsing and searching; develop social interaction and cooperation with others for bargaining, or experience and feeling sharing; play and be entertained during the process. Therefore, it is reasonable to presume that OSC promotion information is positively associated with people's decision to herd by conducting a variety of OSC behaviors (participation, interaction, and play).

Review information can be utilized to reduce the risk of conducting certain behavior. Information searching and trial usages of product/service/activities are usually performed by people to eliminate information asymmetry and reduce the decision uncertainty [22]. However, both strategies often consume additional resources [35][59]. Thus, it is reasonable to check prior users' reviews and follow their actions. This is a herding process in which people identify the successful experience of others in using certain product, develop their updated beliefs toward the product, and accept information or advice from others [46].

Participants in OSC often share a variety of review information, such as shopping experience, usage experience of certain brand or trial product, as well as rating scores of an online store (e.g. product quality, service quality, logistic quality), accumulated good comments regarding a store or a product via multiple channels provided by OSC. The online review information shared by predecessors can even exert influence on consumers' attitudes and decisions more powerful than marketer-generated information [26]. Potential OSC participants monitor the comments of others regarding the OSC products and activities; use them as a basis for their own choices to conduct the OSC behavior. Eventually, people accept the suggestions and perform the OSC behavior by following the leads in review comments. We hereby postulate that review information positively facilitates the herding of OSC behavior (participation, interaction, and play).

Consequently, information incentive in this study is operationalized as a formative construct with two dimensions, namely promotion information and review information. These two dimensions jointly capture the essence of information incentive and affect the OSC behavior. Hence we hypothesize.

H1. Information incentive is positively associated with the OSC behavior.

Social influence and OSC behavior

Another important strategy to diminish the uncertainty of decision is the observation of the same decision has been repeated by many different people [18][65]. According to the compensation-based herd rational, people would like to imitate others due to the risk-aversion strategy [52]. In other words, people may be worried about the possibility of wrongly rejecting a good OSC and then lost the opportunity to get a valuable price offer, interact with other, or have fun during the process. Moreover, others behavior usually serves as a heuristic of social proof which significantly influences people's decision of mimicry [44]. Tanner et al. reveal that even at this Internet era, many consumers' decisions are fundamentally influenced in the social environments [67]. The cognitive process of imitating others can be explained from the perspective of social learning theory (SLT) [11]. The potential participants are able to observe and capture the OSC behavior performed by people in their social networks and net-friends, and endorsers (namely, attention in SLT). Then, they understand how to perform and evaluate their ability to perform the observed OSC behaviors (namely, retention and reproduction). Motivated by risk-aversion strategy, or promotion camping, or other stimulus (namely, motivation), the potential OSC participants (the learner) reproduce what they have learned from others' behavior; in other words, the individual perform the herding of OSC behavior in this context.

During the process of learning and mimicry, besides the number of the predecessors, the identity also matters; both may elicit herd behavior [59][65]. In the context of OSC, the number of people is voluminous, making the identity of the predecessors (e.g., close friends, celebrities, fashion leaders, community members) as the primary determinant. Through the lens of SLT [11], the behavior of people from an individual's reference groups significantly influences his/her own behavior [7][34]. The most powerful influences may be derived from the significant others (e.g., peers, friends, partners, and families) in one's social network [56], or the endorsers represented by celebrities, pop stars, fashion leaders [18], or familiar community members. Accordingly, this study use two reference groups (i.e., peers and endorsers) to examine their social influences in the OSC. And we conceptualize social influence [70] as the OSC behavioral belief derived from the perception of other people's behaviors,

such as from the observation of peers' and endorsers' behaviors.

In general, people mimic multiple aspects (e.g., behavior, gestures, facial expression) of the significant others [67][44]. An individual's behavior during OSC is affected by the behaviors of their peers and other net-friends, since they learn from observations in this virtual social situation. Particularly, according to prior studies based on SLT [19], when friends' behavior are aggregated in one certain platform which allows users to view and recall friends' actions, it makes the link more salient. In this study, people may observe their peers' OSC behaviors (participation, interaction, and play) aggregated on OSC platform, such as gaming, purchasing, cooperating, experience and excitement sharing during the OSC period. Through this observation, people are more likely to mimic their peers' behaviors and preferences [16]. Accordingly, this study postulates that peer mimicry is positively associated with the OSC behavior (participation, interaction, and play).

On the other hand, it is quite common that people follow endorsers (Till & Busler, 1998), such as successful others [11], reputable early adopters [1], and fashion leaders [18], who are believed to have better information and to make correct decisions. Hence, the endorsers have power to create large-scale social influence regarding certain products, concepts, and alike. In the context of 11.11 Global OSC in China, social influence through endorsement has been applied to a large extent. In addition to inviting pop stars, fashion leaders, opinion leaders to promote the OSC during October and November, an evening gala television show performed by many celebrities attracts tens of millions audiences on the day of OSC. The endorsement influence on the OSC behavior of the participants is fully capitalized. Thus, this study postulates that endorsement influence is positively associated with the OSC behavior (participation, interaction, and play).

Accordingly, social influence in this study is operationalized as a formative construct with two indicators, namely peer mimicry and endorsement influence. Social influence derived from peer mimicry and endorsement influence is likely to trigger herding of the OSC behavior. Thus we postulate the following hypothesis:

H2. Social influence is positively associated with the OSC behavior.

Research Model

Based on the discussion above, we proposed a research model as shown in Figure 1. In this model, there is one consequence of herd behavior process: the OSC behavior. We argue that the two antecedents of herd behavior may affect the OSC behavior. First, the information incentive is proposed as a formative construct driven by promotion information (PI) and review information (RI). Meanwhile, the other antecedent, social influence, is also postulated as another formative construct driven by peer mimicry (PM) and endorsement influence (EI). Next, we postulate that the OSC behavior is a formative construct driven by participation (PA), interaction (IN), and playfulness (PL). Finally, we propose that information incentive and social influence are critical factors in fostering the OSC behavior.

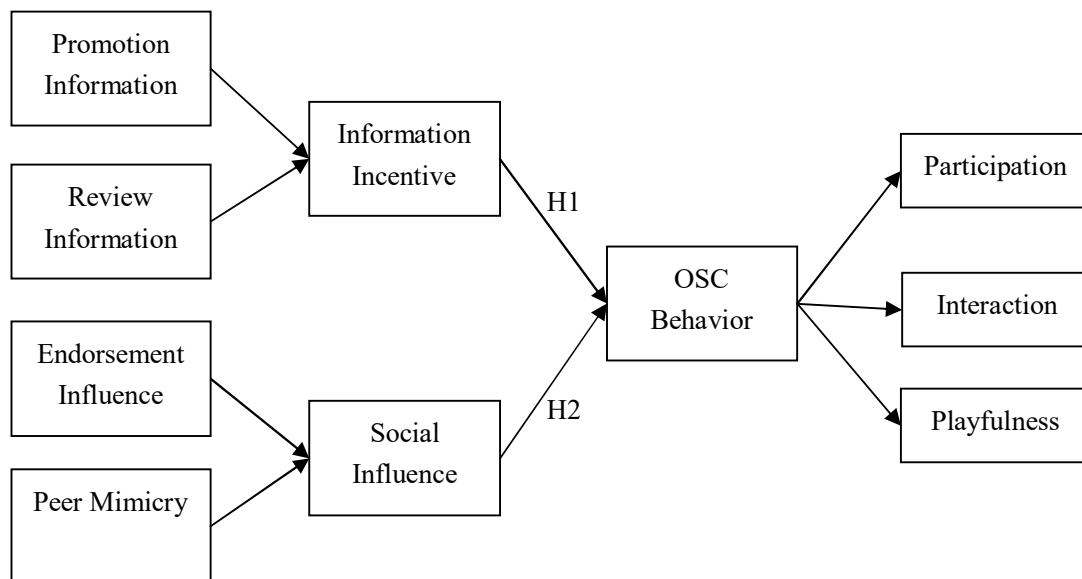


Figure 1: Research Model

REAESARCH DESIGN

Research Instrument Development

A survey questionnaire was developed to collect empirical data. All the construct of the research model were measured via the use of multiple-item perceptual scales. All items were measured using a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The majority of the items are adapted from the extant research, and slightly modified to fit our research context. Based on the definition in the literature and the context of this study, some new items were self-developed and further examined. The social influence items were adapted from Tanner et al. (2008) and Daneshvary and Schwer (2000) [67][27]. The

measures for information incentive were taken from Lai et al. (2006) and Lee et al. (2011) [43][46]. The measures for OSC behavior were modified from Tsai and Pai(2013), Wu et al. (2000) [68][73], and Venkatesh et al. (2012)[70].

In order to ensure the content validity of the instrument, a small scale pretests and personal interviews were conducted. Thirteen panelists (including six professors and four doctoral students of information system departments, three master students who have participated in OSC) were interviewed and a pilot test of the questionnaire was conducted. Eventually, this step aims to ensure the content validity which suggests completeness and the appropriateness of the research instrument. In other words, all the aspects of a construct are measured appropriately in the research domain, which ensures the validity and reliability of the measurement.

Each panelist is expected to judge whether a scale item (a question) is essential for measuring the corresponding constructs in the research model. A formula of content validity ratios (CVR) developed by Lawshe (1975) is applied in this study [45]. The formula is $CVR = (ne - N/2) / (N/2)$, while ne refers to the number of panelists consider the specific questions essential, and N means the total number of panelists. The value of each instrument CVR should be above 0.56 ($p < 0.05$) [45]. Altogether, 31 questions are included in the initial instrument list. According to the results and the feedback of experts, the instrument is refined through wording, rephrasing sentences, and eliminating ambiguous questions. The final questionnaire contains 28 questions.

The questionnaire is consisted of three parts. The first part, a motivation letter, states the purpose of this study and the relevant definitions. In the second part, respondents are asked to answer questions, providing demographic information (e.g., age, gender, occupation, average income, experience and the amount of purchase in the OSC, etc.). Finally, the third part contains the items measuring the constructs of the research model.

Data Collection

The research setting of this study is the 11.11 Global OSC provided by Alibaba Group in China. The reason for choosing this OSC is because it has all the attributes of a traditional carnival described by the TOC [9][10] as shown in Table 1. This study aims to investigate the OSC behavior displayed by the participants. A web-survey approach was preferred due to its advantages in this study. Firstly, it is an effective way to collect data from a wide audience, without being restricted to a geographic location. It is especially suitable in this study since the phenomena we investigate and targeting respondents are all internet related. Secondly, the speed of data collection is an important advantage in a web-based survey. It allows the researcher to obtain a large amount of respondents in a short space of time. The empirical data was collected during March to April, 2015. The respondents were randomly selected to offer a variety of incentives, such as Youku membership. Finally, 473 questionnaires were collect, among which 428 respondents were identified as valid respondents. The valid-return rate is 90.49%. The profile of the valid respondents is presented in Table 2.

Table 2: Demographic profile of respondents

(N=428)	Classification	Number	Percentage
Gender	Male	175	40.89%
	Female	253	59.11%
Age	Less than 18	2	0.47%
	19-23	69	16.12%
	24-30	171	39.95%
	31-40	137	32.01%
	41-50	41	9.58%
	Above 51	8	1.87%
Occupation	Employed	320	74.77%
	Free-lancer	13	3.04%
	Housewife/husband	2	0.47%
	students	85	19.86%
	Job-waiting	2	0.47%
	Retired	0	0%
Monthly income (RMB)	others	6	1.40%
	Less than 500	23	5.37%
	501~1,000	31	7.24%
	1,001~1,500	22	5.14%
	1,501~2,000	13	3.04%
	2,001~3,000	22	5.14%
	3,001~5,000	89	20.79%
	5,001~8,000	132	30.84%
	8,001~15,000	78	18.22%
	15,001~20,000	11	2.57%
		7	1.64%

	Above 20,001		
Experience of participating OSC(2009~2014)	2014	374	87.38%
	2013	302	70.56%
	2012	180	42.06%
	2011	88	20.56%
	2010	48	11.21%
	2009	23	5.37%
	None	26	6.07%
Total purchase in 2015 OSC (RMB)	Less than 100101~500	21	4.91%
	501~1,000	85	19.86%
	1,001~5,000	93	21.73%
	5,001~10,000	149	34.81%
	10,001~20,000	55	12.85%
	20,001~30,000	13	3.04%
	Above 30,001	3	0.70%
	None	4	0.93%
Average number of interaction time per day in 2015 OSC	Above 40 time per day	5	1.17%
	30~39	12	2.80%
	20~29	22	5.14%
	10~19	56	13.08%
	5~9	88	20.56%
	1~4	129	30.14%
	None	108	25.23%
		13	3.04%

Data Analysis Methods

As an important data analysis method, structural equation modeling (SEM) is applied. In the field of IS research [64][37], SEM is a very popular technique for high quality statistical analysis. The goal of SEM is to analyze causal models including the latent constructs measured by multiple items in multivariate data sets [38]. Moreover, SEM has been suggested as a rigorous method with which to examine the reliability and validity of the instruments and the significance of relationships between constructs, and provide a set of indices for evaluating the model fit [66]. Furthermore, SEM is best suited to data analysis in confirmatory research [37][66]. Hence, in order to examine the theory-based research models and hypotheses, SEM has been employed as the data analysis method in the current study.

In this study, partial least squares (PLS) were used to assess the measurement model and then test the hypothesized structural model. PLS was utilized to accommodate the presence of a complex model and the exploratory nature of this research [36]. In addition, PLS uses bootstrapping to estimate standard errors for parameter estimate, which somewhat helps avoid the restrictive distributional assumptions [25]. Due to the above reason mentioned, SmartPLS 2.0 [60] was applied to the data analysis in this study.

In this study, a two-step approach was followed, which is recommended by Anderson and Gerbing (1988) for proceeding with the data analysis [6]. Confirmatory factor analysis (CFA) was used to estimate the measurement model. By using this technique, the reliability and validity of the measurements were examined. Then, the path coefficients and the statistical significance were examined by testing the structural model applying the bootstrapping procedure.

DATA ANALYSIS AND RESULTS

Measurement Validity and Reliability

Confirmatory factor analysis was utilized to test the adequacy of the measurement. The assessment of reliability, convergent validity, and discriminant validity was conducted using PLS 2.0. The reliability of the instruments was assessed by examining the composite reliability [14]. The convergent validity is assessed by factor loading and Average Variance Explained (AVE) [25][36]. The discriminant validity is evaluated by the criteria of the square root of the AVE and the items load on their associated factors comparing with the items load on other factors [25]. The results of which demonstrate a satisfactory fit.

In this study, the value of factor loading are all over the threshold of 0.707, showing that more than half of the variance in an observed item is explained by its construct [64]. The values of Cronbach's alpha which assumes that scores for all items have the same range and meaning; composite reliability and average variance extracted (AVE) of the constructs are all over the thresholds of 0.7, 0.7 and 0.5, respectively, as shown in Table 3. The squared roots of AVE are higher than their correlations with other constructs, as shown in Table 4. In addition, the cross-factor loading was further tested to examine the measurement validity as presented in Appendix B. The results show that all items fit their respective factors quite well. The results suggest the measures have unidimensionality, convergent and discriminant validity.

Table 3: Reliability and validity of measurement

Construct	Dimension (No. of items)	ID	Minimal factor loading	AVE	CR	α
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Informational Incentive	Promotion information (5)	PI	0.71	0.59	0.85	0.77
	Review information (4)	RI	0.74	0.59	0.85	0.76
Social Influence	Endorsement influence (4)	EI	0.78	0.67	0.89	0.84
	Peer mimicry (4)	PM	0.79	0.69	0.90	0.85
OSC behavior	Participation (4)	PA	0.76	0.63	0.87	0.83
	Interaction (4)	IN	0.78	0.67	0.89	0.83
	Playfulness (5)	PL	0.79	0.66	0.92	0.89

Table 4: Inter-construct correlations

	IN	EI	PI	PA	PM	PL	RI
IN	(0.82)	0	0	0	0	0	0
EI	0.56	(0.82)	0	0	0	0	0
PI	0.56	0.65	(0.77)	0	0	0	0
PA	0.59	0.38	0.51	(0.79)	0	0	0
PM	0.60	0.70	0.66	0.478	(0.83)	0	0
PL	0.64	0.54	0.60	0.65	0.62	(0.83)	0
RI	0.45	0.60	0.51	0.38	0.55	0.45	(0.77)

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Evaluation of the Structural Model

To test our research model, we used PLS, a latent structural equations modeling technique that utilizes a component-based approach. Fig. 2 shows the results of the PLS analysis and the path coefficient of the constructs. The predictive validity was evaluated by examining the R square and the path coefficient. The results indicate that the variance of the herd behavior in carnival explained by information incentive (e.g., promotion information and review information) and social influence (e.g., endorsement influence and peer mimicry) is 52.1%. Therefore, the research model demonstrates a strong explanatory power for joining the carnival in OSC.

Hypothesis 1 is strongly supported, according to the significant path coefficient from information incentives to carnival ($\beta = 0.375$, $p < 0.001$). This result implies that the potential participants who perceive a higher level of information incentive are more likely to participate carnival in OSC. Similarly, the direct effect drawn from social influence to OSC is confirmed by the significant path coefficient ($\beta = 0.396$, $p < 0.001$). Accordingly, the hypothesis 2 is supported by the empirical data. It indicates that social influence exerts an even stronger effect on the behavior of carnival in OSC. It can be referred that the potential participants' perceptions of the social influence positively affect the herd behavior of join in SCO.

In addition, as shown in Fig 2, information incentive as a formative second order factor is effectively measured with two first order indicators namely promotion information ($\beta = 0.79$, $p < 0.001$) and review information ($\beta = 0.331$, $p < 0.001$). Similarly, two first order factors endorsement influence ($\beta = 0.332$, $p < 0.001$) and peer imitation ($\beta = 0.739$, $p < 0.001$) contribute significantly in evaluating social influence as the second order factors. Finally, the results indicates that the reflective second order factor carnival is effectively assessed with three first order indicators, participation ($\beta = 0.844$, $p < 0.001$), interaction ($\beta = 0.865$, $p < 0.001$), and playfulness ($\beta = 0.89$, $p < 0.001$).

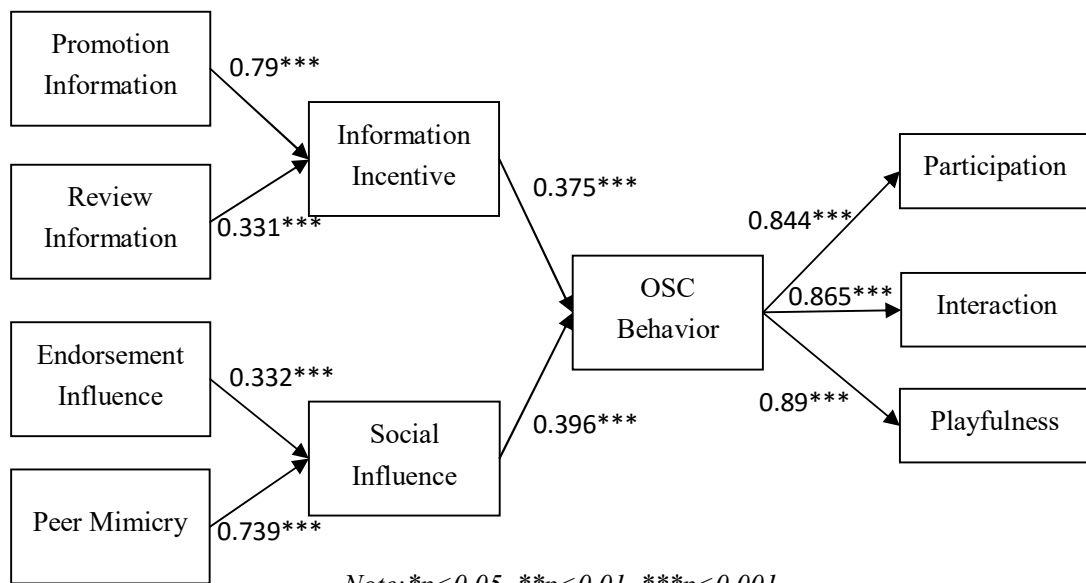


Figure 2: Structural Model

DISCUSSION AND CONCLUSION

In order to explore the successful model of OSC that is mainly boosted by the power of herd behavior, this study aims to investigate the critical factors facilitating herd behavior, explain the herding process, and provide knowledge to the manifestation of typical OSC herd behavior. Building on the theory of carnival and the features of OSC, we firstly identified participation, interaction and playfulness as the three reflective indicators of OSC behaviors. The empirical results suggest participation, interaction, and playfulness almost equally and significantly contribute to assess and reflect OSC behavior, which is supported by the theory, indicating these three sub-constructs as indispensable and key features of OSC behavior.

Refining from Sun (2013), we next examined two constructs (H1) information incentive (e.g. promotion information, review information) and (H2) social influence (e.g. peer mimicry, endorsement influence) as the preconditions of herd behavior. Hypothesis 1 is strongly supported as expected. The result is congruent with prior findings which suggest when people use the information from external sources, such as use review information (e.g. star ratings, product evaluation) to indicate the quality of a product/online store/activity, online herd behavior occurs [24][40]. Therefore, the result suggests that information influence from external sources can enhance potential participants' confidence in their beliefs to herd in OSC behaviors. Similarly, the hypothesis 2 is supported by the empirical data. The result is consistent with prior studies which suggest that others action serves as an inference of the value of a product/service, and a heuristic of social proof, which lead people to imitate others decision, and perform the herd behavior [35][65].

Finally, as shown in Fig 2, the results indicate that information incentive and social influence contribute almost equally to predict herd in OSC behavior. In addition, as two dimensions of information incentive, the promotion information is a stronger indicator perceived by OSC participants, while review information is also a significant sub-construct. The result fits to our expectation, since the promotion campaign delivered the very attractive information which makes OSC special and valuable to participants, such as the lowest price of the year, novel and entertaining shopping games, and the personalized homepages. Meanwhile, endorser influence and peer imitation contribute significantly in evaluating social influence. Evidently, peer imitation is a more critical sub-construct perceived by OSC participants in evaluating social influence than social influence perceived.

Theoretical Implication

Prior studies have extensively investigated how the individual's own beliefs regarding certain product/service determine their behavior/intention (e.g. TAM UTAUT). Instead of merely considering the effect of individual's own private beliefs, taking the perspective of herd behavior, this study compensates the existing literature by examining how the herding process and preconditions drive the OSC behaviors.

This study argues that people are uncertain of their decision when they lack of information to accurately evaluate the consequences of their behavior. Then, people would like to conduct a herd behavior, through the process of following the lead and suggestion from other reliable information sources and imitating others' behavior they observed. This study provides direct empirical evidences to this point of view: information incentives representing the information from reliable resources and social influence capturing the imitation of others' behavior are all critical factors to perform herd behavior. This study explains how the herd behavior happens under which conditions, filling the gaps of "the cognitive process of herd behavior and the preconditions of herd behavior have been rarely investigated in IS field" [65]. Moreover, this study specifically identified and

explored the significance of the different critical information sources (e.g. promotion information, review information) and the identities of predecessors (e.g. peer mimicry, endorsement influence) in influencing the herding of OSC behavior, which adds more knowledge to the essence of the precondition of herd behavior in OSC.

The second contribution is made by integrating the perspective of theory of carnival and extracting the distinct OSC behaviors usually performed and herded by OSC participants. To the best of our knowledge, it makes this study one of the pioneers to conduct the analogy of OSC and traditional carnival. This study indicates that the global online shopping carnival reflects the real world carnival. People conduct behaviors with similar features, called participation, interaction, and playfulness. Thus, the explanatory power of the theory of carnival is extended to the context of e-commerce.

Practical Implication

The findings of our study reveal that herd behavior exerts significant effect on people's decision of the OSC behaviors. Boosting the antecedents of herd behavior can effectively induce individuals to participate OSC. Firstly, practitioners should distribute the information containing strategies of price reduction to the customers, via Internet and many digital channels, as well as TV shows. Moreover, practitioners may present the prior users' purchase experience to customers: such as sales volumes, since demand for a product increases when consumers believe that more people have purchased that product; star ratings and recommendation can be used as cues to infer the actual performance of certain product, since such strategies have compensate need for evaluating the outcome of actual usage.

People would like to follow and imitate a specific group of people. Thus, firstly, the practitioner should positively advertise the OSC endorsers who may create profound social influence regarding the OSC, such as experts, celebrities, fashion leaders, pop stars. Moreover, an individual observe and mimic the people in his/her reference group. Practitioner can initiate programs to reward the customers who recommend the OSC/product/service products to their social networks. And practitioners should design the OSC activities which enable an individual to spread the information regarding his/her dynamic progress in OSC via the social networks.

Limitation and Future Study

Though this study aims to provide some new knowledge to the OSC participants' herd behavior, this study has some limitations which also represent opportunities for further research. Firstly, this study only collected data from the participants of OSC organized by Alibaba group in China. Thereby, it is not clear to what extent the results can be generalized into other area or in a different culture. It would be interesting to find out how the culture influences participants herding behavior. Secondly, this study only investigated two types of antecedents of herd behavior. It worth discussing whether there are more predictors, and how they are related. Thirdly, future research could examine the influence of demographic information (gender, age, income). The investigation of how the people with different gender or age perform differently in herd behavior in OSC would provide several insights to the literature.

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Using the Internet to Create Positive Social Changes: Case Studies in China

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ABSTRACT

In recent years, companies have been increasingly under pressure to deliver programs that can create both business value and social value. Building on the positive social change framework developed by Stephan et al., this paper uses two case studies (Gongyi Baobei and Jutudi) of the Alibaba Group, a leading Internet company in China, to investigate how companies can use the Internet to bring about positive social changes (PSC) to target groups. Our focus is placed on the nature of projects, i.e., surface-level and deep-level PSC projects. Our decision to use different case studies from the same company is based on the assumption that the enabling effects of internal organizational practices should be similar. To be more specific, we want to study the link between PSC projects and the company's existing businesses, the role of the Internet in raising customers' awareness and participation in the programs, and the change mechanism designed and implemented to bring positive social changes to customers. Data were collected through interviews and literature review. Our research provides empirical evidence to show a deep-level PSC project (i.e., Jutudi) can be very different from a surface-level PSC project (i.e., Gongyi Baobei) in terms of the reliance on existing business operations and the design of change mechanisms. Our research limitations and direction for future research will also be discussed.

Keywords: corporate social responsibility, positive social change, Internet, change management, Alibaba Group, case study, shared value.

INTRODUCTION

Climate change has raised the public's awareness of environmental issues and technological advancement enables them to distribute and access information very fast, making corporate social responsibility activities under greater scrutiny. Many companies have treated corporate social responsibility as something that they consider obliged to do. However, traditional corporate social responsibility activities have failed to meet the expectations of the government and the public, and companies have failed to develop stronger relationships with the external world [1]. The key question posed by companies is how to create both social and business value. Companies are required not only to improve their profitability but also to shoulder the responsibility for making a positive impact on the wider society and environment.

Companies are increasingly expected to play a role in solving social challenges, such as public health, education, and environmental pollution, as well as in improving social well-being. There is a growing literature on trying to address how companies can create both social value and business value. They have come up with different terms, such as base of pyramid [2], shared value [3], inclusive growth [4], and positive social change [5].

In this paper, we use the positive social change framework developed by Stephan et al. [5] They define positive social change as "the process of transforming patterns of thought, behavior, social relationships, institutions, and social structure to generate beneficial outcomes for individuals, communities, organizations, society and/or the environment beyond the benefits for the instigators of such transformations." [5] Their framework is a useful tool to understand how and why companies may stimulate positive social change in terms of change mechanisms and organizational practices.

Our research sets out to understand how companies can help to stimulate positive social change by influencing consumers, especially their target groups. We choose to use case studies from the Alibaba Group because we want to focus on change mechanisms while assuming that organizational practices influence both projects in similar ways. Gongyi Baobei is chosen as a surface-level PSC case study and Jutudi as a deep-level PSC case study. To be more specific, our research wants to find out the link between surface-level / deep-level PSC projects and the company's existing businesses, the role of the Internet in raising customers' awareness and participation in the programs, and the change mechanism designed and implemented to bring positive social changes to customers.

In the next section of the paper, we will explain our research methodology. Then, we will discuss the positive social change framework. This is followed by giving a background of Alibaba Group and case studies of Gongyi Baobei and Jutudi. The final section will analyze the case studies and summarize the research findings, possible limitations of the research, and suggestions for future studies.

RESEARCH METHODOLOGY

We first set out to investigate whether companies could create both social and business value in CSR activities. As the research progressed, we narrowed our research to focus on understanding how a company can design a project to stimulate positive social change by influencing consumers, especially the specific target groups.

Our study is explorative in nature, because the research on social positive change is limited and still emerging. We decided to use multiple case studies from the same company, which allows us to focus on studying each project's change mechanism and compare deep- and surface-level PSC projects. We considered the Alibaba Group suitable for our research. Alibaba is the largest online business platform provider and recently overtook Walmart to become the largest retailer in the world [6]. Alibaba is committed to stimulating positive social changes to wider society by engaging in a number of PSC projects, which allowed us to choose from a reasonably-sized pool of case studies. Moreover, little has been written about how Internet companies, especially emerging business platform companies like the Alibaba Group can use the Internet to create both social and business value. Therefore, we chose Alibaba Group as our research target.

RESEARCH FRAMEWORK

Based on their multi-disciplinary literature review, Stephan et al. [5] has categorized companies' strategies into deep-level and surface-level PSC strategies. They are different in terms of the nature, the speed of transformation and the resulting social impact's quality, reach and timing [Figure 1].

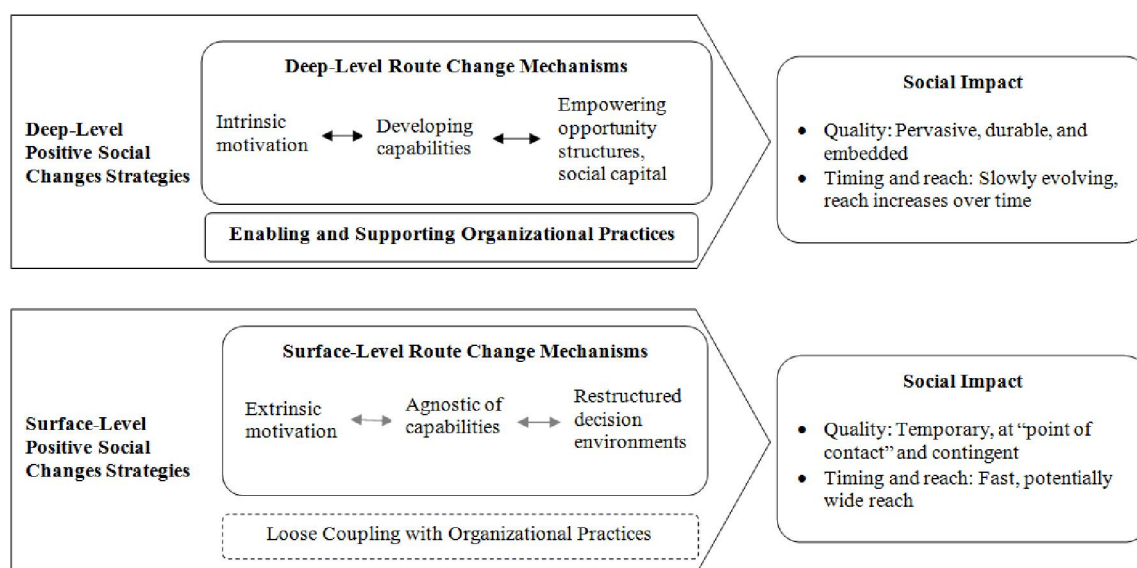


Figure 1: Positive Social Change Framework [5]

Surface-level projects provide extrinsic motivators, such as financial incentives and social pressure, and rearranged decision-making environments for the target group. Target groups' capabilities are not so important, as the behaviors are normally easy to perform and less complicated. Therefore, surface-level projects are effective in bringing about behavior change quickly and to reach a large target group.

Compared with surface-level projects, deep-level projects are often aligned with the company's core competence. The objectives of deep-level projects are to develop the target group's intrinsic motivation by changing their beliefs, and attitudes to build up their skills and capabilities and to provide empowering structures and social capital to facilitate their changes of behavior.

Furthermore, based on the literature review of Stephanie et al, the social impacts created by surface-level projects are more temporary and contingent on the permanent existence of a specific decision-making environment, unless the target groups' changed behavior have become a habit.

Raising the awareness among target groups is considered as a precondition for most PSC projects before they can even understand and make decisions on a particular issue. Motivation, capability, and opportunity have been identified as the three levers for corporate PSC projects. They argue that a lack of any of these three levers can undermine the targeted groups' behavior change [Figure 2]:

- Motivation includes intrinsic and extrinsic motivations. Compared to extrinsic motivation, the target group with intrinsic motivation is more engaged and interested in behavior change. When the target groups consider the behavioral change meaningful and have the required knowledge and they can set goals and receive feedback, it is likely to give the target group intrinsic motivation. Intrinsic motivation can also be stimulated by exerting social normative or coercive pressure. Extrinsic motivation can be stimulated by recognition and image rewards as well as financial rewards.
- Capability building of the target group is more important to deep-level projects. The target group's skills and efficacy to

perform positive behaviors can be stimulated through training, modelling and encouragement.

- Opportunities can be created for the target group by changing their decision-making environment, for example, by removing constraints and providing support. PSC projects need to provide the target groups the relevant information and participation possibilities and make relevant resources available to them. Projects can help strengthen existing relationships and networks and build new ones among previously unconnected parties. Furthermore, projects can rearrange decision-making environments to make behavior change an easier choice for the target group.

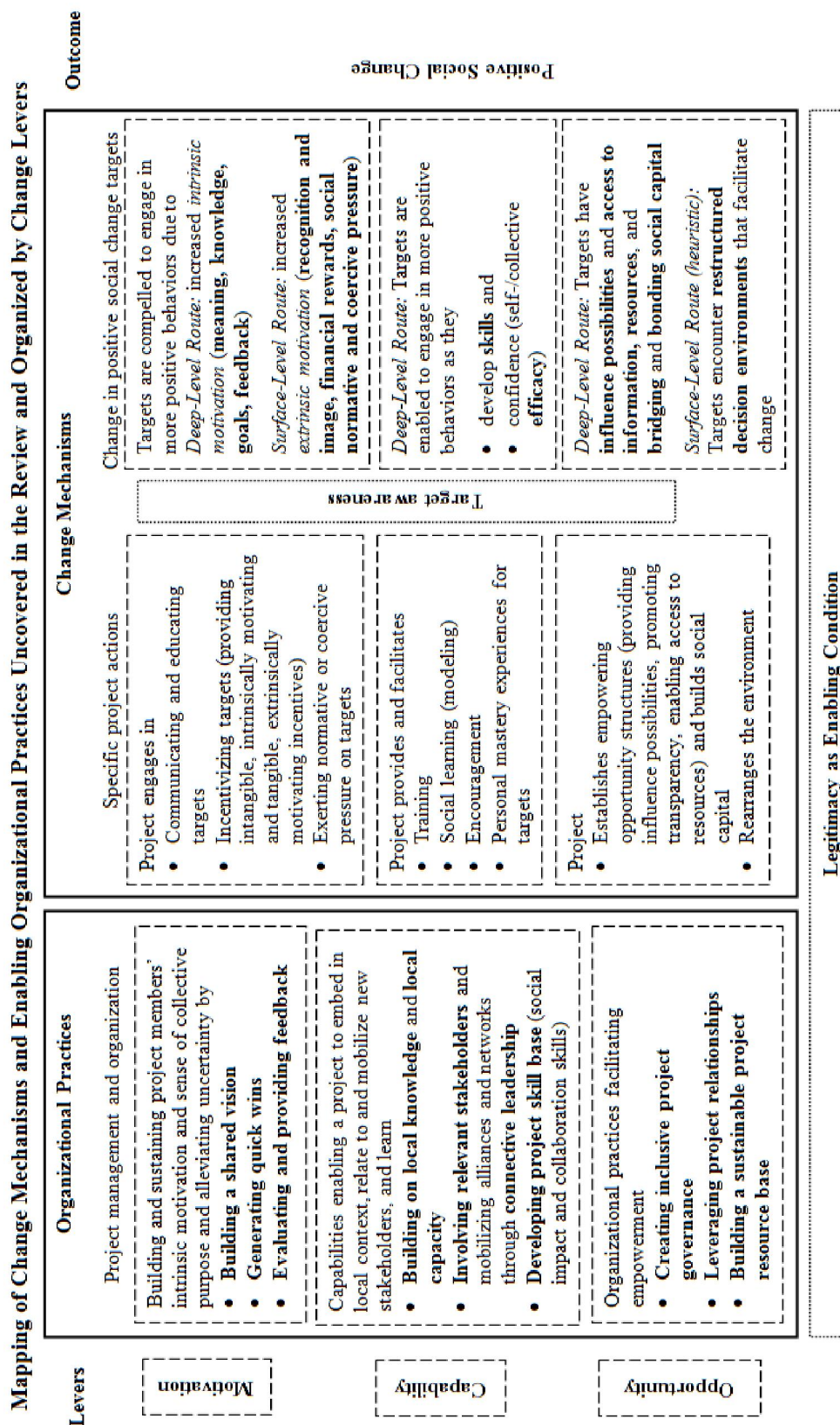


Figure 2: Mapping of Change Mechanisms and Enabling Organizational Practices Organized by Change Levers [5]

A company may have internal tools and procedures to organize, implement and manage PSC projects, which are referred as organizational practices [5]. A combination of change mechanisms and organizational practices can trigger different processes and outcomes of transformation qualitatively. PSC projects mainly cover four areas such as the environment, social and economic inclusion, health and well-being, and civic engagement.

CASE STUDIES

Company Background of Alibaba Group

Alibaba Group is an online shopping giant and a successful multisided digital platform. Founded in 1999 by Jack Ma, the Alibaba Group provides a business-to-business portal for small- and medium-sized merchants in China to sell their products to global buyers. Alibaba Group has developed into the largest online marketplace in China and is listed in the New York Stock Exchange. It has an Internet-based business model featuring “light assets and no inventory”. [8] Besides popular electronic trading platforms, like Taobao and Tmall, Alibaba Group also provides financial, logistics, computing, and other services in order to create an online ecosystem, allowing customers to “meet @ Alibaba”, “work @ Alibaba”, and “live @ Alibaba”.

Alibaba first got involved in CSR projects in 2008 when a terrible earthquake struck Wenchuan in Sichuan Province. Later, Alibaba formally developed a CSR department to develop and coordinate group-wide CSR projects. In 2012, Alibaba announced that they would adopt the platform philanthropy approach as their CSR strategy.

Starting from the first day Alibaba was established, social responsibility is an inseparable part of our business model. All our products and innovations are originated from the aim at solving social problems, which justifies the survival of Alibaba.

– Jack Ma, CEO of the Alibaba Group [7]

Alibaba Group aimed at integrating a culture of public welfare into their everyday operations and business model, creating both economic and social value. Alibaba’s efforts have emphasized raising the public’s awareness of the public interest. The four target groups are employees, customers, industry partners, and social, economic and environmental development stakeholders. Among these, Alibaba considers customers, employees and shareholders interdependent. Alibaba firmly believes that creating value for customers can bring more profit to shareholders, while value creation for customers depends on hard-working, happy, professional, and capable staff. Through these target groups, Alibaba wants to exert a positive influence on the wider society.

Alibaba has engaged in many PSC projects. Among them, Gongyi Baobei and Jutudi are chosen as a surface-level project and a deep-level project respectively.

Gongyi Baobei (Public Welfare Treasured Object / 公益宝贝)

Our final goal is to achieve both business value and public welfare value in every workflow and each activity of our Taobao Platform. We also would like to create the awareness of the public that making transactions at Taobao could contribute to the society, thus attracting more participants and enhancing the power of our public interest initiatives.

– Mr. Daniel Gu, Alibaba CSR Senior Manager [9]

The idea of Gongyi Baobei dates back to the Aixin Baobei Initiative in 2006. Aixin Baobei was initiated by Taobao’s employees to support a mother suffering from cancer who strived unremittingly to earn money by doing business on Taobao’s platform in order to bring up her daughter. The project gained extensive support from online retailers and customers.

Since then, the Gongyi Baobei Initiative has been highly integrated into the Taobao platform. Baobei, which means a “treasured object” in Chinese, is distinguished from other items listed on Taobao.com and Tmall.com by a heart shape or a public welfare logo on its description webpage. When setting up an online shop at Taobao, retailers can choose whether or not to join the Gongyi Baobei Initiative. If they agree to join, they can choose the public welfare project they want to support and decide on the donation amount for each transaction. Then, after an item is sold, this fixed amount will be automatically deducted and donated to that public welfare project. The amount could range from 0.1% to 100% of the amount of each transaction or be a fixed amount of RMB 0.02, 0.1 or 1.

As a platform provider and facilitator, Taobao bears the responsibility to select public welfare organizations to join this initiative, coordinate between these organizations and retailers, monitor the implementation of public welfare projects, and manage feedback. Taobao has reviewed and updated the list of participating organizations on a regular basis. In 2014, 1.3 million retailers joined this initiative with 84.5 million items listed by Taobao, creating 1.1 billion transactions with donations reaching RMB 72.2 million [9]. In 2015 alone, the total number of Gongyi Baobei items sold on Taobao and Tmall almost reached 31 million, which benefited more than 540 public welfare organizations [10].

Jutudi (Group Land Buying / 聚土地)

Jutudi has made a tremendous contribution in terms of using idle land, transferring the local labor, and bringing in more economic profit.

– Mr. Zhang Ping, the biggest donor of Gongyi Baobei in 2015 [10]

On 13 March 2014, Jutudi was launched as a joint effort by Juhuasuan, Alibaba's group-buying platform, and some local farm cooperatives in Jixi, Anhui Province. Jutudi allows city residents to rent idle agriculture land for growing agricultural products of their choice and to have free accommodation when traveling to these farms. Rents and wages become the farmers' income, while city residents can enjoy safe and healthy foods.

In the first phase of the project, the size of the land on offer was 1,000 mu, which is about 666,667 square meters. City residents paid RMB 2,400 for 333 square meters of land. The land could grow vegetables, fruit and/or grain. In three days' time, all the land had been rented out to a total of 3560 city residents [12]. The project did not run smoothly at first. When the first delivery took place in mid-April 2014, over 3000 packages suddenly arrived at the warehouse at the same time which was beyond the warehouse management's capabilities. The limited capacity of local transportation led to a huge vegetable backlog. The situation became even worse owing to the logistics company's lack of experience in handling fresh agricultural products. As a result, many vegetables went bad and had to be discarded before leaving the warehouse. In the first phase, the total sales were RMB 2.28 million and the logistics costs reached RMB 0.84 million, resulting in a total loss of RMB 0.25 million [13]. To solve this problem, they bought new packaging equipment from Germany and provided training to staff. The second phase of the project started on 29 September 2014. They were able to provide more product varieties, faster delivery and improved after-sale customer services. In March 2016, Alibaba formally named the operational model of Jutudi as "Xiangtian Farm" (Suburb Sweet Farm/乡甜农场) and planned for further business expansion [14].

DISCUSSION AND CONCLUSION

As online retailers, we are too busy to have time to participate in philanthropic events. Gongyi Baobei makes it easy for me to do something good for the society but also establishes a special emotional connection between me and my customers.

– Ms. Jiang Li, the biggest donor of Gongyi Baobei in 2015 [10]

Gongyi Baobei is a surface-level PSC project, while Jutudi is a deep-level PSC project. The table below shows a comparison between Gongyi Baobei and Jutudi in terms of their relationship to existing businesses, the role of the Internet, and the change mechanism.

Table 1: Comparison between Gongyi Baobei and Jutudi

	Gongyi Baobei	Jutudi
Relationship to existing business	<ul style="list-style-type: none"> ➤ An add-on feature to the existing system ➤ Complete reliance on the existing business 	<ul style="list-style-type: none"> ➤ A new business model building on the core competence of the existing business ➤ New business processes and products independent of the existing business
Role of the Internet	<ul style="list-style-type: none"> ➤ Advertising on retailers' webpage to raise awareness of the project and related public welfare programs ➤ Fund raising 	<ul style="list-style-type: none"> ➤ Advertising online to raise the awareness of the project ➤ Designated webpage for the project to provide detailed information, training etc.
Change Mechanism	<p><i>Motivation</i></p> <ul style="list-style-type: none"> ➤ Extrinsic motivation: Recognition rewards for participating retailers ➤ Intrinsic motivation: making a positive difference to others <p><i>Capability</i></p> <ul style="list-style-type: none"> ➤ No new skills required <p><i>Opportunity</i></p> <ul style="list-style-type: none"> ➤ Inclusive project governance structures: retailers can choose to sign up during the registration process and consumers can choose to buy items with the project logo. 	<p><i>Motivation</i></p> <ul style="list-style-type: none"> ➤ Extrinsic motivation: city residents' purchase of vegetables with guaranteed quality at lower prices and farmers' income increase. ➤ Intrinsic motivation: shared project values to farmers in terms of business and family values and to city residents about lifestyle values. <p><i>Capability</i></p> <ul style="list-style-type: none"> ➤ New skills required in terms of logistics management and operational management. ➤ New connective leadership required to work with different stakeholders who had never worked together before. ➤ New skills required for diverse

		<p>stakeholders to work on the project.</p> <p><i>Opportunity</i></p> <ul style="list-style-type: none"> ➤ Leverage project relationships: local farmer cooperatives developed to coordinate local farmers; project networks developed to handle business operations and work with local governments. ➤ Innovate to create new opportunities for PSC: business expansion to reach a wider rural area and serve more customers.
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From the above analysis, we find that surface-level PSC projects are very different from deep-level PSC projects in terms of their relationships with existing business operations and change mechanisms. Deep-level PSC projects are less reliant on the existing business model, which in return are more demanding in terms of creating new capabilities and opportunities. The research findings will be useful for companies which are planning to carry out PSC projects.

In our study, we assume that the internal support provided by a company to different projects should be similar. Though this allows us to focus on the change mechanism, it is undeniable that organizational practices do have a significant impact on PSC projects. In fact, Alibaba's platform CSR approach is an innovative, useful way to manage PSC projects. In the future, it will be worthwhile investigating how PSC projects are influenced by different organizational practices, and even whether similar organizational practices will influence projects in different ways.

ACKNOWLEDGEMENT

This paper was fully supported by a grant from the Research Grants Council of the Hong Kong Special Administrative Region, China (UGC/IDS12/14).

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Cultural Industries and Innovation-An Empirical Analysis

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ABSTRACT

The multitude of research work on Creative industries speaks to the importance of this sector of the knowledge-based economy. Creative industries worldwide have witnessed rapid growth in the past decade and this has prompted more interest in this sector. Research on innovation in creative industries on the other hand has been rather limited, although several studies have indicated useful approaches to the management and organization of innovation relevant to the creative industries, however empirical studies in this respect are still far from comprehensive, hence prompting this empirical research on the impact of innovation on productivity in Creative Industries with a focal point on China Online Game Industry.

This paper empirically studies the links between innovation and productivity at the firm level in Creative Industries using Chinese Online Game Industry as the focal point of its analysis. This paper bases its analysis on the recommendations of the Oslo Manual, this approach provides a way to achieve a high level of comparability within the Industry, it also provides standard definitions and indicators of innovation. The paper went further to adopt the scoring matrix approach in order to capture and delineate the various dimensions, dynamics and key features of online gaming enterprises in China. Indicators adopted in the analysis were selected based on literature review and statistical analysis.

The empirical approach is based on data obtained from enterprise-based surveys of innovative activity in Chinese online game firms. The paper applied an econometric model of Research and Development, innovation and productivity interrelations at a firm level similar to that of Crépon, Duguet, and Mairesse (1998) for France, to the micro data obtained for China online gaming industry.

Keywords: Culture Industry, Creative Industries, Creativity, Innovation, Online Games, and Knowledge Production Function.

INNOVATION AND KNOWLEDGE MANAGEMENT

Innovation in creative industries often occurs when those producing creative content respond to the experiences of consumers and users, and make changes to their offer as a result (Miles and Green, 2008).

This paper researches the various aspects of innovation and knowledge management and their impact on productivity at a firm level in creative industries with a focal point on Chinese Online Game Industry. This empirical study enhances the understanding of innovation in firms using data obtained from enterprise based innovation survey in addition to complementary data from various statistical data sets. In the course of analysis this dissertation also raised questions for future research in this field as well as making recommendations to mitigate extant obstacles identified in the course of research. Contrary to long-established analysis that only utilize traditional innovation indicators mainly designed for manufacturing industries, this dissertation applies economic innovation theory to cultural economics, using indicators that better capture the dimensions and dynamics of innovation and creativity in creative industries. Traditional innovation metrics are hardly sufficient to neither capture nor measure innovation performance in the creative industries, hence the need to define a new set of indicators and enhance existing ones. Griliches in 1979 proposed a framework for the analysis of innovation and productivity growth. This framework was presented in the form of a flowchart that depicted the path through which investment in Research and Development activities generated knowledge and the outputs and indicators of knowledge. Crépon, Duguet and Mairesse (1998) enhanced Griliches' framework by proposing an encompassing model that enhanced the understanding of the channels linking investment in knowledge to productivity growth. The Crépon Duguet and Mairesse (1998), elaboration of the Griliches framework detailed measurable quantities and unquantifiable concepts, which had crude proxies. This paper uses an extended model of the Crépon, Duguet and Mairesse model, which is a structural model, made up of three stages of recursive equations. The first stage comprises of innovation input equations. These equations explain a firms' decision to engage in innovation activities and innovation expenditure intensity. For a given probability to innovate, the second equation of the first stage models an innovation expenditure equation. The dependent variable for the second equation is the logarithm of innovation expenditure per employee.

The second stage comprises of innovation output equations. These equations deal with product innovation output intensity and process innovation output. It models the knowledge production function. The final stage is made up of the productivity equation, which explains the impact of innovation output on productivity. It estimates the innovation output productivity link using an enhanced Cobb-Douglas production function.

CREATIVE INDUSTRIES

Creative industries are those activities, which have their origin in individual creativity, skill and talent, and have the potential for wealth creation through the generation and exploitation of intellectual property (DCMS, 1998). Although creativity is not an absolute distinguishing characteristic of creative industries, it is however a core concept of such industries.

It is noteworthy that the dynamic nature of the creative industries is heavily reliant on constant innovation. The terms innovation and creativity are intertwined but not interchangeable, hence they both relate to the same core concept of new creations and originality. Innovation is accepted as the prerequisite for change (technological), ergo it is the foundation of long-term economic growth (cf. Edquist 1997:1/Freeman 1997:316/Fischer 2001:200).

Creative industry on a cursory analysis might seem to be an extrapolation of the cultural industries, however on a closer more critical analysis, the differences between both paradigms become evident. The concept of creative industries originated in Australia in the early 1990s, but it received a wider acclaim and development in the UK in the late 1990s when the Department for Culture, Media and Sport (henceforth DCMS) established its Creative Industries Unit and Task Force. Although there are obvious similarities between cultural industries and creative industries, however the new concept represents a significant shift in approach to potential commercial activities that until then were regarded mainly in non-economic terms. The DCMS further transformed the understanding of the concept, thus bringing about a shift in the view creative industries as industries that are creation-intensive and heavily dependent on intellectual property as opposed to the common association with activities with a strong artistic component that was central to cultural industries.

In the creative industries, culture and economics are juxtaposed. To emphasize this point, UNCTAD (2010) states “.... the creative industries sector lies at the crossroads between the arts, business and technology. A strong, mutually reinforcing relationship exists between and among the different artistic and economically distinct activities that make up the cluster of creative industries, ranging from upstream activities, such as the traditional arts, performing arts, literature and visual arts, to downstream activities such as advertising, design, publishing and media-related activities. The latter applied much closer to the market than the commercial application of traditional cultural activities. Downstream activities derive they commercial value from low reproduction costs and easy transfer to other economic domains. From this perspective, cultural industries make up a subset of the creative industries, while the even broader cluster copyright industries consist of both creative industries and distribution-based industries” (UNCTAD, 2010).

The concept of creative industries is ginormous and it encompasses a vast number of creative sectors, which range from activities rooted in traditional knowledge and cultural heritage such as art crafts, and cultural festivities, to technology intensive and service-oriented subgroups such as audiovisuals and the new media. These sectors are generally lumped together under the “creative industries” umbrella by most nations and organizations without proper classification into domains, groups or categories, this phenomena has caused the process of understanding of the cross-sectoral dynamics to be fraught with error, therefore arousing the need for a standardization in the form of classification to provide clarity and consistency in quantitative and qualitative analysis.

INNOVATION

Innovation is a universal paradigm that deals with novelty, creativity, economic contribution and diffusion of inventions. Innovation can be defined as the application of new idea to the products, processes, or other aspects of the activities that lead to increased “value”. This “value” is defined in a broad way to include higher value added for the firm and also benefits to the consumers or other firms (Greenhalgh and Rogers, 2010). The litany of research work done in this field of study has resulted in a fuzziness with regard to innovation related semantics and concepts. This confusion extends into the taxonomy of innovation. Knowledge research and innovation are of crucial importance for the competitiveness of the modern economy, as well as for high standards of living and welfare (Bloch and Bassols, 2009). Professor Schumpeter identified innovation as a driver of economic development/growth.

Contemporary Innovation Theory

Innovation has become a ubiquitous term (Slade and Bauen, 2009). Innovation refers to an iterative process of inventions and applications that links technical, societal and political change (Green et al., 2009). Innovation classification depends on its origin, nature and effect. It can be classified as incremental, radical, or disruptive, depending upon whether it originates within, or outside, the mainstream, and whether it renders an incumbent technology (or process) obsolete (Green et al., 2009). The roots of innovation theory are multidisciplinary (Gross, 2010).

“Innovation is a broad concept which encompasses a wide ridge of activities and processes, markets, entrepreneurship, networks and competition, but also skills and organizations, creativity and knowledge transfers (OECD, 2009)”.

Based on innovation definitions in the third edition of the Oslo manual (OECD/Eurostat, 2005) innovation can be divided into product innovation Process innovation, marketing innovation and organizational innovation.... “Innovation is the implementation of a new product (good or service), or process, a new marketing method, or a new organizational method in business practices,

workplace organization or external relations (OECD, 2005)". Product innovation: This form of innovation refers to the launch of a completely new product or service or a remarkably augmented version that differs from similar existing products in both characteristics and usage.

Process innovation: As previously noted, process innovation dwells on the induction of new or ameliorated methods or principles applied to reform and enhance both production and delivery processes. The reforms can be in form of equipment, software or techniques upgrade.

Market innovation: This form of innovation involves the application of new marketing concepts, involving changes in product design or packaging, product placement, product promotion or pricing. It could also include discovering new markets for extant products. Organizational innovation: This form of innovation refers to the adoption of nouveau organizational methods in the enterprises' business practices, workplace organization or external relations.

Innovation can be further defined as the application of new ideas to products, processes, or other aspects of the activities of a firm that lead to an increased value. The importance of innovation cannot be overemphasized.... "Not to innovate is to die" wrote Christopher Freeman (1982) in his famous study of the economics of innovation, this further stresses the need for innovation in economies and enterprises alike. Corporations need to be able to innovate (i.e. adapt and evolve) if they wish to survive their competitors. J. Schumpeter postulated that anyone/corporation that seeks profits must innovate. It is therefore evident that innovation is both significant and widely accepted to be a prerequisite for economic development.

The innovation paradigm is so ubiquitous that it verges on becoming a cliché. A review of books published in the United States between 1994 and 1995 reveal that 275 books had the term 'innovation' in their title (Coyne, 1996). The massive use of the term has led to an ambiguity as to how it is comprehended, coupled with the fact that innovation has been a topic for discussion and debate for hundreds of years. It is therefore vital to review innovation in the light of extant literature and track the development and transitions in both innovation semantics and concepts.

REVIEW OF EXTANT LITERATURE

Schumpeter (1934,1939,1942) as prior stated was one of the pioneers of the idea that innovation was critical to economic growth/development. He stated that economies would experience growth due to the development of new products. In summation Schumpeter stated that the competition created by new products was far more valuable than marginal changes in the prices of existing products. Economic development however does not occur in a regular well-defined fashion; instead it occurs in 'bursts' or waves of activity, thereby signaling the important effect of external forces on it. One of such external factors is innovation. Marx made the proposition that innovation could be associated with waves of economic growth. With this proposition in the backdrop, Schumpeter (1934,1939), Kondratieff (1935/51), Abernathy and Utterback (1978) have argued the long-wave theory of innovation. Abernathy and Utterback (1978) postulated that at the commencement of any industrial sector there will be a radical product innovation, which is then sequenced, by radical innovation in production processes, sequenced again by widespread incremental innovation. This postulation received wide acclaim, however it failed to offer any understanding of how to achieve innovative success.

Since it has been determined that innovation is one of the external factors that influences economic growth, it is then necessary to understand what factors that influence innovation. Schumpeter postulated that modern firms equipped with R&D laboratories have become the central innovative actors, thereby identifying R&D as a factor that has critical influence on innovation. However spending on R&D does not have a direct correlation with economic growth, thereby suggesting a more complex linkage with innovation. Further advancement revealed that external sources of knowledge also have significant influence on innovation process, irrespective of the organizational level at which the innovating unit is situated. The instance of Japan illustrates the issue explicitly at the national level (Westney and Sakakibara, 1986; Rosenberg and Sternmuller, 1988; Mansfield, 1988). In the aftermath of the Schumpeterian postulation, other economists made significant contributions to the innovation debate (Chandler, 1962; Nelson and Winter, 1982; Cohen and Leviathan, 1990; Prahalad and Hamel, 1990; Pavitt, 1990; Patel and Pavitt, 2000). Brock (1975) proposed that the Schumpeterian postulation holds true for various industries, for example the computer industry and also in the case of the aluminum industry (Deck, 1962). March and Simon (1958:188) implied that most innovations ensued from borrowing instead of invention. Research on the sources of innovation lent credence to their observation (Muller, 1962; Hamberg, 1963; Myers and Marquis, 1969; Johnston and Gibbons, 1975; von Hippel, 1988).

Although external sources of information/knowledge are of an important nature to the process of innovation, so also is the information emanating from internal units of the firm (Mansfield, 1968). Theoretical research on innovation in 1950s and 1960s widened the perspectives on the sources of innovation. The research during this period pivoted on the promotion of innovation in organizations through effective management of R&D departments and their activities (Xu, 2007). Further research on innovation shed light on the macro-economic importance of innovation investigating the relative significance of different factors to the growth of national economies (Solow, 1957). Solow proposed that the largest contribution to growth was from increases in technical

change as opposed to increases in labor or capital productivity. Solow further postulated that increase in technical change counted for approximately 40% of the total increase in US national income per head.

CREATIVE INDUSTRIES AND INNOVATION

Innovation theory is a well-researched field of economics, however the study of innovation in creative industries is a rather new and evolving academic effort (Brandellero, Kloosterman, 2010; Green et al., 2007). The number of academic studies on innovation in creative industries is so limited that it has a direct impact on the degree to which the mechanism and dynamics of innovations in the said industries is understood. Australian report QUT CIRAC & Company (2003:6) stated, “the nature of research and development within the creative and content industries generally has not been closely examined”. The report went further to state “these industries have tended to be at the fringes of national discussions about science and innovation policy, and of related funding and industry programs”.

The role and potential of research and development to support the creative industries has also been an issue of discussion. A research carried out by the Foundation for Research, Science and Technology (2003) in New Zealand with the aim of addressing this issue reported: “R&D was more often seen as a means of reducing costs, rather than a means of improving products in order to enter new markets (...) Establishing a creative industries consortium (a formal public-private partnership) would therefore be the most effective means to consolidate focused research effort over the long term” (Foundation for Research, Science and Technology, 2003:12&22). Potts (2009:141) was of the opinion that “R&D has a different meaning in creative industries.... in effect constituting a normal business model, not an exceptional (i.e. un-incentivized) activity”. This opinion which does not adequately address the issue of R&D in creative industries, is however quite similar to that provided in the Basin report (Basin, 2013:12) which equates “creation /production rights” with R&D. R&D is an input to the innovation process, it is not an output, hence it is rather pointless equating R&D to creation. The distinguishing element between innovation and creation lies in the nature of knowledge involved, tacit or otherwise (Barrera and Santayana quoted by Paris, 2014), thus such a difference would have an impact on the industrial structure and business model of the enterprises.

Yet another point of view on innovation in the creative industries which was previously unknown was brought to light by Green et al (2007:58). They proposed the concept of the ‘hidden’ character of innovation in the creative industries. They stated, “the creative sectors are under-represented in innovation and R&D surveys. These surveys tend not to sample the small establishments and self-employed individuals that are common features of these industries”. Consequently majorities of creative industry innovation go unnoticed or under-reported in statistical accounts of innovation in the knowledge-based economy and innovation survey statistics. Green et al went further to describe these types of innovation as “hidden” by virtue of being distinctive when compared with those traditionally studied. Innovation metrics were designed primarily for manufacturing industries, equipped with indicators designed to capture innovation performance in such industries, it is difficult to adapt these indicators to efficiently capture/identify innovation in creative industries. Another causative factor of hidden innovation is the fact that most innovation might be hidden because they vary from the originally identified innovation. Several innovations in the creative industry are spontaneous, on-the-job and usually one-time innovations, making it inherently difficult to replicate and record, hence leading to hidden innovations. NESTA (2007) identified four different types of hidden innovation, namely:

- 1) “Innovation that is the same or similar to activities that are measured by traditional indicators, but which is excluded from measurement;
- 2) Innovation without a major scientific /technological basis, such as innovation in organizational forms or business models,
- 3) Innovation created from the novel combination of existing technologies and processes, and,
- 4) Locally-developed, small scale innovations that take place ‘under the radar’ and are therefore unrecognized or accounted for”.

Regarding the degree of ‘hidden innovation’ Miles and Green (2008) stated: “the scale of hidden innovation in the creative industries seems to be great and the forms it takes appears to be extraordinarily diverse”.

Stoneman (2007) put forward the notion of ‘soft innovation’, which he distinguished into innovation in products and innovations in industries. Subsequently Jisun (2010) postulated that creative products are mostly reliant on non-technological ‘soft’ innovations (Stoneman, 2007) connected to the creation of new ideas or a novel combination of extant ideas. T.Paris was of the opinion that creative dynamism is a consequence of the interactions between ‘soft’ and ‘hard’ innovations.

Several studies have attempted to address the question of why creative industries require a distinct internal account of its own organizational and industrial innovation processes. Prominent among these studies are Castner and Campos (2002), who relied on the theory of organizational innovation to examine the role of micro and organizational variables in the process of artistic innovation. Handke (2006,2007) sought to identify the factors driving innovation in the media industries by analyzing innovation surveys. Tether (2003) followed in Handke’s line of research, however he sought to compare innovation performance with other sectors. These afore listed research works have generally shaped the industrial/national framework of the research in innovation in

creative industries. Major instances include, Green et al (2007) who investigated product design and video games in the UK, Stam et al (2008:125-126), who researched innovation in media and publishing in the Netherlands, Eltham (2009:235) who focused on Australia and Cunningham et al (2004:4) and QUT CIRAC Cutler and Company (2003:29) who stated that “the many different research fields involved with creative industries do not relate to each other well and the potential linkages are seldom articulated into an R&D strategy involving the linkages between ICT, creative content, and educational services industry content”. Muller et al (2009:2008:2) researched creative enterprises in Austria. They postulated “creative industries are intensive users of technology and often deemed adaptations and new developments of technology, providing innovation impulses to technology producers”.

ONLINE GAMING

Online gaming is an integral component-industry of the creative industries. This sector of the knowledge-based economy has witnessed an exponential growth since its inception. Further growth has occurred as a result of technological advancements. Advancements in technology keeps increasing and redefining computational power and introducing new platforms adaptable to online gaming. Factors responsible for this exponential growth will be addressed in a later section.

Global and regional growth of this sector has been both explosive and sustained. The growth of online games (also referred to as video games in the US) in the United States has been quite tremendous. In 1999, the online game industries net revenue was a mere \$7.4 billion, in 2002; it jumped to \$13 billion (PC Data, 2000; Graser, 2000; Gaudios, 2001). China and Korea are leading examples of nations that have experienced rapid and sustained growth in the online gaming industry. In 2014 the revenue from the China Online Gaming Industry was 110.81 billion Yuan, exceeding the 100 billion Yuan mark. China online games revenue reached a peak value of 32.08 billion Yuan in the first quarter of 2015; marking the first time that revenue from the industry ever crossed the 30 billion Yuan milestone. This represents an 8.0% quarter-on-quarter growth, as well as a 24.7% year-on-year growth (iresearch.com). The above stated revenues include the revenue of PC client games, PC browser games, as well as mobile games. Mobile games revenue made up 31% of the revenue in the first quarter of 2015. The revenue also encompasses the total spending of online game players in Chinese mainland and the total revenue of China online game enterprises gained from overseas markets.

Evolution and Development of Online Gaming in China

At the outset of the development of online gaming in China, China was situated at the lowest level of the industry value chain. During that period, China served a ‘middleman’, procuring international game licenses for localization and hosting on the Mainland (Chung & Yuan, 2009; Ernkst & Ström, 2008; Ron & Hardwick, 2009). Its primary sources of online games were Korea and western countries. However with increased technical ability and strong innovation systems, China gained competitiveness in this sector, experiencing astronomical growth and expansions. This sustained growth and development resulted in China outperforming Korea in market size in 2006. The online game market size in China was valued at \$788 million at the time. The market size grew to 83.17 billion RMB (\$13.4 billion) in 2013. In 2014 PC-based online games earned a revenue of 53.66 billion RMB, with browser-based games ranking second with a revenue of 12.77 billion RMB, mobile games ranked third with a revenue of 11.29 billion RMB, social networking games followed with a revenue of 5.41 billion RMB, and single player games ranked last, with a revenue of 0.9 billion RMB (GPC, 2004).

The development and spread of broadband technology stimulated a growth in the number of internet users, which in turn led a significant increase of online gamers, which further stimulated growth in this sector. According to CNNIC, China’s Internet population in 2003 was only 80 million, however by the end of 2013, China had 618 million Internet users. CNNIC (2014) stated, that an estimated 338 million Internet users had access to online games via personal computers, while 225 million users had similar access via mobile phones.

The rapid development of the online gaming sector has transformed the role of China from that of a mere importer and distributor of foreign games, to that of a developer and exporter. Various factors have contributed to the immense growth of the online gaming sector in China. Prominent among these factors are the following:

Increased development and operational service competence: As previously stated, China made its debut in the world of online gaming at the lowest level of the industry value chain. The prevalence of piracy and strict governmental policies prevented foreign gaming giants to make inroads to China. This vacuum thus provided an environment suitable for development for Chinese online game companies. These companies who were previously engaged only in licensing and joint ventures with foreign companies, utilized the vacuum to enhance development capabilities. Considering the fact that online games are services, Chinese companies also enhanced their operational service capabilities, adopting and developing business models based on local preference. They utilized their knowledge of the local market as a competitive advantage. The direct consequence of this developmental process is evident in the plethora of domestically developed games in both foreign and local markets. Most companies even developed proprietary game engines. Although their development and operational capabilities has increased exponentially, Chinese companies still lag behind their international counterparts in terms of advanced gaming technology and capabilities. Based on the development trajectory of this industry, it is forecasted that Chinese companies will attain or exceed the capabilities of their foreign counterparts in the near future.

Consumers' propensity to play games: As of June 2014, China had 632 million Internet users, which was an increase of 14.42 million over the past half year (CNNIC). The surge in numbers of Internet users translated to a similar surge in online gamers. Internet users aged between 20-29 years accounted for 30.7% of the total. The number of online gamers reached 368 as of June 2014. Online gaming has a huge appeal to youths (Ewing, 2007). From statistical analysis, it is easily evident that the development of the online games industry is linked to and stimulated by the high proportion of young gamers. Chinese youth affinity to mobile technology has also accelerated growth in the online game sector. By the end of June 2014, the number of mobile game online users reached 252 million, with utilization ratio growing from 43.1% at the end of 2013 to 47.8%, with an increase of 36.48million (CNNIC, 2014). This growth in the number of gamers has a positive correlation to development of the online game industry in China.

Development of games to conform to local tastes and preferences: McKinsey Quarterly (2006) article stated: "Consumers in China (...) have strong national pride, so multinational companies could lose important segments by seeming too foreign". Research has illustrated that the level of Chinese characteristics in online technology and products co-varies positively with Chinese consumers' likelihood of doing business with a company. This sentiment applies succinctly to the online game industry. The cultural difference between the East and the West can easily be exaggerated in gaming scenarios. China and most Asian-Pacific nations have unique cultural values that differ significantly with Western cultural values. Games designed on the tenets of these varying cultural values have a propensity of being more popular domestically as opposed to internationally. This enhances our understanding as to the reasons why Korean and Chinese games have a wider-acclaim both locally and in Asia-Pacific nations. To gain market share in a specific market, the cultural values of the target demographic is a critical factor for consideration during the design process. Domestically developed games are extremely popular with local gamers, because these games are designed with cultural values that local gamers are familiar with and can relate to. A current trend in domestically developed games is to base the plot and gameplay of a game title on a popular TV drama, which is usually released simultaneously with the game.

Advances in technological infrastructure for game play and regulation: This is a composite factor, made up of broadband infrastructure, Internet cafés, mobile networks and personal computer development. Development in all these factors has stimulated growth in the online game sector as well. The development and penetration of broadband technology in China signaled the commencement of a new era. It has been an important driving force in the growth of online gaming business in China (Nystedt, 2007). With the prevalence of broadband connectivity, Internet cafés sprung up all over major cities in China. Internet café are convenient and cost-effective locations for broadband Internet connections. Due to the high stability level of Internet connection required by online games, coupled with cost issues, Internet cafés have become favorite locations for playing online games. PCs, laptops, tablet PCs and mobile phones are the most popular online game access devices. As of 2005 China's personal computer market was ranked second globally. China had an estimated 67.4 million personal computers in use at the time, however the penetration aggregate was only 5.2 per 100 users (Gartner, 2006). The size of mobile internet users in China reached 557 million by the end of 2014, which represents an annual increase of 56.72 million (CNNIC, 2014). Mobile Internet users represent a high proportion of the total netizen population, accounting for 85.8% of the entire population. This population has been on the increase with the rapid development and spread of mobile technology in China. With the popularization of 4G networks, mobile games have experienced an explosive growth, hence fostering the growth of the online gaming industry.

Government regulations and policies: The Chinese government is very protective and supportive of the online gaming industry. This fact is evident in the policies and regulations formulated and proposed to regulate the industry. Government policy developers, academicians, researchers and military leaders place great emphasis on self-reliance and domestic development of technology (Simon, 2001). Ernkvist and Ström (2008) noted that the government imposed restrictions on activities of foreign game companies. The reason for this restriction is two-fold. Firstly, the restrictions were put in place to promote a "healthy" game industry, that in turn produce games that conform to the unique cultural values of the locals (devoid of pornography, violence, etc.). Secondly, the regulations provided the government with tools suitable to combat issues inherent in gaming such as addiction and Internet gambling (Golub and Lingley, 2008). Government policies in the online game industry are fundamentally directed to enhancing the development and service capability of local online gaming enterprises. The government has also provided training programs to groom online game developers and designers (Fowler and Guth, 2004; Xinhua News Agency, 2006). Ernkvist and Ström (2014) stated, "The Chinese government has sought to create a strong domestic online game industry through the use of industry policies that are often ambiguous, (...) they have "imposed several forms of regulations regarding the design of the games themselves and their services since the inception of the industry".

Piracy: Issues of piracy were heavily entrenched in gaming prior to the advent of online games in China. Piracy was one of the factors that dissuaded foreign console gaming giants such as Sony and Microsoft from engaging in the Chinese game market. In the early 2000s there were no effective laws to curb piracy, as a consequence it became so prevalent, that it was considered a barrier to development of the local console gaming industry. Offline games and online games differ considerably, while it is easy to pirate offline and console games, it is extremely complicated to do so with online games. Online gamers gain access to online games via the game operator's servers. Most online games utilize the free-to-play revenue model, hence rendering piracy redundant. The complex nature of online games makes it rather impossible to be pirated. Online games, are not just commodities, they are services.

The service aspect of online games makes piracy much more difficult to accomplish. There have been instances of pirated servers, but their impact on the market is negligible.

Mutations of business models: Online game enterprises in China continually adapt their business models to conform to the latest trends and preferences of gamers (KPMG, 2007). Most enterprises/game operators adopt the free-to-play revenue model; this model however comes with the attachment of item-transaction. Other companies adopt revenue models best suited for their gamer demographic. By the end of 2014, paying gamers accounted for 24.9% of PC online game users, with a monthly payment ranging from 11 RMB and 300 RMB (CNNIC, 2015). Shanda Games is an example of an online game company that slightly modified its revenue model by offering free access to older game titles, while charging for items that enhanced game play.

Industry Structure: The entrance of Chinese online game companies into the gaming industry signaled a transformation. It is a transformation from just game importers, licensors and distributors to game developers, operators and service providers. As a result of this transformation, the annual reports of Tier-1 Chinese game companies reveal rapid growth in revenues. Several Chinese online game companies are listed on foreign stock exchanges. An additional consequence of their transformation is the increase in the number of exported Chinese games. Several locally developed games are currently sold in South Korea and Japan (Ewing, 2007; PR Newswire, 2007a). The first domestically developed game that was exported was the game *Voyage Century*. It was exported to South Korea in 2004. Exports of locally developed games have increased in the past few years. Exports of online games have been growing faster than total revenue at an annualized rate of 63.3%. Revenue from export was estimated to be \$1.0 billion in 2013, which is 7.9% of the total industry revenue. The cultural aspects of Chinese games have restricted its global diffusion, however its low cost still makes it attractive to gaming agencies that are keen to introduce and localize these games in their respective nations. With the continued development of local game companies and enhancement of locally developed games, industry exports are projected to reach \$2.3 billion by 2018, thereby accounting for 8.1% of total industry revenue. ACMR-IBIS World forecasts that in the years leading up to 2018, the online game industry in China will grow at an annualized rate of 17.8% to reach \$28.9 billion. However growth is expected to slow, this is due to decline in the industry's main market-the 15-34 ages, because of China's birth control policies. Growth in the number of online game companies is expected to slow as competition intensifies. Chinese online game companies were previously lagging behind the foreign counterparts in terms of development capabilities, however in recent years, the gap in development capabilities has increasingly narrowed, leading to joint venture partnerships and synergistic cooperation between foreign companies and Chinese enterprises (Ewing, 2007; iResearch, 2015; Pacific Epoch, 2006).

Chinese Online Gaming Companies-A Firm-level Analysis

Several online game companies operate in China. This study selects ten largest online game companies/operators based on revenue accrued as of the third quarter of 2013.

Tencent ranked first with revenue of 8.42 billion RMB, followed by NetEase, ranked second with revenue of 2.10 billion RMB. Changyou had revenue of 980 million RMB, closely followed by Shanda Games with revenue of 960 million RMB, ranking third and fourth respectively. Perfect world came in the fifth position with revenue of 750 million RMB. Giant Interactive, Qihoo 360, Kingsoft, Huanju.cn and TaoMee ranked sixth, seventh, eighth, ninth and tenth, with revenues of 581 million RMB, 407 million RMB, 271 million RMB, 154 million RMB and 63 million RMB, respectively. Although competition amongst these enterprises is stiff, it is however evident that the Tier-1 companies like Tencent and NetEase are dominating the industry (go-globe.com; en.wikipedia.org; iresearch.cn). According to iResearch, Tencent has a commanding lead among the first-tiers companies, with balanced development of three kinds of games. In 2014, Tencent experienced a 40.2% year on year growth. NetEase had a 16.7% year on year growth. Changyou and Shanda had a -3.0% and 13.0% year on year growth respectively in 2014. In the current online gaming environment, leading game operators are expected to maintain their lead of the industry in both revenue and population of diverse innovative products. They are likely to gain more dominance as the market consolidates, and as their large user bases allow them to acquire new titles from overseas, or develop more differentiated products.

Chinese online game companies are continuously exploring new opportunities and expanding their portfolios to include new game categories, such as web games, casual games, Mobile games and SNS games, these additions have a strong appeal to younger generation of gamers. At the end of 2014, the products and services offered by Chinese online game companies had the following component categories; competitive game platforms, which had a share of 11.7%, MMOGs which had the highest user stickiness, it had of 65.7 share, Mobile online games had a share of 7.4%, social games had a share of 4.0%, web games had a share of 7.2%, other categories had a 4.0% share.

Various benchmarks are commonly employed in measuring the popularity of an online game, namely: Peak Concurrent Users (PCU), daily active player base and the net number of registered users for a specific game. According to Tech in Asia (techinasia.com), the top ten most popular games in China are :1) League of Legends ,2) DNF (also called Dungeon and Fighter, Dungeon Fighter Online ,etc.), 3) Cross Fire, 4)QQ Speed, 5) QQX5, 6)Dream of Three Kingdoms, 7)Against War, 8)NBA2KOL,

9) Fantasy Journey to the West and 10) Counter-Strike Online. Tech in Asia based its measurement parameters on which games were the most played in China's Internet cafés.

With growth in capital and human resources, online game companies are releasing an increased number of games each year. In the meantime, industry competition has intensified, especially with products becoming less dissimilar, lacking differentiating features. It has become increasingly difficult to produce hit titles that can satisfy gamer's demands.

INNOVATIONS AND PRODUCTIVITY

Ariel Pakes and Zvi Griliches measured 'inventive output', using patent data in their paper "Patent and R&D at the Firm Level: A First Look". They drew a conclusion that there is a statistically significant relationship between a firm's R&D expenditure and the number of applied and granted patents. The authors portrayed this relationship between R&D and patent as a 'knowledge production function'. However, not all innovations are patented and there is a large degree of heterogeneity among firms' propensity to patent. Ergo, the role of patenting, as a barrier to imitation is relative and the degree of importance vary between sectors and firms.

Another approach for evaluating the innovation productivity link is measuring R&D expenditure. It is of popular opinion that expenditures on R&D and investments in machinery and equipment combined with knowledge labor and ordinary labor have the most impact on a firm's performance (Griliches, 1998; Romer, 1990; Geroski, Machin and Van Reenen, 1993; Jones, 1995; Van Reeneu, 1997). Firms innovate in order to seek 'rent' (J Schumpeter,). Firms' investment in knowledge and capital is generally for the sole purpose of increasing its competitiveness and capability in order to earn 'rent'. Ericson and Pakes (1995) proposed that the random outcome of a firm's investment in R&D combined with physical and human capital as well as marketing and the competitiveness pressure from other firms within or outside the industry in which the firm is situated, determines the sales performance, profitability and growth of the firm.

Regardless of the fact that this approach is codified, it still fails to capture/measure the innovation productivity link effectively. Since R&D is an input into the innovation process, it is not a suitable tenet to base the measurement of innovation productivity measurement on.

This paper employs a different approach. This approach of estimating the innovation productivity link is built on a micro-dataset. The data is representative of the firms' product and process innovations, innovation expenditures, R&D and other knowledge investments, co-operation, obstacles to innovation and the relative importance of various knowledge flows. This approach not only measures R&D, it also measures the firms' intangible assets, combined with the appropriation of sales generated by new products and the implementation of process innovations as a measure of innovation outputs, in lieu of patents.

Griliches (1979) stated that the production function approach with a focus on total factor productivity or labor productivity as a function of prior R&D-investments, physical capital, human capital, firm size and sector specific factors, is the only method of effectively estimating the contribution of R&D to growth. The knowledge function is the most-widely accepted approach for modeling the relationship between innovation and its determinants, and the impact of innovation on productivity is generally modeled in an output production function (Griliches 1979; Griliches and Pakes, 1980). This approach is hinged on the assumption that present and previous investments in new knowledge as well as external knowledge flow influence the production of new knowledge. This approach illustrates the translation of innovation inputs into innovation outputs, and its impact on productivity. The fundamental principle of this approach is that innovation inputs determine innovation output, which in turn affects productivity. Based on the knowledge production function proposed by Griliches, Crépon, Duguet and Mairesse (1998) developed a structural model of the innovation process, delineating the relationship between innovation input, innovation output and productivity. The Crépon, Duguet and Mairesse model (henceforth CDM-model) utilized data from the French Community Innovation Survey in estimating their model.

THE MODEL

The model used in this paper is similar to the CDM-model. Just like the CDM-model, this model is also comprised of three steps, namely:

First Step: Firms' decision to engage in innovation activities and the amount of innovation expenditure (R&D decision and R&D intensity).

Second Step: The Innovation output productivity link. This step models the knowledge production function, describing the relationship between innovation input and innovation output.

Final Step: The Innovation output productivity link. The final step utilizes an improved Cobb-Douglas production function to estimate the innovation output productivity link.

Prior to implementing the structural model, this study estimated three and Ordinary Least Squares (OLS) models, with the aim of ascertaining the influence of the set of variables on the following factors:

Probability to engage in innovation/innovative activities, the degree of innovation inputs employed, labor productivity

The models are depicted in the following format:

(1) Probability to engage in innovation = $\beta_1 + \beta_2 \log(\text{employment}) + \beta_3 \text{group} + \beta_4 \text{foreign market} + \beta_5 \text{obstacle: knowledge} + \beta_6 \text{obstacle: market} + \beta_7 \text{obstacle: cost} + \beta_8 \text{sector} + u$

(2) Log (innovation input) = $\log(\text{innovation input}) = \beta_1 + \beta_2 \text{group} + \beta_3 \text{foreign market} + \beta_4 \text{innovation cooperation} + \beta_5 \text{public support} + \beta_8 \text{sector} + u$

(3) Log (innovation output) = $\beta_1 + \beta_2 \log(\text{employment}) + \beta_3 \text{group} + \beta_4 \text{process innovation} + \beta_5 \log(\text{innovation expenditure per employee}) + \beta_8 \text{sector} + u$

Based on the simplification of the CDM-model by Löf and Heckman (2002), the model used in this paper can be presented in the following form:

$$y_{0i} = \begin{cases} 1 & \text{if } y_{0i}^* = X_{0i}\beta_0 + \varepsilon_{0i} > 0 \\ 0 & \text{if } y_{0i}^* = X_{0i}\beta_0 + \varepsilon_{0i} \leq 0 \end{cases} \quad (4)$$

$$y_{1i} = y_{1i}^* = X_{1i}\beta_1 + \varepsilon_{1i} \quad \text{if } y_{0i} = 1 \quad (5)$$

$$y_{2i} = \alpha_{21}y_{1i} + \alpha_{23}y_{3i} + X_{2i}\beta_2 + \varepsilon_{2i} \quad \text{if } y_{0i} = 1 \quad (6)$$

$$y_{3i} = \alpha_{32}y_{2i} + X_{3i}\beta_3 + \varepsilon_{3i} \quad \text{if } y_{0i} = 1 \quad (7)$$

Model Specifications

According to Crépon, Duguet, and Mairesse, it is innovation input that increases productivity. Based on this background it can be proposed that firms engage in R&D investments to improve process as well as to introduce new products, a spillover of this investment in innovation is the significant increase in productivity.

The first equation of the model is estimated using a generalized Tobit model, also referred to as the Heckman selection model (Heckman, 1979). (8) Probability to innovate = $\beta_1 + \beta_2 \log(\text{employment}) + \beta_3 \text{group} + \beta_4 \text{foreign market} + \beta_5 \text{obstacle: knowledge} + \beta_6 \text{obstacle: market} + \beta_7 \text{obstacle: cost} + \beta_8 \text{sector} + u$ This equation explains the firms' decision to engage or not to engage in innovation activities. With reference to equation (6), the subscript i represents firms; X represents the vector of regressors and σ represents error term, which is normally distributed. It uses the generalized Tobit model to model the probability of a firm innovating. The inverse Mills ratio is estimated in this stage as well. The ratio is used as a regressor in the second and third steps of the model to correct for selectivity. The first equation measures the probability of the firm to innovate based on the size of the firm, which is measured as the logarithm of employment. Other parameters used in the measurement include, whether or not the firm is part of a group (dummy variable), whether or not it serves a foreign market (dummy variable), whether or not it has experienced obstacles of various kinds in pursuit of innovation, and the industry sector to which it belongs.

Table 2:Independent variables used in Equation 8

Variables involved in the Equation 8
Size = Measured as the log of Employment
Group = Dummy variable indicating whether or not the firm belongs to a group
Foreign market= Measured as a dummy variable which indicates whether or not the firm has foreign market share
Obstacle in Knowledge= Measured as a dummy variable
Obstacle in Market= Measured as a dummy variable indicative of obstacles with respect to market
Obstacle in Cost + Measured as a dummy variable indicative of cost related obstacles
Industry Dummy

The second equation of the first stage is given in the form:

$$(9) \text{ Log (innovation input) } = \beta_1 + \beta_2 \text{group} + \beta_3 \text{foreign market} + \beta_4 \text{innovation cooperation} + \beta_5 \text{public support} + \beta_6 \text{sector} + u; \text{ if innovation} = 1$$

The above equation explains the innovation intensity of the firm. When innovation =1, which is indicative that the firm is engaged in innovation activities, then the second equation of the first stage which provides a framework for estimating the innovation intensity of a firm is implemented. In this equation the dependent variable is the logarithm innovation expenditure per employee.

The variables used to estimate the second equation are whether or not the firm belongs to a group, whether or not the firm is operating in a foreign market, whether or not the firm is engaged in co-operation and whether or not the firm is receiving financial public support.

Table 3:Independent variables used in Equation 9

Variables involved in the Equation 9
Group = Dummy variable indicating whether or not the firm belongs to a group
Foreign market= Measured as a dummy variable which indicates whether or not the firm has foreign market share
Co-op= A dummy variable that indicates whether a firm is engaged in cooperation or not
Industry Dummy
Financial Support = Dummy variable indicative of whether or not a firm received public financial support

The third equation is given in the form:

$$(10) \text{ Log (innovation output) } = \beta_1 + \beta_2 \log (\text{employment}) + \beta_3 \text{group} + \beta_4 \text{process innovation} + \beta_5 \text{cooperation: customer} + \beta_6 \text{cooperation: supplier} + \beta_7 \text{cooperation: other firm} + \beta_8 \text{cooperation: public organization} + \beta_9 \text{mills ratio} + \beta_{10} \log (\text{innovation expenditure per employee}) + \beta_{11} \text{sector} + u; \text{ if innovation} = 1$$

This equation models the knowledge production function. Instrumental variables estimator is utilized here to treat for potential endogeneity, due to the fact that some of the explanatory variables in the model might be simultaneously determined as the dependent variables. The dependent variable in this stage is the logarithm innovative sales per employee, which depends on the intensity of investment in innovations, firm size, whether or not the firm is part of a group, process innovation, collaboration with other firms; clients, suppliers, private and public agents and industry dummies. The Mills ratio derived from the first stage is used here to correct for selectivity

Table4: Variables in Equation 10

Variables involved in the Equation 10
Size = Measured as the log of Employment
Group = Dummy variable indicating whether or not the firm belongs to a group
Process innovation= Dummy variable indicative of whether or not a firm introduced a new or significantly improved production process
Cooperation: client
Cooperation: Supplier
Cooperation: other firms
Cooperation: public organization
Inverse Mills ratio
Innovation input =Measured as innovation expenditure per employee in log
Industry dummy

The final equation is given in the form:

$$(11) \text{ Log (labor productivity)} = \beta_1 + \beta_2 \log (\text{employment}) + \beta_3 \text{group} + \beta_4 \text{process innovation} + \beta_5 \text{mills ratio} + \beta_6 \log (\text{turnover with new products per employee}) + \beta_7 \text{sector} + u; \text{ if innovation} = 1$$

Instrumented log (turnover with new products per employee)

Instruments: log (innovation expenditure per employee), cooperation: customer, cooperation: supplier, cooperation: other firm, cooperation: public organization.

The regression uses innovation output (which is measured as sales income from innovation products per employee (in log)) as the dependent variable to estimate the impact of innovation output on productivity. An augmented Cobb-Douglas production function is used as the basis for this estimation. The independent variables include size (log of employment), firm group (dummy variable), process and log innovation sales per employee. The instrumental variables 2-stage least squares are utilized to correct for potential endogeneity of log innovation sales per employee. Owing to the usage of Mills ratio and predicted innovation input, bootstrapping of standard errors was implemented in both the innovation and output production function.

Data

The data employed in this paper was obtained from modified questionnaires designed in accordance with the Oslo Manual for Innovation Surveys and designed to capture the nature and dynamics of innovation-productivity link in the Chinese online gaming industry. Supplementary data was also obtained from other sources in order to ensure the accuracy, reliability and robustness of the data collected for empirical analysis.

Due to the absence of detailed and standardized innovation database similar to the Community Innovation Survey database, the author resorted to conducting a sample survey in addition to obtaining relevant data from the financial reports of the respective enterprises observed in the research. The reference period of interest was innovation activities carried out between the periods of 2010 to 2012.

The survey was designed based on the recommendations of the OECD OSLO Manual. The survey targeted innovations in the online game industry only, and it addressed innovation at the firm level. It fundamentally addressed the four types of innovation, namely: product innovation, process innovation, organizational innovation and market innovation. The survey as designed to observe and obtain detailed information on the observed firms' innovation activities, which include whether a firm's innovation activities were successful, ongoing or abandoned during the reference period. It also focused on discovering what prompts firms to engage in innovation activities and their objectives of doing so therewith. The survey explored the variety and structure of the observed firms' connection to sources of information, funding, technology transfers and knowledge resources. The survey went further to determine the degree of importance that certain factors played in hindering the observed firms' from attaining its

innovation goals. These factors include: strong price competition, strong competition on product quality, reputation/brand, lack of demand, innovations by competitors, dominant market share held by competitors, lack of qualified personnel, lack of adequate finance, high cost of access to new markets, and high cost of meeting government regulations or legal requirements. The survey went further to ascertain the percentage of the observed enterprises employees that had tertiary degrees during the reference period. The survey also determined the impact of patents, design registration, copyright, trademark, complexity of goods or services, and lead time advantages as well as secrecy on increasing the competitiveness of product and process innovations of the observed firms during the reference period.

The design and data collection phase of the sample survey were carried out online (web link will be provided on request). As a result of limitations in funding and processing burdens, the author chose to conduct a sample survey, instead of a census. However, the sample survey conducted and used in this study is representative of the fundamental qualities of the target industry. The sample enterprises involved in the survey was robust and large enough to provide reliable results for the units in the online game industry (target population). The number of responses required to obtain reliable results was derived by estimates of acceptable coefficients of variation. Finally the sample survey utilized stratification techniques. The Oslo Manual recommended that size and principal activity of the statistical units be factored into the stratification of random sample innovation surveys.

Results

The primary aim of this dissertation is to determine whether a firm's productivity performance is correlated with innovation, if so, what factors correlate with the firm's innovation practices.

The fundamental variables of concern in this empirical estimation are: productivity (defined and measured as the log of sales per employee) (ideally, productivity should be measured in terms of value added, instead of in terms of sales), innovation output (measured as the log of turnover from product innovations per employee), innovation input (measured as the log of innovation expenditure per employee), as well as the production-function variables labor force, human capital and physical capital. Human capital in this study is presented as the percentage of employees of the observed firm that had a tertiary degree during the reference period of 2010 to 2012. First, the propensity to engage in innovative activities increase with firm size, this is in confirmation with other empirical findings from current literature. The larger the firm, the larger its likelihood, to engage in innovation activities. The market orientation of firms plays an important role in the product innovation perspective. Global and local markets have varying degrees of requirements on participating firms. Firms that operate in an international market have a higher likelihood of being innovation-intensive with respect to the nature of products they produce and the cycle of producing new or significantly improved products. Such firms tend to produce new or significantly improved products in a shorter time frame/cycle with a seemingly constant regularity, as a result of the high level of competition ubiquitous in the global market place. Firms with a low degree of international market orientation, or firms that do not operate on international markets in contrast are not as product innovation-intensive.

The estimation for grouping (whether or not a firm belongs to a group) returned a positive and significant point estimate, implying that grouping is positively correlated to innovation, in other terms, firms that belong to a group have a high likelihood of engaging in innovation. The estimates derived from the selection equation of the Heckman model in this study are in conformity with results from extant literature, which implies that the probability of a firm to be engaged in innovation activities is positively correlated with firm size, foreign market operation as well as the different obstacles hampering innovation activities. The fact that the probability to innovate is also an increasing function of the different obstacles hampering innovation might seem contradictory at first, but if the issue of obstacles is perceived as being a relevant part of a firm's effort to engage in innovation, it no longer becomes contradictory. An innovative firm is defined as a firm that has innovation expenditures, turnover from innovation products and engages in a form of innovation, whether ongoing, abandoned or successful, since there is a likelihood of a abandoning an innovation process, then factors with the potential of hampering innovation need to be factored in, ergo they are relevant. This seeming contradictory result may also be interpreted to mean that the innovative firm is constantly exploring and implementing new ideas.

Estimates from the outcome equation of the Heckman model show that once a firm has decided to be engaged in innovative activities, the grouping variable (whether or not a firm belongs to a group) does not have any effect on the amount of innovation input (defined and measured as the log of innovation expenditure per employee) of the firm. It further reveals that the amount of a firm's innovation input correlates with cooperation on innovation with other firm and market orientation (foreign market). Further analysis of the empirical results reveal that although larger firms tend to have a higher number of product innovations, however the innovation input tends to decrease with firm size. Earlier on in this section, innovation input was defined as the log of innovation per employee, it can be deduced from this definition that the larger the firm the lower the input to the innovation process per employee. It can therefore be proposed that smaller firms achieve a higher input to the innovation process per employee. This result is contradictory to most empirical research in this area. Worthy of mention is the hypothesis of a non-linear U-shaped relationship between innovation intensity and firm size put forward by Kamien and Schwartz (1975). The value of the

Chi2 statistic suggests that the error terms of the Heckman model equations, namely: selection and outcome equations are not correlated, thereby implying that the first step of the model is far from satisfactory.

Instrumental Variable Regression: Innovation Output: As previously delineated, innovation output (defined and measured as the log of sales income from product innovations per employee), is determined by innovation intensity. Coefficients derived from this estimation reveal that there is a positive correlation between innovation expenditure per employee and innovation output per employee, this is in conformation with results from similar empirical studies. However the value of the coefficients obtained in this study are larger than those obtained in other studies. Examples of such studies include but are not limited to Crépon, Duguet and Mairesse (1998), Lööf and Heshmati (2002), Lööf et al. (2003), Ebersberger and Lööf (2005), Janz, Lööf and Peters (2004), and Janz, Lööf and Peters (2004). All these studies have elasticity within the range of 0.01-0.40, and had a concentration of about 0.10. The elasticity value derived in this study is however more in line with recent studies that suggest that the correlation estimates between innovation output and innovation expenditure should be in the range of 0.20-0.40. It is evident from the empirical results that the point estimates for the correlation between the log of innovation sales and the log of innovation expenditures are feasible albeit not statistically significant. The predicted mills ratio was included in this estimation to correct for selection bias, however the results do not indicate a statistical significance.

The estimation results show a negative size effect on innovation input. This can be interpreted to mean that smaller firms accomplished a higher innovation output per employee. The group variable estimate is significant, indicating that firms, which belong to a group, tend to have an easier access to global knowledge, which in turn could be positively correlated, with its performance.

The cooperation variable, which is a compound variable detailing cooperation with various partners, is not related to innovation output. In other terms the estimates derived do not show any definitive impact, so it can be postulated that cooperation partners are not in themselves pertinent to a firm's innovation performance. This is in conformance with previous empirical findings in other literature.

Finally it can be deduced from the results that changes in physical capital (defined and measured as the log of gross investments in tangible goods per employee) is positively related to innovation expenditure.

Instrumental Variable Regression-Labor Productivity: This section dwells on the productivity effects of innovation. From the empirical results of this instrumental variable regression, it is observed that the point elasticity for innovation output (which was carried forward from the previous instrumental variable regression) is statistically significant. This outcome conforms to the authors a priori expectation. The outcome also signifies that a firm's performance, measured as a function of productivity, increases both in size and value with innovation output.

The results of the estimation also reveals that productivity increases with firm size, in contrast human capital does not display any significant effect in explaining productivity. The number of employees with a tertiary degree is not correlated with firms' performance.

Further deductions from the empirical findings show that market orientation affects productivity. Firms with a global market orientation have a better firm performance. On extrapolation, it can be deduced that the export share of firms with a global market orientation is significant and positively correlated with labor productivity. The Inverse Mills ratio was included in this stage of the estimation to treat selectivity, and it is quite significant thereby emphasizing a selectivity issue.

Due to the fact that this study focused on knowledge intensive firms with a high level of propensity to innovate, it is therefore not surprising that the estimates of productivity effects of innovation output seem higher than those obtained in similar empirical studies, for instance, Griliches (1998) and Lööf and Heshmati (2003). Analyzing both quantitative and qualitative variables used in this econometric estimation, there is an evident variation in the size of the coefficients of quantitative variables, however the variations are not sizable, ergo, they are not considered statistically significant. On the other hand, the variations in the size of the coefficients of qualitative variables are quite significant, both in strategies for innovations and firm wise framework.

Sensitivity Test

In order to test the robustness and reliability of the obtained results, a sensitivity analysis was conducted. The results obtained from the structural model estimation were compared and contrasted with the output estimates of the OLS regression performed prior to the structural model estimations. The OLS regression results for the innovation output equation and the productivity equations were utilized, the estimates of emphasis are the innovation input and innovation output. Fundamentally, this sensitivity test focused on the elasticity of innovation output (log innovation sales per employee) with respect to innovation input and the elasticity of productivity (log sales per employee) with respect to innovation output. A comparison of both empirical findings (simple OLS regressions and Structural model estimations) reveals that the estimates derived for this elasticity are significant, although there are nuances in the variables of interest. Deductions from both estimations show that innovation output is an increasing function of

innovation input and that labor productivity has a significant impact on innovation output. Although the estimates in both results are significant, however the OLS estimates are more in-line with results from similar empirical studies. In view of the absence of contradictory variations, it can therefore be concluded that the results derived from the estimation are robust and reliable. The econometric model implemented in the estimation is also considered robust.

CONCLUSION

This study has explored the impact of innovation on productivity in the Chinese online game industry, by extension it has delineated and captured the dynamics of innovation in firm performance in firms in creative industries. It has empirically studied the links between innovation and productivity at the firm level using the Chinese online game industry as the focal point of its analysis. The dissertation based its analysis on the recommendations of the OECD Oslo Manual, an approach that provided a high level of comparability as well as definitions of standards and indicators.

Online Game Evolution in Retrospect

The study presented the evolution of the online games industry China.

The growth trajectory and the extent of innovation present in the Chinese online game industry have been examined through different focal points. The role of this industry in the society at large has also been illustrated. Factors hindering the development were also discussed and relevant statistics were presented.

In the course of the discourse on the evolution of the Chinese online game industry, it was shown that the industry is one of the fastest growing industries and it is highly competitive (Landreth, 2007). Operating from a previous position of weakness, the industry has evolved into one of the most powerful, dynamic and diverse online game industries. During its nascent years, the Chinese online game industry was positioned at the lowest level of the industry value chain, chiefly playing the role of an importer and distributor of foreign games. However in the mid-2000's, the industry experienced an influx of local firms. These firms at first were incapable of game development, but eventually they became technologically equipped to develop and operate games. This influx of local enterprises triggered the commencement of the full development of the industry. There were approximately 150 local/joint-venture online game operators, and approximately 100 game development centers in 2007. During the same period, there were approximately 30 local game enterprises marketing and distributing both domestic and foreign online games (Chung, 2007;Ewing, 2007).

As a result of firm-related innovative practices, a vast majority of domestic online game enterprises have earned very high revenues. Several of these enterprises are also listed on foreign stock exchanges. The high return on investments of these companies, coupled with being listed on foreign stock exchanges is directly attributable to the increasing competitiveness of this industry.

From the innovation standpoint, it is evident from the innovation survey and analysis implemented in this study that innovation is a primary driver of growth in the online game industry. A high percentage of all observed firms were engaged in various forms of innovation and to varying degrees during the reference period.

Creative Industries and Innovation

Innovations are ubiquitous in creative industries; innovations in creative are manifested in various forms. However, not all manifestations of innovations are technologically intensive. Innovations can be radical or marginal, radical innovations involve new paradigms leading to technological revolutions as well as significant economic impact, while marginal innovations in contrast are combinations of existing innovations to create added value. The latter kind of innovation is more commonplace in creative industries.

A vast majority of innovations in the creative industries go unnoticed or under-reported. This phenomenon is due to the fact that a large proportion of small makes up the creative sector and medium enterprises, and they are under-represented in innovation and R&D surveys. Green et al, (2007:58) and Söndermann both referred to this as 'hidden innovations'. The extent of these hidden innovations make it particularly cumbersome to evaluate innovations and its attendant effects on firm performance in the creative industries. Traditional innovation metrics designed primarily for manufacturing industries can hardly capture the mechanisms and dynamics of innovation in the creative industries. Therefore this dissertation concludes that a more robust and differentiated concept of innovation should be established to take into consideration the unique features and dynamics of the creative industries and service sectors. The extant definitions of innovation has limiting effects on innovation, firstly, it fails to acknowledge the innovation potential of creative industries and service sectors, secondly, it limits incentive promotion to technological innovations, thereby ignoring to a large extent the creation potential of creative industries. Thirdly, with respect to established incentive programs. The concept of innovation is at odds with the manner in which creative industries operate. Finally, the creative sector will not experience growth in the absence of favorable innovation policies, because innovation is the driver of growth.

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APPENDIX

Table 1: Summary descriptive statistics for indicator variables

	All firms		Innovative firms	
	Mean	Std. Dev.	Min	Max
Group	0.61	0.45	0.73	0.62
Foreign Market	0.59	0.47	0.80	0.43
Knowledge obstacles	0.15	0.36	0.18	0.36
Market obstacles	0.26	0.43	0.30	0.42
Cost obstacles	0.29	0.45	0.33	0.44
Cooperation: customer	-	-	0.60	0.38
Cooperation: supplier	-	-	0.15	0.20
Cooperation: public org	-	-	0.56	0.44
Cooperation: Other Firms	-	-	0.79	0.39

Table 2: Heckman Equation

Independent Variables	Selection equation Dependent variable: Innovative Firm	Output equation Dependent variable: Innovation Input
Group	0.223 (0.041)	0.120 (0.135)
Size	0.157*** (0.031)	
Foreign Market	0.613*** (0.045)	0.621*** (0.164)
Knowledge Obstacles	0.319*** (0.081)	
Market Obstacles	-0.062 (0.048)	
Cost Obstacles	0.259 (0.046)	
Public Support		0.446 (-0.173)
Cooperation		0.422*** (0.173)
Sector	Included	Included
Prob>chi2		0.138
N	57	43

Table 3: Instrumental Variable Regression

Independent variables	Innovation Output Equation	Productivity Equation
Innovation input	0.188 (0.136)	
Inverse Mills ratio	-0.010 (0.272)	0.077 (0.075)
Process Innovation	0.147** (0.049)	-0.048 (0.053)

Group	0.212** (0.084)	0.068* (0.045)
Size	-0.107 (0.052)	0.091*** (0.020)
Cooperation: customer	-0.153 (0.121)	
Cooperation: supplier	0.254* (0.114)	
Cooperation: Public Org	0.036 (0.112)	
Cooperation: other firms	-0.103 (0.123)	
Sector dummy	Included	Included
N	43	43

Table 4: Ordinary Least Square

Independent variables	Innovation Output	Productivity Equation
Group	0.188** (0.091)	0.118*** (0.043)
Employment	0.008 (0.033)	0.082*** (0.014)
Foreign Market	0.0270 (-0.021)	
Process Innovation	0.096 (0.078)	-0.024 (0.035)
Public Support	0.479 (-0.476)	
Cooperation: customer	-0.107 (0.117)	
Cooperation: supplier		
	0.255** (0.106)	
Cooperation: Public org	0.0422 (0.107)	
Cooperation: other firms		
Sector	-0.140 (0.032)	
Constant	Included	Included
N	Included 43	Included 43

Table 5: Scoring Index

Enterprise	Tencent	NetEase	Shanda Games	Changyou	Perfect World	Giant	Kingsoft	Taomee	YY Inc
Diversity in Business	★★★★	★★★		★			★★		★
Online game Innovation Intensity	★★★★	★★★★	★	★★	★★	★★	★★	★★	★★
Operation	★★	★★	★★	★★	★	★★		★★	★★

Enterprise	Tencent	NetEase	Shanda Games	Changyou	Perfect World	Giant	Kingsoft	Taomee	YY Inc
g capability									
Popularity	★★★★	★★★★	★★★★	★★	★	★★		★★	★★
Game Diversity	★★★★★	★★★★	★★	★★	★★	★★		★★★★	★★
Development pipeline	★★★★	★★	★★	★	★	★			
Local Market orientation	★★★★	★★★★	★★	★★★★	★★★★	★★	★	★★★★	★★
Global market orientation	★		★★		★★★★				
New to firm product innovation	★★★★	★★	★★	★★	★★	★	★	★	★
New to market product innovation	★★								
Process innovation	★★★★	★★	★★	★★	★★	★★	★★	★★	★
In-house R&D	★★★★	★★	★★	★★	★★★★	★★	★★	★★	★★
External R&D	★★	★	★	★	★	★	★	★	★
In-house Training	★★	★★	★★	★★	★★★★	★★	★★	★★	★★
Organizational Innovation	★★★★	★★	★★	★	★	★	★	★	
Market innovation	★★	★	★	★	★	★	★	★	★★

Gauging Loyalty: A Local Swim School Fitness Training Study

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ABSTRACT

Local swim schools are places where parents can pay and have their children undertake useful fitness training programs. This study follows a pre-event, at-event and post-event behavioral model to gauge how parent loyalty may be promoted over time. This value model shows swim schools with quality products, reasonable pricing, good servicing and offering an emotionally satisfying experience likely generate ongoing parent loyalty. Hence swim schools monitoring parent perceptions of their fitness training programs should deploy skilled (and personable) fitness trainers (or coaches) and should build programs that grow the parent's motivation to attend.

Keywords: Swim school, fitness, training, sport, value, loyalty.

FITNESS TRAINING

Parents utilize fitness training options and activity-based programs as a mechanism to actively engage their children. Such options and programs encourage individual participation, individual skills development and personal improvement, and these in-turn encourage a healthy and competitive lifestyle. Fitness training includes preparation for any of the raft of Olympic sports, any other team and competitive sports (including cross-fit, baseball, squash, cricket, car racing) and any location-specific sports (including surf life-saving, hiking, mountain biking, sky-diving). Activity-based programs can extend across aspects of dancing, Zumba, rock-climbing, gaming, debating through to passive activities like chess, memory-recall or cards.

In each of these fitness options the participant's mind and body sharpen over time, and further coordination is acquired. Hence parents seek-out the locally available fitness programs that they or their children deem suitable. The fitness programs chosen are generally within an acceptable travelling distance from the parents' home and they often emanate from the school sport program in which the child shows some prowess.

Fitness training is competitively structured to appeal to a range of potential participants, and to motivate them into continuing to attend [10]. These motivated participants also display behaviors that align with their specific suite of attendance and activity expectations. Participants and their parents can also be grouped, and compared based on their attendance motives [21][30][31].

This study assesses the parents' perspectives of a local swim school in North Queensland Australia, and seeks to determine the values they believe are being extracted, along with their reflective views concerning the level of satisfaction they hold consequently their loyalty to this local swim club. It follows the model established and tested by Hamilton and Tee [11][12] and Hamilton et al., [13][14]. This model is adapted (Figure 1) to capture the behavioural motives (as parent expectations (but not attitudes), consumption (as parent values being acquired through the swim school activities with their children) and gratification levels of the swim school parents as satisfaction and loyalty).

Loyalty [14] is an outcome construct generated partly from servicing and facilities quality (Howat et al. [17]. It is also influenced by the emotive experiences (satisfiers) being acquired (Marandi & Harris, 2010), and the performance being perceived [16][17] and servicing being provided [18] in health and fitness clubs. In regard to sporting clubs Ferrand and Pages [8] apply Aaker's [1] study of value acquisitions delivering loyalty and satisfaction.

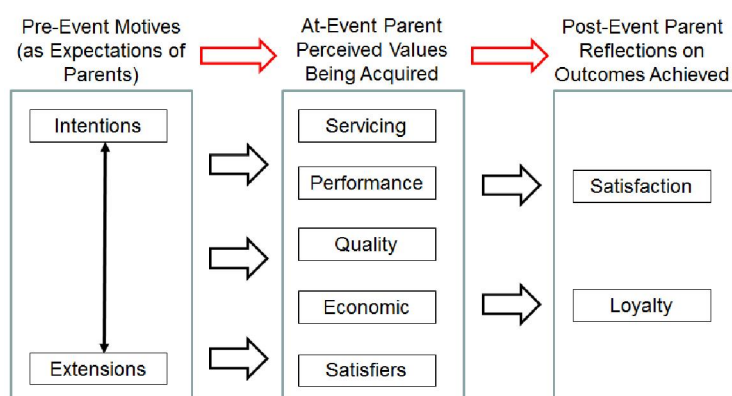


Figure 1: Value deliverance model Swim school to parents of participants

VALUE DELIVERANCE

Motivation

Swim schools provide passive interactions between the swim school and its coaches and the participants, but they do offer a broad sharing of knowledge, ideas and information [29] relevant to their service and its improvement.

Psychological studies section consumers [21] studies behaviour and groups it into hedonic (emotional) or utilitarian (rational) motivates. Ajzen [2][3] extends the theory of reasoned action [1][8] into planned behaviour and recognizes that motivation can be captured as an intention to then perform or participate in a behaviour. Intention has a second level herein termed extension where unexpected input contributions can raise the performance of the behaviour.

Psychologically motivation arouses controls within the parents to reinforce and to act towards reinforcing their (and their children's) goal-selected behaviors. These motives emanate from their physiological, cognitive, behavioral, and social perspectives, and overall they drive an inner goal (or behavioral direction) that innately pursues the parent's inner well-being. This psychological framework may be expressed by the parent's actions and their recognition of this swim school's activities being fit-for-purpose [25].

Such parental behavior can be viewed as extrinsic (actions followed through because they as seen to be useful – such as providing feedback to the swim school and intrinsic (enjoyable interesting activity that enlists an actionable commitment to attending, supporting and motivating their children) [5][6]. Both motivations apply to the parent's and their children's engagement with the swim school, and both form an intention to attend. These motives also invoke a subsequent consumptive behavior, and during this consumption a set of values is continually being accumulated. Reflecting on these values collectively a net satisfaction level is collated in the parent's mind, and if sufficient value is derived then a strong sense of loyalty can result [20 p. viii].

Consumptive Value

Eastman, Goldsmith & Flynn [7] see status consumption as the motivational process where persons (parents) strive to achieve improvement by conspicuously absorbing an item (swim school activities) that offers status to both the individual (parent) and those immediately around them (participating children).

This status consumption can also motivate parents into undertaking additional consumption activities – suggesting that with more consumer status being derived more engagement in these consumptive behaviors occurs. Hence consumption theory is the value (or effect) that parents are obtaining through their acquisitions of ongoing swim school interactions.

Sheth et al. [26][27], Sweeney and Soutar [28]; Roig et al. [24]; Prebensen et al. [23]; Hamilton and Tee [12] extend the consumptive value concept into a multi-construct as shown in Figure 1. This is logical as value is a conclusion that is being derived across many forms of input. Performance is a value dimension being recognized, servicing is a value dimension being received, economic value is a value dimension against monetary transaction position, quality is a comparison value dimension, satisfiers are the emotive value acquisitions being framed. Thus each value dimension has a different reason to exist, and each contributes the parent's overall value positioning, and this value positioning changes in real-time as differing mixes are interpreted by the parent.

Gratification

The parent's consumptive value acquisitions arise from their ongoing experience at the swim school. Where these are favorable then a level of satisfaction may be derived as a reflective outcome. If this satisfaction level is deemed sufficiently strong by the parent then they may express a loyalty commitment towards the swim school [15].

RESEARCH STUDY

This study was conducted in August 2016 at a Swim School in North Queensland Australia. It involved 101 parents of Swim School participants. Beyond the parental demographics capture a 5-point strongly disagree (1) to strongly agree (5) Likert scale question motivation-consumption-gratification approach was engaged to assess the key model pathways to win parental loyalty.

ANALYSIS

The average age of respondent parents is just under forty years, and seventy five per cent of these parents bring their children to the swim school only once per week, and thirteen per cent attend twice a week.

Table 1 shows the driver in attending the swim school is the parent's perception that their children improve in their swimming ability. Minor drivers are the cost, the proximity and the staff capabilities. The actual service levels (performance) being provided towards the children is not seen to be a significant offering – probably because it is expected.

Table 1: Swim school offerings

Swim school offers	%	Cum %
value for \$\$	10.9	10.9
good service	5	15.8
close proximity	12.9	28.7
improvement to child's swimming	58.4	87.1
experienced staff	12.9	100

Table 2's demographics show across the age ranges studied parents of children attending the swim school are loyal and they are prepared to travel some distance to operationalise this fitness training task for their children. Ten per cent of parents with participating children at the swim school travel over twenty kilometres to attend each week, but the greatest appeal of the swim school lies with those parents of participating children who live within a five kilometre radius of the swim school. This suggests a five kilometre targeted marketing campaign (such as household letter drops and/or approaches through local schools or local sport clubs and supported via website information) may bring new participants to the swim school

Table 2: Parent loyalty drivers

Travel	Age	Loyal				
		st disagree	disagree	neutral	agree	st agree
>5km	>20	0	0	1	1	2
	20-39	0	0	1	11	10
	40-59	0	0	2	6	7
	60+	0	0	0	2	0
5-10km	20-39	0	0	1	3	6
	40-59	0	0	1	5	8
10-15km	>20	0	1	0	1	0
	20-39	0	0	0	5	3
	40-59	0	1	0	1	4
15-20km	>20	0	0	1	0	2
	20-39	0	0	1	1	1
	40-59	0	1	0	0	0
20km +	20-39	0	0	0	2	4
	40-59	0	0	0	1	4

Table 3 suggests these same parents are also well satisfied with the swim schools and the fitness training offerings provided to their children.

Table 3: Satisfaction of parents

Age	Satisfied	
	agree	st agree
>20	4	2
20-39	27	22
40-59	23	20
60+	3	0

Table 4: Two worst and best features and how source the swim school

Worst swim school items	%	Cum %	Best swim school items	%	Cum %	Discover the swim school	%	Cum %
none	27.7	27.7	none	7.4	7.4	WoM	50.5	50.5
shade	19.8	47.5	staff	49	56.4	newspaper	2	52.5
parking	12.9	60.4	location	35.6	92.1	family/friend	36.6	89.1
other	39.6	100	other	7.9	100	webpage	9.9	99

Table 4 shows only thirty three per cent of parents offer parking and shade as areas for future improvement, and most find out about the swim school through personal contacts. The website enables ten per cent to find out about the swim school, but newspaper information reaches almost no-one in the targeted demographic. Eighty seven per cent find-out about the swim school by personal discussions and by word-of-mouth (WoM) sharing.

Knowledge of Respondents

The above tables show the parents understand the swim school and its deliverables, and they are likely to spread the news that it is effective in delivering fitness training and swim skills to their participating children. Next we model the constructs that may contribute towards parent swim school loyalty.

Table 5 summarizes the constructs, their measures, and their properties that may be engaged to determine the pathways to acquiring swim school loyalty.

All constructs are derived using factor reduction under principal axis factoring and oblim rotation (as some constructs are not normal). Resultant factor are stepwise derived after considering communalities, loads, cross-loadings and residuals. All resultant constructs (factors) have suitable Cronbach alphas, means, SD's and represent at least 50% of the average variance expected. Hence all are suitable constructs for path analysis, for SEM modelling, and from which the total effects of constructs on loyalty may be determined.

Table 5: Swim school loyalty build constructs

Construct items used N=101	Loading	Construct Parameters			
		Alpha	Mean	SD	AVE
Intension Expectations		0.78	4.23	0.59	0.55
3. share excitement and experiences with others	0.81				
2. enjoy the lesson with friends and/or family	0.76				
1. have fun throughout the lesson	0.64				
Extension expectations		0.74	2.95	0.74	0.5
8. lesson are longer	0.80				
9. Prices are reduced	0.66				
6. my viewing position is improved	0.66				
Performance being acquired		0.79	3.60	0.64	0.57
14. Behaviour	0.86				
15. Confidence and communication	0.78				
12. Strength	0.62				
Economic value for money		0.80	4.14	0.60	0.58
17. long enough	0.78				
16. value for money	0.77				
18. delivering the skills I expect to see	0.73				
Servicing being delivered		0.79	4.33	0.57	0.61
25. happy with operating hours	0.93				
24. able to approach a staff member at anytime	0.71				
23. happy with overall pool facilities	0.67				
Quality being experienced		0.77	4.19	0.55	0.48
28. the level of service I'm experiencing is consistent	0.87				
27. is acceptable time length	0.66				
26. is outstanding	0.62				
29. health and hygiene services available are acceptable	0.57				
Satisfiers (emotions being engaged)		0.92	4.23	0.60	0.71
30. fun	0.89				
31. interesting	0.88				
32. educational	0.84				
33. enjoying	0.84				
33. meeting my needs	0.76				
Loyalty (due to values acknowledged)		0.85	4.43	0.53	0.54
39. attending the swim school was a good choice	0.88				
43. overall I am loyal to this swim school	0.79				
37. today's lesson gave me everything I expected	0.76				
34. sign up for term 4 of swimming lessons	0.65				

The Figure 2 loyalty path model developed from Table 5 using AMOS 23 shows a valid and high quality model exists ($\chi^2/df =$

1.76, $p(\text{Bollen}) < 0.23$, all paths significant at $p < 0.05$, no MI paths to add, small data set $\text{TLI} = 0.94$, $\text{CFI} = 0.97$, $\text{RMR} = 0.30$). The $\text{RMSEA} = 0.08$ is on the upper limit but with a small bootstrapped data set it is a less accurate measure. The multivariate kurtosis is 4.1. Thus, a valid and good path model exists.

Figure 2 captures a parent's motivation as their intention and extension expectations concerning their children's participation in the swim school fitness training activities. As the parent's experience their children's swim school fitness training development they see consumptive values being acquired.

The servicing, eco-value and satisfiers dimensions of value then, in-turn, display a significant and direct influence on the parent's loyalty position concerning the swim school. Thus the servicing, eco-value and satisfiers dimensions of value are focal points when the swim school is targeting expanding its market or improving its parent satisfaction levels.

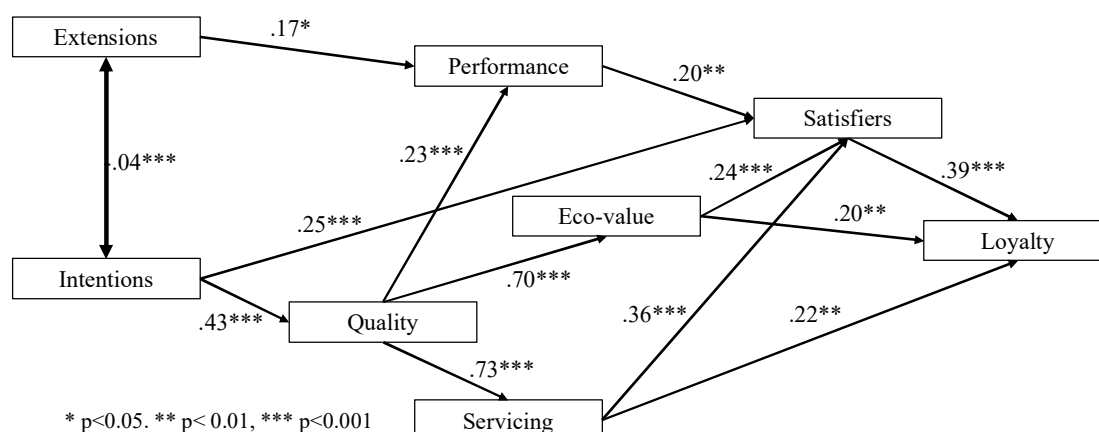


Figure 2: Loyalty path model

The total effects of the figure 2 constructs on parent loyalty clearly shows where intension is met, and servicing is being delivered, and a value for money proposition exists, and emotionally, the swim school fitness training is a pleasing experience, then parent loyalty is likely generated.

Table 6: Total effects of constructs across Figure 2

Constructs	Extra Expectation	Intended Expectation	Quality	Servicing	Eco-value	Performance	Satisfiers
Quality		0.47					
Servicing		0.33	0.70				
Eco-value		0.30	0.64				
Performance	0.20	0.23	0.49				
Satisfiers	0.04	0.50	0.52	0.36	0.24	0.23	
Loyalty	0.02	0.37	0.54	0.40	0.34	0.10	0.44

DISCUSSION

Using this local swim school as an example, from figure 2's loyalty path model it may be inferred that swim schools providing a quality product, and at a reasonable value for money price point, whilst also providing levels of servicing, along with a net emotionally satisfying experience are likely perceived by parents of swim school children as fitness training facilities that warrant their ongoing loyalty. These parents see that their children's fitness and performance capabilities do improve over time, but they do not see this swim school construct as a strong consideration in their acquisition of a loyalty and supporting position.

Hence swim schools should carefully monitor the perceptions of their fitness training programs. They should carefully select and deploy skilled (and personable) fitness trainers (or coaches). They should also build programs that grow the parent's motivation to attend (and participate). They should also offer facilities supporting the parents (who pay, bring their children, and have them participate in fitness training classes). Simple things like: short travel distance from home to the swim school, convenient parking, and comfortable observation positions, can help drive parent loyalty.

Higher levels of parent loyal add support to the wider local community's perceptions of this swim school as a place-of-value in terms of fitness training. Such swim school perceptions articulate as free publicity via ongoing word-of-mouth comments in the local community, and through ongoing discussions with the participant family's members and their friends. Another cheap publicity vehicle is the updating of the website and social media site with ongoing stories of individual successes and swim

school achievements.

Thus, the formula for success in this field of fitness training is simple, yet it can be very effective, and measured via the growth in participant children numbers over time.

CONCLUSION

A theoretical approach (using a swim school) is used to gauge parental loyalty. This in-turn reflects the parents' evaluation of their family's participation across the swim school's fitness training programs. Parental motives to involve their family are captured by their intentions to participate in swim school activities, and by the extra offerings they encounter from the swim school. The parents see their family members participating – receiving quality instruction, performing better, and receiving solid attention (servicing). They see this as value for money. These constructs combine and are seen delivering a net emotionally satisfying experience that then drives their loyalty.

Hence, this research supports figure 1's approach that pre-event motivations (intentions and extensions) do influence at-event consumptions (quality, performance, servicing, economic value and satisfiers), and as shown in figure 2, these in-turn do deliver post-event gratification (loyalty).

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Research Status and Prospect of Consumer Behavior in Omni-Channel Retailing

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ABSTRACT

In recent years, the entity retail sales continue to decline in China, and retail enterprises are facing problems to combined the real economy effectively with the 'Internet plus'. With the development of the retail industry, Omni-Channel Retailing, combined with the physical channels, e-commerce, information media channels, came into being. We discuss the present situation of retailing in China. We also introduce articles in this special issue on consumer behavior. We end with putting forward limitations and future research in this area.

Keywords: consumer behavior, customer experience, Omni-Channel Retailing, e-business, electronic commerce

Introduction

In recent years, the rapid development of electronic commerce, rising costs and strong business competition in the retail trade industry, make the entity retail show all weakness in China. According to the statistics from the China National Commercial Information Center (CNCIC), in 2015 retail sales of more than a hundred large retail enterprises continued to decline, and the growth rate slowed down. Retail sales decline in performance is becoming the 'new norm' in China, retail enterprises are facing problems of digital transformation. How to put the real economy effectively combined with the 'Internet plus', became a problem that entity retails must face to.

Despite the surge in the wave of e-commerce and the huge impact on sales performance of physical stores, physical stores and online stores is not a substitute for each other, but the integration of win-win. Premier Li Keqiang referred to "get to the Internet as the carrier, develop the consumption of online and offline interaction" in government work report in 2015, and he stressed to encourage interactive online and offline again in the government work report in 2016, to promote the innovation and transformation of entity commerce. As numerous of entrepreneur and capital get into the O2O field, integration of online and offline has been the trend, and more merchants make attempts to interact between online and offline.

In response to the pressure of revenue and profit, as well as to respond to changes in consumers' consumption habits, retail enterprises began to look for the direction of transformation actively a few years ago. The focus of Chinese retail enterprises transformation used to be expansion to the lower-tier cities, developing of multiple formats, merger and reorganization, local processes and operations improvement, and the development of electronic business. However, since 2015, Chinese retail enterprises change their center of gravity to Omni-channel Retailing characterized by WeChat and Micro-blog mobile marketing, overseas purchase and cross-border e-commerce, supply chain optimization and reconstruction.

With the development of the retail industry, Omni-Channel Retailing, combined with the physical channels, e-commerce, information media channels, came into being. The emergence of the conception of Omni-channel Retailing can be referred to two preconditions, Multi-channel Retailing and Cross-channel Retailing. The development of mobile Internet, the popularity of smart phones and tablet computers, keep many consumers maintain an unprecedented scale online state, which lays the foundation for the production of the Omni-channel Retailing model. In this model, physical stores and online stores integrate together, retail enterprises can almost meet the consumer's need at any time, any place, and any way to buy.

The Concept of Omni-channel Retailing

A channel is defined as the process or path that transfers goods and services from producers to consumers, and it is not only the

The Sixteenth International Conference on Electronic Business, Xiamen, December 4-8, 2016

point to contact with enterprise and customers, but also the interaction media between the enterprises and customers (Neslin, 2006). With the development of e-commerce technology, the channel has evolved into a variety of forms, such as direct sales staff, stores, mail order, TV shopping channel, call center, e-commerce sites and mobile commerce etc. Li Fei (2013) argues that the retail channel refers to the transfer path through which product or service from a business operator to another subject (individual or organization). These products and services are mainly used for final consumption, and the transactions are always in small single batches. A retail channel is regarded as a full path to complete the transaction.

In 2011, the concept of "Omni-Channel Retailing" first attracted the attention of scholars. Darrell (2011) pointed out in the article "The Future of Shopping" published by "Harvard Business Review" issued in 2011 twelfth that with the evolution of the situation, the digital retail is changing rapidly, it is necessary for us to give it a new name "Omni-Channel Retailing". This means that retailers will be able to interact with customers through various channels, including websites, stores, service terminals, direct mails and directory, call centers, social medias, mobile equipment, door-to-door service, etc."

Li Fei (2013) identifies the meaning, causes and countermeasures of Omni-Channel Retailing in his article. And he defines Omni-Channel Retailing as the behavior to take as much as possible of the types of retail channels to combine and integrate the sales channel. In order to satisfy customers' shopping, entertainment and social comprehensive experience requirements, these channels types including physical shops, intangible shops, and information media (website, call center, social media, Email, twitter, WeChat), etc.. As the result of information technology being widely used in the era of social networks and mobile networks, a large group of consumers based their work and life on the Omni-Channel Retailing, and an information transmission path has become a retail channel. He puts forward the countermeasures of Omni-Channel Retailing that changes of the 'nature of the retail' (sales, entertainment and social) and the 'five flows of retail' (passenger flow, shop flow, information flow, cash flow and logistics) need to be considered, and then retailing enterprises made multi-channel combination and integrated strategy decisions according to the target customers and marketing positioning.

Consumer Behavior in Multi-channel Retailing and Omni-channel Retailing

Based on the existing researches, researches of consumer behavior related to the Omni-channel Retailing are mainly talked about consumer channel utilization behavior. Channel use behaviors generally include the purchase of channel use behavior or search channel behavior. The consumer channel utilization behavior under Omni-Channel Retailing refers to the consumer's careful evaluation of channel characteristics, channel cost, convenience and quality of service according to their shopping, entertainment and social experience demand, as well as consumer collects product information and produces purchase behavior through channels which has been rationally integration (Wu Zhong and Tang Min 2015).

Psychological characteristics such as lifestyle, innovation characteristics and behavioral characteristics such as shopping experience are able to affect the consumer's choice and preferences of channels (Dabholka et al. 2002; Inman et al. 2004). Not only the hedonic values such as entertainment and social have a significant impact on the consumer channels utilization behavior, but also the utility values such as information availability and waiting time have a significant impact on the consumer channels utilization behavior (Liu Cuihua 2010). The consumer factors (shopping motivation, risk perception, etc.), channel factors, situational factors and product factors have significant influence on customer consumption behavior (Wang Yazhuo 2011).

Cao Yuzhi (2012) proves that the differences of the terminal equipment, communication network, convenience, personalization and risk what consumers perceive between the Internet and mobile Internet environment significantly influence consumer transfer from online channels to mobile Internet usage. Long Zhenjie et al. (2013) carried an empirical research from the Angle of dual channel for the influence factors of consumers' online shopping behavior, and came to the conclusion that customer factors, situational factors, product attributes, channel characteristics, enterprises have a significant positive impact on

consumer online shopping choice behavior. Wu Zhong (2015) carried out a research on consumer in single channel, dual channel and multi-channel, and results showed that the external situation, subjective norms, perceived mobility, social perception, perception of life service, personalized, risk perception and convenience perception have significant impact on consumer channel utilization behavior.

Some scholars in China have analyzed the consumer behavior in multi-channel retailing environment in electronic commerce. Jiang Kan (2010) launched the research from the view of enterprises and channels, and points out that consumer behavior in multi-channel is a multi-dimensional structure which was impact by consumer characteristics, retailers, product types, the channel characteristics and situation factors, and on this basis, put forward the channel choice behavior model and management suggestions. Fan Xiaojun (2008) put forward a development strategy model of retailing in a multi-channel environment from the retailer's perspective. The model can be decomposed by 6 processes: setting up the retail channel strategy, identify consumer choice of channel demand, to find alternative retail channels, channels efficiency evaluation, determine the decision rules and choose retail channel strategy, implement the retail channel strategy. Jin Zhou (2015) study the manufacturer and retailer's pricing and promotion strategies in multi-channel retailing.

Consumer Behavior Research about Customer Experience

To adapt to changes of consumer behavior, retailers should implement the strategy of the Omni-Channel Retailing, and link up online and offline channels, to provide customers with seamless integration experience. It begins with the understanding of customers' demand and consumption behavior, and then designs how to put the brand into the customers living habits and lifestyle products, transfer efficient and enjoyable shopping experience to customers. The focal point of the Omni-Channel strategy is to establish contact with customers based on a variety of channels and customers, and then enable customers to get a consistent shopping experience in the physical store, on the Internet and in mobile terminals.

Joseph Pine and James Gilmore (2004) in their book "experience economy", suggests that followed product economy and service economy, experience economy age has come around, the phase of consumers pay more attention to the experience in the process of consumption. Customer experience is an important influence factor of customers purchase intention and repurchases intention, and customer experience can be used to predict customer buying behavior (Wu Pei-xun and Huang Yong-zhe 2006). From the view of the existing literature, there has not been a consistent academic definition of customer experience. Some typical definitions of customer experience are as follows in table 1.

From the point of view of Chinese and scholars in other countries on the definition of customer experience, although the expression of is different, but all their essences emphasize the whole process of customers' participation, and experience is customers' subjective feeling. Now in the process of consumption, the customer is not only focus on product and service acquisition, but also increasingly concerned about the shopping experience in the whole process.

For the division of customer experience, scholars presented many classification methods from different perspectives. Schmitt (1999) argues that the customer experience can be divided into sensory experience, emotional experience, thinking experience, action experience and related experience, and puts forward the Strategic Experiential Modules (SEMs). Li Jianzhou et al. (2006) divides customer experience into social experience, functional experience including service product experience, service environment experience, employee service experience, emotional experience including positive emotion and negative emotion. From the customer's view of point on the demand, Chen Anquan (2011) put forwards that customers' experience includes practicality, cognitiveness, affectivity, social value, etc.

Based on the value co-creation theory, the boundaries between enterprises and consumers have no longer been obvious, as well as enterprises and consumers are no longer a simple value creators and consumers, but who create value together. The meaning

of value and the process of value creation are rapidly shifting from a product- and firm-centric view to personalized consumer experiences. The interaction between the firm and the consumer is becoming the locus of value creation and value extraction (Prahalad and Ramaswamy 2004). Since the value co-creation runs through the entire purchase experience, the process of enterprises and customers together to create value can be viewed as the process of the formation process of experience value, and customer is the core factor in the process of the value creating. Enterprises should focus on provide excellent shopping environment for customers, so that customers can create a unique experience in the shopping process.

Table 1: Definitions of customer experience

Authors	Year	Definitions of customer experience
Holbrook & Hirschman	1982	Experience is defined as a personal occurrence, often with important emotional significance, founded on the interaction with stimuli which are the products or services consumed as cited in Carù & Cova (2003).
Carbone &Haeckel	1994	The take-away impression formed by people’s encounters with products, services, and businesses, a perception produced when humans consolidate sensory information
Robinette et al.	2002	The collection of points at which companies and consumers exchange sensory stimuli, information, and emotion
Zhu Shiping	2003	Customer experience is to meet the needs of customers’ internal experience and in an interaction process between customers and company.
Zhang Yimei	2004	Customer experience is customer perception of the formation of external stimuli, generally through the direct observation or participation in an event and the formation of different individuals showed differences.
Meyer & Schwager	2007	“The internal and subjective response that customers have of any direct or indirect contact with a company. Direct contact generally occurs in the course of purchase, use and service, and is usually initiated by the customer. Indirect contact most often involves unplanned encounters with representatives of a company’s products, services, or brands and takes the form of word-of-mouth recommendations or criticisms, advertising, news reports and reviews”
Wen Tao	2007	Customer experience refers to the customer’s perception and emotion generated in the process of the interactive relationship between the products, services, and other things which is provided by the enterprise.
Ismail et al.	2011	Emotions provoked, sensations felt, knowledge gained and skills acquired through active involvement with the firm pre, during and post consumption.

Research Review of Customer Experience on Consumer Behavior in Multi-channel Retailing

Based on the research of customer experience, Chinese scholars have studied the customer experience in the e-commerce shopping process. Yao Gong-an (2009) explores the dimensions of customer experience satisfaction in e-commerce, and finds that satisfaction of experience can make a good explanation of customers' interaction with e-companies; it develops basic assumptions that customers' satisfaction of experience can be classified as information searching experience and net shopping experience in e-commerce. To explore the mechanism of how multi-channel integration quality affects online purchase intention from the perspective of traditional retailers, Wu Jinfeng et al. (2014) conducts a research and analyses how the customer’s evaluation on multi-channel integration quality affects online purchase intention through customer perceived value.

Service quality of multi-channel integration has positive impact on customer loyalty and service quality of physical channel is favorable for promoting service quality of multi-channel integration. “Retailers should promote the service quality of physical channel and this is the basis for service quality of multi-channel integration. Besides, under multi-channel retailing

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environment, retailers should also perfect service quality of multi-channel integration to enhance customer loyalty (Qi Yongzhi et al. 2015).”

The online channels and new digital channels (such as mobile channels and social media), has changed the retail business model, the implementation of the retail portfolio and consumer behavior (Peter et al. 2015). To discourage the problem of consumer cross-channel free riding, Eleonora et al. (2015) proposed a new environment where one retailer can handles more channels simultaneously. Compared to the single handled channel, the emerging integrated environment would engage more consumers, which in turn would avoid switching behaviors towards competitors' channels. The research results lead to suggest that participants in this research showed positive emotional reactions towards the environment, which lead them to choose this environment for purchases.

Consumers' buying process can be divided into the following steps: demand generation, looking for goods, goods choice, placing orders, payment, delivery or receiving goods, and use and feedback process. Relatively, retailer's sales process can be divided into the following steps: demand trigger and import, commodity display, persuade customer to purchase, orders accept, receive money, and delivery, provide support services, response to feedback. In order to meet consumers' experience demand to buy in the whole process, in Omni-Channel, retail enterprises need to understand consumers' preferences and requirements, to provide multi-channel precision marketing in the demand trigger and purchase decision stage, and record and analyze the process of consumer chooses and buys behavior indifferently, make decisions to take action to attract customers to place orders.

Limitations and Future Research

According to the research report “Omni-channel transformation road” issued by Chinese Franchise Association (CFA) and IBM jointly, in the process of transformation of the Omni-channel Retailing, still exist great difficulties in the new retailing business model, design of customer experience, supply chain improvement, and the integration of online and offline. Retail enterprises, especially traditional retail enterprises, should pay attention to the characteristics and requirements of consumers in the new environment. Consumers' original flat demand is infinitely extending in time and space. The same consumer demand are changing in different time and place, the enterprise marketing audience is no longer a group, but to focus on each individual, and the people at that time, the current needs and behavior.

Retailers should focus on the customer experience in the new situation, and promote the user transformation through improve user's experience. Therefore, based on the Omni-channel Retailing, carry on the research to the relationship between customer experience and consumer behavior is beneficial to the development of the retail enterprises. Based on the related researches, there is almost no research on the customer experience in Omni-channel Retailing, which can be based on the research of multi-channel integration and multi-channel retail environment.

Scholars mainly discussed issues of the integration and marketing synergy of online and offline retail channels from the perspective of retailers. About researches of customer experience in the mode of Multi-channel Retailing, scholars mainly focus on Multi-channel retail channel selection and the influence factor of customer behavior, and customer behavior research mainly from the perspective of customer loyalty. Further study of the relationship between customer experience and consumer behavior of Omni-channel Retailing, could base on researches of customer experience and consumer behavior, from perspectives of customer and retailers, to provide reference for the retail enterprises to gain the advantages of integration.

Models to explain the consumer behavior can be divided into a complete system model, cognitive appraisal model and attitude formation model, the rational purchase model and stochastic purchase model. The complete system model was the most frequently used in the empirical studies to explain the process of consumer purchase decision, mainly including the model

Nicosia Model, the Howard-Sheth Model and the Engel-Blackwell-Miniard (EBM) Model. The nature of consumer decision-making process does not change in e-commerce today. The EBM model is still applicable, and can be used as a basis for further study. The Structural Equation Model (SEM) has been widely applied to the empirical analysis of consumer behavior factors.

The Omni-channel Retailing is put forward in recent years, and it is a new subject no matter in theory or in practice. The available literatures mainly focus on the concept of the Omni-Channel, its developing trend, and the Omni-channel Retailing inventory strategy. Research on consumer behavior in Omni-Channel Retailing from the perspective based on the influence of customer experience has theoretical significance and practical significance.

Firstly, since customers pay more and more attention to the consumer experience, and little research of Omni-Channel unfolded from the perspective of customers, we investigated the channel characteristics of retail, build the Omni-Channel and retail environment customer experience relation with consumer behavior model and explore the Omni-Channel and retail customer experience and mechanism of the influence of consumer behavior, for all channels to provide a new Angle for the research of retail. So the study of characteristics and the influence mechanism of customer experience and consumer behavior in Omni-Channel Retail, and then set up the relationship model which can provide a new the perspective for the study of the whole retail channels.

Secondly, due to the different characteristics of the physical channels, e-commerce and information media channels, experience customers expect will differ in different retail model. Research of influence factors of customer experience based on Omni-Channel Retail, will provide a reference for retail enterprises improving customer experience.

Finally, studying the relation between consumer behavior and customer experience, analysis of consumer channel using behavior, can help retailers to increase sales, will contribute to the coordination between retail enterprises through various channels, to obtain the best effect, to maximize consumer satisfaction and purchase intention of consumers.

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The Indirect Effect of Culture on Privacy Concerns in E-commerce: A Cross-Country Study

Research-in-Progress

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ABSTRACT

In this study, we attempt to examine the indirect and moderating effects of culture on privacy concerns at the national level by comparing key determinants of privacy concerns and their effects between the culturally different two countries. We select the U.S. and South Korea (hereafter S. Korea) as a test bed because these two countries are significantly different in Hofstede's cultural scores. We designate the United States as Type I culture with "small power distance–strong individualistic–strong masculinity–weak uncertainty avoidance" characteristics to contrast with Type II culture countries (S. Korea) with "large power distance–weak individualistic (collectivistic)–weak masculinity (feminine)–strong uncertainty avoidance" characteristics, consistent with previous studies.

INTRODUCTION

Individuals' perceptions of information privacy and fair practices seem to vary across cultures, which constitute a challenge to firms and social platform providers that operate globally through the Web [6]. Even in similar cultures, people have different perspective of privacy. For example, while many people in the United States view privacy as a lawful right that could be negotiable to some degree, people in Europe consider privacy as a fundamental human right that cannot be comprised. Therefore, examining the role of culture in individuals' privacy is crucial. Supported by a better understanding of the cultural effects on online privacy, firms can devise and implement appropriate practice to foster exchanges on the Web globally [16].

Previous studies have treated culture as an explanatory variable of privacy concerns and highlighted its direct effects at the individual or national level [6][16][10][11][37]. Through the lens of the Hofstede's cultural dimension model (1988), prior studies have commonly scrutinized the relationship between a cultural dimension such as individualism-collectivism and privacy concerns. However, previous studies also emphasize indirect effects of national culture on attitude or behavior through cognitive appraisal of relevant factors [17][9]. In their cross-cultural cognitive model, Busenitz and Lau (1996) suggest that national culture guides behavior by affecting cognitive structure (i.e., the way of acquire knowledge) and process (i.e., the manner of using acquired knowledge). Doney et al. (1998) also propose a cultural model in which national culture affects trust by adjusting the cognitive appraisals of trust foundations. As Adler et al. (1986) note, the relationship between cognition and culture is a central foundation of cross-cultural research. In line with that, we suggest that national culture affects cognitive appraisals of a privacy concerns determinant and subsequently influences privacy concerns. In addition, we examine moderating effects of culture on the relationship between privacy concerns and its key determinants. The examination reveals the effects of cultural characteristics on the relationship between constructs which are equivalent across different cultures and thus provides a more implication and interpretation on the role of culture [34].

We identify key determinants of privacy concerns, drawing on protection motivation theory [38] [45] and procedural fairness [14], with some changes fit to our context: (a) vulnerability (i.e., conditional probability that a threatened event occurs), (b) severity (i.e., magnitude of noxiousness of a threatened event), (c) self-efficacy (i.e., confidence in ability to successfully protect privacy), (d) response efficacy (i.e., availability of effective a coping strategy), (e) notice (i.e., information practice of providing relevant information for data collection and use), and (f) consent (i.e., information practice of obtaining consent for data collection and use). Overall, we focalize the indirect and moderating effects of culture on key determinants of privacy concerns (i.e., vulnerability, severity, self-efficacy, and response-efficacy), which is believed to provide a more understanding of why people in different cultures shape different levels of privacy concerns.

LITERATURE REVIEW

Hofstede (1991) defined culture as collective mental programming which affects patterns of thinking on various aspects of life, thereby differentiating a group of people from another. Hofstede (1988) first identified four distinct cultural dimensions (Power Distance, Uncertainty Avoidance, Individualism, and Femininity) and later added fifth and sixth dimension (Long-term versus Short-term Orientation, Indulgence versus Restraint) [23]. The descriptions of cultural dimensions are summarized in table 1.

Table 1. Cultural dimensions

Cultural dimension	Description
Power distance (PDI)	The degree to which members in a society expect and accept the inequality of power distribution.
Uncertainty Avoidance (UAI)	The degree to which members of a society feel threatened by uncertain

	situation and have created institutions to avoid the uncertainty.
Individualism vs. collectivism (IDV)	The degree of interdependence that a society maintains among its members.
Masculinity-femininity (MAS)	The degree to which a society reinforces the traditional masculine work role model.
Long-term Orientation	The degree to which members in a society prefer to maintain time-honored traditions and norms rather than prepare for the future.
Indulgence	The degree to which members in a society try to control their desires and impulses.

Source: Adapted from Lowry *et al.* (2011) and Cho *et al.* (2009)

Prior studies have examined the effects of culture on online privacy concerns, particularly with focus on four cultural dimensions (PDI, IDV, UAI, and MAS). Milberg *et al.* (1995) proposed positive relationship between cultural dimensions of UAI and PDI and privacy concerns but found no support for the relationships, partly due to the limited set of cultural values. Later, Milberg *et al.* (2000) additionally included IDV and MAS dimensions and examined the effects of culture. The results indicated that cultural dimensions of IDV, and MAS were positively associated with privacy concerns due to the emphasis on private life. PDI was also positively associated with privacy concerns because low trust on powerful group in high PDI culture requires more privacy regulation. In contrast, Bellman *et al.* (2004) found negative relationship between three cultural dimensions (PDI, IDV, and MAS) and privacy concerns. Further UAI exhibited no significant effect on privacy concerns. They attribute the differences in findings to the method of analysis employed. Dinev *et al.* (2006) compared privacy concerns between US and Italy based on Hofstede's cultural dimensions (1991) and Fukuyama's institutional trust dimension (1995). Individuals in Italy were more tolerant of privacy concerns than those in US, partly because of low institutional trust. From a survey of 1200 Internet users from five cities (Bangalore, Seoul, Singapore, Sydney and New York), Cho *et al.* (2009) found the significant effect of nationality and national culture on online privacy concerns. More specifically, female Internet users from an individualistic culture were found to be more concerned about online privacy than their counterparts from a collectivistic culture. Lowry *et al.* (2011) compared individual cultural value between people in China and the U.S. to scrutinize the effect of culture on privacy concerns associated with use of instant messaging technology. The results indicated negative relationship between cultural dimensions of IDV and PDI and privacy concerns; but UAI was positively related with the concerns. The literature is summarized in table 2.

Table 2. Summaries of Representative Studies

Table 2. Summaries of Representative Studies					
Research	Cultural dimension	Hypotheses	Sample	Context/ Level	Hypothesis test results
Milberg et al. (1995)	Uncertainty avoidance	Positive: higher scores are associated with high levels of anxiety, stress, and concerns	900 samples from 9 countries.	Privacy regulation/ National	Not support
	Power distance	Positive: higher scores exhibit lower levels of interpersonal trust and people in the culture feel more threat.			Not support
	Individualism	Positive: higher scores indicate more emphasis on value of personal lives so people has the belief that everyone has the right to a private life.			Not support
Milberg et al. (2000)	Uncertainty avoidance	Positive: higher scores are related with high levels of concerns for security.	595 samples from 25 different nationalities.	Corporate privacy management/ National	Not support (negatively associated)
	Power distance	Positive: higher scores are positively associated with interpersonal distrust and concerns for personal privacy			Support
	Individualism	Positive: higher scores are associated with belief of private life			Support
	Masculinity				Support
Bellman et al. (2004)	Uncertainty avoidance	Negative: higher scores indicate that individuals tend to reduce uncertainty by embracing written rules and regulation	534 samples from 38 countries.	Internet use/ National	Not support
	Power distance	Positive: higher scores are associated with greater mistrust of more powerful groups such as companies			Not support
	Individualism	Positive: lower scores show greater acceptance of private life			Not support
	Masculinity	Positive: higher scores indicate greater			Not support

		emphasis on achievement and material success			
Dinev et al. (2006)	Individualism	Positive: higher scores exhibit less dependency upon family and distinction between public and private space.	889 samples from Italy and 422 samples from the U.S.	E-commerce/ National	Support
	Uncertainty avoidance	Positive: higher scores exhibit sensitivity to possible risks			Support
	Institutional trust	Negative: higher scores exhibit that people are comfortable with a lower state of privacy			Support
Cho et al. (2009)	Individualism	Positive: higher scores exhibit higher levels of concerns because people care about independence from the collective, favour security and clear rules and exhibit higher distrust of organization.	1261 samples from five cities (Bangalore, Sydney, Singapore, Seoul, and New York).	Internet use /National	Support
	Uncertainty avoidance				Not support
	Power distance				Not support
	Masculinity	Negative: higher scores exhibit lower levels of concerns as people are more willing to provide personal information in exchange for potential economic benefits.			Not support
Lowry et al. (2011)	Individualism	Negative: higher scores exhibit less concerned about privacy because people put a greater emphasis on achievement and material success and understand the need to forego privacy to gain benefits.	284 samples from China and 202 samples from the U.S.	Instant messenger use/ Individual	Supported
	Masculinity				Supported
	Power distance	Negative: higher scores indicate that people are accustomed to authorities having access to their personal information and have fewer concerns about privacy.			Not supported
	Uncertainty avoidance	Positive: higher scores indicate that people attempt to minimize uncertainty about their personal information by limiting others' access.			Supported
Krasnova et al. (2014)	Individualism	Positive: higher scores exhibit that people tend to show higher tolerance towards distributional inequality and form more privacy concerns when they perceive the violation of distributive justice.	138 samples from Germany, 212 from Russia, and 210 from Morocco.	Social Network/National	Not support
	Power distance	Negative: higher scores exhibit that people are likely to exhibit less anger when faced with unfair treatment and form less privacy concerns when they perceive the violation of procedural justice.			Not support

Gap Analysis

Our literature review of cross-cultural research related to privacy concerns reveals several gaps to address. First, most of previous studies adopt culture-as-main-effect approach and focus on direct effect of a cultural dimension on privacy concerns, thereby overlooking the indirect effects of culture on privacy concerns. Privacy concerns are determined by various factors, and knowing how culture jointly affects privacy concerns with the factors helps to get a better understanding of the role of culture. Second, scant studies examine the effects of culture on privacy concerns in e-commerce.

RESEARCH MODEL AND HYPOTHESIS

Key Determinants of Privacy Concerns in E-commerce

Drawing on the PMT, we determine the key antecedents of privacy concerns online with some changes fit to our context. The theory suggests that individuals' protection behaviors are affected by cognitive appraisals of vulnerability (i.e., conditional probability that a threatened event occurs), severity (i.e., magnitude of noxiousness of a threatened event), response efficacy (i.e., availability and effectiveness of a coping strategy), and self-efficacy (i.e., confidence in ability to successfully adopt the recommended coping strategy) [38][45]. The cognitive appraisals echo the sources of a fear appeal, and people shape anxiety or concerns about an object or behavior by construing them [45]. Applying the theory to the privacy context, people tend to form privacy concerns by appraising the sources of the

fear associated with privacy threat. Thus, privacy concerns are theorized as a mediating variable that explains individuals' cognitive appraisals and protection behaviors.

We also consider appraisal of procedural fairness as a key antecedent of privacy concerns. Procedural fairness denotes the fairness pertains to the method or procedure with which a resource allocation decision is made [8]. Different from information sharing on social network website, in e-commerce, individuals often exchange or trade their personal information with some rewards [1][41]. In the exchange process, online vendors sometimes behave opportunistically and pursue their own interest at the expense of information providers, which increases the uncertainty or risk associated with the exchange [43]. Therefore people expect online vendors to have fair procedure in collecting and using personal information, and the violation of the fairness demotivates people to participate in the exchange and restrict information disclosure. [13][2]. Procedural fairness allows people to exert direct control over personal information in the exchange process and significantly affects perceived risk [14][13][3]. In specific, we focus on notice and consent which are two core dimensions of procedural fairness. While notice refers to the practice that information collectors notice what information is collected and how it is used, consent indicates the practice that information collectors ask for consent before collecting information and using it. Overall, we identify vulnerability, severity, self-efficacy, response-efficacy, notice, and consent as key determinants of privacy concerns in e-commerce.

We suggest that culture not only directly affects key determinants of privacy concerns but also moderates the effect of the determinants on information disclosure in e-commerce. Not only would key determinants of privacy concerns but also the magnitude of their effects on privacy concerns be significantly different between the two countries. Our research model is illustrated in figure 1.

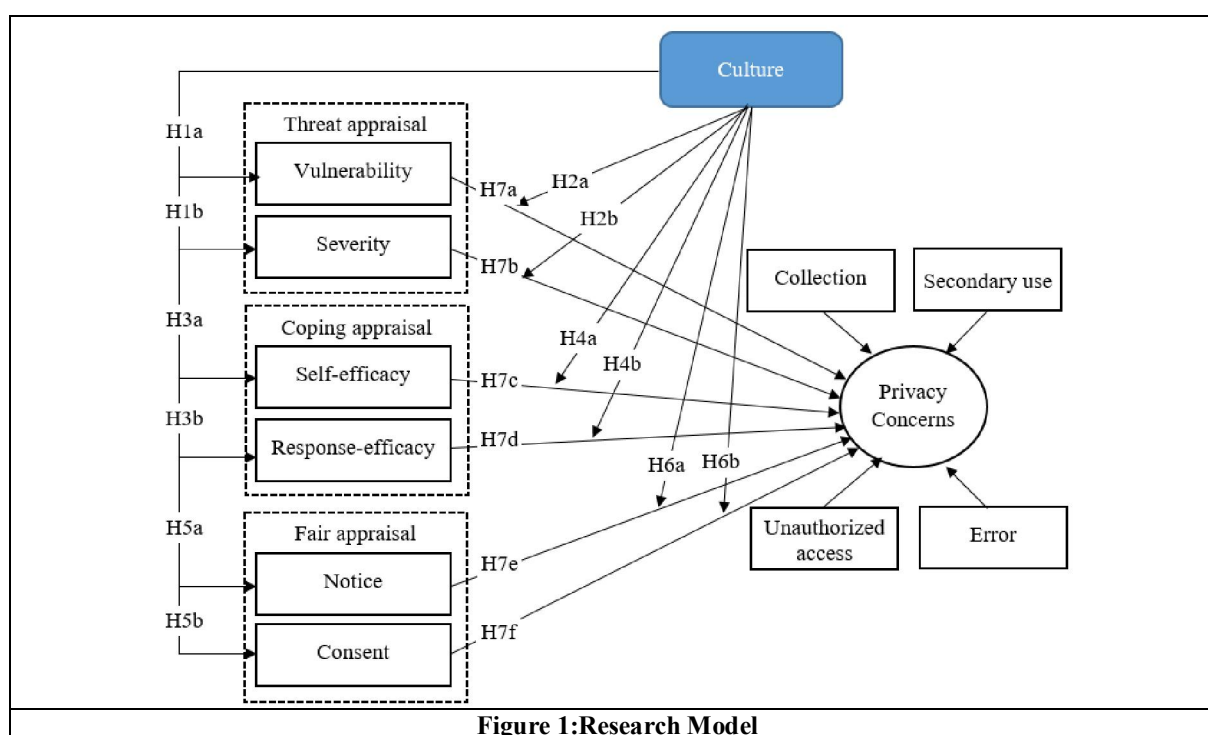


Figure 1: Research Model

Threat Appraisal

The effect of culture on individuals' risk perception has been often examined through the lens of cultural theory of risk [56] [53][48][24]. Individuals form worldviews as a result of socialization and participation, which guide and justify different way of behaving, called a cultural way of life [42]. The theory characterizes worldview along with the group and grid dimension [53], which correspond to IDV and PDI cultural dimension in Hofstede's model. While the group dimension refers to the degree to which social units are being tied, the grid dimension denotes the degree to which actions or behaviors are restricted by external regulations such as social norms. According to the theory, individuals in low group culture (i.e., high IDV) have a tendency of seeing benefits from activities or events due to their emphasis on individuals' achievement and competitiveness [24][42]. They tend to view risk as opportunity, thereby being more risk-seeker than those in collectivistic culture. In addition, they tend to put greater faith on their ability or skill to affect the course of event and perceive activities under their direct control as less risky. Consequently, people in low group culture may assess privacy risks as lower than those in high group culture (i.e., low IDV).

The theory also postulates that individuals in hierarchy culture (i.e., high PDI) are more comfortable with accepting risk, compared to those in egalitarian culture (i.e., low PDI)[53]. In a hierarchy society, people in the lower class tend to obey authorities of upper class and show greater tolerance on social, economic, or political inequality, which making feel more comfortable with accepting risk than egalitarians [19][56]. However, the pervasive inequality leads hierarchists to become more cautious to personal risk although they admit the necessary of taking risks to solve social issues such as environment pollution [44][15]. In contrast, egalitarians show more tendency of risk taking due to the better chance of getting rewards from the risk taking[44]. In addition, individuals in high PDI culture tend to exhibit greater mistrust of more powerful groups such as government or companies and assess the risk of getting privacy invaded relatively high [40][6]. The distrust on organizations leads people to suspect the opportunistic behavior of them in data collection and use, thereby increasing the perception of privacy risk [18].

High uncertainty avoidance (UAI) denotes that individuals in this culture are more sensitive to uncertainty and thus try to minimize unpredictability by seeking control over environment, constructing rule-based institution, and resisting change [35][37]. In assessing risk, risk aversion decision maker is more likely to attend to and weigh negative consequences and thus overestimate the level of risk inherent in a decision situation relative to the probability of gain [47][12]. Thus, individuals in the culture may overestimate privacy risk to iron out the uncertainty inherent to disclosure of personal information. Prior studies suggest that individuals in high uncertainty avoidance may limit others' access on personal information to minimize the uncertainty of disclosing personal information [10][37]. Individuals in high masculinity culture tend to see benefits from activities or events and thus be more risk-taker because of emphasis on work goals, assertiveness, competitiveness, and material possession than relationship with others and cooperation.

Hypothesis 1: Individuals in type I culture perceive lower vulnerability than those in type II culture.

Because of the tendency of viewing risk as opportunity, people in individualistic (IDV) and masculinity (MAS) culture may not deliberate the negative consequences of disclosing personal information. In assessing risk, they tend to weigh positive outcome more and thus underestimate the probability of loss relative to the probability of gain [37][12]. Further, mistrust toward institute or government often found in high power distance may steer people to think about the negative consequences more because of likelihood of opportunistic behavior[6]. Therefore:

Hypothesis 2: Individuals in type I culture perceive severity of negative consequences of disclosing personal information less than those in type II culture.

We also model the moderating effect of culture on the relationship between threat appraisal and privacy concerns. Hsee and Weber (1988) observed more risk-taking behavior from Chinese students than US students, different from expectation. They proposed "cushion hypothesis" to explain the difference in risk taking behaviors between the two countries. Cushion hypothesis proposes that individuals in collectivistic cultures like China expect to get helps from their family or other in-group members when they encounter a catastrophic loss. On the other hand, people in individualistic cultures like US expect to personally bear the negative consequences of their decision. Later, Weber and Hsee (1998) tested the hypothesis with data collected from US, Chinese, Polish, and German students and observed pattern of cross-cultural differences in risk preference, consistent with what cushion hypothesis predicts. Accordingly, although people in individualistic and collectivistic culture sense a same level of privacy risk, the cushion effect suggests that the privacy risk has a greater effect on behavior in individualistic culture. Similarly, Dinev et al. (2006) suggest that privacy risk has a lower effect on information disclosure in collectivistic culture, due to the translocation of personal information from private space to public space. According to them, collectivism tend to diminish personal space and enlarge public space. In the collectivistic culture, individuals tend to establish very close, emotional family or group relationships, which often lead to diminish personal space and disclose their personal information easily. Therefore, the translocation of personal information to public space may weaken the effect of privacy risk on privacy concerns because the information is not considered as personal.

Individuals in high uncertainty avoidance tend to minimize unpredictable events, prefer more formal, structured arrangement, and resist changes in their lives. In this light, people in the high uncertainty avoidance (UAI) may be more risk aversion and weigh negative outcomes, thus often overestimating the risk associated with behavior. The strong risk aversion attitude leads to overestimate a risk to lessen the uncertainty that arises from uncounted factors in risk assessment. Thus, the minimization of uncertainty may increase individuals' confidence in managing a threatening situation and lead to lower privacy concerns. In high uncertainty avoidance, privacy risk is expected to have a lower effect on privacy concerns.

In high power distance culture, the greater tolerance on power inequality leads individuals in low authority class to feel more comfortable of authorities' access on their personal information [6][10]. Furthermore, the formal standard of control and authorities in high power distance culture often construct centralized knowledge and restrict exchange of the knowledge, thereby restricting people in low authority to access information about the negative consequences of personal information disclosure [37]. Combined with inequality associated with information access by authorities, information asymmetry related to negative consequences may lead people to underestimate the effect of privacy risk on privacy concerns.

Hypothesis 3: The effect of (a) vulnerability and (b) severity on information disclosure is stronger in type I culture than type II culture.

Coping Appraisals

Individualistic culture emphasizes individuals' achievement and fosters independent thinking [37]. Individuals in the culture tend to believe in their own abilities and thinking, thereby convincing their ability [29]. In the same token, masculinity culture tends to put a higher value on individuals' ability due to its emphasis on individual achievement and competitiveness over social relationship [46]. On the other hand, people in collectivistic and feminine culture tend to emphasize cooperation among group members rather than individual ability or competitiveness [22]. Consequently, people in individualistic culture may have more chance to develop their ability to be competitive or to observe success of others, thereby showing higher self-efficacy than those in collectivistic culture [4][5].

Individuals in high power distance tend to perceive unequal distribution of power and readily accept for supervisor to make unilateral decision on their behalf. Thus individuals in such culture are less willing to participate in goal settings and dispute an established performance norm, which leads to lower self-efficacy [49][30]. Furthermore, people in high power distance culture tend to rely on the knowledge of authorities because of unequal distribution of social resources including information across social classes [42]. The reliance on the knowledge of authorities deprives people in low authority of chance to develop their own ability to manage risk.

We also posit that people in individualistic culture perceive more response-efficacy than those in collectivistic culture. Due to the emphasis on individual value or goal, in individualistic culture, privacy is considered human right and should be protected. On the other hand, collectivistic culture tends to diminish personal space and enlarge public space, due to the address on value or goal of a society [16]. Thus privacy is not a central value in the culture. In this light, a society in individualistic culture may make a more effort to provide effective privacy protections through a third-party privacy assurance such as eTrust or political or lawful support.

Hypothesis 4: Individuals in type I culture perceive higher (a) self-efficacy and (b) response-efficacy than individuals in type II culture. Individuals in high power distance culture may also put lower faith on the protections provided government or organizations because of likelihood of opportunistic behavior of authorities [18]. Distrust toward authorities is another factor that weakens the perceived efficacy of protections offered by authorities. The asymmetric distribution of resources tends to tempt authorities to take opportunistic behavior to maximize their utility, and the presence of opportunistic behavior may decrease trust toward authorities. Accordingly, in privacy context, people in non-authority position may put low faith on the efficacy of protections provided by authorities because of likelihood of opportunistic behavior.

We posit that the sensitivity to uncertainty may affect the effects on self-efficacy and response-efficacy on privacy concerns. Individuals in high uncertainty avoidance may try to minimize any uncertainty in applying their ability or adopting an effective response to diminish privacy concerns. The internal resources such as possessed knowledge or skills can be readily applied for protecting privacy and their effectiveness are expectable. However, privacy protections from government or companies are not assured if they can be used in time of a need instantly.

Hypothesis 5: Individuals in type I culture perceive (a) a less effect of self-efficacy but (b) a greater effect of response efficacy than those in type II culture.

Justice Appraisal

Online vendors are believed to have different information practices across cultures. While individualistic culture emphasizes personal value or right and rely on explicit formalized procedures or rules for protecting the value or right, collectivistic culture more appeals social value or goal and prefer social norms or personalized relationships to control its members' behaviors to support the value [7][31]. Therefore, online vendors in individualistic culture are more likely to respect privacy as an important right and have formal procedure of information collection with the protection of privacy. In addition, different from high power distance culture in which unilateral decision is common due to unequal power distribution, low power distance culture generally provides an equal chance of raising voices about an issue to all relevant people [30]. Furthermore, a greater trust toward government or organizations observed in low power distance culture leads people to believe that online vendors would comply with guideline in data collection from government. Therefore, we posit that people in type I culture are more likely to expect online vendors to comply with fair information practice by providing relevant information and obtaining consent for collecting and using personal information.

Hypothesis 6: Individuals in type I culture have higher belief of (a) notice and (b) consent in data collection than those in type II culture. Procedural justice have two distinct aspects: structural and social aspect. While the former deals with formal policies and procedures, the latter focuses on the interpersonal treatment [50]. Structural aspect suggests *voice* as an important procedural justice principle [52]. The allowance of voice as input into decision-making leads people to perceive an outcome allocation as fairer than otherwise [36]. In particular, the principle of voice echoes the desire for control because people perceive some control over a decision or process when they are allowed voice as input [52]. In contrast, social aspect suggests that people tend to perceive a decision or process as fair when they are treated with respectful and courtesy manner and is offer relevant information explaining how a decision is made [54].

People in individualistic culture tend to judge procedural justice based on the degree to which they could exercise control over personal information disclosure, which is closely connected to structural aspect of procedural justice [32]. For example, individualists show more preference for adversary procedure because of opportunity to exercise control over the dispute [32]. Because of the value on autonomy, independence, and competition in individualistic culture, people in the culture tend to pursue control over dispute process and prefer the use of adversary dispute resolution procedures. In contrast, collectivistic culture appeals more value of harmony, cooperation, supporting others' faces which are more likely to be associated with social aspect of procedural justice. In dispute, collectivists tend to show strong preference for mediation and bargaining rather than adversary procedure because of their desire for maintaining a harmonious relationship after the dispute is settled (i.e., interpersonal harmony) [31]. Overall, individualists perceive a decision or process as fairer when they exert control over the decision or process whereas collectivists more focus on the provision of relevant information and respectful treatment in assessing procedural justice. Thus we posit that, in individualistic culture, control over personal information would have a greater effect on privacy concerns whereas the effect of notice on privacy concerns would be greater in collectivistic culture.

Hypothesis 7: Individuals in type I culture perceive (a) a greater effect of consent but (b) a lower effect of notice than those in type II culture.

RESEARCH METHODOLOGY & DISCUSSIONS

A survey-based study will be conducted to empirically examine the proposed model. Following the precedents of prior studies of a similar nature (e.g. Kim, 2008), our study targeted e-commerce adopters in US and South Korea since these users were thought to have the best experience of electronic transaction characteristics, privacy, and threats. Data was collected using either paper-based or online-based survey over the course of several weeks. All measures for this study were either adopted or adapted from prior literature. Most constructs were measured using multi-item, 5-point response scales ranging either from "strongly disagree" to "strongly agree" or from "no extent" to "very great extent". Construct items can be found in the Appendix. All variables were modeled as reflective constructs. The survey will then face validated by two small sized samples.

In sum, we focalize the indirect and moderating effects of culture on key determinants of privacy concerns (i.e., vulnerability, severity, self-efficacy, and response-efficacy), which is believed to provide a more understanding of why people in different cultures shape different levels of privacy concerns.

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Appendix – Instrument Items

Please answer the following questions

Demographic information:

- Gender: Male / Female
- Age: _____
- Number of years in college/university: _____ years

Please mark the number most appropriately describe your personality

	High	Moderate	Somewhat	Neutral	Somewhat	Moderate	High	
introverted	1	2	3	4	5	6	7	extroverted
unenergetic	1	2	3	4	5	6	7	energetic
silent	1	2	3	4	5	6	7	talkative
timid	1	2	3	4	5	6	7	bold
inactive	1	2	3	4	5	6	7	active
unassertive	1	2	3	4	5	6	7	assertive
unadventurous	1	2	3	4	5	6	7	adventurous

Please indicate the number most appropriately describing your general behavior

	Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
1. I talk about myself frequently	1	2	3	4	5	6	7
2. I usually talk about myself for fairly long time	1	2	3	4	5	6	7
3. I often share my feelings with others.	1	2	3	4	5	6	7
4. I often disclose intimate, personal things without hesitation.	1	2	3	4	5	6	7
5. Once I get started, I fully reveal myself.	1	2	3	4	5	6	7
6. I disclose who I really am, openly and fully in my conversation with others.	1	2	3	4	5	6	7

Please indicate the number most appropriately reflecting your personal value

	Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
1. Being accepted as a member of the group is more important than having autonomy and independence.	1	2	3	4	5	6	7
2. Group success is more important than individual success.	1	2	3	4	5	6	7
3. Being loyal to the group is more important than individual gain.	1	2	3	4	5	6	7
4. Individual rewards are not as important as group welfare.	1	2	3	4	5	6	7
5. Rules and regulations are very important to support the society.	1	2	3	4	5	6	7
6. It is better to have a bad situation that I know about, than to have an uncertain situation.	1	2	3	4	5	6	7
7. Providing opportunities to be innovative is more important than requiring standardized procedural such as social norms.	1	2	3	4	5	6	7
8. People should avoid making changes because things could get worse.	1	2	3	4	5	6	7
9. People in higher positions can make most decisions without consulting people in lower position.	1	2	3	4	5	6	7
10. People in higher a position should not ask people in a less important position for advice, because this might make them	1	2	3	4	5	6	7

	Strongly disagree	Disagree	Somewhat disagree	Neutra l	Somewha t agree	Agree	Strongly agree
appear less powerful.							
11. Decision making power should stay with people in higher positions in the organization and not be delegated to people in a less important position.	1-----	2-----	3-----	4-----	5-----	6-----	7-----
12. People in less important position should not question decisions of people in higher position in the organization.	1-----	2-----	3-----	4-----	5-----	6-----	7-----

[Please read the following scenario carefully and answer the following questions.]

DISCLIUB is an online vendor that sells a variety of products, such as consumer electronics, cosmetics, medical supplies, clothing, books, and entertainment content. This vendor offers a paid membership program through which people pay an annual fee of \$50 to receive handsome price discounts and personal services. DISCLIUB now reconstructs its website and launches a marketing campaign to recruit new members by offering substantial discounts for select products and free coupons. In this campaign, people can waive the membership fee by providing some personal information in the application.

Please indicate the number most appropriate describing your **general privacy concerns**

	Strongly disagree	Disagree	Somewhat disagree	Neutra l	Somewha t agree	Agree	Strongly agree
1. All things considered, providing my personal information to online vendors would cause serious privacy problems.	1-----	2-----	3-----	4-----	5-----	6-----	7-----
2. I am concerned that the personal information I submit to online vendors could be misused.	1-----	2-----	3-----	4-----	5-----	6-----	7-----
3. I am concerned about threats to my personal privacy when I provide my personal information to online vendors.	1-----	2-----	3-----	4-----	5-----	6-----	7-----
4. I am concerned about disclosing personal information to online vendors, because it could be used in ways I did not foresee.	1-----	2-----	3-----	4-----	5-----	6-----	7-----

Please indicate the number most appropriate describing your **perceived benefits of information disclosure**.

	Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
1. Providing personal information is helpful for getting monetary benefits (e.g., coupon, discount) or personalized service (e.g., product recommendations, hot deal information) from online vendors.	1-----	2-----	3-----	4-----	5-----	6-----	7-----
2. Offering personal information is useful for receiving monetary benefits or personalized services from online vendors.	1-----	2-----	3-----	4-----	5-----	6-----	7-----
3. Disclosing personal information works for getting monetary benefits or personalized services given by online vendors.	1-----	2-----	3-----	4-----	5-----	6-----	7-----
4. Personal information disclosures enable me to receive monetary benefits or personalized services from online vendors.	1-----	2-----	3-----	4-----	5-----	6-----	7-----

Please indicate the number most appropriate describing your **perceived general privacy risk**.

	Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
1. In general, it would be risky to disclose my personal information to online vendors.	1-----	2-----	3-----	4-----	5-----	6-----	7-----
2. There would be high potential for privacy loss associated with providing my personal information to online vendors.	1-----	2-----	3-----	4-----	5-----	6-----	7-----
3. There would be too much uncertainty associated with my giving personal information to online vendors.	1-----	2-----	3-----	4-----	5-----	6-----	7-----
4. Providing a vendor with my personal information would create many unexpected problems.	1-----	2-----	3-----	4-----	5-----	6-----	7-----

Please indicate the number most appropriate describing your **perceived general self-efficacy of protecting privacy**.

	Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
1. I can protect my online privacy even if there is no one around to help me do so.	1-----	2-----	3-----	4-----	5-----	6-----	7-----
2. In my mind, I have the knowledge and skills necessary for protecting my privacy online.	1-----	2-----	3-----	4-----	5-----	6-----	7-----
3. I think that it is not difficult finding effective ways to protect my own privacy in online settings.	1-----	2-----	3-----	4-----	5-----	6-----	7-----
4. I am confident that I am able to protect my privacy in online contexts.	1-----	2-----	3-----	4-----	5-----	6-----	7-----

Please indicate the number most appropriate describing your **perceived general response-efficacy of protecting privacy**.

	Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
1. I believe that there would be effective ways to reduce the risk of online privacy invasion (e.g., checking an online vendor's privacy policy), even if I reveal my personal information to online vendors.	1-----	2-----	3-----	4-----	5-----	6-----	7-----
2. In my belief, I could find effective means to protect my own privacy (e.g., checking third-part certification such as eTrust), even though I submit my personal information to online	1-----	2-----	3-----	4-----	5-----	6-----	7-----

	Strongly disagree	Disagree	Somewhat disagree	Neutra l	Somewha t agree	Agree	Strongly agree
vendors.							

3. I believe that actions (such as checking the list of companies violating fair information practice) work for protecting my own privacy, even though I reveal my personal information to online vendors.	1-----	2-----	3-----	4-----	5-----	6-----	7-----

4. By adopting effective means (such as checking privacy policy of online vendors), I can protect my own privacy.	1-----	2-----	3-----	4-----	5-----	6-----	7-----

Are you willing to provide personal information including name, gender, email address, and mailing address to an online vendor in return for some rewards?

Yes [] / No []

Comparison on Cross-Border e-Commerce Industry in Pilot Free Trade Zone Under The Context of Supplying Reform

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ABSTRACT

Cross-border e-commerce is a kind of internet+ industry different from traditional trade. Four pilot free trade zones are featured with similarities in the aspects of resource supplies as business environment, supporting policies and platform construction, all of which emphasize the principles of innovation, consistency and efficiency. While, there are many disparities such as industry resource including foundations, general industry developing layout. The differences urge the Pilot FTZS into the adoption of different modes featured with ladder stages in the imported transaction. In order to coordinate regional industry development and narrow the disparities, this paper will put forward several measures to refine the business environment, promote the construction of virtuous competition platform and improve the talent cultivation mechanism in accordance with the principles of innovation, differentiation and cooperation.

Keywords: comparison; cross-border e-commerce; supplying reform; pilot free trade zone

PREFACE

Cross-border e-commerce is a kind of new e-commerce mode upgrading traditional trade, and presented as intergration of Internet+ platform economy and international trade. In the new economic situation, China is trying to build pilot free trade zones to dig out new market economic potentials. The innovative mechanisms including transformation of government functions, development of fresh trade modes, new patterns for foreign cooperation promote the national economic development. The moves that government adopted that approved Shanghai, Fujian, Guangdong, Tianjin Pilot Free Trade Zone as cross-border e-commerce trade pilot area launched an new engine for developing economic. Four Pilot FTZs devoted themselves to accelerate the development of cross-border e-commerce industry, and refine the supportive policies to cultivate cross-border business enterprise, service platform, and logistics warehousing industry. All the measures are beneficial to improve cross-border settlement process, government services and supervision. However, Disparities in resource supplies as geographical characteristics, industrial fundaments and economic development help avoid excessive vicious competition of homogenization, and promote the government service supervision system innovation in the situation of horizontal and diversified competition. In addition to the preferential policies to attract foreign investment, the local government needs to strengthen regional cooperation to boost the development of cross-border e-commerce which would become source of power that facilitates the economic development. In one word, the new trade patterns produced in Internet+ era would lead our economic into a further growth.

SITUATION OF CROSS-BORDER E-COMMERCE INDUSTRY IN PILOT FREE TRADE ZONES

The birth of Cross-border e-commerce industry is the sign of new economy in the Internet era, aiming to create a new rise rapidly period. Relevant statistics show that, in 2015 the turnover of cross-border e-commerce business is about RMB5.4 trillion Yuan, an increase of 28.6% compared with last year, of which the imported retail e-commerce transaction reached RMB1184.3 billion Yuan, with year on year growth of 111.9%^[1]; in the future, the average annual growth of cross-border e-commerce transaction will be more than 30%, until to 2016, cross-border e-commerce transactions is expected to reach RMB6.8 trillion Yuan, and more than RMB8 trillion Yuan in 2017^[2]. Transaction in Cross-border e-commerce industry has inspired the growth of Chinese import and export, which is considered as new trade modes leading economy out of sluggish condition. The volumes of Cross-border e-commerce in regions showed a rapid growing trend. The latest data in 2015 released by Shanghai Customs show that sales volume of Cross-border e-commerce on Shanghai port exceeded RMB4 billion Yuan with an increase of 10.2 times compared with last year, and amount of e-commerce ventures' register record reached 433, commodity record RMB58.8 million Yuan, respectively increasing by 4 and 6 times than last year. At the same time, the import and export volume of cross-border e-commerce in Guangdong reached RMB 16.73 billion Yuan with a year on year growth of 3.6 times^[3]. As highly exported-oriented economy province, cross-border e-commerce transactions in Fujian amounted to approximately RMB195 billion Yuan, of which the turnover in Xiamen reach RMB 1100 billion Yuan, increased by 50%. There are more than 300 cross-border e-commerce ventures in Fuzhou who really start to carry out business operation and more than 1000 enterprises have completed registration for business. There are 46 batches of importing and exporting commodities in the form of cross-border e-commerce in Pingtan, the values of which exceeded RMB 20 million Yuan. Cross-border e-commerce in Ping Tan are at the fresh stage with a prospect future. According to the statistics, Fujian is devoted to creating a complete industry chain cluster to attain competitiveness through cultivating cross-border e-commerce industrial park. Being different from Fujian, Tianjin Port Pilot Free Trade Zone, Dongjiang Bonded Port Area, etc. approved cross-border pilot one after another, and there have been a number of cross-border e-commerce ventures agglomerating in the business district; in 2015 there are more than 1800 newly settled related enterprises, accounting for nearly 40% of total. Fenggu oversea buying as commercial and Retail Federation in Tianjin Pilot Free Trade Zone firstly presented o2o mode in 2015, and International Tianjin Airport cross-border Pavilion followed being opened. Cross-border e-commerce is still under

pilot, while it is deemed that there are a lot of developing potentials in the future. We know cross-border e-commerce in four Pilot Free Trade Zones in 2015 show vigorous growing trends, while the transaction scale varied greatly with positive growth in spite of economy recession.

Tab.1 2015 comparison sheet of cross-border e-commerce in Pilot Free Trade Zone

2015	Nation (billion)	Shanghai (billion)	Guangdong (billion)	Fujian (billion)	Tianjin (billion)
Total amount	54000	4	167.3	1950	7000 (e-commerce)
Yoy growth	28.6%	920%	260%	42%	40.8%
type	Retailing export,bonded import,direct mail import	Retailing export,bonded import,direct mail import	Retailing export,bonded import,direct mail import	Retailing export,bonded import,direct mail import	Retailing export,bonded import,direct mail import
location	Pilot city	In and out of the Pilot Free trade Zone	In and out of the Pilot Free trade Zone	In and out of the Pilot Free trade Zone	In and out of the Pilot Free trade Zone

Four Pilot Free Trade Zones try to carry out cross-border e-commerce pilot transactions in accordance with the principle of reform and innovation, and finally made considerable achievement in this aspect. Every zone adopted three kinds of retail outlet export, bonded imported and direct mail import. The business processes of the industry are gradually mature. As to export rankings, Guangdong Province ranked first on the cross-border e-commerce export list, followed by Zhejiang, Shanghai, Fujian, and Shenzhen with 51% overwhelming ranked first in regions followed by Shanghai, Fuzhou, and Xiamen. In addition to the Pilot areas, there are many cross-border e-commerce areas outside Pilot regions, Guangdong is expanded to the place such as Dongguan, Jinmen, Forshaw, Zhuhai, Shanghai expanded to Songjiang, Jiading, Putuo, Fujian to Quanzhou, Putian, and Tianjin to Tianjin Port Free Trade Zone, Dongjiang Bonded Port, airport economic zone. Above-mentioned regions inside and outside Pilot Free Trade Zone are engaged in the cross-border e-commerce pilot business. Cross-border e-commerce industry are enlarged throughout inside and outside Pilot Zone and featured with various business modes. There are mature e-commerce ventures, comprehensive service platforms, developed logistics and warehouse industries, and innovative settlement modes through the industrial chain. The resources, supports from the governments and benefits from the innovative physical mechanism are basic condition guaranteeing to create an international, legalized business environment for cross-border e-commerce industry.

COMPARISON ON CROSS-BORDER E-COMMERCE INDUSTRY IN PILOT FREE TRADE ZONES FROM THE PERSPECTIVE OF THE SUPPLYING SIDE

Similarities of Cross-border E-commerce Industry in Pilot FTZs Supplies

The major four pilot free trade zones featured with characteristic differences from similarities in fields of e-commerce, logistics, modern finance, and other industry. Being superior to traditional trade mode, we can ensure the vigorous foundation for developing cross-border e-commerce industry with a series of conditions such as resource supplies including innovating management environment, constructing public service platform, introducing industrial support policies etc, see Table 2.

The convergence of innovative environmental resource factors

Through regional development difference is not synchronized with different progress in various districts, pilot free trade zones launched series of management and system innovations to construct fresh innovation system model, which help build legalized, international, and facilitated business environment for the development of cross-border e-commerce industry.

a. The refined simplification of the administrative environment in pilot FTZs

The governments in pilot Free trade zones focus on reform and innovation in multi direction through transforming government functions and implementing administrative system reform. Flattening management system reduced the organization levels, simplified government administrative examination and approval process. It is the first step in the fields of the government management system reform. Decentralizing administrative examination and approval authority, promoting foreign investment management filing system, implementing "decentralization" strategy in the government controlling fields while strengthening government regulation and oversight, they can help build green and transparent administrative environment. Internet++ Civilians and government communication platform helped improve the transparency of administrative affairs, and the liability list of affairs constraint administrative law enforcement, all of which promote construction of fair and open government affairs environment. After one-year pilot, Shanghai introduced 28 testing measurements items to other districts. Based on the replication of initial innovative pilot measurements, Guangdong, Fujian, Tianjin have enlarged reforming fields involving the agencies simplification and regulation in process and afterwards supervision innovation. All of these initiatives provided the international benchmarking environment for the development of new trade industry.

b. The trade-facilitation environment in pilot free trade zones

System innovation in Pilot Free Trade Zones is a key driving force to build an international business environment for the development of cross-border e-commerce industry. The important aspects of system reform are to found cross-border simple tax supervision and reform tax system; the innovative initiatives of trade facilitation are presented in the form of simplification of customs clearance and integration of clearance formalities. Many traditional items in the customs and inspection are integrated in the fields of examination and verification of customs clearance formalities and finally create the international trade "single window". "Single window" of international trade brings the customs, inspection and quarantine, foreign exchange management, taxation and other management departments together, optimizing the cross-border import and export customs clearance process, and establish simple and convenient one-stop customs clearance environment. Based on the principles of "release on the first-line and control on the second-line", the processes of customs clearance are simplified. The imported goods are stored by voucher on first-line, and the import cargo declaration procedures are eliminated. On second-line, the customers foster the supervision and management of imports by checking the electronic data comparison list for the record, the risk categories etc. which strengthen customs clearance management of bonded import to reinforce the customs supervision system featured with the tier of first-second lines and gave birth of trade facilitation innovation. Trade system innovation is the main driving force for development of cross-border e-commerce industry. Reform of the trade system helps to improve the efficiency of business operation, and enhances the brand competitiveness of enterprises. All are regarded as effective ways to achieve the transformation and upgrading of foreign trade.

Government-led public service platform for cross-border e-commerce

Cross-border e-commerce service platform is a product of institutional innovation and management innovation in reality, bringing e-commerce enterprises, logistics, payment, customs clearance, foreign exchange, taxation and other departments together. To promote the development of new trade modes, the governments in four pilot free trade zones play the leading role to build full range of government-led service platforms with cross-border e-commerce, financial settlement, and logistic and warehouse enterprises attending. The 56, 57 documents of General Administration of Customs explicitly put forward that the e-commerce enterprises or individual can distribute collection, settle the tax rebate through cross-border e-commerce customs clearance service platform. In 2014, General Administration of Customs launched customs clearance service platform, which provide a unified customs clearance for the import and export in foreign trade enterprises. Advantages of the public service platform and innovative policies in pilot Free trade zones are combined to help launch comprehensive supervision and service system covering a variety of customs clearance channels and business forms, promoting the construction of greener supporting environment. Cross-border e-commerce service platform in Shanghai launched pilot operation in the late of 2013. In early 2016, in order to further improve operation mechanism of the cross-border e-commerce public service platform, Shanghai cross-border e-commerce Public Service Co., Ltd. officially started to upgrade the cross-border e-commerce public service platform. iSoftStone Holdings Company in Guangdong built cross-border e-commerce public service platform which made commitment to provide one-stop customs clearance, payment and other integration services for the business enterprise. This service platform punctually connected the real-time docking logistics, customs and other aspects. At the end of 2015, iSoftStone signed the strategic cooperation agreement with the Central Business District Management Committee, Tianjin Binhai New Area for construction of Tianjin, cross-border e-commerce public service platform since the implementation of cross-border e-commerce pilot. The Government in Fujian pilot free trade zone tried to build a government-led cross-border e-commerce public service platform, providing comprehensive one-stop logistics, warehousing, customs clearance, settlement, and other public services for the e-commerce enterprise. Government-led public service platforms accelerate the cross-border e-commerce developed into high-scale, standardized, agglomerated stage.

Government supporting policies for cross-border e-commerce

Relying on the top design from the central government and nourishing by supporting policies from the two levels government, it is easy to create a standardized, fair green environment for cultivating cross-border e-commerce. The cross-border e-commerce enterprises enjoy dual policy concessions of free trade and cross-border e-commerce pilot in the pilot zone, where the governments have given a high attention and supplied policies as nutrients for industry development on a new platform. Since 2013, the State Council, the Ministry of Commerce, Ministry of finance, State Administration of Taxation and other departments issued several policies including "Implementation Suggestions Supporting the Relevant Policies On Cross-border E-commerce Retail Outlet", "Implementation Proposal on Promoting E-commerce Application", "Notice Of Cross-border E-commerce Retail Export Tax Policy", "Several Advices On Supporting the Steady Growth of Foreign Trade", "Guidance From Office of the State Council On Promoting Cross-border E-commerce Healthy And Rapid Development" and other series documents to supporting policies, which provide clear instructions for industry cultivation, development and supervision and other aspects. The local governments in Four Pilot Free trade Zones launched related supporting policies for the development of cross-border e-commerce. In 2015, Shanghai issued "Several Opinions On Promoting Cross-border E-commerce Development" covering 5 industry chains and 2 system construction; the Commerce Department of Guangdong province in September 2015 issued three policies to support the e-commerce enterprise development, and gave special financial supports for cross-border e-commerce enterprises, padded short boards in the fields of public services, logistics, warehousing, park construction and other aspects; "Measures On the Support And Promotion Of Chinese (Tianjin) Pilot Free Trade Zone Construction From the General Administration of Customs" specially mentioned the supports for development of cross-border e-commerce in addition to copycat from customs supervision system in Shanghai Pilot Free Trade Zone. The government in Fujian Province issued "Notice of Action Plan for Promoting Cross-border E-commerce Development from Office of the Fujian Provincial People's Government". Fuzhou, Pingtan, Xiamen area have introduced special management measures for

cross-border e-commerce industry, clarifying support funds and matching grants for e-commerce enterprises. The supporting policies and managing methods for cross-border e-commerce in the four Pilot Free Trade Zones help establish five major functional platforms integrating warehousing and logistics, payment settlement and Internet banking, large e-commercial enterprises, financial intermediation and comprehensive services industries, cultivating full cross-border e-commerce industry chains. The policies also foster the preferential subsidies for cross-border subject, business service platform, logistics system, e-commerce Demonstration Park, electric business modes innovation, financial and taxation, customs inspection, personnel training etc., which accelerate a virtuous cycle of cross-border e-commerce industry chain.

Tab.2 Factors comparison for cross-border e-commerce

	Business environment	Public service platforms	Supporting policies
Shanghai	Administrative management innovation : transformation of government functions, implementation of flattering management, reduction of structural levels, simplification of checking and approval process, authority of approval decentralization, filing system of foreign investment management, government-civilian communication platform, affair liability list;	Public service platform for cross-border e-commerce industry in Shanghai created by stock limited company consisting of stated-owned companies	“several opinions on promoting cross-border e-commerce development in the city” “evaluation methods for cross-border e-commerce Demonstration park in Shanghai”
Guangdong	Trade environment facilitation: simple taxing supervision for cross-border e-commerce and taxing system, simplification of the customers clearance process and clearance formalities, international trade “single windows, first-line release、second-line control	Public service platform for cross-border e-commerce industry in Guangdong constructed by isoftware and comprehensive service platforms in different areas created by stock limited company consisting of stated-owned companies	“Notice of the people's Government of Guangdong Province on printing the implementation scheme of the new impetus to accelerate the development of electronic commerce”, “The office of the Guangdong Provincial People's Government on promoting the implementation of the healthy and rapid development of cross-border E-commerce”, “special management methods for cross-border e-commerce industrial in different area”
Fujian		Public service platform for cross-border e-commerce industry in Fujian constructed by isoftware and comprehensive service platforms in different areas created by stock limited company consisting of stated-owned companies	“notice of action plan for promoting cross-border e-commerce development from Office of the Fujian Provincial People's government”, “special management methods for cross-border e-commerce industrial in different areas”
Tianjin		Public service platform for cross-border e-commerce industry in Tian Jin constructed by isoftware	Implementation plans to enlarge export of cross-border e-commerce in Tianjin etc.

As shown in the table, there is innovation and reforming atmosphere in four pilot free trade zones, such as supporting policies for cultivating industry and government-led cross-border e-commerce service platform connecting inspection and customer's platforms. All the governments are eager to supply rich recourses to improve industry chain in the aspects of environment refinery, platform construction and policies supplies. They are devoted to creating an international standard industrial environment with resource of high-quality, trying to improve industrial soft power and supplying necessary recourses to develop the industry. In spite of the similarities, there is obvious heterogeneity in different zones, which help develop differentiation developing strategies.

Different Resource Supplies for Cross-border E-commerce in Pilot Free Trade Zones

Disparity of cross-border e-commerce industry Factors

Compared with Tianjin and Fujian, Shanghai, Guangdong undoubtedly attracts the high attention as two major economic developed zones. In 2015, GDP in Guangzhou amounted to RMB138377.97Yuan, Shenzhen to RMB 162381.97 Yuan, both of which were higher than the national average. In the same year, Shanghai's GDP increased by 6.9% over the previous year and the per capita GDP reached RMB103100 Yuan, while per capita GDP in Fujian Province for RMB68260.17 Yuan, and Xiamen reached RMB90971.39 Yuan, Fuzhou RMB75613.73 Yuan, which were below the level of Shenzhen, Guangzhou, and

Shanghai. Although per capita GDP in Tianjin reached RMB 10thousand Yuan, there is still much gap in infrastructure and urban development compared with the first North Canton. Therefore, based on the comparison of the economic quality level and national income, it is known that Shanghai and Guangdong have good economic foundation, of which Fujian rank in the middle position. As for Tianjin, the production volume of third industry exceed that of the second industry in 2015, which help stabilize the industry structure of“三二一”in Tianjin. While compared with the other three zones, economic foundation and industrial infrastructure in Tianjin lagged behind. Economic development level in four region are at different stage, with infrastructures improved in varying degrees, operation and management differing, all of which affected the factors needed by the industry development including ecological environment, administrative efficiency, information channels, business operating costs and etc. The differences of Infrastructure industries foundation for new business modes such as warehousing, logistics, financial innovation make factor supplies for industrial development disparity. Replicating Shanghai innovation template, many different reforming and innovating initiatives are launched in the light of local conditions in the four Pilot Free Trade Zones, in which the institutional innovation has stepped differently, leading to the differences of innovation efficiency including industrial development business cost, industrial agglomeration effect differences. All of these affected the competitiveness of cross-border e-commerce industry chain. The local governments in the four zones have different location and cooperating goals. Shanghai oriented to open to the world, creating an opening-up threshold to all the world's countries and regions, and Tianjin to the South Korea, Fujian with Taiwan, Guangdong with Hong Kong and Macao. Relying on its own economic volume and development level, taking use of its geographical advantages, the governments seek cooperation opportunities with others for agglomeration differentiation. As Industrial foundation of cross-border e-commerce industry in Pilot FTZs is different, the strategies for different cooperating goal in the region ensure the implementation differentiation initiatives.

Overall planning layout for cross-border e-commerce industry

It is advantageous to cultivate cross-border e-commerce industry on the fertile ground full of innovation and reform. Although there are differences in industry developing layout, clear goals set before facilitate to promote the development of cross-border e-commerce industry in cross-border e-commerce Comprehensive Pilot Zone. On January 15, 2016, the State Council released “Official Reply on the Establishment of a Comprehensive Pilot Zone for Cross-border E-commerce In 12 Cities Including Tianjin”. This paper agreed to set up cross-border electronic commerce Comprehensive Pilot Zone in Tianjin, Shanghai, Guangzhou and other 12 cities, which started development of cross-border e-commerce industry backed by benefits and privileges from cross-border comprehensive pilot zone and Pilot Free Trade Zones in Shanghai, Guangdong, Tianjin. The establishment of Cross-border comprehensive pilot zone inspired the innovative idea to found six systems and two platform modes. The utilities of new mechanism and preferential policies in Pilot Free Trade Zones speed up regulatory innovation, service innovation, management innovation, promoting construction of the industrial chain featured with large-scale, intensivism and standardization.”Implementation of the comprehensive pilot area of cross-border E-commerce” in Shanghai was approved too, encouraging using service spirits to create public service platform, strengthening information sharing and data exchange, optimizing Park function cluster and completing industrial chain construction, and mainly benchmarking international standards, innovating regulatory systems to cultivate cross-border e-commerce industry; The industrial developing plan in Tianjin emphasized on the regulation innovation to consolidate foundation of two platforms, five foundation item, 8 systems. To build and nurture the blueprint of a complete industrial chain, and to enhance the strength for developing new trade pattern, Guangdong is devoted to deepen the cooperation with Hong Kong and Macao for establishment of cross-border e-commerce industrial platform. There are distinctive key points of four pilot zones, and the initiatives seeking similarities from differences help form the standardized and regulated environment to facilitate the growth and maturity of cross-border e-commerce industry. In spite of lack of comprehensive pilot area advantages, single-effect zone in Fujian is still nourished by the innovation of Pilot Free Trade Zone. The effects in the form of new trade modes together with the policy guidance from the provincial government and Department of commerce help stimulate economic growth through encouraging advantageous industries cultivation and construction of cross-border e-commerce industry development supporting system. The four Pilot Free Trade Zones is trying to explore new trade mode, and strengthen the development of cross-border e-commerce industries. So, Different blueprint with the same developing goal help lay seeking the means of differentiation strategies.

Products varieties of cross-border e-commerce industry

They leap and move firstly, accelerating the development of cross-border e-commerce industry, and increase the innovative effects to seek economic developing opportunities. In compliance with items on the positive list of cross-border e-commerce retail, the governments in four pilot free trade zones enlarge the scope of the product categories step by step, releasing from easy-storage category import to the fresh category according to different schedule. In April 2016, import positive list of cross-border e-commerce announced covering 1142 kinds of goods with eight digit tariff numbers, including main formula, cosmetics, food, health care products and fresh fruit and seafood. Owing to geographical advantages from Taiwan and innovative initiatives, cross-border-commerce enterprises in Fujian PFTZs open up the cross-border B2C direct purchasing modes and establish online and offline marketing platform with the Juhuasuan, Alibaba and other large business organizations to import fresh fruit from Taiwan in addition to other specialties. Relying on cross-border links platform, the e-commerce enterprises in Shanghai had created online marketing model for selling fresh fruit from Australia, the United States, Mexico, and NewZealand in mid 2015, providing high-quality personalized service for domestic and cross-border customers. In June 2016, Shanghai announced the “Notice from Shanghai CIQ on Supporting the Entry Meat and Aquatic Products to Carry out Online Shopping Bonded Cross-border E-commerce Mode”, and this document clearly supported import of meat and aquatic

products selling in the form of the cross-border e-commerce bonded online mode. Although it is easily operated according to the policy document, the Cross-border e-commerce mode for fresh meat and aquatic products sales is still under discussion. We believe in the near future, vegetables, aquatic products, flowers, etc. are also expected to be operated under the cross-border e-commerce products categories. Guangdong Province lead the way to on-line business of imported fruits, aquatic products and foreign fresh food, and seafood grow by 516% month on month only in August 2015; The cross-border fresh food in Tianjin pilot Free Trade Zone have been formed scale, and fruits, aquatic products, meat and other products through cross-border B2B and B2C modes gradually stepped into the developing stage. The main cross-border products varieties in Guangdong and Shanghai are in a wide range and have diverse sources. The characteristics regional advantages between Fujian and Taiwan conducted Fujian specialized in exploring the on-line marketing modes for products imported from Taiwan. Cooperated with South Korean, Tianjin has also gradually realized the goal aiming at enriching cross-border products items. The disparities of economic development, infrastructure, operation and management in four pilot free trade zones and differences in the fields of the perfectness of supporting industries, foreign cooperation orientation and patterns make the industrial subjects take differentiation strategies to expand the products scope.

The governments in the four pilot free trade zones are devoted to seeking similarities from disparities and differences in common to explore coordinated differentiation strategies for the development of cross-border e-commerce industry, which can help promote the cross-border e-commerce industrial development through the adoption of the unique strategic positions in each region.

INITIATIVES TO PROMOTE THE DEVELOPMENT OF CROSS-BORDER E-COMMERCE INDUSTRY IN PILOT FTZS

Speed up innovative construction in pilot FTZs, and build international-standard business environment

Promote the establishment of international trade single window

Every local government should be devoted to improve the use of international trade single window including defining the application scope and subjects, and find measures to realize inter departmental systems interconnection and data sharing and cooperation, aiming to provide customs clearance facilitation for cross-border trade by streamlining customs procedure. To refine the international trade single window, they gradually added involved departments to the whole system of single window, leading to the Department data joint, information sharing, and finally realized cross-regional single window docking. Shanghai and Guangdong upgraded the single window and actively push through the use of version2. Fujian, Tianjin also join the team to explore the upgrading single window. Firstly, they should strengthen the replicated effect of the upgrading version. Based on the former version 2.0, Fujian, Tianjin actively accelerate the establishment of upgrading single window with multi function, balancing single window construction in Pilot FTZs agglomeration area; secondly, they should refine the single window. They should build cross-sector mutual recognition through information sharing, and strengthen cooperation memorandum of single window to form single-window agglomeration, and fully enhance the innovative role to expand the influence of clearance integration. Finally, four pilot FTZs should cooperate with neighboring provinces to enhance single window docking by out-in region joint, and gradually realize the integration of cross regional clearance. The cooperation of cross-region single windows with information sharing gradually help to promote foreign customs clearance cooperation, build an earth village of inward-outward information recognition, mutual assistant for clearance, and create an international environment for development of cross-border e-commerce industry.

Improve legal business management system

The local governments should improve the laws and regulations in pilot FTZs and enhance the management of the legal system. In accordance with the requirements of the management system in pilot area, they adjust some kind of regulation and normative documents, secure implemented reforming measures and explore adaptive local legislation to improve legal construction of new business formats, and finally insert pilot achievements into the local laws and regulations to protect standard and legal status of cross-border pilot reform items. In addition to the above-mentioned measures, they should establish the intellectual property rights management mechanism for cross-border e-commerce. The local governments should accelerate the establishment of patent, trademark and other cross-border intellectual property protection legal system, and explore the pilot FTZs judicial pilot service benchmarking the international business dispute settlement rules for cross-border e-commerce industry, which can provides professional legal aid to promote dispute settlement mechanism for cross-border e-commerce. Shanghai aims to perfect the legal construction by foster normalized exchanges and cooperation mechanism with international trade arbitration legal institutions. Guangdong enhances the construction of exclusive legal platform among Hongkong and Macao; Fujian actively explores the dispute settlement mechanism of mutual identification with Taiwan; Tianjin is devoted to promoting construction of the legal system in the pilot Free trade zone. To establish a law governance business environment for cross-border e-commerce industry, they should seek to resolve disputes in time, and put forward up several measures to create ecological environment for cross-border e-commerce industry ecology.

Implement regional differentiation strategies, and create a healthy competitive platform

Enlarge products categories for cross-border e-commerce

Cross-border e-commerce industry is a shot in the arm of the new economic era. They play a key role and smooth the path for the economic development through reducing market links to decrease the actual buying cost for domestic customers who can buy foreign products through a formal convenient channel ^[7]. The key points that state clearly standardized product category list help regulate the general trade and cross-border e-commerce product segmentation, and standardize the customs clearance

process on different various ports which improve the efficiency of customs clearance. But a same positive list means that there are homogenized competitions of same products import in various regions, inducing to homogenization challenge, which is not conducive to the development of the country's industry and disobey overall planning. On the other hand, with the growing domestic demand diversification, the items on the positive list is difficult to meet the customers' needs, and several kinds of simple categories are hard to form the sustainable purchase attractive, especially hindering the cultivation of characteristics cross-border e-commerce industry and finally making the whole industry dismiss the driving effect in long term. Therefore, considering the disparities of the economic development and key industry developing layout in pilot FTZs, the local governments should draw attention on different fields when developing cross-border e-commerce to avoid the homogenized competition^[8]. In the long-term, they should gradually expand scope of import products category as regional characteristics to secure the long-term buying attractiveness and keep sustained vigor for cross-border e-commerce market, which facilitate to adopt differentiation strategies. To succeed in implementing products specialty strategies, they should adjust measures according to local conditions, which can enhance the regional competitiveness with specialty products, ensuring cross-border e-commerce industry symbiotic synergy in Pilot Free Trade Zones.

Enhance characteristics regional cooperation

The general planning for foreign cooperation in four pilot free trade zones are different. Shanghai aims at opening to the global; Tianjin focusing on expanding cooperation with South Korea, Fujian on Taiwan and Guangdong target on Hongkong and Macao. The local governments should strengthen distinctive regional cooperation with the important area, and build the sustainability of the docking cooperation bridge by fostering mutual connection, specifying cooperation programs, especially strengthening the three-way cooperation among governments, enterprises and schools. Shanghai is wide-opened and explores wide cooperation space. They should strengthen cooperation with the global free economic demonstration zones and take advantage of the cross-border e-commerce platform encouraging the foundation of cross-border marketing network, enhancing the deep exchanges with foreign personnel, goods and capital. Guangdong should establish exchange platform with HongKong and Marco, step up personnel exchanges interoperability, and carry out in-depth cooperation in order to achieve a deeper cultural and economic cooperation and exchange during intercommunication environment construction. With help of the Cross strait Services Trade Agreement, Fujian is devoted to opening up to e-commerce industry in Taiwan. They want to promote the ecological circle construction for cross-border e-commerce industry and improve win-win platform establishment by inducing cross-strait Customs information exchange, supervision mutual recognition, and mutual law enforcement aids. Tianjin should make full use of the Beijing Tianjin Hebei integration platform and strengthen foreign cooperation to create an atmosphere with system innovation, management innovation and Beijing Tianjin Hebei 3-linkage to create a broader foreign cooperating market.

Promote cross-region talents exchange and cooperation, and strengthen professional personnel training

Talents are the most valuable resources in 21 Century; talents are invisible assets for creating industrial competitiveness. The lack of talents will inevitably hinder the industrial development and social progress. To promote development of cross-border e-commerce industry, we should strengthen the construction for talents teams. Reform and innovation are key factors to build a breeding ground for development and growth of cross-border e-commerce industry, while they need to build a sound mechanism for talents cultivation to add power and fuel for development. Firstly, they should build government-led personnel training mechanism between government and enterprise, actively promoting docking between cross-border e-commerce Industrial Parks and schools, and then connect students to linking points of industrial chain to cultivate applied talents for cross-border e-commerce industry talents; every local governments should encourage the talents exchanges and cooperation between enterprises and schools, inviting experts from business and scholars in Colleges and universities to train small and medium business in large-scale to provide professional knowledge to small and medium sized enterprises of cross-border e-commerce industry. All of these measures are beneficial to enhance corporate soft power. Secondly, they should to promote the implementation of talent training projects in the pilot FTZs. The establishments of training center for electronic commerce talent in the pilot free trade zones form professional talent agglomeration. There, governments can establish preferential platform for talents, improve supporting infrastructure to encourage entrepreneurship to build innovation incubator, and finally lead to the formation of new talent agglomeration. It is important to construct the talents training system to adapt to market development, which can store the necessary talents for enterprises. Finally, promote cross-region talent exchanges and cooperation, and build talent ecosystem. It is beneficial to hold a cross-region talent exchange conference regularly to promote the four -linkage with the aid of information exchange. The methods to learn from the advanced experience and practice in other zones and duly conferences held by news media, industry associations attended by many experts and scholars are helpful to break geographical boundaries, achieve mastery of talent and promote the flowing and sharing of knowledge.

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Acknowledgements

This research work was supported by Projec of Fujian Provincial Social Science Foundation(2014B097).Project of Fuzhou Science and Technology Bureau(2015-G-60).Special project on cross-strait communication and cooperation in vocational education of The Education Deparment Of Fujian Province Project Of Fujian Branch Of The National Insititute of Vocational Education of The Education Department Of Fujian Province Project of Fujian Brance of the National Institute of Vocational Education(GZM15002).The supports are gratefully acknowledge.

Industrial Migration Factors Shaping Regional Network Economy Formation: Based on Diamond Economic Circle Empirical Study

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ABSTRACT

The purpose of this paper is to provide new evidence on the relationship between industrial migration and “Internet+” economy diffusion. For this purpose we conduct the research by Industrial Structure Migration Assessment Model as well as empirical data during the period from 2010 to 2015. On the basis of empirical tests of Chengdu, Chongqing, Xi’an and Kunming, we focus on the “Internet+” economy development of growth poles in Diamond Economic Circle. We find that industrial structure in these regions has shown an obvious trend of advanced, inertia and cooperative, which improves the capacity of e-readiness and lays favorable foundation for “Internet+” economy diffusion for Diamond Economic Circle. Policies for developing “Internet+” economy in Diamond Economic Circle are suggested at last.

Keywords: Industrial structure, internet economy, industrial migration, e-readiness.

INTRODUCTION

Purpose

As the economic structure upgrading of an area has mainly dependent on technology progress, innovative ways from Internet technology have been found out to alter regional economic efficiency. Thus, the use of electronic commerce and its diffusion in economy society have drawn much attention nowadays. With broadly spread of the information technology and network infrastructure, the Internet and e-commerce have been bringing various areas into a networked economy, which is also known as Internet-based economy or “Internet+” economy. Furthermore, e-commerce is the core presentation of this new kind of economic formation. Accordingly, how to adopt e-commerce and to spur economic innovations are both crucial issues for regional economy, since it opens new ways for them to interact with the global market and enhances their competitive ability with in turn advance the economic efficiency.

Although transformation to “Internet+” is important for regional economy, the ability of developing in Internet differs greatly in various areas ((The Economist Intelligence Unit)EIU) [5]. Assessing this ability and taking effective measures are crucial issues to alter transforming to “Internet+” economy. This kind of ability is Internet-based, which is figured out as e-readiness. E-readiness is definite as the “capacity of the community to use ICT as infrastructure to transfer the traditional economy into a digital economy”[5] [1]. Nowadays, e-readiness is becoming more accepted at the level of governments, organizations especially in the growing global open market [11] [4]. Moreover, corporations and governments try to carry out more efficient policy to improve their e-readiness and to alter transformation to Internet. Therefore, the relationship between e-readiness and its ability to transformation have been hot topics in academic circle, corporations and governments.

Chengdu, Chongqing, Xi'an and Kunming are leaders of western advanced productivity, which are situated in the largest urban agglomeration of western region, and play a crucial role in connecting "The Belt and Road" and Changjiang River Economic Zone. As growth poles of the Diamond Economic Circle., development of these cities has an important influence on growth paths of regional economy and is core forcing of western area's sustainable economic growth. Therefore, assessing e-readiness of the four cities based on industrial upgrading is important to keep western region more competitive.

Literature Review

A substantial part of the recent e-readiness literature would prefer to assess factors influencing e-commerce adoption and diffusion [1] [2]. As e-readiness is the main ability of transforming to “Internet+” economy, it can facilitate economic society of competitive advantage and opportunities [5]. The first effort in defining e-readiness is conducted in 1998 by the Computer System Policy Project (CSPP) [12] [18]. From then on, the concept of e-readiness has been defined in some-what different manner. Colecchia(2001) stated that e-readiness “are issues of preparing the technical, commercial and social infrastructures that are necessary to support e-commerce” [3]. The United Nations University claimed that “e-readiness measures how well a society is positioned to utilize the opportunities provided by ICT, where ICT infrastructure, human capital, regulations, policies and internet penetration are all crucial components of e-readiness”. [15]. Harvard University argued that e-readiness is the degree to which a community is prepared to participate in the Networked World [1]. From the above perspective, the nature of e-readiness can be defined as the ability of using Internet infrastructure to transform to “Internet+” economy.

To accelerate to “Internet+” economy, assessment of e-readiness assessment is essential. Many researchers have conducted e-readiness assessment according to its economic or social perspective [9], and factors affect e-readiness are classified to one or more of four categories, such as businesses, customers, environment and government facilitation [2] [6] [7]. Colecchia (2001) put forward a framework based on life circle to measure the relative size or the relative impacts of e-commerce, which “reflects the country's socio-economic and technological infrastructure and usage [3]. Gibbs and Kraemer(2004) developed and tested an integrated model of e-commerce determinants across a broad range of countries[7][8]. Soares and Reis(2008) and

Lou(2010) confirmed that e-readiness is a dominant factor to the success of e-commerce implementation[16] [11]. A research of Oliveira and Dhillon(2015) put forward TOE(technology, organization, and environment) framework and studied the e-commerce adoption and reutilizations across Europe[14]. Wan et al (2008) established e-readiness assessment model to evaluate Wuhan's ecommerce adoption level[19]. Based on estimation results, researchers argue that e-readiness has become crucial capacity of Internet-based economic development, and it in turn dramatic advances the economic growth[17] [20].

Conclusion as a result, the analysis of the above researches indicates that most of researches estimate e-readiness related to internet infrastructure and technology. Yet there is not much in the way of applying economic theory to explain e-readiness's economic function, and especially little has been carried out to explain e-readiness from industrial base, let alone researches on Diamond Economic Circle. As industrial structure upgrading is important for "Internet+" economy formation, we extend e-readiness assessment and focus on empirical study of Diamond Economic Circle by establishing regional industrial structure model, and explore to extend e-readiness research to "Internet+" economy on the basis of industrial structure migration.

Approach and Structure

Given the nature of e-readiness as presented above and the growth problems of Diamond Economic Circle, our research approach followed concentrates on industrial migration direction and its upgrading rate. By keeping track of industrial structure migration, our researches try to explain e-readiness viewed from industrial structure change. The researches differ from previous studies in extending e-readiness assessment to industrial level based on evaluating industrial structure migration. This paper is organized as follow. The next section describes our methodology for assessing industrial migration based on the perspective of developing "Internet+" economy. In this section, we present Industrial Structure Migration Assessment Model, which is constructed of evaluating migration rate and its direction. In section 3, We focus on Diamond Economic Circle's industrial migration evaluation on the basis of data collected from China Statistic Yearbook during the period from the year 2010 to 2015. We analyze the development trend of Chengdu, Chongqing, Xi'an and Kunming in section 4, and further our study on establishing the relationship between industrial migration and "Internet+" economy. In the last section we summarize our research findings, its policy and managerial implications. Limitations and future research are all raised in this part.

ASSESSMENT MODEL

Industrial structure is the result of interior cooperation and division of labor in national economy. Its structural change is seemed to be the core force of economic growth [10]. Based on industrial structure theory and on growth pole theory, this paper establishes Industrial Structure Migration Assessment Model (ISMAM) to explain the relationship between e-readiness and industrial changing, which consists of two parts, Migration Direction Model and Migration Rate Model.

Migration Direction Model

Industrial migration direction is important to socio-economic transformation in "Internet+" environment. Industrial Advance Coefficient is shown as the level of a certain industry beyond the whole economic system. Industrial Advance Coefficient is given by the following equation 1 and 2:

$$E_i = r_i + (r_i - 1) / R_i \quad (1)$$

Where E_i is Industrial Advance Coefficient, r_i is the i^{th} industrial's ratio of the portion between the reporting period the base period, and R_i is the i^{th} industrial's average growth rate in its economic system.

$$R_i = \sqrt[m]{GDP_1 / GDP_0} - 1 \quad (2)$$

Where GDP_1 is the GDP (Gross Domestic Production) of reporting period, GDP_0 is the GDP of base period, and m is number of years during observation.

Migration Rate Model

The angle between reporting period and base period is selected as the index for evaluating industrial migration level, which can be captured by equation 3, 4 and 5.

$$M = \cos(\theta) = \frac{\sum \omega_{i0} \omega_{it}}{\sqrt{(\sum \omega_{i0}^2) \times (\sum \omega_{it}^2)}} \quad (3)$$

Where M is the structure migration value, ω_{i0} and ω_{it} are the regional proportion of reporting period and base period respectively, and θ is the vector angle. The Smaller M and greater θ indicate the faster industrial migration.

$$\theta = \arccos \frac{\sum \omega_{i0} \omega_{it}}{\sqrt{(\sum \omega_{i0}^2) \times (\sum \omega_{it}^2)}} \quad (4)$$

Annual migration ratio presents industrial structure transfer rate, which is signed as alphabet k . Annual migration ratio can be calculated by the following equation:

$$k = \left(\sum_{i=1}^n |\omega_{it} - \omega_{i0}| \right) / m \quad (5)$$

Where n is the number of industries, and m is the number of years during observation.

EMPIRICAL TEST RESULTS

To observe e-readiness from industrial migration, we collect research data from China Statistical Yearbook, including data of Chengdu, Chongqing, Xi'an and Kunming, and estimate industrial rate and its direction in these regions by ISMAM.

Empirical Results of Regional Industrial Migration Direction

We estimate industrial migration direction of research cities mentioned above based on equation 1 and 2. Our estimates indicate the changing situation of industrial structure on the whole. Firstly, the portion of Agriculture has been decreasing continuously during the observation period, with negative coefficient in these regions. As shown in the following Table 1, the average advance coefficient is -0.9915, which implicates transformation from agriculture to other industries obviously in growth poles of Diamond Economic Circle. Secondly, the industrial structure has been transforming to Service in the period from the year 2010 to 2015, with 2.0625% superior to the whole economic system. Furthermore, the industrial structure migrates diversely in various regions. For example, advance coefficients of Service in Xi'an and Kunming have shown a faster structure migration trend than those of Chongqing and Chengdu, which are 2.6543 and 2.6160 respectively. Chengdu and Chongqing are both the largest economic aggregate cities in western area, with GDP over trillion. However, their industrial structure migrations slower than those of Xi'an and Kunming. Our estimates are shown at the following table 1.

Table 1: Assessment Results of Industrial Migration Direction for Core Cities (2010—2015)

Value of E	Agriculture	Industry	Service
Chengdu	-2.1803	0.4650	1.8048
Xi'an	-0.9704	-0.7873	2.6543
Kunming	-0.2778	-0.5436	2.6160
Chongqing	-0.5373	1.1065	1.1750
Average value	-0.9915	0.0602	2.0625

Empirical Results of Regional Industrial Migration Ratio

We calculate the migration ratio of Chengdu, Chongqing, Xi'an and Kunming based on equations 3, 4 and 5. The results show that the value of θ varies greatly among these cities. Apparently, the ratios of Xi'an and Kunming are moving faster than those of Chengdu and Chongqing. For example, the θ values are all over 7 in Xi'an and Kunming, but it only 3.4689 and 1.0661 in Chengdu and Chongqing respectively. Moreover, there is an interesting phenomenon that the region with small economic aggregate has faster migration ratio in observation cities. As demonstrated results following, migration ratio of Xi'an and Kunming is similar to 3, which is only 0.4476% in Chongqing and 1.3814% in Chengdu during the period from 2010 to 2015. As shown in China Statistic Yearbook, GDP in Xi'an and Kunming are 5810.03 billion and 3970 billion Yuan, which are much less than those of Chengdu and Chongqing over the same period. Our findings are shown in table 2.

Table 2: Assessment Results of Industrial Migration Rate for core cities (2010—2015)

	M value	θ	Migration ratio (%)
Chengdu	0.9982	3.4689	1.3814
Xi'an	0.9916	7.4292	2.7067
Kunming	0.9907	7.8036	2.7425
Chongqing	0.9998	1.0661	0.4476
Average value	0.9951	4.9420	1.8196

ANALYSIS OF THE RESULTS

Industrial structure is the basis for "Internet+" economy transforming from, and it also in turn has heavily impact on "Internet+" moving direction and formation. From results present in section 3, the industrial structures of the four cities have been tending obviously advanced change, inertial trend and cooperative development.

Industrial Structure Advance Trend

Industrial structure advanced trend is considered important for “Internet+” transformation since it improves resource allocation efficiency and provides more possibility for regional economy to contact with network market. Accordingly, this trend should be treated as the core factor of e-readiness for regional economy and also the foundations for network economy development. As it is presented in above tables, the average changing rate for migration direction is 2.0625%, and the average migration rate for structure change is close to 2%. The phenomena hint that a more reasonable and advanced industrial structure have been forming in observation areas, reflecting more competitive in resource allocation and in developing on Internet than other western regions. Therefore, with stronger capacity for “Internet+” development, the four cities’ economy changing rate on Internet is critical for deploying “Internet+” economy strategies in western regions.

Industrial Structure inertial Trend

Industrial structure inertial trend is the impact on economic growth stemming from original resources allocation patterns, production methods and social division of labor. With obvious path-dependence on industrial structure change, this trend can disturb “Internet+” transformation. Consequently, industrial structure inertial is important to e-readiness for “Internet+” transformation. As presented in our empirical results, the inertial trends of the four cities are evident, especially in Chongqing. The data from National Bureau of Statistics shows that the GDP of Chongqing is 15719.72 billion Yuan in the year 2015. Although Chongqing’s economic aggregate ranks the first in western region, its industrial migration rate is only 0.4476% and is the lowest one in these cities. How to adapt to inertial trend and what positive actions should be taken are both important issues, which western regions have to be faced up with in the “Internet+” transformation.

Industrial Structure cooperative Trend

Chengdu-Chongqing urban agglomeration, Guanzhong city cluster and Central Yunan city group are vital agglomeration in China’s socio-economic development. Chengdu, Chongqing, Xi’an and Kunming are all traditional major drivers of economic system in these clusters. As shown above, industrial structures in these cities have obvious advanced, rationalize and inertial trend, which has further enhanced their pole function in regional economic development. As growth poles in their respective cluster, they have crucial effects on leading respective areas to participate in cross-regional collaboration and in turn to spur industrial upgrading. Accordingly, industrial structure cooperative trend is forming during observation period. Chengdu is prominent in electronic information and aviation industry, and is known as a famous consumer center; Chongqing is a traditional industrial city, and is noted for its advanced manufacturing and electronic industry; Xi’an has abundance resources of education, science and technology, and has prominent ability in technological research and talent training; Kunming is a excellent tourist city, and is outstanding in tourism and new material industry. Visible differences in industrial structure make a favorable le-readiness and lay substantial foundation for cooperation in Internet.

DISCUSSION AND IMPLICATIONS

Discussion of findings

This research confirms the importance of e-commerce for economic sustainable development based on regional industrial structure analysis and explores to assess e-readiness from industrial structure migration. Our research extends previous assessment framework of e-readiness by adopting Industrial Structure Migration Assessment Model. The research also demonstrates that the original industrial structure is as important as Internet infrastructure in shaping “Internet+” economy formation. Our findings are listed as following: (1) Industrial structures in core cities of Diamond Economic Circle have been optimized during observation period, which are consequently beneficial to western economy transfer to Internet. (2) Chengdu, Chongqing, Xi’an and Kunming are economic growth poles in Diamond Economic Circle, and industrial rationalizing and upgrading in these cities’ have dramatically enhanced the capacity for these areas to collaborate with global industrial chain resources via Internet. Consequently, much more attention should be paid to industrial structure upgrading for improve e-readiness situations in regional economy. (3) Although industrial structures of Chengdu, Chongqing, Xi’an and Kunming have been upgrading obviously, the industrial transformation and upgrading are still impacted seriously by traditional social resources allocation. Accordingly, how to adapt to this situation and to improve e-readiness level in these areas are both crucial issues to Diamond Economic Circle.

Policy and managerial implications

Our research results have both policy and managerial implications. According to our findings, much more attention should be paid to the following issues. Firstly, it is no doubt that “Internet+” economy is becoming more accepted in recent years for its ability to spur sustainable economic growth in the growing competitive global market. E-readiness is the core capacity for a society in developing “Internet+” economy, especially its industrial upgrading and transformation in these areas. Therefore, much more measures should be taken to accelerate industrial migration towards advance, collaboration and optimization. And in this way, e-readiness of Diamond Economic Circle can be consolidated and promoted consequently. Secondly, Chengdu, Chongqing, Xi’an and Kunming are relatively developed area in western of China. Based on growth pole theory, promoting the growth rate of transformation towards “Internet+” will accelerate network economy diffusion more effectively. So, more efficient policies should be conducted to encourage industrial innovation and transformation in western growth poles. Thus the efficiency of e-readiness and the abilities to participate in “Internet+” economy will be improved in Diamond Economic Circle through polarization effect and (trickling-down effect. Thirdly, collaboration cross-regions extend the capacity for regions to keep up with the global economy in a digital way, thus it is essential to take efficient steps to strengthen regional cooperation by breaking through the restriction

Limitations and future research

The study limited in several ways. First, the results are based on statistical data during the period from 2010 to 2015, so results may not be accurate enough to reflect the trend of industrial structure migration in these regions. Further research with longer observation period will be carried out to estimate more accurately about industrial migration in observation areas and to explain more realistically the e-readiness and “Internet+” economy development from industrial structure changing. Second, due to our choice of research method, Internet infrastructure is not concluded in our research framework, which is characterized as the base of e-readiness and “Internet+” economy. So, to estimate e-readiness more accurately and to accelerate “Internet+” economy diffusion, comprehensive framework will be explored in future research. Third, as opening, sharing and innovation are core features of “Internet+” economy, regions should strengthen their cooperation activities via Internet and to improve the general ability of extending in digital economy. Therefore, future research also should pay more attention to regional collaboration factors in e-readiness assessment framework. Finally, our observation areas are Chengdu, Chongqing, Xi'an and Kunming. Thus results modest represent e-readiness level based on industrial structure in Diamond Economic Circle, which cannot explain the function of growth poles in regional “Internet+” transformation. More areas should be included in our future research to show a richer, multi - level regional industrial migration and to capture more accurately the pattern of tra

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The Development and Tendency of Cross-Border E-Commerce in China

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ABSTRACT

Recent years witness the rapidly development of cross-border e-commerce in China, which presents as the springing up of the cross-border e-commerce platforms and enterprises. Beginning from analyzing the development of cross-border e-commerce in China, this article introduces the business modes and transaction process of cross-border e-commerce, finds out several problems which are against further development, and predicts the tendency of cross-border E-commerce.

Keywords: Cross-border E-commerce; Business mode; Transaction process

INTRODUCTION

E-commerce is a dynamic and an important sector of the economy, and it means a set of transaction made by computer networks, especially by Internet. These transactions always concern on the purchase or sale of goods and services ordered online, but the payment and the delivery may be performed in any form (online or offline) [1]. Cross-border E-commerce is a special kind of E-commerce, of which trading partners are in different countries. It has the characteristics both of e-commerce and of international trade.

On the last March 15, the Chinese Premier Li presented the “Internet Plus” as the strategic planning of the Chinese economy in the Report on the Work of the Government, and he pointed in particular to the development of the cross-border e-commerce. We regard “Internet Plus” as a kind of power, which comes from the information enabled by the Internet. When pulling this kind of power into international trading, we get cross-border e-commerce [2]. In the context of the grim international trading, the trade volume of cross-border e-commerce can be continued growth at the rate of more than 30%, which shows that the superiority of it. Thanks to the benefit of the national policy, China’s cross-border e-commerce achieved the explosive growth in 2015. According to the statistical report released by the Chinese Ministry of Commerce, there are more than 5,000 cross-border e-commerce business platforms and more than 200,000 cross-border enterprises doing business on these platforms in China [3].

There are three kinds of cross-border platforms contributing to the development of China’s cross-border e-commerce. The first one is the original and well-known cross-border e-commerce platforms, like e-Bay and Amazon. As the data from eBay, Chinese sellers sell their goods to more than 220 countries. The next one is some new platforms, include both the platforms developed by huge e-commerce enterprises, like Tmall Global and the platforms no user base like Darling. The last kind of platform is developed by traditional industry. These enterprises take the advantage of financial resources to build the cross-border e-commerce platforms for holding tight the opportunity of it. For example, Heysroad Technology is a cross-border e-commerce company founded by ZET group, who is famous as the producing of mobile phone. ZETmart is the export platform of Heysroad Technology, on which the main goods exported are shoes. There are also some other enterprise starting to set up online sales channels, through which sell their products to other countries.

The rest of this paper is organized as follows. In the next section, we summarize and analyze the business modes of cross-border e-commerce. We then describe respectively the transaction processes of import and export cross-border e-commerce, after which we explore the bottleneck and the tendency of the cross-border e-commerce in China. In the final section, we present our conclusion.

BUSINESS MODES OF CROSS-BORDER E-COMMERCE

Same as traditional e-commerce, the business modes of cross-border e-commerce can be divided into C2C (customer to customer), B2C (business to customer), B2B (business to business) and O2O (online to offline) etc., according to the type of two parties of a deal. The differences between traditional e-commerce and cross-border e-commerce in business mode are that the mode M2C (manufacturer to customer) is used a lot in cross-border e-commerce, and that the mode B2B matched and the mode community e-commerce turn up under the background of cross-border e-commerce.

Business Modes of Cross- border Export E-commerce

Currently, the main business modes of Cross-border export e-commerce are C2C and B2B. In the mode C2C, the market is based on numerous small business people who focus on foreign markets in order to avoid the fierce competition in the domestic e-commerce environment. The main platforms for these small business people are eBay and Ali Express. Ali Express is a cross-border export platform under Alibaba group. It is an active platform. The trade data shows that there were 21,240,000 orders on the day November 11, 2015, the buyers covered 214 countries and regions [4]. Same as the cross-border import e-commerce, the mode C2C export also has some weakness such as the lack of the sincerity and inefficient. Considering these, Ali Express announced that the platform will be all for industries not for business people so that transform

the mode from C2C to B2C [5].

As the whole cross-border e-commerce industry, the main force of the trading volume is enterprise in the mode B2B. The cross-border export e-commerce platform Alibaba is the first business of Alibaba group and it runs in the mode B2B. There are more than one million small and medium-sized enterprises sell their products to the world through the platform Alibaba. By the end of 2015, the domestic suppliers on the Alibaba had amounted to millions and there were 10 million domestic buyers and 100 million overseas buyers, which show the development potential of the B2B cross-border e-commerce [6].

A New Business Mode in Cross-border E-commerce

M2C means the mode manufacturers to customer. This is a mode appeared early but not well known until it is widely used in cross-border e-commerce. The fragmentation of the demand drives the manufactures turn their business mode from B2B to M2C. M2C have four advantages over other modes. First, it can offer lower price to the customers, because the reducing of the circulation leads to the decrease of the selling cost. Second, it can offer customization to the customers. In this mode, customers order goods directly towards the manufacturers. It can not only meet the customized needs of the customers, but also reduce the production risk of the manufacturers. Third, through M2C, the customers can get better after-sales service. Manufacturers provide all kind of after-sales services directly in which to shorten the time for solving the problems, and the customers don't need to worry anything about the after-sales service. Last, it's a mode conducive to innovation. The manufacturers can feed back by the customers more easily so that they develop new products according to the demand of the market. Ningbo is one of the pilot cities for cross-border trade who runs in the mode M2C. Ningbo has fulfilled orders more than 15 million and sales of 380 million CNY.

TRANSACTION PROCESS OF CROSS-BORDER E-COMMERCE

Import Transaction Process

Currently, in the case of import cross-border e-commerce enterprises in B2B mode, the online websites just be used for advertising and posting products information, the transaction and the customs clearance process are substantially completed offline. However, in the B2C mode, the transaction and the customs clearance process are completed online. There are three main types of transaction processes, namely bonded stocking mode, bonded goods collection mode and direct mail mode.

Bonded stocking mode allows the e-commercial enterprises importing certain commodities, the declaration forms to customs are the same as importing goods. Commodities are bonded storage in bonded zone, waiting for the online orders generation. Then the e-commercial enterprises will declare the customs clearance procedures and pay parcel tax. In this mode, the e-commercial enterprises purchasing, customs clearance and logistics costs will decrease significantly. As a result, the profits will increase. The transaction process of bonded stocking mode is shown in Figure 1.

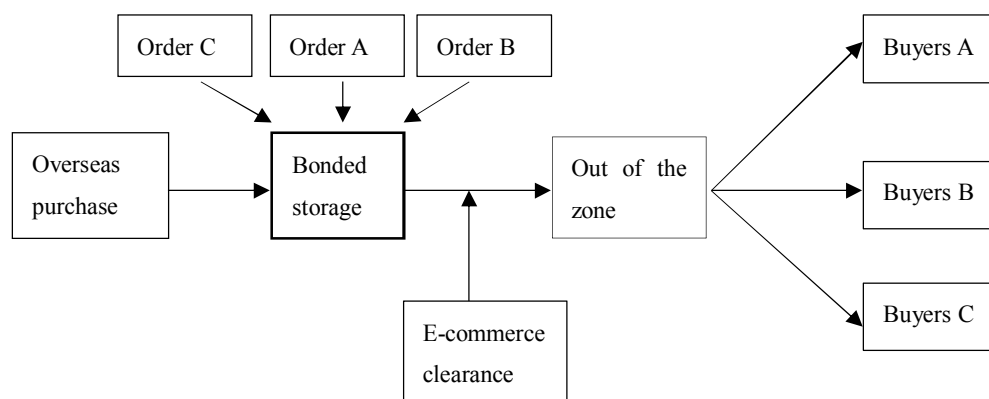


Figure1: Bonded stocking mode flow

The transaction process of bonded goods collection mode is shown in Figure 2. After consumers place their orders on the e-commercial business platform, the e-commercial enterprises will ship the goods to special customs supervision area and commission logistics enterprises to submit "cross-border e-commerce trade entry and exit of goods declaration list" to customs. Then based on the orders information, logistics enterprises package the goods into parcels in the regulatory region. After customs clearance inspection, the parcels will be out of the district as personal belongings and will be delivered to the consumer by domestic courier company.

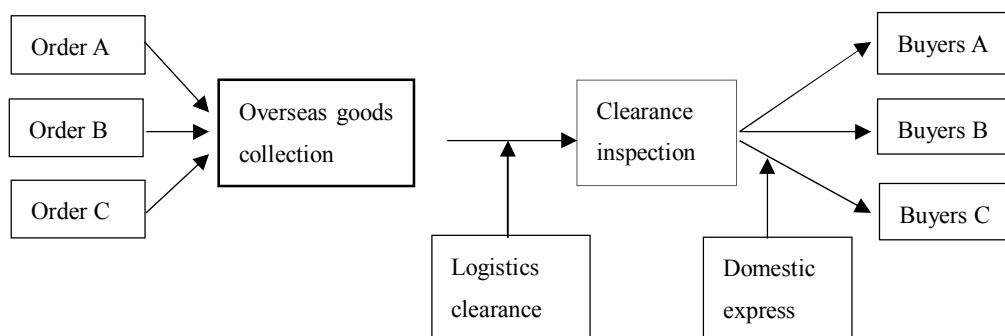


Figure 1 :Bonded goods collection mode flow

Figure 3 shows the transaction process of direct mail mode. Consumers order on the e-commercial business platform. The e-commercial enterprises will be responsible for the goods which are packed into parcels to the customs express supervision area, and commission logistics enterprises to submit “cross-border e-commerce trade entry and exit of goods declaration list” to customs. After customs clearance inspection, the parcels will be out of the district as personal belongings and will be delivered to the consumer by domestic courier company.

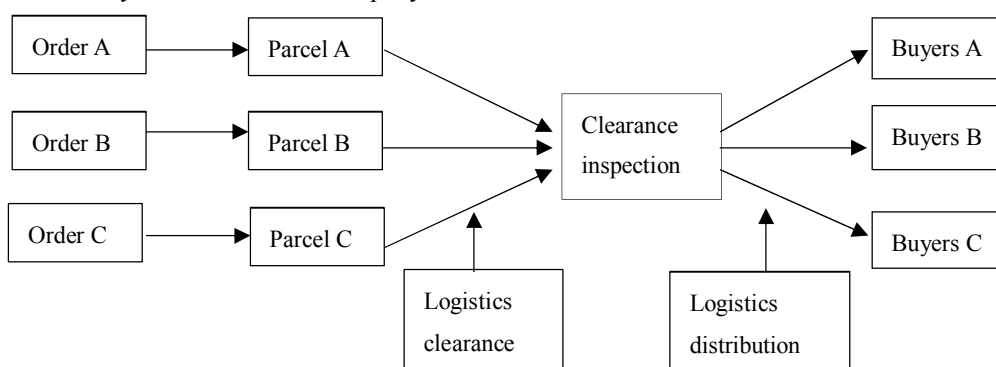


Figure 2 :Direct mail mode flow

Export Transaction Process

The e-commercial enterprises which completed transaction process online are basically B2C or C2C mode. In these two kinds of modes, the transaction processes are mainly of two types. one is direct mail mode and the other is overseas warehousing mode. Wherein the e-commercial enterprises of C2C mode use direct mail mode, which is similar to import direct mail mode transaction process. This mode is mainly relying on the international logistics company which is also the main body of the declaration, therefore, logistics costs will be relatively high and the size of transaction will be smaller.

Most cross-border e-commercial enterprises of B2C mode have their own overseas warehouses. According to the eBay's data shows that the percentage is 85%, that means overseas warehouses have become the basic standard configuration of cross-border export e-commercial enterprises. Similar to bonded stocking mode of cross-border import e-commercial enterprises, overseas warehousing mode refers to sellers established their own overseas warehouse in the other countries, commodities are shipped from one's own country to the overseas warehouses and customers ordered to buy items they need through the internet. Then the sellers only need to give the operation order to overseas warehouses online for order fulfilment. Finally, the commodities are delivered from the buyer's home country, the delivery time is greatly reduced compared with the commodities are delivered from the seller's home country.

DEVELOPMENT BOTTLENECK OF CROSS-BORDER E-COMMERCE

The first development bottleneck is uneven integrity level of consumer. In the import e-commerce, consumers often doubt whether their buying is genuine, the fermentation effect of this kind of fake events is often stronger than most people would think. For example, Vip.com had been plunged into a crisis of confidence because of its selling event. One of cross-border e-commerce advantages lies in the lower price, but people would not be willing to spend more money in this area if there is no genuine guarantee. Another aspect, the cross-border export e-commercial enterprises are also facing the risk of international buyer fraud. Foreign media reports that the government dealt with a \$1.7 trillion return fraud. The buyers replaced the genuine product using a fake and returned to the seller, then received a full refund through the cross-border e-commerce trading platform. As can be seen from the above example, the cross-border e-commercial enterprises provide service to a wider customer market, have more profit opportunities, besides, they also face more risks and challenges. Thus, the consumer's integrity crisis becomes a big problem especially in a market with weak regulation.

The second development bottleneck is cross-border logistics. As we know that the delay of logistics delivery will not only bring bad experience consumption to consumers, but also bring huge economic losses to the sellers. In order to minimize the

impact of cross-border logistics to export e-commerce Alibaba Group Ali Express and Rookie network jointly launched “AliExpress Easy Logistics” services including taking express, distribution, logistics details tracking, logistics disputes handling, after sale payment and other one-stop logistics solutions for sellers. “Worry Logistics” effect remains to be tested.

The third development bottleneck is inefficient information exchange. The construction of information sharing platform needs to invest lots of financial and human resources. Cross-border e-commercial enterprises are hard to succeed facing with the unpredictable global economic environment without a strong, effective information exchange platform to support.

THE DEVELOPMENT TREND OF CROSS-BORDER E-COMMERCE

Future development focus on B2B mode

The pillar of the entire cross-border e-commerce industry is B2B mode cross-border e-commerce. From the perspective of market scale, cross-border e-commerce accounted for about 17% of the proportion of foreign trade imports and exports, of which 90% are B2B mode, part of cross-border retail trade accounted for only about 3% of foreign trade. In the first half of 2015, the total cross-border e-commerce transactions in China has exceeded 2 trillion CNY. Ministry of Commerce predicts that by 2016 China's imports and exports trade volume of cross-border e-commerce will reach 6.5 trillion CNY, the next few years, the proportion of cross-border e-commerce in China's imports and exports trade will increase to 20%. Compared with B2C mode, B2B mode has a good ability to resist fake, and the transaction has the characteristics of high value in this mode. Therefore, the next focus should be placed on the development of B2B mode cross-border e-commerce. Further we could borrow overseas advanced experiences to improve our tax policy system, establish the information exchange platform, set up cross-border logistics support network, etc.

Standardization of the cross-border e-commerce process

The standardization of the process is an important issue for the sustainable development of the cross-border e-commerce. Normative declaration process and logistics process make the supervision easy for the custom, which guarantee the goods come from the regular channels.

The work of the standardization of the process is the mission of the government. The typical example is the first cross-border e-commerce comprehensive experimental zone in Hangzhou. Hangzhou through the building of Information sharing system, Financial service system, Intelligent logistics system, E-commerce credit system, statistical monitoring system, Risk prevention and control system, as well as the online “single window” platform and the offline “comprehensive park” platform, which called “six systems and two platforms”, realized the converging of the information flow, the capital flow and the cargo flow in the cross-border e-commerce market. Based on these, Hangzhou government established a set of new regulatory rules for cross-border e-commerce. With the exploration on the management of cross-border e-commerce, it developed well in Hangzhou, and the success of it can be copied. So, the central government set up another twelve cities as cross-border e-commerce comprehensive experimental zone, include Tianjin, Shanghai, Zhengzhou etc.

CONCLUSION

Cross-border e-commerce in China is in the stage of innovation and integration, which reflected in the diversification of business modes and the irregularity of the transaction process. We consider that B2B mode will be the main force in the cross-border e-commerce. Although the rapidly development of the cross-border e-commerce is widely recognized, we can't affirm if it is in the state of overheated. With the further development and the implementation of the new policy, maybe many of the cross-border e-commerce enterprises would be driven out of the market and creating a “there are only one super and several big enterprises in the market” situation.

Our research has several implications for theory and practice. First, to the best of our knowledge, there is few researches focus on the Cross-border E-commerce at the context of Chinese national. Our studies are focus on the development and the tendency of the cross-border e-commerce in China and try to draw a whole picture of it, so it lay a foundation of the future research. Second, we provide some bottlenecks of the development of the cross-border e-commerce, which can encourage the enterprises innovation to find out the solutions of the problems. Moreover, it can also help the government making policy to stimulate the development of cross-border e-commerce. The further study will lay on the process optimization of the cross-border e-commerce based on the analysis of the process in this paper.

ACKNOWLEDGEMENT

This research was supported by the Xi'an Science and Technology Project under Grant SF1502(1).

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The Cross-border Electricity Business Cloud Services Platform Based On A Combination Of Cloud Computing Services Composition

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ABSTRACT

Nowadays cloud computing industry has turned to the stage of small-scale application from the stage of import and preparation, so business model has become an integral part in cloud computing. According to the existing problem of commercial operation in cloud computing, by analyzing and forecasting the service composition effects, this paper proposes the theoretical thought of synthetic prediction of risk management for cloud computing services composition systems, gives a synthetic prediction model of services composition, namely multi-layer recurrent model, and analyzes its properties. Then based on multi-layer recurrent model, the construction and application prospect of the cloud service platform based on cloud computing service portfolio is discussed.

Keywords: Cloud computing, Services composition, Synthetic prediction, Cross-border electricity business.

INTRODUCTION

Information technology is recognized as one of the most important focuses of national competition. Cloud computing is the latest development trend in IT industry. In cloud, IT resources including software, hardware and platform, are provided as infrastructure to users in the form of service [9]. Most of the existing researches focus on cloud computing technology (e.g. virtualization, standardization, parallel computing and open source computing). Few literatures of cloud computing from the perspective of company or organizational management in business and management context exists [7]. Cloud computing, as a new utility computing model, is the development of grid computing, distributed computing and parallel computing. And it is the commercial implementation of these models. The success of cloud computing services systems largely depends on the development of the commercial operation mechanism. For a cloud computing service carrier, a market strategy in line with the business interests, is an essential point [14]. The biggest difference between cloud computing and previous computing paradigms is that its emerging business model, which creates remarkable commercial value [15]. In the study of Weinhardt et al. [12], they propose a cloud business model framework, which suggests that each of cloud service model should be based on a certain business model [8]. And Zhang, Cheng and Boutaba [13] presents that the business model in cloud computing is usually considered synonymous with the role of carrier. Fischer and Turner [3] suggests that cloud computing is a cooperation-oriented system composed by different stakeholders of cloud computing carriers and service providers as a service supply chain.

However, cloud computing services carriers in commercial operation is facing a key issue, i.e. in order to better address customer need and buck for the long-term development of enterprises, they need generate some strategies to coordinate the behavior of members in cloud computing services supply chain so that each member can consider the impact of its action on other members to make the optimal strategy in the whole supply chain system, to share market risk, to achieve a win-win situation, and to improve the competitiveness of the entire cloud computing service supply chain. Therefore, based on the former studies, the paper introduces the theory of services composition to solve the above problem.

By cloud computing services composition, we mean that the related services are assembled dynamically by the specific needs then published as a new service that accomplishes particular tasks. This is showed in Figure 1. Modern service enterprises can effectively utilize the shared IT resources of the whole society and the intelligent analysis of customer demand by services composition, and they can formulate and implement various innovative and targeted service measures so as to achieve ahead of the competition and sustainable development.

In fact, when consumers select service patterns or services composition patterns, they choose better services composition generally by analyzing and forecasting future effects of various service patterns. Here selection obviously contains the component of prediction. So we can establish the respective prediction models to all sorts of service patterns, and utilize the prediction results of all prediction models, by using the idea of combination forecasting [11] [1] [2] or synthetic prediction [6] [10] [5]. The services composition with ideal future prediction by appropriate combination can be called synthetic prediction model of services composition. Here there is no establishing that these are ideal or that there is an appropriate combination. In this paper, an idea of synthetic prediction of cloud computing services composition is given. And the construction and application prospect of the cloud service platform based on cloud computing service portfolio is discussed.

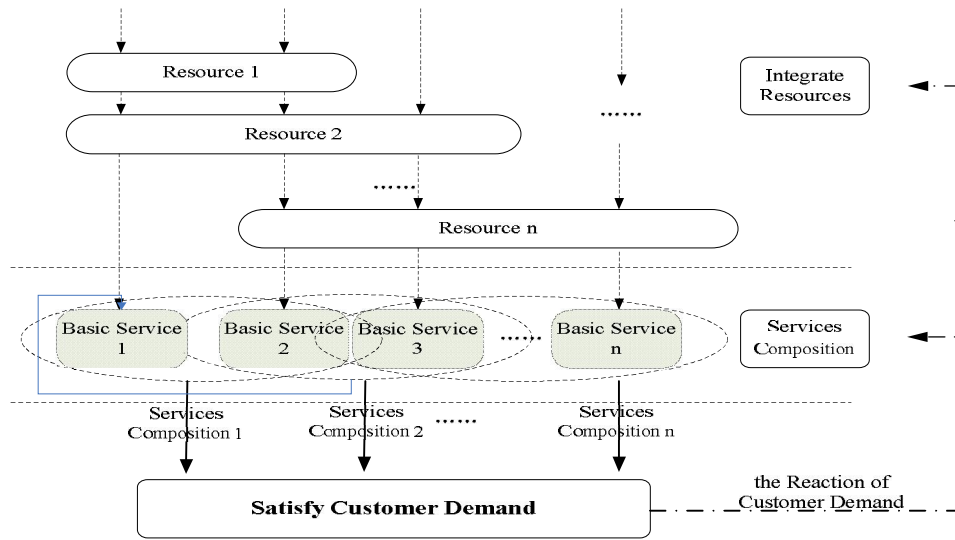


Figure 1: Cloud computing services composition systems

MULTI-LAYER RECURRENT PREDICTION MODEL OF CLOUD COMPUTING SERVICES COMPOSITION

Basic Concept

Suppose S is a dynamic cloud computing service composition system, F is a model family that all models are corresponded to kinds of service composition modes, and M_i denotes the model in the model family. So the following expression is showed:

$$F = \{M_i, i \in I\} \text{ or } \{M\}, \quad (1)$$

where I represents the indicator set.

Only consider the case of discrete time system. k is a discrete timevariable (e.g. year, month, or day). $y(k)$ is the output of S , and $u(k)$ is the input. Without loss of generality, let the model $M \in F$, and it can also be written as one step forward prediction form:

$$M : y(k) = f_M[Y_{k-1}^{k-n}, U_{k-1}^{k-n}, \theta, v(k), k], \quad (2)$$

Where θ is a parameter, $v(k)$ is the random noise of difficult to measure for the system, $Y_{k-1}^{k-n} = \{y(k-1), L, y(k-n)\}$, and $U_{k-1}^{k-n} = \{u(k-1), L, u(k-m)\}$ (n and m are both model order).

Multi-Layer Recurrent Prediction Model

Multi-layer recurrent model is an improved method on least squares composition model. The basic form of the prediction model is

$$y(k) = \sum_{l=1}^h \beta_l M_l(k | k-1). \quad (3)$$

When $\phi(k) = (M_1(k+1|k), L, M_h(k+1|k))^T$ and $\beta = (\beta_1, L, \beta_h)^T$, expression (3) can be written as

$$y(k) = \phi(k)^T \beta \quad (4)$$

If these known observation data are

$$(y(k), \phi(k)), k = N_0 + 1, N_0 + 2, L, N,$$

$\hat{\beta}(k)$, the estimation of β , is obtained by the following recursive algorithm:

$$\hat{\beta}(k) = \hat{\beta}(k-1) + \frac{\phi(k)}{\|\phi(k)\|^2} \{y(k) - \phi(k)^T \hat{\beta}(k-1)\}. \quad (5)$$

When the matrix

$$H(h) = \begin{bmatrix} \phi(N_0+1)^T \\ \phi(N_0+2)^T \\ \Lambda \\ \phi(N_0+h)^T \end{bmatrix}$$

is an invertible, the initial value $\hat{\beta}(N_0)$ in expression (5) is given by $H(h)^{-1} \hat{\beta}(N_0) = Y$, where

$$Y = [y(N_0+1), L, y(N_0+h)]^T.$$

Suppose the estimation sequence of $\hat{\beta}$ is $\hat{\beta}(N_0+1), \hat{\beta}(N_0+2), L, \hat{\beta}(N)$.

Therefore

(1) According to the above estimation sequence, the model that the parameter $\beta(k)$ satisfies is determined by application of appropriate identification.

(2) $\hat{\beta}(N)$ of one step forward predictive value is given by application of the model:

$$\hat{\beta}(N+1|N) = (\hat{\beta}_1(N+1|N), L, \hat{\beta}_h(N+1|N))^T.$$

Then the multi-layer recurrent prediction model is

$$\hat{y}_M(N+1|N) = \sum_{l=1}^h \hat{\beta}_l(N+1|N) M_l(N+1|N) = \phi(N+1)^T \hat{\beta}(N+1|N). \quad (6)$$

Previous research^[4] elucidates that as long as the error between the parameter's predictive value $\hat{\beta}(N+1|N)$ and the parameter's estimation $\hat{\beta}(N+1)$ is sufficiently small, the prediction error of multi-layer recurrent prediction model is small enough, that is, with a multi-layer recurrent prediction model to solve the prediction problem of cloud computing services composition systems can reduce the prediction error.

The practical economic meaning of this composition mode (expressions (1)-(6)) is that because of full consideration to the dynamic time-frequency features of the system, the prediction error is greatly reduced (by the theoretical proof of the literature^[5]) and the effect of the future services composition becomes better because the prediction accuracy is improved.

THE THEORETICAL THOUGHT OF SYNTHETIC PREDICTION MODE

The Best Matching Criterion Of The Model And Algorithm

The basic idea of synthetic prediction pattern [6] [10] is that based on the observation data, the most suitable prediction model, the most appropriate parameter estimation algorithm and parameters prediction algorithm are selected, in order to get the best match of the model and the algorithm separately from the existing model family and algorithm family, and as much as possible

to obtain a better prediction results. Therefore, the key to solve the synthetic prediction problems is the search for the best matching criterion of the model and algorithm with data [5].

For the sake of convenience, it is assumed that by some appropriate steps, all models are written in the form of prediction model with unknown parameters: $M_1 : y(k) = M_1(\theta_1(k)) + e_1(k)$,

$$\begin{aligned} M_2 : y(k) &= M_2(\theta_2(k)) + e_2(k), \\ \dots \\ M_n : y(k) &= M_n(\theta_n(k)) + e_n(k), \end{aligned}$$

where n is the number of models, $y(k)$ is the predicted value, and $e_i(k) (i=1, 2, \dots, n)$ is the random noise. So the model family is $M = \{M_1, M_2, \dots, M_n\}$.

The basic assumptions are as followed:

Suppose S is a dynamic cloud computing service composition system to be predicted; $e(k)$ represents the white noise with constant variance and it is not a zero mean in the system. It is typically around 10^{-9} . If the system S is described correctly by the model M_i , there exists $e_i(k) = e(k)$.

Due to the model with unknown parameters, primarily the unknown parameters need to be estimated for solving the prediction problem. Suppose l_1 parameter estimation algorithms can be applied. Based on the observation data and application of parameter estimation algorithm, a series of estimation of the parameters can be drawn in the last moment:

$$\hat{\theta}_i(1), \hat{\theta}_i(2), \hat{\theta}_i(3), \dots, \hat{\theta}_i(M), i=1, 2, \dots, n.$$

Then, the parameter $\hat{\theta}_i(k)$'s predictive value $\hat{\theta}^*(M+h) (h \geq 1)$ can be determined by appropriate parameters prediction method. If there are l_2 kinds of prediction methods available, the number of matching modes between parameter estimation algorithms and parameters prediction algorithm is $l_1 l_2$, let $m = l_1 l_2$. So there will be an algorithm family $A = \{A_1, A_2, \dots, A_m\}$, containing m kinds of matching modes.

The prediction results of the model M_i and the algorithms A_j for system S meet some optimal criterion, this is to say, the model M_i and the algorithm A_j with the system S is the best match under this criterion.

Suppose that the algorithm A_j is good enough to make the best matching among the model M_i and the algorithm A_j with the system S . Then the residual error is

$$\varepsilon_i^j(k) = y(k) - M_i(\hat{\theta}_i^j(k)), M < k \leq N. \quad (7)$$

which is the sample value of the white noise $e(k)$, and $\hat{\theta}_i^j$ represents the evaluation of the parameter in the model M_i by the algorithm A_j .

Prediction Accuracy Discriminate

If the model with the most specific match to the prediction system S at time k is M_{i_0} , and the algorithm is A_{j_0} , there is

$$\varepsilon_{i_0}^{j_0}(k)^2 = \min_{i,j} \varepsilon_i^j(k)^2, M < k \leq N. \quad (8)$$

Take into account that time-variation and diversity of the system prediction model. So instead of directly using a squared error value of this prediction as the criterion for determining the prediction system with the most specific match to the model and algorithm, the following weighted average is adopted:

$$\eta_i^j(k) = \alpha \eta_i^j(k-1) + (1-\alpha) \varepsilon_i^j(k)^2, M < k \leq N, \text{ and } \eta_i^j(M+1) = \varepsilon_i^j(M+1)^2. \quad (9)$$

Where α satisfies $0 < \alpha < 1$. So $\eta_i^j(k)$ is called the prediction accuracy when the system S is matching with the model M_i and the algorithm A_j . Then, the prediction accuracy discriminate is given by:

If the model M_{i_0} and the algorithm A_{j_0} satisfy

$$\eta_{i_0}^{j_0}(k)^2 = \min_{i,j} \eta_i^j(k), \quad (10)$$

the system S with the model M_{i_0} and the algorithm A_{j_0} are the best match (by the theoretical proof of the literature [10]).

SYNTHETIC PREDICTION METHOD OF CLOUD COMPUTING SERVICE COMPOSITION

Based on the foregoing research, the main steps of the synthetic prediction method of cloud computing services composition can be further drawn:

(1) According to the characteristics of the observation data, a subfamily u_0 is made up of some models from the model family, which are available for the observation data.

(2) Unknown parameters of each model in the subfamily u_0 should be dependent on the observation data, and estimated by the estimation algorithm. Suppose the estimation sequence obtained is

$$\hat{\theta}_i^{l_1}(1), \hat{\theta}_i^{l_1}(2), L, \hat{\theta}_i^{l_1}(N_0),$$

Where i is the sequence number of the model in u_0 , l_1 is the label of the estimation algorithm, $N_0 = N - h$ is the end time of the observation data, and h_0 is the length of the test predicted segment. The last parameter h_0 generally depends on the number of the observational data, and the value can be $1 \sim 5$, usually $h_0 = 3$ or $h_0 = 2$.

(3) Derive the parameter predictive value during the test predicted segment:

$$\hat{\theta}_i^{*l_1 l_2}(N_0+1), L, \hat{\theta}_i^{*l_1 l_2}(N_0+h_0),$$

Where l_2 is the sequence number of the parameter prediction algorithm.

(4) Calculate

$$\varepsilon_i^{*l_1 l_2}(N_0+\gamma) = y(N_0+\gamma) - M_i(\hat{\theta}_i^{*l_1 l_2}(N_0+\gamma)), \quad \gamma = 1, 2, L, h. \quad (11)$$

(5) The model and the algorithm with the most specific match to the system at N time is determined by the prediction accuracy discriminance, and suppose the model is M_{i_0} and the algorithm is A_{j_0} .

(6) Work out the parameter predictive value $\hat{\theta}_{i_0}^{j_0}(N+1)$.

(7) The one step forward predictive value can be got by the prediction formula:

$$\hat{y}(N+1|N) = M_{i_0}(\hat{\theta}_{i_0}^{j_0}(N+1)). \quad (12)$$

Finally, with the obtained prediction results, changing N to $N+1$, and repeating step (2)~(7), the prediction results in h step forward can be determined.

CLOUD COMPUTING SERVICES PORTFOLIO SYSTEM APPLICATION---HARBIN “CHINA-RUSSIA” CROSS-BORDER ELECTRICITY BUSINESS CLOUD SERVICES PLATFORM

Harbin “China-Russia” Cross-Border Electricity Business Platform To Build Cloud Services

Harbin “China-Russian” cross-border cloud service platform construction goal is: put forward the model of cross-border e-commerce services and solutions, security technology R & D information based e-commerce cross-border trusted collaborative technology and other basic services, customs clearance, to demonstrate the application of network technology and transaction related business integration platform and significantly improve the cross-border network transaction based information credibility, efficiency and other aspects of customs clearance network, transaction related business integration, will create the following specific objectives:

- (1) According to the particularity of the “China-Russian” border trade, focusing on cross-border e-commerce service platform, fully open to Russia bilateral trade new e-commerce business era, the new Russian e-commerce cloud service platform, in order to solve the problems of China foreign trade enterprises and businesses in the development of trade with Russia on the difficulties encountered;
- (2) The use of one-stop high credible Russian e-commerce service system, including solving customs, operations, marketing, logistics, payment and other issues, so that China foreign trade enterprises and businesses easy to conduct trade with Russia, to promote the rapid development of economy and trade of the “China-Russian” benign operation;
- (3) Vigorously develop cloud services platform for China's foreign trade enterprises and businesses to expand the Russian trade provides the best solution and ways to make “China-Russian” international trade to a new stage of development.
- (4) The Harbin cross-border e-commerce pilot city and country attaches great importance to “China-Russian” economic and trade relations, focus on the development of more than 3 cross-border e-commerce service enterprises, the formation of 5 billion / years the size of the trade, promoting cross-border e-commerce full service.

Harbin “China-Russia” Cross-Border Electricity Suppliers Cloud Service Platform Construction Content

The platform construction includes: Research on innovative service mode of Sino Russian trade cross-border e-commerce based on cloud services platform, breakthrough business application platform, the whole network management, network promotion, information service and information sharing, transaction optimization and integration, flexible supply chain and the supply chain finance, mobile services, cloud service integration 8 the key technology research and application of the Sino Russian cross-border e-commerce services.

The core technology of big data era of cross-border e-commerce is in a comprehensive perception, reliable transmission based on cloud computing platform using intelligent processing technology, the vast amounts of data and information (or data) analysis and processing, so as to provide all-round services for the development of cross-border e-commerce.

The platform will design and implement a new cross-border e-commerce business model and service model based on cloud computing services, mainly through the “China-Russian” cross-border electronic commerce involves the logistics, warehousing, trading, payment, customs declaration, inspection and other cloud platform system, solve the “China-Russian” cross-border e-commerce bottleneck problem fundamentally, promote the rapid development of e-commerce industry.

In view of the current needs of the development of cross-border e-commerce in China and Russia, with the idea of cloud computing services to explore the service model, to form a ““China-Russian” cross-border e-commerce cloud services platform” as the core of the service model, focusing on the realization of:

- (1) To achieve the platform of basic services and unified security services.
- (2) The key process optimization of cross-border e-commerce, online inspection, customs clearance, tax rebates, foreign exchange, exchange of resources, content distribution and other business services.
- (3) Docking government management business, customs inspection and Quarantine on the formation of resources, resources, logistics resources, resource tax, foreign exchange resources, effectively regulate the comprehensive use of resources.
- (4) For “China-Russian” enterprise application, the realization of multi-language resources network, centralized reporting,

logistics visualization, commodity classification and merge, goods traceability query, statistical analysis and other services.

CONCLUSION: APPLICATION PROSPECT

This paper analyzes and forecasts the control from the perspective of the combination of the cloud computing services, discusses the coordination of such dynamic system prediction problem, some new results of system identification and control system and the comprehensive use of theory, put forward a comprehensive coordination model in theory; this theory seeks to establish Harbin China-Russian cross-border electricity supplier based on cloud platform, and carry out the actual application.

At present, the calculation of the composite service system based on cloud service platform - Harbin“China-Russian” cross-border trade through the dragon, has officially launched startup, specific verification and implementation under operation; and focus on the application of landing to the Longjiang silk road to bring things to the main trunk line (from Suifenhe via Harbin to Manchuria City on the key nodes), which as the center of Harbin City, including: East of Mudanjiang and Suifenhe, west of Daqing and Qiqihar, extending to Inner Mongolia and Manchuria; and promote the province's border node city and important node city transit logistics; e-commerce will gradually guide the enterprise innovation project relies on cloud computing infrastructure and service platform, the formation of leading edge computing the service in the electronic commerce industry of cloud, cloud computing to the e-commerce industry chain integration and optimization, truly reflect the cloud computing service group The huge economic benefits and social benefits brought by the combination system.

ACKNOWLEDGEMENT

This work is supported by the Program of National Nature Science Foundation of China under Grant No.71672128.

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Smart Manufacturing Capability Maturity Model: Connotation, Feature And Trend

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ABSTRACT

In March 2015, the Chinese government unveiled Internet Plus, an action plan expected to push forward the Chinese economy. The plan aims to integrate mobile Internet, cloud computing, big data, and the Internet of Things (IoT) with traditional industries to promote economic restructuring, improve people's livelihoods, and even transform government and enterprises functions. However for the enterprises, how to evaluate the capability is still an unsolved issue. In this study, considering capability maturity theory and model existed, we summarized the concepts of smart manufacturing and relative research field, combined with the development trend of smart manufacturing and characteristics of the enterprise's competition, a smart manufacturing capability maturity initial model with five levels and seven dimensions was defined. With this model, the connotation of smart manufacturing capability was unveiled and the model also provides reference for enterprises to assess and improve smart manufacturing capability.

Keywords: Smart Manufacturing, Capability Maturity Model (CMM), Five Levels and Seven Dimensions

INTRODUCTION

With continuously generation and application of advanced manufacturing models, manufacturing technologies and manufacturing equipment, as well as the rapid development of business mode such as e-commerce in the internet age, the market environment and social environment faced by Chinese manufacturing enterprises have changed greatly. Product life cycles are getting shorter, the product variety is also increasing, and the user's expectations for products and services and the delivery cycle requirements are getting higher. Manufacturing enterprises have put forward higher requirements in improving product quality and reducing resource consumption, and improving production efficiency and reducing production costs. Production process visualization, intelligence and global optimization have become the manufacturing enterprises' focus [9].

The information technology revolution based on electronic computer and internet has a profound impact on the traditional manufacturing industry, which makes the resource allocation of manufacturing industry develops in the direction of information/knowledge-intensive. The production and applications of knowledge and information have become the main way to create wealth in today's society. As a manufacturing powerhouse, the Chinese national economy is in a crucial period of restructuring and changing of development mode. China urgently needs to make use of the high-tech including information technology to transform traditional manufacturing industries, which need to be upgraded comprehensively and scientifically to trend green manufacturing and smart manufacturing. Traditional manufacturing enterprises have a lot of resources which are difficult to directly apply to users, such as the design model, simulation data, and high-end equipment and various experience knowledge. The introduction of intelligence resources can effectively integrate these resources that can be able to be provided with a capability method, which means enterprises provide original resources and also complete solution and additional services for user at the same time; on the other hand, in order to meet the needs of users' personalization and professional services, service platform needs to provide multi type, multi granularity, and high quality and low cost services. Through the service technology of manufacturing capability, manufacturing capability can be smart and flexible combination and decomposition, so that it can make use of existing resources to form services of different functions, different types and different granularities and provide to the user according to users' need to meet the needs of users in the greatest extent.

This study summarizes the smart manufacturing, smart manufacturing capability and the capability mature research present situation both at home and abroad, combines with China manufacturing industry on the smart manufacturing capability of the actual demand and the trend of transition, gives the connotation and composition of smart manufacturing capability maturity. On the basis, a smart manufacturing capability maturity model with five levels and seven dimensions is constructed. The five levels include the initial level, repeatable level, defined level, managed level and optimizing level. The seven dimensions include smart manufacturing strategy, process, personnel, equipment, technology, knowledge and innovation. A description framework for this model is proposed.

THEORETICAL BACKGROUND

Smart Manufacturing

Smart manufacturing is a collaborative manufacturing mode of human-machine-object which is oriented service and based on knowledge, under the support of internet of service, internet of things, content/knowledge network, interpersonal network and advanced manufacturing technology, all kinds of manufacturing resources are connected together and form a unified resources pool, according to customer's individual needs and context perception, smart response are made under the decision of human-machine-object, in manufacturing life cycle process, smart manufacturing takes the customer as the center to provide customized, on demand, transparent and reliable human-oriented manufacturing services for customer [24] (see Figure 1), smart manufacturing mainly includes cloud manufacturing and smart union. Traditional manufacturing techniques combine with artificial intelligence and automation, which form smart advanced manufacturing technology. Driven by the market demand and

science and technology, advanced manufacturing technology has 10 kind of characteristics, which are precision, automation, information technology, flexible, graphical and smart, visualization, multimedia, integration and networking.

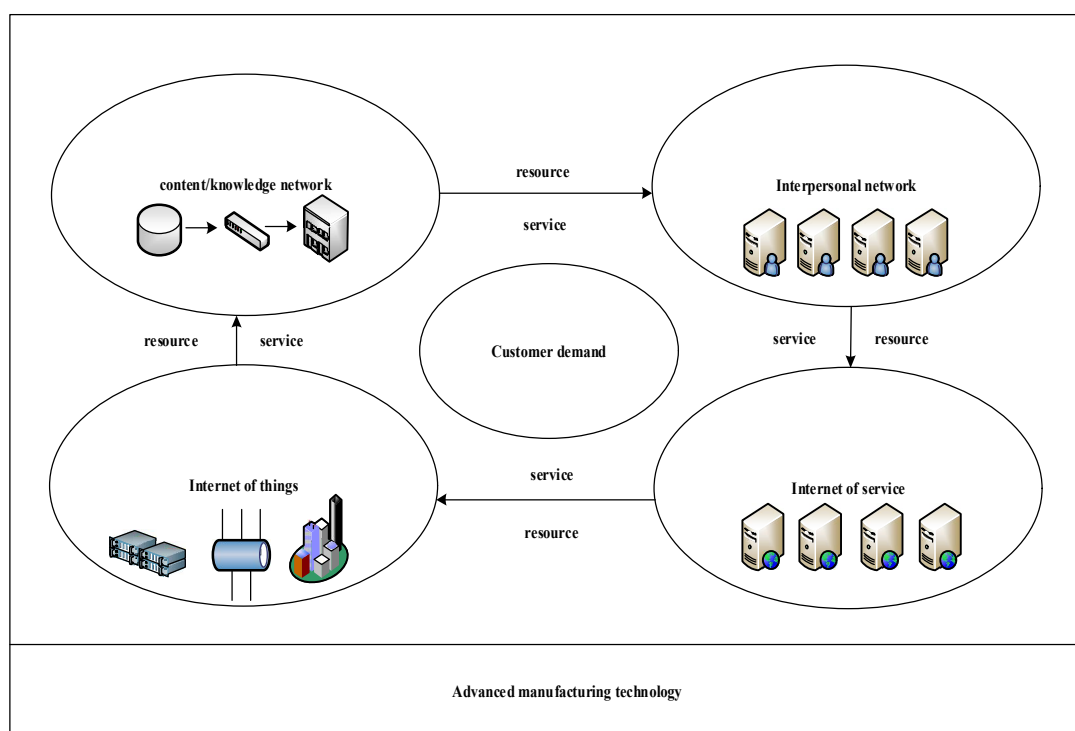


Figure 1: Four networks and smart manufacturing

Smart manufacturing is a new type of industrial form after the depth integration of information and industrialization, which emphasizes taking “smart” technology integration and optimization of manufacturing enterprise's design, production, management, services, and business to enhance comprehensive competitiveness of manufacturing enterprises. It reflects the development trend of the manufacturing technology from mechanization, automation, digital to intellectualization. The connotation of smart manufacturing mainly includes:

More thorough perception: Enterprises can quickly perceive various information related to the enterprise through sense networks. Sense networks have pooled together all kinds of information from enterprises, users, processes, devices, and systems of information. At the same time, sense networks service for different enterprises, which can expand and deepen the scope of sensory information of enterprises, also can greatly improve the completeness and accuracy of information search and comprehensively break the wasted of resources caused by the information asymmetry. When the smart terminal of the manufacturing enterprise is aware of the remaining resources in real time, the information of the residual manufacturing resources and the ability can be smartly passed through the virtual access technology and can be released to the application and the service support layer, and then through cloud service management of application and service support layer to make centralized manage the dispersed resources and then disperse use the pooling resources and achieve the optimal allocation of manufacturing resources and capability [25].

More extensive interconnection and intercommunication: An enterprise can achieve interconnection and intercommunication of inside and outside the enterprise information through the internet, wireless networks and the internet of things. The user needs to be accurate and timely meet. The resources are fully utilized, the work efficiency is maximized, and all kinds of waste are controlled at the lowest level. In China, the researches of internet of things technologies and industry chain are still in the conceptual and exploratory stage, the overall technology architecture and industry pattern have not been formed. However, with the development and improvement of correlation technology of internet of things, unified architecture standard system and related agreements and data security, more extensive interconnection and intercommunication are realized.

More intelligent, Knowledge of massive data and information: The clarity of the value and relationship of massive knowledge; knowledge integration in different disciplines; human-machine cooperative organic; high efficiency of product innovation and process innovation; precision of business management and control precision; the flexibility of the strategy-process-resource path in the four network interactive environment.

Higher standards of talent demand and a wider range of employee participation: Personnel training of manufacturing is not only a basic need about the skills and management, but also a more advanced training as an operational need, innovation and quickly response to the market enterprises own competition capability, which is a key factor to improve the enterprises' economic

performance [5]. Manufacturing enterprises of different scale will reassignment the employee depending on the professional qualifications and technical level through the supply chain, advanced technology suppliers, innovation and start-up companies [18]; scientific talent evaluation and a broader employee involvement.

The smart manufacturing technology includes intelligent innovation network, manufacturing network and management network, people put forward the smart manufacturing based on the data, and information and knowledge as well, which is an inevitable result when manufacturing informatization and integrated develop to a certain extent.

This research focuses on smart manufacturing capability maturity to understand the enterprises' transformation demand and development trend of smart manufacturing capability and composition of smart manufacturing capability maturity model, promote enterprises' smart manufacturing capability evaluation and improvement.

Smart Manufacturing Capability

In recent years, smart manufacturing is hot in the academy and industrial. However, there is no consensus on the definition of smart manufacturing capability. Smart manufacturing capability is a smart upgrading of manufacturing capability. Compared with the traditional manufacturing capability, smart manufacturing capability owns higher requirements in the advancement and collaborative of human-machine-object and knowledge, which also increases to take into account of the innovation, service and environmental factors. Many scholars at home and abroad have studied the smart manufacturing capability from different perspectives. Through combing the relevant literature at home and abroad, Luo, Y.L. et al. (2012) summarized the manufacturing capability of cloud manufacturing mode from the view of macro strategy angle and micro resources angle. They believe that the manufacturing capability of cloud manufacturing mode is produced in the process of a specific activity, embodies as a kind of manufacturing resources allocation and integration capability, reflects a standard level of the manufacturing enterprise or manufacturing entity completed a task and the expected target, contains all kinds of capabilities in the manufacturing life cycle, such as design ability, and simulation ability and production and processing ability, etc.. The manufacturing resources refer to all kinds of software and hardware resources in the manufacturing process, which are the basis of the formation of manufacturing capability [13]. Li, X.B. and Yin C. (2016) summarized the characteristics and operation mode of cloud manufacturing, they believe that successful implementation of cloud manufacturing mode requires enterprises to have the ability of production process management based on cloud services, the high degree sharing ability of manufacturing resource and the ability to manufacturing information to interact in real-time based on large data [12]. Ngai, E.W.T. et al. (2012) researched on clothing manufacturing enterprises, determined the successful RFID use of the eight key factors. Although enterprises for the case study they selected are not smart manufacturing enterprises in the strict sense, RFID as one of the key technologies of smart manufacturing, the key success factors can be seen as a pioneer in the successful implementation of the smart manufacturing capability, which are worth for reference [16]. Choi, S. et al. (2015) believed that global is developing different smart manufacturing methods in constant, virtual factory has solved (improve) and manage (control) problems and the overall actual production tasks website, put forward the effective strategic planning and systematic design, achieves real application of virtual factory manufacturing enterprises, through the establishment of strategy and system design to take diagnosis and evaluation for virtual factory and implement intelligent manufacturing system better [3].

Through analysis and summary of the related literature, we define the smart manufacturing capability as the method and process of the integration and application resources in manufacturing process through using the advanced manufacturing technology as well as skills, technologies, knowledge and abilities that accumulated in the process in the "four networks" integration environment. Smart manufacturing capability is the integration and innovation abilities of enterprise integrate informatization and industrialization in depth, which is the main capability that can help enterprises to obtain sustainable competitive advantage in the manufacturing fields in the future.

Capability Maturity

Maturity is the concrete quantification of the development and perfection of things and it is a special ability to measure and assess the expected goal of an organization [22], which can be evaluated by the company itself or a third party to put forward an effective and continuous improvement programs [19]. Maturity thinking comes from the theory of the quality maturity grid proposed by Crosby, P.B. (1979) [4]. The capability maturity model (CMM) was proposed by Carnegie Mellon University [8] initially as a best practice tool to guide enterprises to improve the quality of the software process, because it presented an evolutionary and dynamic scale standard to drive software development organizations to constantly improve and perfect in practice and make software development management from chaos and immature to mature and standard, which is a great success in software business applications and gradually extended to other areas [14, 15, 20, 21]. De Bruin, T. et al. (2005) considered capacity maturity was a life cycle model, which was composed by range defined, design model, application, test, adjustment, improvement and other steps [6].

Smart manufacturing is a system engineering which is from exploration to science, from technology dependence to early warning management, from extensive decision to precise scheduling. Smart manufacturing is also an immature to mature process which is a gradually improving process of the comprehensive manufacturing capability. By using capability maturity theory to build a smart manufacturing capability maturity model (CMM), the purpose is to find and continue to improve low efficiency link through evaluating the maturity level of management process and integrating resource, to assess and analyze smart manufacturing capability, to provide decision support for managers and to improve and perfect the management process, which

also can provide guidance to improve enterprise performance, ensure enterprise production orderly, efficient and high quality, plan resources reasonably and reduce all kinds of waste and loss due to poor management and information asymmetry.

SMART MANUFACTURING CAPABILITY MATURITY MODEL

Related Work

We use a general method made by Lahrmann, G. et al. (2011) [11] for reference to establish a smart manufacturing capability maturity model (see Table 1).

Table 1: Method of capability maturity model

Procedures	Methods
(1) Identify needs or new opportunities	<ul style="list-style-type: none"> ➤ innovation methods ➤ focus groups ➤ case study ➤ literature review ➤ field survey
(2) Define scope	<ul style="list-style-type: none"> ➤ providing data ➤ making plans
(3) Design model	<ul style="list-style-type: none"> ➤ design from top to bottom ➤ design from bottom to top ◇ Delphi method ◇ algorithm analysis ◇ case study ◇ data provide ◇ literature review ◇ theory suggests
(4) Assess design	<ul style="list-style-type: none"> ➤ functional test ➤ structure test ➤ survey ➤ focus groups ➤ interview
(5) Reflect improvement process	<ul style="list-style-type: none"> ➤ field trips ➤ interview

We adopt the design method from top to bottom, the procedures are like these: first, after selecting the design object we get the main indicators and secondary indicators through consulting literature and expert interview method and according to the process from top to bottom to complete the initial model design; then we use a measurement software to measure the validity, reliability and applicability of the design model, after evaluating, we eliminate the indexes of the initial capability maturity model, which did not pass the test; finally, we obtain the final revised model.

SM-CMM Dimensions and Levels

We extracted dimensions first by taking the method of consulting literature review, we searched articles whose key words contain “smart manufacturing” and “capability maturity” in domestic and foreign data platform of CNKI, SCI&SSCI, ProQuest, Science Direct and Web of Science and the time set to 2005-2016, a total of more than 800 articles were searched. We sorted and eliminated these articles according to the number of citation, subject classification and relevance and a total of 52 papers were obtained. According to the research needs and the research integrity, eventually we screened out 23 articles these were the most authoritative and the latest. Then, through studying and analyzing these 23 articles, we determined the dimensions and levels of the smart manufacturing capability maturity model, summarized the key process areas contained in each dimension and on this basis modified the framework of the smart manufacturing capability maturity model through 3 rounds of interviews.

The first round, the participates including 5 Ph.D. and 1 masters came from mechanical manufacturing professional, whose length of 3 hours, mainly aimed at inducting and extracting dimensions sorted by literature analysis method; the second round, the participates were 16 executives and CEO of manufacturing enterprises from Daqing, Harbin and Foshan, the interview divided into 2 ways of interview and video and 4 times, 30 minutes to 1 hours each time, mainly for inducting and extracting the key processes contained by the dimensions determined by the first round interview, and determined level boundaries; the third round, the participates were 3 experts in the field of manufacturing, aiming at consulting experts advices respectively for the first two rounds of the extracted dimensions, key process areas and key practices.

After the third round of interviews, we finally determined the dimensions of the initial theoretical model, key process areas and key practices. Seven dimensions are strategy, process, personnel, equipment, technology, knowledge and innovation (see Table 2).

Table : SM-CMM dimensions

Dimension	Reference
Strategy	Choi, S. et al. (2015); Ngai, E.W.T. et al. (2012); Jung, K. et al. (2015) [10]
Process	Choi, S. et al. (2015); Ngai, E.W.T. et al. (2012); Abrell, T. et al. (2016) [1]; Jung, K. et al. (2015); Xiao, Y. et al. (2013) [23]; Li, X.B. and Yin, C. (2016); Zhou, J.J. and Yao, X.F. (2015) [26]
Personnel	Ngai, E.W.T. et al. (2012); Davis, J. et al. (2012)

Equipment	Choi, S. et al. (2015); Ngai, E.W.T. et al. (2012); Jung, K. et al. (2015); Xiao, Y. et al. (2013); Li, X.B. and Yin, C. (2016)
Technology	Ngai, E.W.T. et al. (2012); Davis, J. et al. (2012); Abrell, T. et al. (2016); Baily, M.N. and Bosworth, B.P. (2014) [2]; Zhou, J.J. and Yao, X.F. (2015)
Knowledge	Abrell, T. et al. (2016); Li, X.B. and Yin, C. (2016); Zhou, J.J. and Yao, X.F. (2015)
Innovation	Abrell, T. et al. (2016); Baily, M.N. and Bosworth, B.P. (2014); Zhou, J.J. and Yao, X.F. (2015)

A dimension describes the different aspects of maturity assessment objectives, which is a division of the specific capacity area. The description of the dimension is detailed and distinguishable best. Each dimension of the maturity model can further explain a series of characteristics of each maturity level[7].

According to the characteristics of CMM research results and smart manufacturing, we set the initial theoretical model as five levels: the initial level, the repeatable level, the defined level, the managed level and the optimizing level (see Table 3).

Table 3: SM-CMM levels

Code	Level	Description
I	Initial	Relying on technology, management disorder
II	Repeatable	Following the benchmarking enterprise, productivity is the first pursuit
III	Defined	Meeting industry standards, exploring the flexible management mode actively
IV	Managed	Getting the industry leading level, and constantly improve the level of smart service
V	Optimizing	Keeping continuous innovation, and keeping the harmonious development of man, machine, material

Each level should have a series of characteristics that can be distinguished by empirical testing [17]. Each maturity level is impassable, which shows the process of smart manufacturing from chaos to mature. The upgrading of maturity represents the continuous improvement of the level of smart manufacturing.

Smart Manufacturing Capability Maturity Initial Model

The SM-CMM initial model is divided into seven dimensions. We explain and summarize the connotations of the seven dimensions, combine literature and expert opinions to deconstruct the dimensions into key process areas and key practices which are corresponded different levels by functions, then construct a complete smart manufacturing capability maturity models (see Table 4).

Table 4: SM-CMM initial model

Level Dimension	Initial (I)	Repeatable (II)	Defined (III)	Managed (IV)	Optimizing (V)
Strategy	To improve productivity	Keeping up with industry benchmark	Suitable for enterprise's overall strategy	Long-term strategy	Collaborative strategy
Process	Information to support	Continuous improvement	To match the production task	Implementation of the flexibility	Service oriented and customer requirements
Personnel	High technical competencies	Inter-disciplinary talent demand gradually	Rising to the requirement of management	Focus on the professional training and scientific evaluation	Efficient talent can fuse with the machine and environment friendly
Equipment	High demand of smart performing, mainly to meet the production tasks	For intelligent diagnosis and self-optimization ability to ascend	Higher requirements under uncertain environment	Owning a standard to equipment maintenance function	Equipment has self-learning and share the ability to learn, and perfect match with people
Technology	Support the complete intelligent manufacturing process of the enterprise	Continuously improve technology, improve production efficiency	Meet the customized needs of customers, at the same time, control costs	Provide support for service-oriented manufacturing	To the perfect control and manufacturing resources integration
Knowledge	Knowledge acquisition, expression, storage,	Management of real-time updating and putted forward to	Recording all kinds of data information in the whole life	To provide decision support for user needs and services	Intelligent matching and dynamic combination

	organization, and management in manufacturing process	case base	cycle of manufacturing and unified coding		support as needed
Innovation	Focus on technology innovation	Focus on production and design innovation	Focus on management mode innovation	Focus on personnel innovation ability	Focus on service innovation

Smart manufacturing strategy dimension: strategy affects all aspects of the smart manufacturing enterprise management decision-making, which decides the enterprise how to implement the smart manufacturing in the daily production activities. Strategy is the plan of the smart manufacturing goals, integrity, long-term and collaborative for managers, whose essence is through the influence enterprise resource efficient configuration to achieve the unique competitive advantage.

Smart manufacturing management process dimension: process reflects the procedure of smart manufacturing capability optimizes resource configuration, emphasizes on the basis of manufacturing resources and the description of the business process and all kinds of knowledge in the process, such as business process constraints, design scheme, the simulation model and empirical knowledge.

Smart manufacturing personnel dimension: personnel are the important factor of uncertainty in smart manufacturing. The workers' quality is significantly higher than generally labor-intensive industries, especially requesting for workers with innovation ability, being good at coordination, owning the basic thinking of science and technology literacy and ability and needing innovative management talents and skilled technical personnel.

Smart manufacturing equipment dimension: in the process of dependent testing, intelligent diagnosis, self-optimizing virtualization/service technology, all kinds of open source tools that applied to every level of smart manufacturing, decision package, the knowledge base and database that function, they should have a set of executive abilities needs to be smart. When equipment is performing smart of implementation, preparation and maintenance equipment processing behavior, remote intelligent monitoring for the integration and summarize and analyze the requirements of all sorts of perform smart functions of devices; when preparing processing tasks, equipment should have independent changes in uncertain environment planning process parameters, preparation of codes and determine the control logic and other best behavior strategy abilities; when doing equipment maintenance, equipment can make independent failure detection, intelligent maintenance and remote intelligent maintenance, at the same time they have the ability to learn and share, whose functions are interaction and mutual support.

Smart manufacturing technology dimension: all the relevant technology to realize smart manufacturing and improve the efficiency, such as the semantic Web, Internet of things and finally realizes the control of the manufacturing resources.

Smart manufacturing knowledge dimension: knowledge is the foundation and conditions of the smart, which includes the knowledge base, case base, rule base and model base to provide decision support for the enterprise. Knowledge basis mainly implemented in the process of smart manufacturing capabilities to describe all kinds of knowledge acquisition, expression, storage, organization and management; case base is mainly implemented the organization and management of the business case for smart manufacturing products, which puts all kinds of data information in the whole life cycle process of manufacturing to update to the case base to provide decision support for users ultimately; rule base and model base are to describe and produced in the process of trading rules and unified organization and management.

Smart manufacturing innovation dimension: innovation is the soul of smart manufacturing. As the service integrates into products, effectively designing the product-service combination becomes a new challenge for product design, the great services and services in the physical sexual differences lead to there must be new thoughts and methods for service innovation and the design of the product-service.

CONCLUSIONS

In this study, we combined relative researches of smart manufacturing and capability maturity. Smart manufacturing (SM) and smart manufacturing capability (SMC) were clearly defined. A smart manufacturing capability maturity model with five levels and seven dimensions was constructed to help enterprises to evaluate their own smart manufacturing capability in the processing of transformation. This research results could be applied in the fields of innovation, strategy, organizational behavior, process reengineering, human resources and IT technology etc. The smart manufacturing capability maturity model could be optimized and improved according to the theory developing in the future and more benefits will be added to the enterprises.

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The Problem and Countermeasures of Cross-border E-commerce Logistics

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Abstract

With the development of free trade zone, strategy of One Belt and One Road and the policy of cross-border e-commerce, many domestic electric business platforms enter into industry of cross-border electricity. Cross-border e-commerce which is a new business model has advantages, such as, fewer links, short processing cycle and low cost. It can powerfully develop today. However, cross-border logistics which is short slab of cross-border e-commerce restricts the development of cross-border e-commerce. Cross-border e-commerce that has multi-function, multiple frequency operation and comprehensive characteristics require logistics service has the characteristics of agility, high efficiency, low cost and visualization.

The model of cross-border logistics in our country has many problems. For example, high cost, long time, incomplete logistics information system, lack of large-scale logistics service enterprises. This factors seriously restrict the development of cross-border e-commerce. In this paper, cross-border electricity development present in our country and its existing problems have been discussed, and we put forward relevant countermeasures. And the goal of the paper is to provide electric commercial enterprises some reference and experience.

Key Words: cross-border logistics; logistics problem; countermeasures

INTRODUCTION

In the past few years, Internet has brought great changes to people's life. Housebound online shopping gradually becomes a popular trend. This model is not only reflected in domestic trade, but also has been widely used in international trade. But it is different with domestic e-commerce trade, because of the differences among the parties in economic, political, cultural, and geographical. The international e-commerce trade faces many obstacles in the actual developing. The most prominent problem is cross-border e-commerce logistics. According to the characteristics of the cross-border e-commerce business logistics, scholars have put forward the "overseas warehouse"^[1] mode. Overseas warehouse model refers to the enterprises engaged in export of cross-border e-commerce self-built or rent warehouse abroad, so as to realize the form that sales and distributes goods in the local. Although "overseas warehouse" mode partly solve the problem puzzled people for logistics, this model does not apply to the small-scale e-commerce enterprise.

At present, the research of cross-border e-commerce business logistics is not much. And the research about problems and countermeasures of cross-border e-commerce business logistics is not deep. In this paper, it detailed explains the problems existing in the cross-border e-commerce and puts forward some measures, such as the construction of large logistics companies. But this article don't mention how to build large logistics enterprises and put forward concrete measures. Although it is feasible in theoretically, it will encounter many problems in practice.

THE PRESENT SITUATION OF CROSS-BOEDER E-COMMERCE LOGISTICS

With the continuous development of China's cross-border e-commerce and the implement of supportive policy from government, more and more enterprises join the force of cross-border e-commerce. The industry of cross-border e-commerce grows into an emerging and pillar one. And it provides cross-border e-commerce logistics opportunities. However, there are many barrier factors in the development of cross-border e-commerce logistics today.

The Insufficient National Policy Support

The Ministry of finance, General Administration of Customs, State Bureau of Taxation, on 24th March, 2016, jointly issued the Notice of Import Tax Policies on Cross-border E-commerce Retail, it clearly stipulates the tax policy of cross-border e-commerce retail import. And it provides some supportive policy for cross-border e-commerce development. For example, the single limit of trading volume from cross-border e-commerce retail is 2000 yuan, and the limit of annual individual trading is 20000 yuan. If the company and individual import goods below the limitation, the customs duty rate is 0%. Within introduced of these policy, the development of cross-border e-commerce will enter another spring.

However, because of the short development time of cross-border e-commerce, compared with developed countries, some corresponding supportive policies are inadequate. It is poor for the development of cross-border e-commerce logistics enterprises.

The Demand of Domestic Cross-Border Logistics Is Less Than The Supply^[2]

In recent years, the development speed of China's cross-border e-commerce is striking. China's cross-border e-commerce trading size is 4.2 trillion yuan in 2014, and the growth rate was 35.48%. And the trading size was 5.4 trillion yuan in 2015, with year-on-year growth of 28.6%. The cross-border e-commerce export trade scale up to 4.49 trillion yuan, when cross-border e-commerce import trading sum up to 907.2 billion yuan. The trade total will increase to 6.5 trillion yuan in 2016. And trade

scale is expected to grow for 8 trillion yuan in 2017, and average annual growth rate close to 30%.

However, our cross-border e-commerce logistics mainly relies on the international logistics company to complete. Although there are some domestic enterprises seize the opportunity and join to the industry of cross-border e-commerce logistics. However, due to its smaller scale, lack of relevant experience and lower awareness, these enterprises is in a disadvantage condition, within compared international express company.

Laggard Logistics Infrastructure Construction In China

Compared with the developed countries, the appearance of logistics was late in our country. The logistics enterprises has developed in recent years. And there have many problems, such as less transport hub and backward construction of logistics. Cross-border logistics is a complicated problem, which includes storage, distribution, transportation, customs clearance and tax and a series of other problems. Nowadays, cross-border logistics has some problems, including expensive, long cycle, troublesome process, customs seized and so on. These problems have become important factors that hinder the development of the cross-border e-commerce.

The Number of Third Party Logistics Enterprises Is Less

The third-party logistics can help companies to save costs, and provide specialized services. And the third-party logistics usually cooperate with local logistics company, and the local logistics company knows a lot about local customs, culture and so on. So the third party logistics will help improve customer satisfaction.

In recent years, STO, SF express and other well-known domestic logistics enterprises have opened international lines. Because the development time cross-border e-commerce is short. These domestic logistics company, in terms of infrastructure and the speed of distribution and coverage, is lagged far behind the international third party logistics company.

THE MODE OF CROSS-BORDER E-COMMERCE LOGISTICS[3]

International Small Packet Mode

International small packet is sent to foreign through the airmail service from postal service. The weight is required LE 2000 g. The sum of outer packing's length, width and height is required LE 90cm. And the longest edge LE 60 cm. According to statistics, the 70% of China's cross-border e-commerce business is through the international small packet. Although the postal service around the world, the postal transportation time is longer and the loss rate of packet is higher.

The Internationalization of Domestic Express Service Mode

In recent years, more and more domestic express join the cross-border business logistics. For example, STO, SF and so on early take some measures in cross-border logistics. Because the industry just start in recent years, the accounts for the market is less, and covering overseas market is limited.

International Express Enterprise Mode

Compared with domestic express company, international express company, such as UPS, FedEx, DHL, TNT and so on, has long history. And the infrastructure is perfect. Due to its quick speed and good customer experience, it occupies a large part of market. Meanwhile, because its price is very expensive, this model is fit for product with high value.

Overseas Warehouse Model

Overseas warehouse means that an enterprise that is engaged in the export of cross-border e-commerce built or rent warehouse by itself and sell and delivery in foreign countries. Compared with the international small packet, international express enterprise mode, overseas warehouse model overcomes previous disadvantage, such as expensive, long logistics cycle long, customs confiscated and so on. This is a great innovation in cross-border logistics. The model is suitable for large cargo, heavy cargo and the product sell like hot cakes.

Cross-Border Railway Logistics Mode

Cross-border railway logistics means that commodities are sent to foreign countries by air bag, then send products to customer's hands through the local cooperation company. This way reduces cost mainly by economies. But the covering area is limited, the scale effect was weakened.

THE EXISTENCE QUESTION

The High Cost

The cost of cross-border e-commerce logistics includes the charge to build corresponding network, customs, duties and delivery cost. For example, if a company sent goods whose weight is 400g from china to America, it needs 240yuan by China postal service when it needs 270yuan by UPS(not including fuel surcharge). And after completion of cross-border transactions, due to the problems, such as changing or refunding, will lead to money cost and time cost increased.

Long Shipping Time^[4]

Cross-border logistics link is more complex than domestic logistics. The product from the seller to consumers, have to pass the domestic logistics, customs, international transportation, foreign logistics, foreign customs and many other links. Whether

anyone link has matter, the product cannot reach consumers' hands. For example, postal service needs 10-15 days to deliver goods of 400g to America when it needs about 45 days to places such as Russia, Brazil. Especially at Christmas and Spring Festival shopping season, with so many back order on hand, it need longer periods to sent products to customers.

Informatization Logistics Existence Question

On the one hand, today most cross-border logistics enterprises adopt the postal parcel and some international logistics companies. But these two kinds of model have a problem that cross-border e-commerce businesses cannot get information about the product. This opaque cross-border logistics is caused by asymmetric information of both parties. In this case, packet loss rate is high, and consumer satisfaction and loyalty of cross-border e-commerce is not high.

On the other hand, the body of the cross-border e-commerce come from two different countries. This is a difference between the two countries, such as Information development degree, custom, habits and consumer preferences. They difference is also reflected in the cross-border e-commerce business logistics. Due to different informationization development level, logistics have difficult in docking system. In this case, each link of the cross-border e-commerce cannot connect, so as to make cross-border business logistics waste time and money.

Lacking of Domestic Large Cross-Border Logistics Services Company

Nowadays, although the domestic well-known logistics companies, such as SF and STO, have opened the international business. Because of the limitation of its capital and technology, the expansion of overseas market is very slow. Compared with big international express delivery, domestic cross-border logistics don't take shape comprehensive service system to adapt the multi-level demand. In especial, some foreign comprehensive logistics enterprises have begun to make up for their own defects. And it provides omni-directional and multi-level services to the Chinese cross-border e-commerce. However, domestic cross-border e-commerce merely do well in providing some kind of services, some point and special line. while the logistics enterprises also have a certain market, it is limited for the long-term development.

THE CORRESPONDING COUNTERMEASURES

The Construction of Overseas Warehouse^[5-8]

Overseas warehouse is a great innovation to solve the disadvantages of traditional model of logistics, such as high cost, slow speed and so on. Overseas warehouse mode can be divided into proprietary overseas warehouse and third-party public service overseas warehouse according to different subject of operating.

The process of overseas warehouse

Step 1: The export of cross-border e-commerce through shipping, air and other ways to send their products to their overseas warehouse.

Step 2: Export enterprises monitor storage conditions of the goods by own or partner's information system.

Step 3: When export cross-border e-commerce business receives orders, the logistics company sort, package, and distribution goods according to the instruction from the export of cross-border e-commerce.

Step 4: when the shipment is completed, the company of logistics should be updated their system.

The advantages and disadvantages of overseas warehouse

For the large-scale export cross-border e-commerce, overseas warehouse advantage is very obvious. On the one hand, with distribution of products to overseas warehouse, the enterprise can save the cost. It makes the enterprises occupy in competition with foreign enterprises. On the other hand, because the goods have already been stored in the warehouse, it effectively shortens the response time. But the overseas warehouse also has limitations: a. The applicable scope is limited. It is difficult for small and medium-sized export company to build and rent a overseas ware house's. The risk is higher, if the enterprise cannot accurately forecast the sales volume in overseas, it easily lead to the backlog and shortages of goods.

The Reasonable Choice of Cross-Border Logistics Mode

In this paper, the second part has introduced five patterns of cross-border electronic business logistics. International small packet conduces a limit on the weight length, width and height of goods. And its transportation time is long. So, it is suitable for products that can storage long time; International express price more expensive than others mode, but the speed of this pattern is fast. And it has good customer experience. Therefore, it is suitable for goods with high additional value, such as jewelry, clothing, etc.; Overseas warehouse is suitable for large cargo, heavy cargo and goods sell like hot cakes. Each mode has its own advantages and disadvantages. When the enterprise chooses the appropriate mode that combined with its own characteristics of goods and their own business situation, it can reduce logistics cost.

To Strengthen The Construction of Logistics Information

Asymmetry logistics information becomes a big obstacle that baffles the development of cross-border e-commerce logistics in terms of the current development cross-border e-commerce. Thus, the build of cross-border e-commerce logistics information system become urgent issue that need to solve. And it needs government participation to complete the information system. Our

government can coordinate cross-border e-commerce enterprises, international logistics company and customs, etc. And it also jointly builds global cross-border logistics information system^[9]. The logistics will become opaque by these measures.

The Construction of Large Logistics Service Enterprises

Small and medium-sized enterprise can joint venture to set up large-scale logistics service enterprise which specialized in international logistics in the face of massive demand of cross-border e-commerce. Construction of large logistics companies can make full use of and develop a broader overseas markets. Of course, companies need to solve the problem of integrating resources and dividing the profit before build the large logistics service enterprise. Otherwise, the construction of large logistics service enterprise will be a challenge.

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Taiwan Vs Globalization In Data Mining :

A Study Of Research Trends, Forecasts And Citations

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ABSTRACT

Although data mining (DM) has already become more important recently, there are few comprehensive studies and categorization schemes to discuss the characteristics for DM. Applying bibliometric method, this paper explores research potential of DM in Taiwan through comparing globalization DM trends, forecasts and citations from 1993 to 2016 by locating heading “data mining” in topic in the Web of Science (WoS) database. The bibliometric analytical technique was used to examine the topic in WoS journals from 1993 to 2016, we found of 245 articles of Taiwan and 3053 articles of globalization. This paper surveys and classifies DM articles between Taiwan and globalization using the following eight categories – publication year, citation, document type, country/territory, institute name, language, source title and research area – for different distribution status in order to find the difference and how DM technologies and applications have developed in this period. Finally, the study will analyze DM technology trends, forecasts and citations based on the above results. Also, the paper performs the K-S test to check whether the distribution of author article production of Taiwan and globalization follows Lotka’s law or not. According to the analyzing results, this paper provides a roadmap for future researches, abstracts technology trend information and facilitates knowledge accumulation. Therefore, the researches of DM in Taiwan can follow and concentrate the globalization categories, and create the potential in the near future.

Keywords: Data mining, Research trend analysis, Bibliometric methodology

INTRODUCTION

DM is treated as an interdisciplinary domain that combines artificial intelligence, database management, data visualization, machine learning, mathematic algorithms, and statistics. DM, also being as knowledge discovery in databases (KDD) [1-2], is a rapidly emerging domain. This technology introduces different methodology for decision-making, problem solving, analysis, planning, diagnosis, detection, integration, prevention, learning, and innovation.

Since the 1960s, DM techniques have formed a branch of applied artificial intelligence. During the intervening decades, important innovations in computer systems have initialized the introduction of new technologies [3], for web-based education. Data mining allows a search, for valuable information, in large volumes of data [4]. The explosive growth in databases has created a need to develop technologies that use information and knowledge intelligently. Therefore, DM technique has become an increasingly important research area [5].

This technology is motivated by the need of new techniques to help analyze, understand or even visualize the huge amounts of stored data gathered from business and scientific applications. It is the process of discovering interesting knowledge, such as patterns, associations, changes, anomalies and significant structures from large amounts of data stored in databases, data warehouses, or other information repositories. It can be used to help companies to make better decisions to stay competitive in the marketplace. It is suggested by [6] that different social science methodologies, such as psychology, cognitive science and human behavior might implement DM technique, as an alternative to the methodologies already on offer. The major DM functions that are developed in commercial and research communities include summarization, association, classification, prediction and clustering. These functions can be implemented using a variety of technologies, such as database-oriented techniques, machine learning and statistical techniques [7].

DM was defined by [8] as a process that uses statistical, mathematical, artificial intelligence and machine-learning techniques to extract and identify useful information and subsequently gain knowledge from large databases. In an effort to develop new insights into practice-performance relationships, [9] indicated that DM was used to explore improvement programs, strategic priorities, environmental factors, manufacturing performance dimensions and their interactions. DM was also defined as the process of extracting or detecting hidden patterns or information from large databases [10-13]. With an enormous amount of customer data, DM technology can support business intelligence to generate new opportunities [14-21].

Recently, [22] demonstrated a number of DM applications and prototypes have been developed for a variety of domains including marketing, banking, financing, manufacturing and health care. In addition, DM has also been applied to other types of data such as time-series, spatial, telecommunications, web, and multimedia data. In general, the DM process, and the DM technique and function to be applied depend very much on the application domain and the nature of the data available. Based on prior research, this study tries to explore the research potential of DM in Taiwan by bibliometric through comparing globalization trends. In section two, this paper presents the material and methodology. In section three, this study presents the research results, while the section four and five is devoted to an analysis and a discussion of the study, and also describes research limits and makes suggestions for future research.

MATERIAL AND METHODOLOGY

Research material

The very influential role of the monopolist citation data producer ISI (Institute for Scientific Information, now Thomson

Scientific) was pointed by as its commercialization of these data [25] rapidly increased the non-expert use of bibliometric analysis such as rankings. The materials used in this study were accessed from the database of the Social Science Citation Index (SSCI), obtained by subscription from the ISI, Web of Science (WoS), Philadelphia, PA, USA. In this research, we discuss the papers published in the period from 1993 to 2016 because there was only few data prior to that year.

Research methodology

Bibliometrics was defined by [26] as the application of mathematics and statistical methods to books and other media of communication. [27] also defined bibliometrics as the quantitative study of physical published units, or of bibliographic units, or of the surrogates for either. Bibliometric techniques have been used primarily by information scientists to study the growth and distribution of the scientific article. Researchers may use bibliometric methods of evaluation to determine the influence of a single writer, for example, or to describe the relationship between two or more writers or works. Besides, properly designed and constructed [28-30], bibliometrics can be applied as a powerful support tool to peer review. This is certainly possible for interdisciplinary research fields [31]. One common way of conducting bibliometric research is to use the Social Science Citation Index (SSCI), the Science Citation Index (SCI), the Arts and Humanities Citation Index (A&HCI), the Conference Proceedings Citation Index-Science (CPCI-S) or the Conference Proceedings Citation Index-Social Science & Humanities (CPCI-SSH) to trace citations.

Lotka's law

Lotka's law indicates the frequency of publication by authors in a given field. It mentions that the number of authors making n contributions is about $1/n^2$ of those making one; and the proportion of all contributors, that make a single contribution, is about 60 percent [32]. Lotka's law is stated by the following formula is where y is the number of authors making x contributions, the exponent n and the constant c are parameters to be estimated from a given set of author productivity data. This means that out of all the authors in a given field, about 60 percent will have just one publication, about 15 percent will have two publications ($1/2^2$ times 0.60), about 7 percent of authors will have three publications ($1/3^2$ times 0.60), and so on. Lotka's law, when applied to large bodies of article over a fairly long period of time, can be accurate in general, but not statistically exact. It is often used to

estimate the frequency with which authors will appear in an online catalog [33].

Lotka's law is generally used for understanding the productivity patterns of authors in a bibliography [34-39]. In this article, Lotka's law is chosen to perform bibliometric analysis to check the number of publications versus accumulated authors between 1993 and 2016 to perform an author productivity inspection to collect the results for research tendency in the near future. To verify the analysis, the paper implements the K-S test to evaluate whether the result matches Lotka's law.

Research architecture

Using a bibliometric approach, the paper explores research potential of DM in Taiwan through comparing globalization DM trends, forecasts and citations from 1993 to 2016 by locating heading "data mining" in topics in the WoS database. The bibliometric analytical technique was used to examine the topic in WoS journals from 1993 to 2016, we found of 245 articles in Taiwan and 3053 articles in globalization. This paper surveys and classifies DM articles between Taiwan and globalization using the following eight categories – publication year, citation, document type, country/territory, institute name, language, source title and research area – for different distribution status in order to find the difference and how DM technologies and applications have developed in this period. Finally, the study will analyze DM technology trends, forecasts and citations under the above results.

As a verification of its analysis, the paper implements the following steps to check whether the analysis follows Lotka's law:

- (1) Collect data
- (2) List author & article distribution table
- (3) Calculation the value of n (slope)

According to Lotka's law, the generalized formula is $x^n y = c$, the value of n is -2. The parameter n of applied field is calculated by the least square-method using the following formula [39]:

$$n = \frac{N \sum XY - \sum X \sum Y}{N \sum X^2 - (\sum X)^2} \quad (1)$$

N is the number of pairs of data, X is the logarithm of publications(x) and Y is the logarithm of authors (y).

The least-square method is used to estimate the best value for the slope of a regression line which is the exponent n for Lotka's law [39]. The slope is usually calculated without data points representing authors of high productivity. Since values of the slope change with different number of points for the same set of data, we have made several computations of n . The median or

the mean values of n can also be identified as the best slope for the observed distribution [39]. Different values of n produce different values of the constant c .

(4) Calculation the value of c

According to Lotka's law, the generalized formula is $x^n y = c$, the value of c is 0.6079. The parameter c of applied field is calculated using the following formula [39]:

$$c = \frac{1}{\sum_{p=1}^{p-1} \frac{1}{x^n} + \frac{1}{(n-1)p^{n-1}} + \frac{1}{2p^n} + \frac{n}{24(p-1)^{n+1}}} \quad (2)$$

p is the 20, n is the value obtained in (3) Calculation the value of n , and x is the number of publications.

(5) Utilizing the K-S (Kolmogorov-Smirnov, K-S) test to evaluate whether the analysis matches Lotka's law [39] suggests the K-S test, a goodness-of-fit statistical test to assert that the observed author productivity distribution is not significantly different from a theoretical distribution. The hypothesis concerns a comparison between observed and expected frequencies. The test allows the determination of the associated probability that the observed maximum deviation occurs within the limits of chance. The maximum deviation between the cumulative proportions of the observed and theoretical frequency is determined by the following formula [39]:

$$D = \text{Max } |F_o(x) - S_n(x)| \quad (3)$$

$F_o(x)$ = theoretical cumulative frequency

$S_n(x)$ = observed cumulative frequency

The test is performed at the 0.01 level of significance. When sample size is greater than 35, the critical value of significance is calculated by the following formula [39]:

$$\text{The critical value at the 0.01 level of significance} = 1.63/\sqrt{\sum y} \quad (4)$$

$\sum y$ = the total population under study

If the maximum deviation falls within the critical value the null hypothesis that the data set conforms to Lotka's law can be accepted at a certain level of significance. But if it exceeds the critical value the null hypothesis must be rejected at a certain level of significance and concluded that the observed distribution is significantly different from the theoretical distribution. Based on the analyzing results, this paper provides a roadmap for future researches, abstracts technology trend information and facilitates knowledge accumulation. Therefore, the researches of DM in Taiwan can follow and concentrate the globalization categories, and create the potential in the near future.

RESEARCH RESULTS

Distribution by Publication Year

As Fig. 1 shows, the article production of Taiwan and globalization on DM has been rising since 1995. The article distribution can be divided into three segments to show the trend of development: (1) from 1993 to 2004, (2) from 2005 to 2008 and (3) from 2009 to 2016 in Taiwan, and (1) from 1993 to 2000, (2) from 2001 to 2005 and (3) from 2006 to 2016 in globalization. From 1993 to 1998, DM did not draw many researchers' attention. After 1998, the publication productivity per annum steadily increased, was followed by fast growth between 1999 and 2003, and rapidly peaked in 2015. The publication in 2016 is still increase. The status implicates that DM has great potential to grow in the future.

Regarding the relationship between article production and citations in DM of Taiwan, the citations almost follow the article production ranking accordingly (Fig. 2). On the other side, the citations also follow the article production ranking accordingly (Fig. 3).

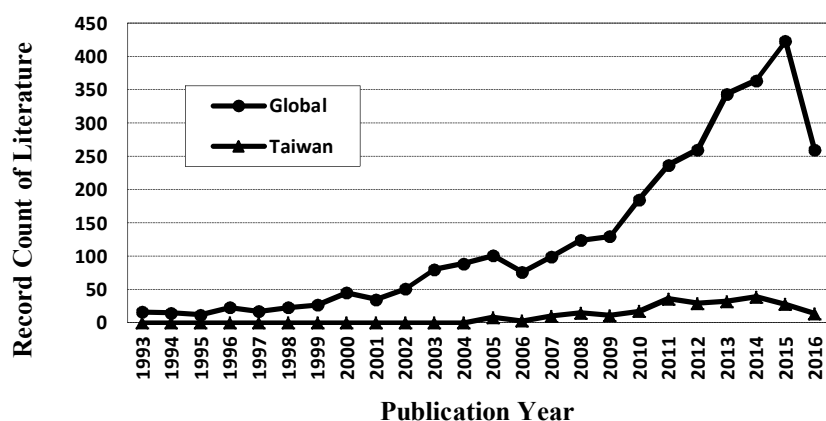


Figure 1: The tendency chart of publication growth of DMin Taiwan and globalization area
(Source: WoS database on 2016/06/28)

Distribution by Citation

From Fig. 4, we can see that the citation distribution of Taiwan and globalizationon DM is not easy to recognize between 1993 and 1999, followed by a dramatic growth and rapidly peaked in 2015 of DM. The citation in 2016 is still increase. The result indicates that DM will become more popular in the future.

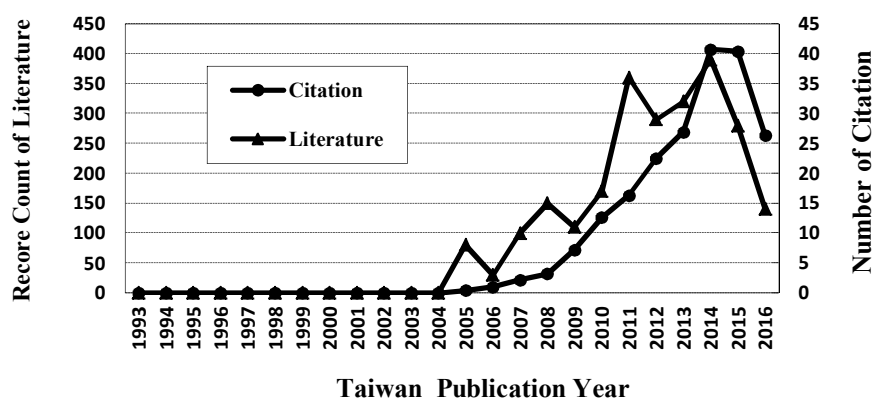


Figure2: Publication and citation distribution of publication year in Taiwan of DM
(Source: WoS database on 2016/06/28)

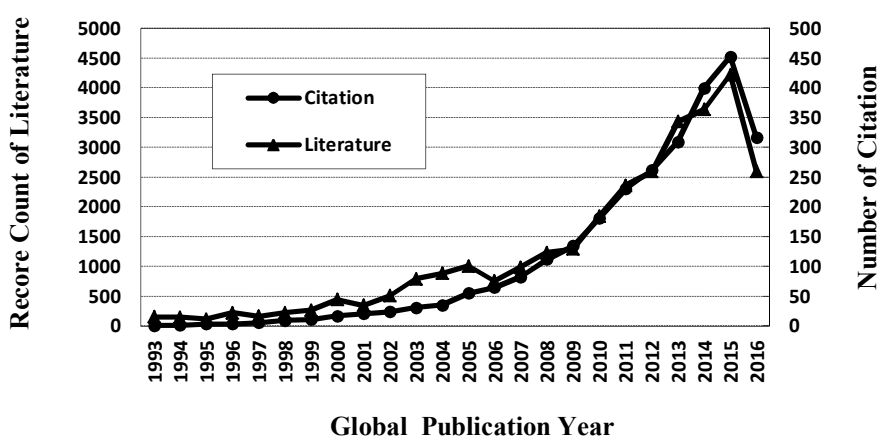


Figure3: Publication and citation distribution of publication year in globalization of DM
(Source: WoS database on 2016/06/28)

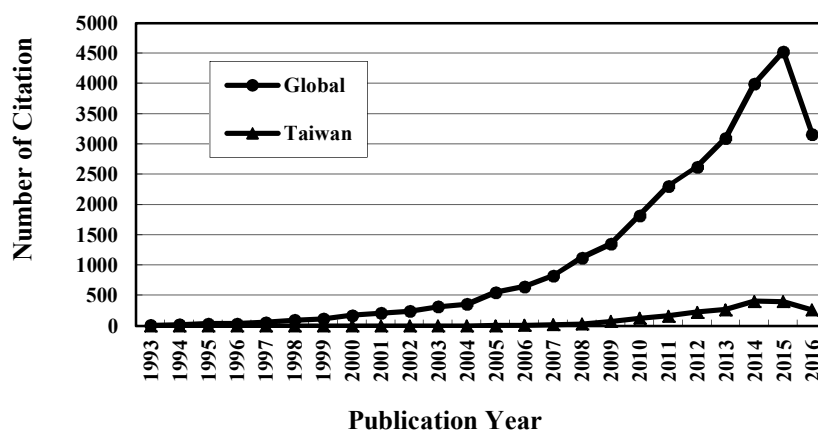


Figure4: Citation status in each year of DM in Taiwan and globalization area
(Source: WoS database on 2016/06/28)

Distribution by Country/Territory

According to Fig. 5, we can figure out that the US is at the top with 1225 (40.12%) in DM of globalization, following by England, with 288 (9.43%), respectively. Taiwan ranks third with 245 (8.03%) in DM. Behind them, the PRC, Australia, Canada, Spain and Germany are also major academic providers in the field of DM.

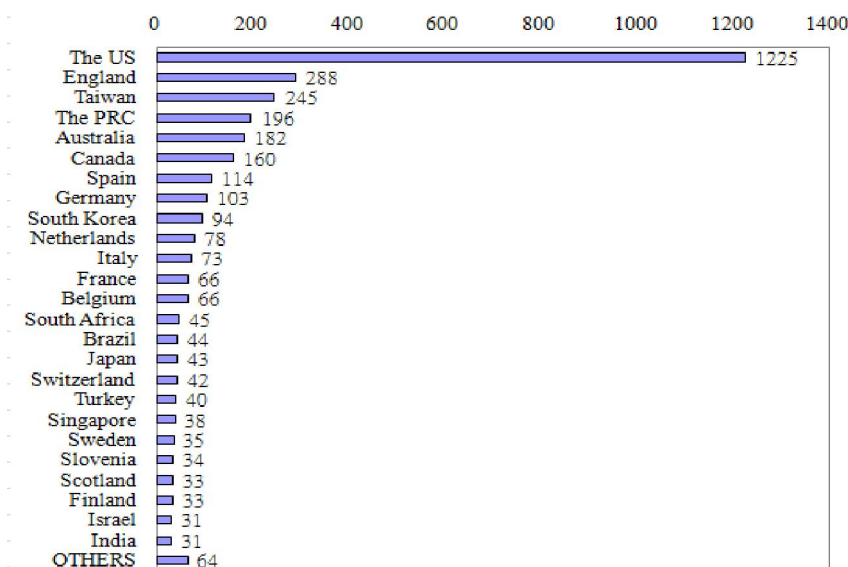


Figure5: Distribution of top 25 countries/territories in DM of globalization from 1993 to 2016
(source: WoS database on 2016/06/28)

Distribution by Institution Name

Table 1 is easy to summarize that National Central University and National ChiaoTung University are the same scholarly affiliations of both Taiwan and globalization in DM research domain. The distribution of institutions shows that the US is still the most productive country within the research aspect of DM in globalization.

Regarding the relationship between article production and citations in DM of Taiwan, there are 25 articles from National ChiaoTung University and 16 articles from TamKang University, but their citations are 411 times and 222 times in the domain. The others almost follow the article production ranking accordingly (Fig. 6). On the other side, there are 29 articles from University of Wisconsin, 29 articles from Pennsylvania State University and 25 articles from National ChiaoTung University in DM of globalization, but their citations are 385 times, 477 times and 411 times in the domain. The others follow the article production ranking accordingly (Fig. 7).

Table 1: Distribution of the top 10 institutions for DM from 1993 to 2016
(source: WoS database on 2016/06/28)

Data Mining of Taiwan			Data Mining of Globalization			
Institution Name	NP	% of 245	Institution Name	NP	% of 3053	Country

National Central University	28	11.43%	Columbia University	31	1.02%	The US
National ChiaoTung University	25	10.20%	University of Wisconsin	29	0.95%	The US
NationalChungChengUniversity	17	6.94%	University of Illinois	29	0.95%	The US
TamKangUniversity	16	6.53%	National Central University	28	0.92%	Taiwan
National Taiwan University	13	5.31%	Pennsylvania State University	27	0.88%	The US
NationalChangHuaUniversityofEducation	13	5.31%	NIOSH	27	0.88%	The US
NationalChengChiUniversity	12	4.90%	University of Pennsylvania	26	0.85%	The US
NationalTsingHuaUniversity	11	4.49%	University of Queensland	25	0.82%	Australia
NationalChengKungUniversity	11	4.49%	National ChiaoTung University	25	0.82%	Taiwan
YuanZeUniversity	10	4.08%	KatholiekeUniversiteit Leuven	24	0.79%	Belgium
NationalYunLinUniversity of Science and Technology	10	4.08%	Hong KongPolytech University	24	0.79%	The PRC
National Taiwan University of Science and Technology	10	4.08%				

NP=number of publication

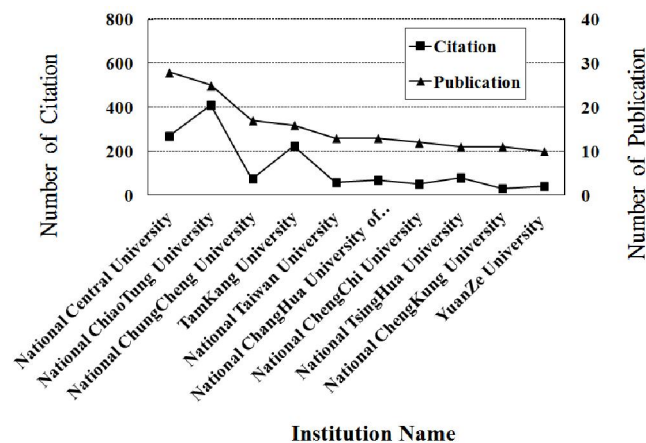


Figure6:Publication and citation distribution of top 10 institutions of DM in Taiwan
(Source: WoS database on 2016/06/28)

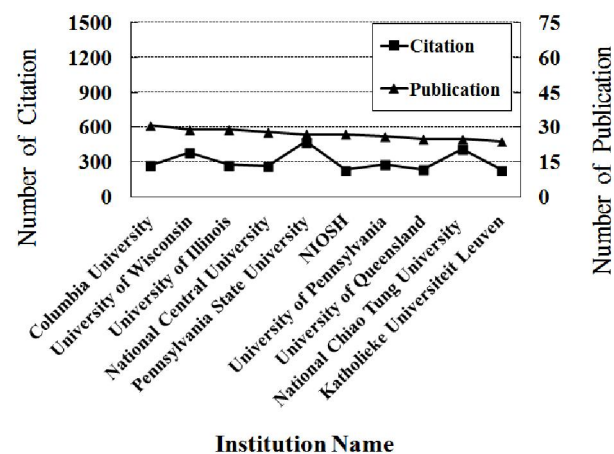


Figure7:Publication and citation distribution of top 10 institutions of DM in globalization
(Source: WoS database on 2016/06/28)

Distribution by Document Type

In Table 2, the distribution of document types from 1993 to 2016 indicates that the most popular publication document type is “Article” (2777 articles, 90.96% in globalization and 240 articles, 97.96% in Taiwan). The result demonstrates that the article is the major tendency of document type in DM research domain.

Table 2: Distribution of document types for DM from 1993 to 2016
(source: WoS database on 2016/06/28)

Data Mining of Taiwan			Data Mining of Globalization		
Document Type	NP	% of 245	Document Type	NP	% of 3053
Article	240	97.96%	Article	2777	90.96%
Proceedings Paper	7	2.86%	Proceedings Paper	135	4.42%
Review	2	0.82%	Review	103	3.37%
Meeting Abstract	2	0.82%	Book Review	76	2.49%
			Editorial Material	49	1.61%
Total	245	100%	Meeting Abstract	38	1.25%
			Note	3	0.10%
			Correction	3	0.10%
			News Item	2	0.07%
			Book Chapter	2	0.07%
			Total	3053	100%

NP=number of publication

Distribution by Language

In Table 3, the majority language for Taiwan and globalization researchers is English, with 245 articles (100.00%) in Taiwan and 2973 articles (97.38%) in globalization. Clearly, English is still the main trend in DM research domain.

Table 3: Distribution of languages for DM from 1993 to 2016
(source: WoS database on 2016/06/28)

Data Mining of Taiwan			Data Mining of Globalization		
Language	NP	% of 245	Language	NP	% of 3053
English	245	100%	English	2973	97.38%
			Spanish	23	0.75%
Total	245	100%	German	13	0.43%
			Portuguese	11	0.36%
			French	6	0.20%
			Slovak	5	0.16%
			Czech	5	0.16%
			Slovene	3	0.10%
			Russian	3	0.10%
			Japanese	3	0.10%
			Italian	3	0.10%
			Korean	2	0.07%
			Total	3053	100%

NP= number of publication

Table 4: Distribution of top 10 research areas for DM from 1993 to 2016
(source: WoS database on 2016/06/28)

Data Mining of Taiwan			Data Mining of Globalization		
Research Area	NP	% of 245	Research Area	NP	% of 3053
Computer Science	154	62.86%	Computer Science	998	32.69%
Engineering	78	31.84%	BusinessEconomics	623	20.41%
Operations Research & Management Science	75	30.61%	Information Science & Library Science	483	15.82%

Information Science & Library Science	45	18.37%	Engineering	443	14.51%
BusinessEconomics	37	15.10%	Operations Research & Management Science	400	13.10%
Education & Educational Research	30	12.25%	Environmental Sciences Ecology	228	7.47%
Medical Informatics	16	6.53%	PublicEnvironmental&Occupational Health	213	6.98%
Health Care Sciences& Services	11	4.49%	Psychology	162	5.31%
Social Sciences& Other Topics	9	3.67%	Geography	140	4.59%
Mathematics	6	2.45%	Medical Informatics	136	4.46%
			Neurosciences Neurology	33	1.08%

NP=number of publication

Distribution by ResearchArea

Table 4 offers critical information for future research tendencies in DM, allowing researchers a better understanding of the distribution of the top 10 research areas in future research. The top three research areas in Taiwan for DM research domains are computer science (154 articles, 62.86%), followed by engineering (78 articles, 31.84%) and operations research & management science (75 articles, 30.61%). Besides, this paper's analysis suggests that there are other important research disciplines in Taiwanfor DM article production such as information science & library science, business economics, education & educational research, medical Informatics, healthcare sciences & services, social sciences & other topics and mathematics. On the other hand, the top three in globalization for DM research domains are computer science (998 articles, 32.69%), followed by business economics (623 articles, 20.41%) and information science & library science (483 articles, 15.82%). Analysis reveals that there are many additional research domains in globalizationfor DM article production, such as engineering, operations research &management science, environmental sciences ecology, public environmental & occupational health, psychology, geography and medical informatics.

As Fig. 8 illustrates, the citations of Taiwanfollow article production ranking in the top 10 research area, except for Social sciences & other topics (14.89 average citations per article). From Fig. 9, we can find that the citations of globalization follow article production ranking in the top 10 research area, except for public environmental & occupational health (9.56 average citations per article).

Analysis of the top five research area—computer science, business economics, information science & library science, engineering, and operations research & management science—shows that these research area are all repeated in DM research for Taiwan and globalization, indicating that these research area will become the most important category for DM researchers.

Table 5: Distribution of top 10 source titles for DM from 1993 to 2016
(source: WoS database on 2016/06/28)

Data Miningof Taiwan			Data Mining of Globalization		
Source Title	NP	% of 245	Source Title	NP	% of 3053
<i>Expert Systems</i> with Applications	55	22.45%	<i>Expert Systems</i> with Applications	177	5.80%
<i>Electronic Library</i>	10	4.08%	<i>Journalof the American Medical Informatics Association</i>	58	1.90%
<i>Computers & Education</i>	9	3.67%	<i>Decision Support Systems</i>	50	1.64%
<i>Knowledge Based Systems</i>	8	3.27%	<i>International Journal of Geographical Information Science</i>	46	1.51%
<i>Journalof Information Science</i>	8	3.27%	<i>Journalof the American Society for Information Science and Technology</i>	44	1.44%
<i>Educational Technology & Society</i>	7	2.86%	<i>Resources Policy</i>	41	1.34%
<i>Decision Support Systems</i>	6	2.45%	<i>Information Processing &Management</i>	39	1.28%
<i>Online Information Review</i>	5	2.04%	<i>Journalof the Operational Research Society</i>	32	1.05%
<i>Information Processing &Management</i>	5	2.04%	<i>Journal of Information Science</i>	28	0.92%
<i>Electronic Commerce Research and Applications</i>	5	2.04%	<i>Scientometrics</i>	27	0.88%

NP=number of publication

Distribution by Source Title

Table 5 highlights information on trends for DM, allowing researchers to closely approach the distribution of the top 25 source

titles in future research. The top three DM research journals in Taiwan are *Expert Systems with Applications* (55 articles, 22.45%), followed by *Electronic Library* (10 articles, 4.08%) and *Computers & Education* (9 articles, 3.67%). In addition, there are a significant number of research sources for DM article production in Taiwan such as *Knowledge Based Systems*, *Journal of Information Science*, *Educational Technology & Society*, *Decision Support Systems*, *Online Information Review*, *Information Processing & Management* and *Electronic Commerce Research and Applications*.

In the meantime, the top three DM research journals in globalization are *Expert Systems with Applications* (177 articles, 5.80%), followed by *Journal of the American Medical Informatics Association* (58 articles, 1.90%) and *Decision Support Systems* (50 articles, 1.64%). Moreover, it also finds out that there are a lot of research sources for DM article production such as *International Journal of Geographical Information Science*, *Journal of the American Society for Information and Technology*, *Resources Policy*, *Information Processing & Management*, *Journal of the Operational Research Society*, *Journal of Information Science* and *Scientometrics*.

In Fig. 10, the citations of Taiwan follow article production ranking in the top 10 sources, except for *Electronic Library* (4.90 average citations per article), *Decision Support Systems* (11.83 average citations per article), *Information Processing & Management* (8.20 average citations per article), and *Electronic Commerce Research and Applications* (8.00 average citations per article).

As Fig. 11 shows, we can find that the citations of globalization follow article production ranking in the top 10 sources, except for *Decision Support Systems* (16.74 average citations per article), *International Journal of Geographical Information Science* (13.87 average citations per article), *Information Processing & Management* (9.69 average citations per article), *International Journal of Geographical Information Science* (9.70 average citations per article) and *Scientometrics* (9.63 average citations per article).

Analysis of the top ten journal sources—*Expert Systems with Applications*, *Decision Support Systems*, *Information Processing & Management* and *Journal of Information Science*—shows that these source titles are all the same at DM research for Taiwan and globalization, indicating that these source titles will become the most important category for DM researchers.

DISCUSSION

The section implements the steps which are demonstrated in Section 2.2.2 to verify whether the distribution of author article production of Taiwan and globalization follows Lotka's law in DM research domain.

Taiwan

(1) Collect data and

(2) List author & article distribution table

Author quantity is calculated by the equality method from 245 articles retrieved by the WoS index. Altogether, 495 authors on DM in Taiwan are included. See Table 6 for reference.

(3) Calculation the value of n (slope)

In Table 7, we list the number of authors and the number of publications by one author for calculation of the exponent n with the topic as “data mining” in WoS database. The results of the calculations in Table 7 can be brought into the Equation (1) to calculate the value of n:

$$n = \frac{12(2.59) - (8.68)(7.83)}{12(7.46) - (8.68)(8.68)} \quad (5)$$

Then we can find $n = -2.591496952$

Table 6: Calculation of author productivity of DM in Taiwan

NP	Author (s)	(NP) * (Author)	Accumulated Record	Accumulated Record %	Accumulated Author(s)	Accumulated Author(s)%
12	1	12	12	1.75%	1	0.20%
11	0	0	12	1.75%	1	0.20%
10	0	0	12	1.75%	1	0.20%
9	0	0	12	1.75%	1	0.20%
8	1	8	20	2.92%	2	0.40%

7	0	0	20	2.92%	2	0.40%
6	4	24	44	6.42%	6	1.21%
5	3	15	59	8.61%	9	1.82%
4	10	40	99	14.45%	19	3.84%
3	22	66	165	24.09%	41	8.28%
2	66	132	297	43.36%	107	21.62%
1	388	388	685	100.00%	495	100.00%

NP=number of publication

(4) Calculation the value of c

The value of c is calculated by using the Equation (2), where $P = 20$, $x = 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12$ and $n = 2.591496952$, then we can find $c = 0.777715357$.

With $n = -2.591496952$ and $c = 0.777715357$, the Lotka's law equation of DM in Taiwan is:

$$f(x) = 0.777715357/x^{2.591496952} \quad (6)$$

When the result is compared to Table 6, we can see that authors with only one article account for 78.38% ($100\% - 21.62\% = 78.38\%$), which almost matches the primitive c value 77.77% generated by Lotka's law. The values for n and c can be calculated by the least squares law and then brought into further analysis for Lotka's law compliance.

According to [40], the absolute value of n should be between 1.2 and 3.8, as given by the generalized Lotka's law. The result indicates that n (=2.591496952) is between 1.2 and 3.8 and is matched the reference data by observation. The detail distribution chart is shown in Fig. 12.

Table 7: Calculation of the exponent n for DM in Taiwan

x (NP)	y (Author)	X=log(x)	Y=log(y)	XY	XX
12	1	1.08	0.00	0.00	1.16
11	0	1.04	-	-	1.08
10	0	1.00	-	-	1.00
9	0	0.95	-	-	0.91
8	1	0.90	0.00	0.00	0.82
7	0	0.85	-	-	0.71
6	4	0.78	0.60	0.47	0.61
5	3	0.70	0.48	0.33	0.49
4	10	0.60	1.00	0.60	0.36
3	22	0.48	1.34	0.64	0.23
2	66	0.30	1.82	0.55	0.09
1	388	0.00	2.59	0.00	0.00
Total	495	8.68	7.83	2.59	7.46

x= number of publication

y=author

X = logarithm of x

Y = logarithm of y

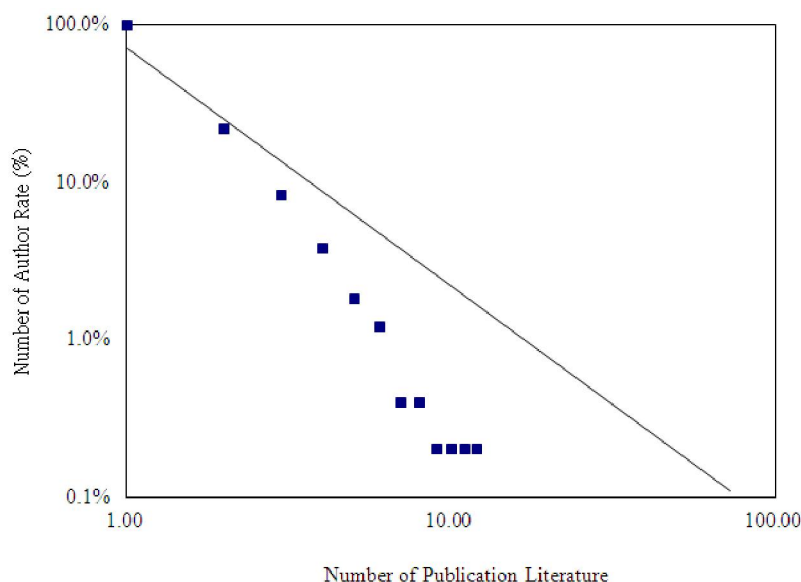


Figure12: Distribution of literature productivity of author on DM research aspect in Taiwan

(5) Utilize the K-S test to evaluate whether the analysis matches Lotka's law

We use Equation (3) to evaluate whether the analysis matches Lotka's law. From Table 8, we can find $D = 0.0104$ ($D = \max |F_o(x) - S_n(x)|$). According to the K-S test, the critical value at 0.01 level of significance is calculated by Equation (4):

$$1.63 / \sqrt{495} = 0.07326305 \quad (7)$$

Table 8: The K-S test for DM in Taiwan

NP	Author (s)	Taiwan (Observed)	$S_n(x)$	Taiwan (Expected)	$F_o(x)$	D
1	388	0.7838	0.7838	0.7777	0.7777	0.0061
2	66	0.1333	0.9172	0.1290	0.9067	0.0104
3	22	0.0444	0.9616	0.0451	0.9519	0.0097
4	10	0.0202	0.9818	0.0214	0.9733	0.0085
5	3	0.0061	0.9879	0.0120	0.9853	0.0026
6	4	0.0081	0.9960	0.0075	0.9928	0.0032
7	0	0.0000	0.9960	0.0050	0.9978	0.0018
8	1	0.0020	0.9980	0.0036	1.0013	0.0034
9	0	0.0000	0.9980	0.0026	1.0040	0.0060
10	0	0.0000	0.9980	0.0020	1.0060	0.0080
11	0	0.0000	0.9980	0.0016	1.0075	0.0095
12	1	0.0020	1.0000	0.0012	1.0088	0.0088

NP: number of publication; Taiwan: author productivity of Taiwan; $S_n(x)$ = observed cumulative frequency; $F_o(x)$ = theoretical cumulative frequency; D = maximum deviation

Globalization

(1) Collect data and

(2) List author & article distribution table

Author quantity is calculated by the equality method from 3053 articles retrieved by the WoS index. Altogether, 7354 authors on DM in globalization are included. See Table 9 for reference.

Table 9: Calculation of author productivity of DM in globalization

NP	Author (s)	(NP) * (Author)	Accumulated Record	Accumulated Record %	Accumulated Author(s)	Accumulated Author(s)%
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15	1	15	15	0.17%	1	0.01%
14	1	14	29	0.33%	2	0.03%
13	0	0	29	0.33%	2	0.03%
12	2	24	53	0.60%	4	0.05%
11	4	44	97	1.09%	8	0.11%
10	1	10	107	1.21%	9	0.12%
9	4	36	143	1.61%	13	0.18%
8	5	40	183	2.06%	18	0.24%
7	8	56	239	2.69%	26	0.35%
6	15	90	329	3.71%	41	0.56%
5	20	100	429	4.84%	61	0.83%
4	57	228	657	7.41%	118	1.60%
3	175	525	1182	13.32%	293	3.98%
2	629	1258	2440	27.50%	922	12.54%
1	6432	6432	8872	100.00%	7354	100.00%

NP = number of publication

(3) Calculation the value of n (slope)

In Table 10, we list the number of authors and the number of publications by one author for calculation of the exponent n with the topic as “data mining” in WoS database. The results of the calculations in Table 10 can be brought into the Equation (1) to calculate the value of n:

$$n = \frac{15(7.08) - (12.12)(15.49)}{15(11.4) - (12.12)^2} \quad (8)$$

Then we can find $n = -3.36257094$

Table 10: Calculation of the exponent n for DM in globalization

x (NP)	y (Author)	X=log(x)	Y=log(y)	XY	XX
15	1	1.18	0.00	0.00	1.38
14	1	1.15	0.00	0.00	1.31
13	0	1.11	-	-	1.24
12	2	1.08	0.30	0.32	1.16
11	4	1.04	0.60	0.63	1.08
10	1	1.00	0.00	0.00	1.00
9	4	0.95	0.60	0.57	0.91
8	5	0.90	0.00	0.00	0.82
7	8	0.85	0.90	0.76	0.71
6	15	0.78	1.18	0.92	0.61
5	20	0.70	1.30	0.91	0.49
4	57	0.60	1.76	1.06	0.36
3	175	0.48	2.24	1.07	0.23
2	629	0.30	2.80	0.84	0.09
1	6432	0.00	3.81	0.00	0.00
Total	7354	12.12	15.49	7.08	11.40

x = number of publication

y = author

X = logarithm of x

Y = logarithm of y

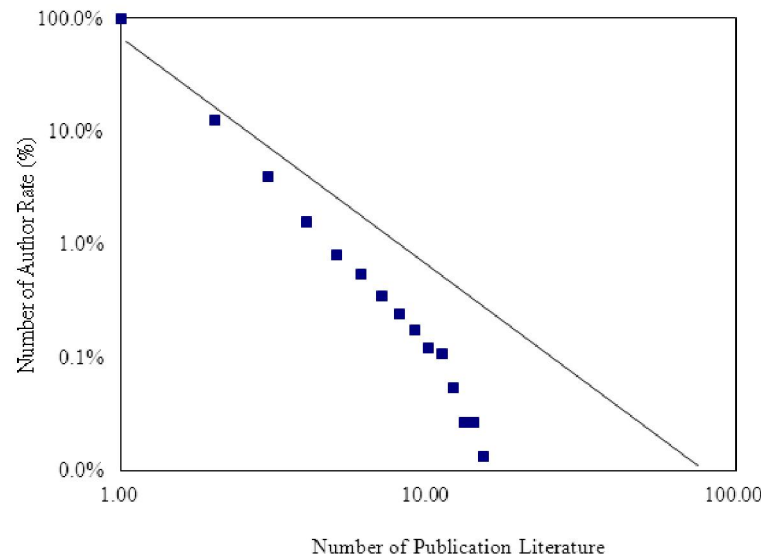


Figure13: Distribution of literature productivity of author on DM research aspect in globalization

(4) Calculation the value of c

The value of c is calculated by using the Equation (2), where $P = 20$, $x = 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15$ and $n = 3.36257094$, then we can find $c = 0.87243801$.

With $n = -3.36257094$ and $c = 0.87243801$, the Lotka's law equation of DM is:

$$f(x) = 0.87243801/x^{3.36257094} \quad (9)$$

When the result is compared to Table 9, we can see that authors with only one article account for 87.46% ($100\% - 12.54\% = 87.46\%$), which almost matches the primitive c value 87.24% generated by Lotka's law. The values for n and c can be calculated by the least squares law and then brought into further analysis for Lotka's law compliance.

According to [40], the absolute value of n should be between 1.2 and 3.8, as given by the generalized Lotka's law. The result indicates that $n (=3.36257094)$ is between 1.2 and 3.8 and is matched the reference data by observation. The detail distribution chart is shown in Fig. 13.

(5) Utilize the K-S test to evaluate whether the analysis matches Lotka's law

We use Equation (3) to evaluate whether the analysis matches Lotka's law. From Table 11, we can find D ($D = \max |F_o(x) - S_n(x)|$) = 0.0050. According to the K-S test, the critical value at 0.01 level of significance is calculated by using the Equation (4):

$$1.63/\sqrt{7354} = 0.01900753 \quad (10)$$

Table 11: The K-S test for DM in globalization

NP	Author (s)	Globalization (Observed)	$S_n(x)$	Globalization (Expected)	$F_o(x)$	D
1	6432	0.8746	0.8746	0.8724	0.8724	0.0022
2	629	0.0855	0.9602	0.0848	0.9573	0.0029
3	175	0.0238	0.9840	0.0217	0.9790	0.0050
4	57	0.0078	0.9917	0.0082	0.9872	0.0045
5	20	0.0027	0.9944	0.0039	0.9911	0.0033
6	15	0.0020	0.9965	0.0021	0.9932	0.0033
7	8	0.0011	0.9976	0.0013	0.9945	0.0031
8	5	0.0007	0.9982	0.0008	0.9953	0.0030
9	4	0.0005	0.9988	0.0005	0.9958	0.0030

10	1	0.0001	0.9989	0.0004	0.9962	0.0027
11	4	0.0005	0.9995	0.0003	0.9965	0.0030
12	2	0.0003	0.9997	0.0002	0.9967	0.0031
13	0	0.0000	0.9997	0.0002	0.9968	0.0029
14	1	0.0001	0.9999	0.0001	0.9969	0.0029
15	1	0.0001	1.0000	0.0001	0.9970	0.0030

NP = number of publication

Data Mining = author productivity of data mining

$S_n(x)$ = observed cumulative frequency

$F_o(x)$ = theoretical cumulative frequency

D = maximum deviation

Discussion

- (1) Constant c computed 0.777715357. Using the K-S test it is found that at the 0.01 level of significance the maximum deviation is 0.0104 which is smaller than the critical value of 0.07326305. Therefore, it can be concluded that the author productivity distribution of DM in Taiwan conforms to Lotka's law.
- (2) Based on Lotka's methodology, the value of the exponent n for DM is estimated 3.36257094 and the constant c computed 0.87243801. Using the K-S test it is found that at the 0.01 level of significance the maximum deviation is 0.0050 which falls within the critical value of 0.01900753. Therefore, it can be concluded that the author productivity distribution of DM fits Lotka's law.

CONCLUSION

Although DM has already become more important recently, there are few comprehensive studies and categorization schemes to discuss the characteristics for DM. Using a bibliometric approach, the paper explores research potential of DM in Taiwan through comparing globalization DM trends, forecasts and citations from 1993 to 2016 by locating heading "data mining" in topic in the WoS database. The bibliometric analytical technique was used to examine the topic in WoS journals from 1993 to 2016, we found of 245 articles of Taiwan and 3053 articles of globalization. This paper surveys and classifies DM articles between Taiwan and globalization using the following eight categories – publication year, citation, document type, country/territory, institute name, language, source title and research area – for different distribution status in order to find the difference and how DM technologies and applications have developed in this period. Finally, the study will analyze DM technology trends, forecasts and citations under the above results. Also, the paper performs the K-S test to check whether the distribution of author article production of Taiwan and globalization follows Lotka's law or not.

The results in this study have several important conclusions:

- (1) From the distribution of publication year, DM has more potential to grow up and becomes more popular.
- (2) The article is the main tendency of document type in DM research both for Taiwan and globalization area.
- (3) Clearly, English is still the major trend of language in DM research both for Taiwan and globalization area.
- (4) An existing upward trend of DM is expected to continue in the future from the distribution of citation.
- (5) On the basis of the countries/territories, the US, England, and Taiwan are the top three countries/territories in DM research. Besides, the PRC, Australia, Canada, Spain and Germany are also the major academic article providers in DM.
- (6) Regarding the institutions, National Central University and National ChiaoTung University are the specific scholarly affiliations in DM research both for Taiwan and globalization. Analysis of the locations of these affiliations shows that the US is still the most productive country within the research aspect of DM in Taiwan and globalization. Regarding the relationship between article production and citations in DM of Taiwan, there are 25 articles from National ChiaoTung University and 16 articles from TamKang University, but their citations are 411 times and 222 times in the domain. The others almost follow the article production ranking accordingly. On the other side, there are 29 articles from University of Wisconsin, 29 articles from Pennsylvania State University and 25 articles from National ChiaoTung University in DM of globalization, but their citations are 385 times, 477 times and 411 times in the domain. The others follow the article production ranking accordingly.
- (7) Judging from the research area, the most relevant disciplines in DM research category provided by computer science, business economics, information science & library science, engineering, and operations research & management science will become the most important categories for DM researchers in Taiwan and globalization. The citations of Taiwan follow article production ranking in the top 10 research area, except for Social sciences & other topics. In the meantime,

we can find that the citations of globalization follow article production ranking in the top 10 research area, except for public environmental & occupational health.

- (8) Based on the sources, the most enthusiastic supports for DM scholarly publishing enterprise come from *Expert Systems with Applications*, *Decision Support Systems*, *Information Processing & Management* and *Journal of Information Science* which are repeated in DM research domain and will turn into the most critical journals for DM researchers in Taiwan and globalization. The citations of Taiwan follow article production ranking in the top 10 sources, except for *Electronic Library*, *Decision Support Systems*, *Information Processing & Management*, and *Electronic Commerce Research and Applications*. On the other hand, we can find that the citations of globalization follow article production ranking in the top 10 sources, except for *Decision Support Systems*, *International Journal of Geographical Information Science*, *Information Processing & Management*, *International Journal of Geographical Information Science* (9.70 average citations per article) and *Scientometrics*.
- (9) According to the K-S test, the result shows that the author productivity distribution predicted by Lotka holds for both in Taiwan and globalization of DM. This means that out of all the authors in DM, about 60 percent will have just one publication, about 15 percent will have two publications, about 7 percent of authors will have three publications, and so on.

Besides, these findings can support to recognize scientific research tendencies and realize the scale of researching development on DM domain in Taiwan by analyzing the increases of the article authors. The resources are always limited, especially for emerging and developing countries, and small and medium enterprises. According to these above information, Taiwan government and enterprises may infer collective trends and demands for scientific researchers on DM domain to organize and create proper training strategies and policies in the future.

Based on the analyzing results, this paper provides a roadmap for future researches, abstracts technology trend information and facilitates knowledge accumulation. Therefore, the researches of DM in Taiwan can follow and concentrate the globalization categories, and create the potential in the near future.

Limitation of the study

The results and conclusion are limited and not intended to be exclusive. WoS journals adopt stringent journal reviewing criteria, the articles might take one or two years from submission to publication. Therefore, findings in this study may not reflect the most recent research trends.

Research on DM has been carried out since the 1960s and 1970s, and even before that date. However, this study used only one search term each ("data mining") to analyze DM publications from 1993 to 2016 collected in the WoS databases at that time. Future studies with greater resources, using more search terms, are needed to expand these findings.

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Digital Literacies and Sustainable Development: Narratives From A Tale of Two Cities.

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ABSTRACT

This article is a status report of the on-going efforts of the DiLiterati Group (funded by Singapore's Ministry of Education and led by Ravi Sharma) to investigate the role of digital literacies in fostering sustainable development. In this research, we are trying to investigate how the knowledge disparities could be bridged with digital literacy and whether the resultant "level playing field" will generate greater contributions of national wealth and a more equitable sharing of it. This culminated in the synthesis of a Digital Literacy Maturity Model. A quantitative approach to sense-making did not reveal much support for the model we had anticipated. Therefore a procedure to delve deeper into the qualitative and contextual was formulated to frame "narratives" that suggest "lessons learnt" and "best practices" from economies that have demonstrated successful sustainable growth and development. To test the efficacy of the procedure, Singapore and Hong Kong were selected as pilot subjects of interest.

Keywords: knowledge societies, digital economy, fourth industrial revolution.

INTRODUCTION & BACKGROUND

Building a Knowledge Society represents an aspiration that has been the thread of a voluminous body of work ranging from the classic treatise by Adam Smith (1776) to more contemporary projects by the World Bank [8]. It has been shown that knowledge and its diffusion become potent factors of innovation; and this creates a level of playing field of opportunities and hence reduces income and wealth disparities [3]. This paper is a status report of the on-going research of the DiLiterati Group, funded by Singapore's Ministry of Education, in addressing the following key questions. How can knowledge be diffused across a society so that it may be more effectively exploited to create national wealth? Can we bridge knowledge disparities with digital literacy? Will the resultant "level playing field" generate greater contributions of national wealth and a more equitable sharing of it?

There is considerable agreement across disciplines that knowledge is a key driver of sustainable development (cf [6] for a review). In this context, we adopt the view that sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs. The challenge of sustainable development is that it should result in the ideal of equitable opportunities for value creation across the community at large. Equality of socio-economic participation and well-being is one of the key ideas of justice as espoused by the philosopher-economist Amartya Sen and echoed by Piketty [3]. The research described in this paper attempts to understand the rich linkages between access to knowledge, its diffusion through society, and society's ability to apply such knowledge towards sustainable development. In this era of the Internet-of-Things and the emergence of the so-called Fourth Industrial Revolution [4], a critical mass of such activities take place through digital exchanges of codified information shared across networks and applied in order to create value. Understandably, the United Nations has declared access to Internet services to be a basic human right. Inclusion and participation of a given population in such purposeful activities has hence attracted much scholarly interest. More specifically, digital participation has now become synonymous with active, engaged citizens – a public good referred to as digital entitlements [5]. The next section is a brief recap of prior research.

PREVIOUS WORK

Prior work by the DiLiterati Group highlight key characteristics of knowledge societies: i) they are necessary and sufficient conditions for growth in the knowledge economy, ii) they have high knowledge absorptive capacity and complex chains of creation, production and distribution, and iii) they consist of a sustainable learning community which emphasizes innovation. Four knowledge pillars actively used by the World Bank's Knowledge Assessment Methodology (information infrastructure, economic and institutional governance, education and human capital, and innovation system) have been effective in deriving a set of best practices in developing knowledge policies [5]. In a Structured Literature Review conducted by the DiLiterati Group [forthcoming], we note that prior research did not examine participation gaps arising from the uneven distribution of resources in developing skills and literacies throughout the world and in the lack of transparency in the way digital literacies shape perceptions of the world. At this juncture of the new participatory culture, the key question of "how we can guarantee that the rich opportunities afforded by the expanding digital landscape are made available to all," still remains unanswered.

Scholarly efforts to lay the conceptual foundations of economic, social, institutional and environmental indicators spanning ICT and knowledge domains have attracted long-standing interest. However, much of this work (including our own) was tentative and provisional. There is a need for: i) more accurate models, metaphors, and measures to describe human enterprise relative to society; ii) substantial improvements regarding digital citizenship and governance; iii) major enhancement in public awareness, along with provision of the education needed for the transition to sustainability; and, iv) tackling sustainability as a series of

divergent problems formed out of the tensions between competing disciplines. The research being undertaken by the DiLiterati Group is an attempt at fixing the above gaps. More specifically, we shall undertake four major phases that address the development of a theoretical basis as well as rigorous empirical investigation of a measurement scorecard for knowledge disparities.

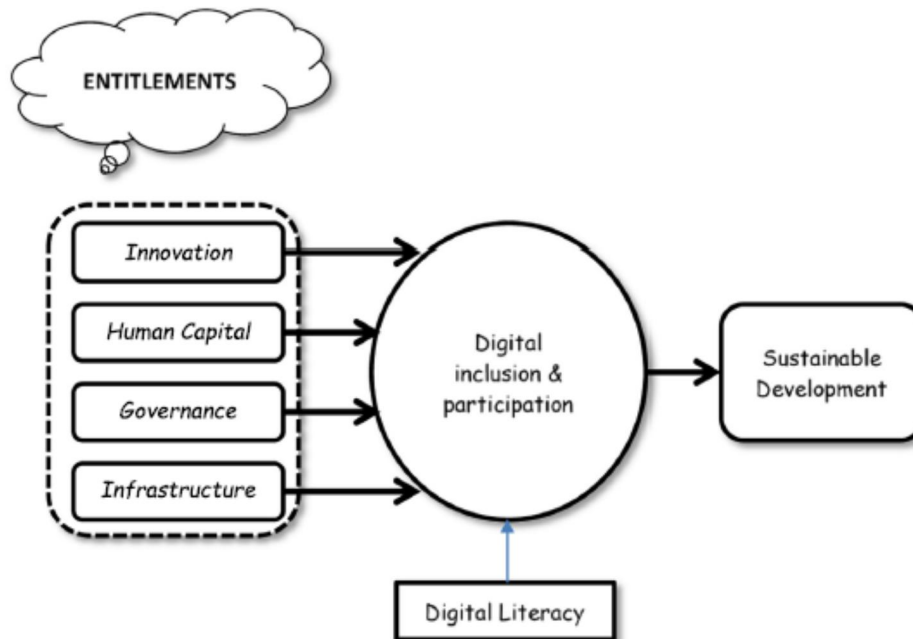


Figure 1: Digital Transformations and Sustainable Development [6, p 641]

Figure 1 above conceptualizes what we propose as a general theory of digital literacies, knowledge societies and sustainable development. Specifically, ICT infrastructure, governance in terms of policy implementation, human capital development, and the creation and endorsement of a culture of innovation are a set of digital entitlements that would promote inclusiveness as well as participation in opportunities for growth and development. Digital literacy skills are “contingency factors”, i.e. they are acquired and applied by citizens when there is a value proposition. The notions of digital inclusion and participation are deeply entwined. Inclusion is an effort by the state to reach out to its citizens, be it through a physical or virtual public sphere. Participation is when this outreach (presumably in the form of access, content and applications) is useful and usable. Even so, inclusion and participation must embrace economic, technical, and socio-political feasibility. Such an interaction, we had theorized in [6], ultimately leads to sustainable growth and development for the evolution into knowledge societies.

Our framework for digital inclusion moderated by digital literacy, is also consistent with four knowledge pillars actively used by the World Bank’s Knowledge Assessment Methodology [8]: information infrastructure, economic & institutional governance, education & human capital, and innovation system. This has been effective in deriving a set of measures and investigating knowledge policies in several field studies [8]. However, these studies did not examine participation gaps arising from the uneven distribution of resources in developing skills and literacies throughout the world and in the lack of transparency in the way digital media shapes perceptions of the world. At this juncture of the new participatory culture, the key question of “how we can guarantee that the rich opportunities afforded by the expanding digital landscape are made available to all,” still remains unanswered. In the next section, a quantitative approach to probing this is explored.

DATA MINING AND SENSE-MAKING

Given the voluminous, public domain datasets available, we first performed data mining in order to ascertain the linkages between our theory and reality. Drawing from secondary data sources such as the World Bank’s World Economic Indicators, United Nations’ Databases, and the World Economic Forum; panel data from 100+ countries covering as many key indicators were mined for a 10-year period. The variables were categorized (1) under the 4 sets of entitlements shown in Figure 1 (information infrastructure, economic & institutional governance, education & human capital, and innovation system); and (2) as indicators, a moderator and their effect on the outcome (ie sustainability). This two-step categorisation allowed for deeper data analysis on the impact of each factor in the development of sustainable knowledge societies as shown in Table 1.

The choice of datasets was based on a timeline. Data for countries were required for the years between 2005 and 2015 so as to allow a lag of 10 years. Another requirement was that the data had to be recent and up-to-date. The ICT Development Index, which indicates the development of ICT in countries under three themes: access, use and skills, was considered the sole moderator in our model. The association among the indicators, and the outcome, as well as the effect of the moderator were determined. Countries with missing values were eliminated based on a threshold and linear regression was used to obtain the values for the remaining missing values for the respective years. Once pre-processing of the data was completed, data for 102 countries was available across all nine indicators shown in Table 1.

Table 1: Data Dictionary of the Sense-Making Model.

Category	Sources (with classification as per knowledge pillars)
Indicators	Global Innovation Index (GII): innovation system [11]
	Government Effectiveness (GOVe): economic and institutional governance [12]
	Human Development Index (HDI): education and human capital [13]
	Network Readiness Index (NRI): economic and institutional governance [14]
	Political Stability (PoIS): economic and institutional governance [12]
	Regulatory Quality (RegQ): economic and institutional governance [12]
	Rule Of Law (RuIL): economic and institutional governance [12]
Moderator	ICT Development Index (ICTD): information infrastructure [15]
Outcome	Sustainable Society Index (SSI) [16]

Values for different variables were in different scales. Therefore, z-score standardization was used to convert all indicators to a common scale with an average of zero and standard deviation of one. Standard data mining techniques such as Visualisation of Descriptive Statistics, Principal Components Analysis, and Structured Equation Modeling. The next section delves into some preliminary results and observations.

PRELIMINARY RESULTS

In the first pass of data mining, visualization techniques such as scatter-plots did not shown any clear relationships (positive or negative) among the indications. However, using ADANCO 2.0 for 2005 to 2015 data, we found consistently high cross correlations among the indicators. This may suggest multi-collinearity.

Table 2: Heterotrait Monotrait Ratio of Correlations (HMRT).

Construct	SSI	GII	GOVe	HDI	NRI	PoIS	RegQ	RuIL	ICTD
SSI									
GII	0.5411								
GOVe	0.4737	0.8902							
HDI	0.4711	0.8236	0.8546						
NRI	0.4734	0.9218	0.9216	0.8834					
PoIS	0.4777	0.7214	0.7758	0.6956	0.7367				
RegQ	0.5197	0.8543	0.9122	0.7902	0.8694	0.7589			
RuIL	0.4519	0.8705	0.9427	0.7859	0.8843	0.8169	0.9025		
ICTD	0.4892	0.8900	0.8749	0.9519	0.9224	0.7295	0.8236	0.8289	

Table 2 shows the ratio of cross correlations for 2015 data. From Table 2, we evince higher correlations among the indicators than with the outcome. This is interesting because it also suggests that the indicators seem to be measuring similar phenomena (SSI?) but at the same time do not sufficiently capture the nuances of SSI individually.

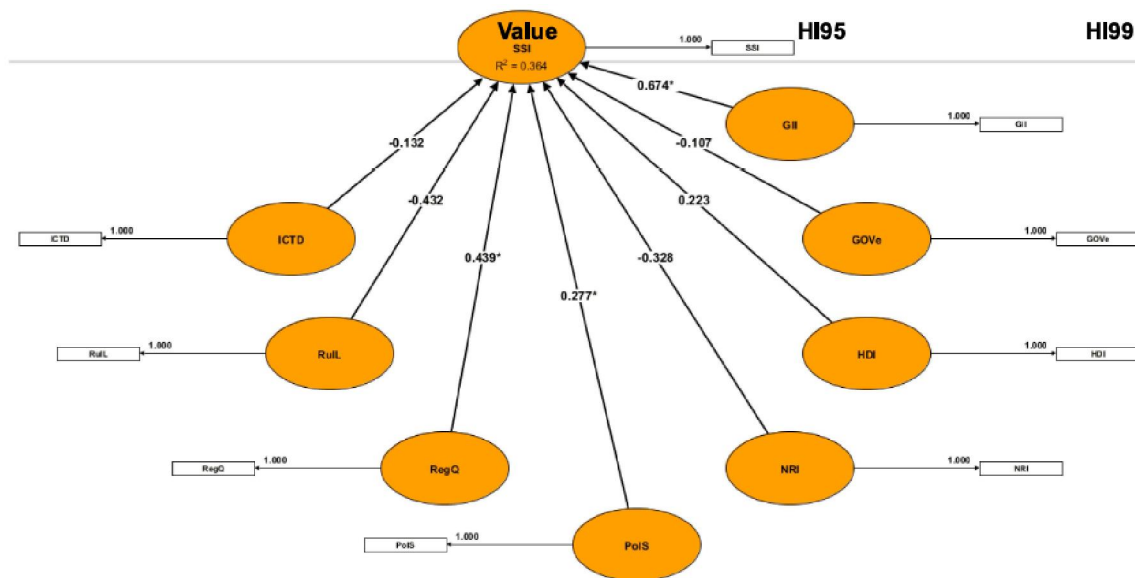


Figure 2: Graphical Representation of the Model (ADANCO 2.0 Output).

Again for 2015 data, path analysis showed that GII, PolS, and RegQ (innovation, political stability and regulatory regime) are significant contributors to SSI. It was surprising that neither HDI nor ICTD-NRI were significant. Such anomalous characteristics did not make sense and could not be explained. There was also difficulty in relating our provisional results to existing theory. For example, it is generally accepted by political economists that the soundness of political and economic institutions underlie economic success, yet the “governance” indicators were not significant contributors to sustainability outcomes.

To probe further, we next attempted random effect regression and pooled regression (with / without time dummies, with / without interaction terms). This set of fixed effect regression seemed to be relatively reasonable (although the results were still not completely within our expectation). More specifically: i) on average, GII has a negative impact and HDI has a positive impact. In terms of magnitude, HDI is far more important than any other variables in affecting SSI. Other variables NRI, INSG and ICTD do not significantly affect SSI; ii) the impacts of GII, HDI, NRI and IG on SSI are enhanced by ICTD. In countries with large ICTD, GII has an even larger negative impact on SSI; and HDI has a more positive impact on SSI. Thus, our preliminary data mining seems to suggest that human capital is the sole significant source of growth and development. Digitisation (ICTD or NRI) is a moderating variable at best. As an explanation, it could be conjectured that population densities, levels of HDI, and proportion of the middle class may also be moderators as the link between the indicators and outcomes are complex and nuanced.

Our empirical model suggests that human capital is the sole significant source of growth and development. At this point, it appears that the digital transformation of society through mass digital literacies is a moderating variable at best. It was further conjectured that population densities, levels of HDI, and proportion of the middle class may also be moderators as the link between the indicators and outcomes are complex and nuanced. This is at odds with the theory we had formulated after an extensive SLR [forthcoming] and Grounded Theory validation [6]. We concluded at this time that quantitative analyses were insufficient to explain the linkages between policy indicators and socio-economic outcomes.

ON-GOING RESEARCH AGENDA

Given the ambiguity of the sense-making phase of the research, a “narrative” using the Digital Literacies Maturity Model [7] was developed whose efficacy was to be tested with Singapore and Hong Kong SAR as observation points. At this point, we gratefully acknowledge the contributions of Fang Zhang (UniSIM) in the time-series data modelling, and Carol Soon (NUS) and Marko Skoric (CUHK) for the expert inputs on SGP and HK respectively. For our purpose, a narrative encapsulates best practices and lessons learnt as a means of explicitly capturing the qualitative associations between indicators, moderators and outcomes. Consistent with the approach of the Constructivist Grounded Theory, narratives combine the richness of case studies with the structure of theory building using inductive techniques of observation, insights and hypothesis. Our development of narratives proceeded as follows. First we selected 20 knowledge societies as subjects based on size, geography, and performance. We then applied a maturity model as framework for the elicitation of how these economies / societies were able to develop sustainably over the past decade. Finally, using a standard, off-the-shelf, information mining tool, we tracked official websites of our subjects, policy pronouncements by their leaders, and other published reports, we considered the question of whether these characteristics made the society more ready for the Fourth Industrial Revolution. The litmus test is whether “leaders and citizens together shape a future that works for all by putting people first, empowering them and constantly reminding ourselves that all of these new technologies are first and foremost tools made by people for people” [4]. This may be considered the industrial perspective to digital literacies and sustainable development.

The relationship between knowledge societies, digital inclusion and digital literacies may hence be examined through the lens of a Digital Literacies Maturity Model (DLMM) that was proposed in [7]. A maturity model is an assessment tool used to evaluate an entity (e.g., an organization, industry, economy etc.) or a process. The term "maturity" relates to the degree of optimization of practices. Typically, a maturity model formally defines steps and resultant metrics which are applied to the management of best practices and active optimization of processes [7]. Our proposed DLMM combines the World Bank's four knowledge policy pillars with the four levels of digital development (please refer to the work of Armenta et al., 2012 listed in Further Readings) and provides a framework on how to promote sustainable development and socio-economic well-being.

The matrix shown in Table 3, with its cells populated with generic descriptors, is proposed as a template for the pilot run of developing narratives which could potentially answer why certain patterns of correlations, causations and moderation were not observed from the data. Each cell in the matrix has a focus theme that characterizes knowledge policy for a given pillar and level of development.

Table 3: Developing Narratives with the Digital Literacy Maturity Model

	GOVERNANCE	INFRASTRUC TURE	EDUCATION & HUMAN CAPITAL	INNOVATION
HUMAN VALUES	<i>Sustainable Growth & Development</i>	<i>Community Involvement & Socio-economic Returns</i>	<i>Civic Responsibility</i>	<i>Collective Intelligence</i>
PARTICI PATION	<i>Grassroots Participation</i>	<i>Network Effects</i>	<i>Community Participation & Community Leadership</i>	<i>Knowledge Exchange & Co-Creation</i>
USAGE	<i>Training</i>	<i>Applications</i>	<i>Skills Experience &</i>	<i>Information Economy</i>
ACCESS	<i>Universal Service Obligation</i>	<i>Devices & Networks</i>	<i>Utility</i>	<i>Seeking Value</i>

For example, at the most basic level of digital development (the access level), governance policies mainly focus on universal service obligations extracted by the regulator from licensed service providers so that no segment of society is excluded from access to basic digital services including mobile apps. The infrastructure dimension focuses on improving access to devices and network and the training is geared towards utilitarian functions. Most innovative efforts are engaged in seeking value through efficiency and effectiveness. Assuming ubiquitous penetration of Internet services is achieved, the next level focuses on the usage. Government policies promoting skill-based training and applications are essential to the development of an information economy. When both Internet usage and access "cross the chasm", the next policy imperative is how best accelerate digital participation, such as grassroots take-up, community leadership and knowledge exchange. Similarly, at the highest level of digital development (the human values level), innovation policies would seek to capture the collective intelligence of the community (sometimes known as the wisdom of the crowds) to provide an avenue for problem-solving and having a stake in making the solution work.

As a pilot test of the narrative construction method, we picked Singapore and Hong Kong SAR as convenient observation points. For each, we considered the 4 levels of digital literacies (access-usage-participation-values) across the 4 pillars of our framework referred to in Figure 1. For each cell, the key question addressed was – which indicators within that pillar were most effective (best practices) and least effective (lessons learnt) in transforming the corresponding level of digital literacy. Another way of looking at this is to consider, in terms of velocity, scope, and systems impact, how ready is each facet of a society for the Fourth Industrial of digital transformation. [4] prescribes some guidelines for such a readiness check. For the purpose of bench-marking and bench-learning, we limited our observations to domains of government, education and health. These 3 domains are generally considered the pace-setters in digital policies among OECD nations.

The comparison of Singapore and Hong Kong SAR is intended to provide provisional findings for the tale of two cities. While focus group workshops were initially considered, Design Thinking (Steve Eppinger, MIT, personal communication, 2016) suggests that in-depth interviews with key stakeholders (citizens, policy makers, academics, industry players, etc) could be just as effective. The entire exercise will serve as a pilot to validate the efficacy of the DLMM as a template for our narratives. It is anticipated that the construction of narratives results in a procedure whereby feasible and useful best practices and lessons learnt may be placed in context. Hence, to complete the research objectives, we shall undertake a total of 20 narratives in order to support inductive reasoning as the basis of substantiating our general theory of digital transformations, knowledge disparities and sustainable development. The quantitative techniques we used in the sense-making process did not address the research

questions but left much answered. As Caffo, Leek & Peng “view it as a success if we can show that the data can't answer the questions being asked.” Hence we may justify the mixed methods.

The intended contributions of the DiLiterati research programme are four-fold. First, whereas economic measures of wealth and income disparities are historical, we undertake to investigate knowledge disparities and their impact on future growth and development. In an era of disruptive innovation and rapid change, this research proposal and its findings would be relevant and timely to document best practices and lessons learnt. Second, whilst the World Bank, OECD and the UNDP have longstanding programmes on knowledge for development, they do not specifically address the challenge facing the more compact “smart cities” such as Singapore with an overwhelming dependence on intellectual capital (mostly human, leveraged by structural and relational) with the ambition of keeping ahead of the growth and innovation curve. Third, there is a lack of detailed narratives that address the dilemma of disparities in advanced economies and policy solutions. Fourth, the creation of a body of theoretically- sound tools and methods for bridging knowledge disparities (such as a generic scorecard for knowledge disparities and applying it to benchmark and drive policy initiatives. We believe that our efforts would be a small but purposeful contribution to the World Bank’s gargantuan mission of eliminating poverty by 2030 (cf <http://live.worldbank.org/within-our-grasp-world-free-poverty>).

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Corporate Leadership in The Digital Age

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ABSTRACT

Using the corporate leader's (CL) digital age positioning horizons matrix, the CL can find a unique strategic positioning point that is applicable to their corporate and to their chosen strategic directions within the digital age. This can be as a transformational, a transactional, an authentic or as a matrix-combined leadership approach. This paper suggests digital age leadership is best considered from a matrix-combined leadership approach.

Keywords: digitize, organizational, leadership, technology, strategy

INTRODUCTION

The International Data Corporation (<https://www.idc.com/>) suggest before the end of 2017 two-thirds of global 2000 businesses are likely to have digital-transformation embedded into their core corporate strategies. The digital age brings new challenges for corporate leaders (CLs). The 'in-demand' skills and knowledge that leaders can deploy to transition the successes of today's corporates across tomorrow's digitally-disruptive domains are both wide-ranging and diverse [19].

Today's leading edge CLs (including Apple, Samsung, Rio Tinto, Tesla, and BMW) are encapsulating the digital environment. These CLs often focused towards a strong global market positioning, and as such their corporates are usually substantive, financially-solid, technically-astute, operationally-organized, suitably-resourced, and workforce effective. Each CLs chosen strategies set embracing digitization, innovation and latest disruptive technologies offers pathways towards new efficiencies, and towards new connectivities solutions that instantly interlink the corporate's value networks directly to their individual global consumers.

These leading edge CLs recognize being a market leader offers their corporate both financial, and consumer-reach benefits. Hence, their corporate often focuses towards corporate-wide, rapid: (1) intelligent connectivities [6][12][42], (2) instantaneous informative diffusions of knowledge [38][42], (3) complex change transparencies, (4) innovations delivery through leading edge research and development against latest output products, (5) corporate precision [6][12][42], (6) innovative corporate hierarchical dissolutions [18][19] across internal workforce and external servicing, (7) workforce efficiencies that align human capital, and (8) customerization [16][17] and diversification into new markets.

Harnessed correctly, these 'blue ocean' strategies [27], allow the CL to continually reframe their leading-edge global corporates as value deliverers into their targeted global societies. Most leading-edge corporates reside within the world's industrialized nations. Consumers recognize such corporates meet ethical standards and abide by global regulatory standards. This trust means a consumer from a distant place can perceive a low risk in buying from this corporate's latest product or service offerings [22]. Hence, the CLs ability to quickly interpret, and astutely direct, although within the normal scope of exiting steady-state corporate governance must now react quickly to today's accelerating rate of emerging technologies [7].

Future CLs likely require still greater suites of digital skills – possibly fusing substantive technologies understanding with astute consumer alignment [6][21] and dynamic financial modelling [26]. These CLs may further align such outcome areas as corporate responsive and changeable strategies - geared specifically to generate successes across their chaotic, disruptive and increasingly-digital operational domains.

Future CLs are likely to rely less on their past knowledge (such as an option to repeat a version of a past success). Instead, they are likely to be sharp dynamic thinkers – planning and energizing others, patterning and exciting solutions, positioning and delivering edge, perceiving and executing strategies, and delivering overall passionate ploys (; Walsh,). In addition these future CLs are likely to be highly technologies savvy, innovations drivers, and ones who perceptively interpret the fickleness of the corporate's global consumer markets.

How these digitally savvy CLs then digitize their leading edge corporate can also influence successes and/or failures. Another complicating factor to the CL is the emergence of new game changing business models such as Uber to the taxi industry, scramjets to flight transportation, new industry-reframing technologies such as 3D printing into construction, robotics into surgery and nursing, and nano-tech and genetic solutions into medicine. Hence, with corporate agility now an essential component of the CLs governance toolkit, which leadership styles are likely applicable to future CLs as they seek to advance their corporate into and through future digitization game changes.

LEADERSHIP STYLES

Today researchers typically view CLs as managing complex, internal and external digitally-changing domains. Three predominate leadership styles are gaining preference.

Transformational leaders

Transformational, business-reinventing CLs: exert an idealized influence [8][43], provide inspiration [10], imbue intellectual stimulation [28] and exert individualized considerations [3][4][9] across their corporate's business transforming options. They also frame perceptive, persuasive and pervasive visionary directionally-driven innovations pathways to move the corporate to a new frame of success reference.

Transactional leaders

The transactional, values-based CLs display a behaviourally-focused and human capital motivation perspective. They recognise a collaborative approach [31] can deliver a degree of competitive advantage [13]. They recognise this value-laden component [32][34][37] can: increase capital productivity reduce investment costs [11], build collaboration [40], and drive competitiveness [5]. They bring trust, loyalty and integrity into their corporate and its workforce. Here, complex ideas are generated through workforce encouragement to co-create initiatives, and through workforce empowerment to build change [25]. The corporate is talent-aligned towards specifically transacting with each external consumer.

Authentic leaders

The authentic CL is a self-aware and enduring organisation builder [15][41] who balances analysis against scenario solutions [2][38][41], and who builds transparent, genuine, decision-making situational solutions[2][42]. The authentic CL is morally-aligned towards transparent corporate and workforce-aligned values deliverance [36], but is also a thorough, rational and rigorous financial decision-maker.

Each CLs pursues a competitiveness position and this often delivers organizational change [30]. The speed of organizational change is affected by the corporate's agility capabilities, and these interconnect with its digital-technologies and cloud data inclusions. Such digitized inclusions can build corporate change-convergence [14], and/or create corporate change-divergence [38] and/or cater for external (or internal) digitally disruptive forces [19].

DIGITIZATION

Digitization encompasses disruptive technologies, digital transformations and digital change [19]. Each digitization area may be viewed across a broad range of perspectives, but each can also be grouped under a suite of digitizing constructs such as those outlined below. The first four groupings largely fit within the transformational leadership domain, the next two groupings are largely within the authentic leadership realm, and the last two groupings are associated primarily with transactional leadership encounters.

Intelligent connectivities

Chew [12], [6] and Westerman et al. [42] include interactions and communicative channels [7]. These connectivities enhance knowledge sharing. They generate efficiencies and effective options through enhanced business value (performance, quality, economic-value, servicing, satisfiers) [20] capture. Their business intelligence releases new innovation and creativity ideas, and these ideas channels and network across the value chain [35][39].

Instantaneous informative diffusions

Westerman et al. [42] and Rogers [38] enable the CL to interactively-collate and then interpret governance decision-making into a near real-time diffusion process [7][14][28]. This decision-making is supported by corporate internet-of-things and cloud knowledge capture across smart business analytics systems.

Complex change transparencies

Ben-Hur [5] brings competitiveness into the CLs consistent governance perspective into driving broad, intelligent, attuned corporate-wide decisions.

Innovations delivery

Mithas, Tafti and Mitchell [33] see innovation as the CLs agility and enabling directions that then swiftly-generate: imaginative focused suites of new products, new services and knowledge, and greater first-mover profits [11][23].

Corporate hierarchical dissolutions

These enable the CL to shorten their information channels and to remove selected middle manager levels [19] who often filter the operational level information from their CL [42]. This strategic alignment of business and IT [24] shortens and directs information channelling, and so offers increased corporate performance opportunities.

Corporate precision

Chew [12], Berman and Marshall [6] and Westerman et al. [42] use collated analysis drawn from cloud knowledge sources to frame faster, high-integrity decision making options for the CL.

Workforce collaboration

Iansiti and Levien [25], Lhuer et al. [31]; Mahoney and Kor [32]; Molloy and Barney [34] and Ployhart [37] build the CLs toolkit to align the corporate's human capital into a single, effective and united channel.

Customerization

Hamilton [16][17] dynamically assess each consumer's digital business engagement activities - and then individually provides the business digital offerings that most closely align to the prior actions or requirements of this consumer. This transactional (e & m commerce) approach draws business and consumers into a digitally-connected interdependency [6] – where all and everything are mutually interdependent.

TODAY'S CL APPROACHES

Today researchers typically view CLs as managing complex, digitally- changing organizations. The three leadership styles transactional values-based, transformational business-reinvention, and authentic self-aware enduring organization builds show preference. These leadership styles each making different contributions, and they do not have to be mutually exclusive. Hence, future leading edge CLs can develop their strategies separately (as pure transactional, pure transformational or pure authentic) or by incorporating aspects of all three leadership styles. To help understand the complexities facing today's CLs and their ongoing corporate digitalizing considerations we map these leadership styles as three separate dimensions, and present them as a Figure 1 CL digital age positioning horizons model.

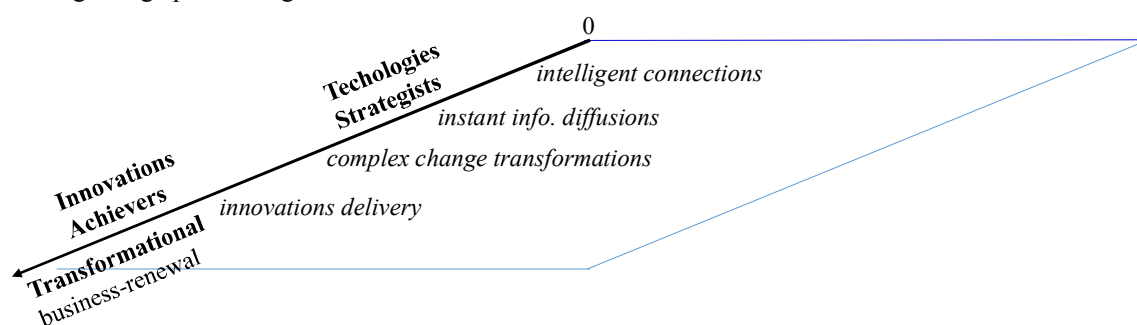


Figure 1: Transformational CL digital age positioning

Considered in isolation, Figure 1's CL transformational approaches in the digital age suggests the corporate's strategic approaches can be levelled to a degree (but with overlap). The easy solutions are the builds of intelligent connections across the value chain and into cloud databases these collectively can build further intelligences and can contribute to corporate agility and relative competitive positioning. Stepping these up by adding vast sets of sensory internet-of things (IoT) devices can in combination provide interconnecting analyses across the value chains of the corporate and deliver instant information diffusion within the corporate. Where this approach is applied across the entire corporate business process reengineering, through to a full roboticized Industrie 4.0 solution is achievable. The highest level of transformation CL approaches is when the corporate leads the Gartner hype cycle and works to become an innovations achiever. Here the corporate pursues a competitive advantage as it commercializes its hype cycle innovations into new corporate products, services or disruptive systems.

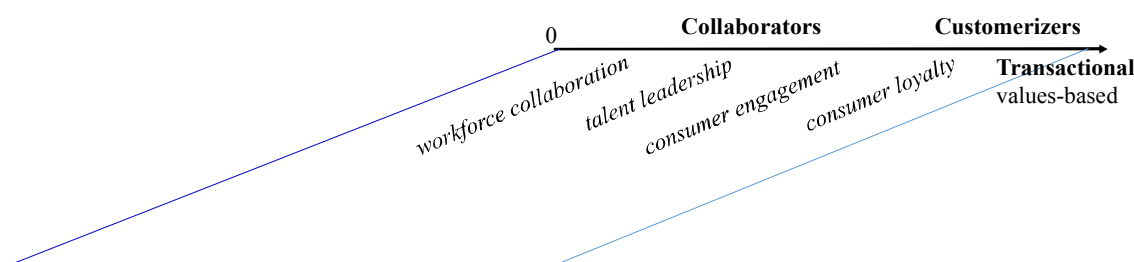


Figure 2: Transactional CL digital age positioning

Figure 2's CL transactional approaches in the digital age are human capital focused. Internally as new technologies are added over-time the nature of work changes and new structures and staff roles emerge within the operational realm. With astute talent leadership, the CL can establish cost savings, and can drive a new e-business solution for the corporate. These hierarchical, talent-based, human capital reductions, and e-business solutions save on costs, improve communications and speed CL decision making processes. Extending the human capital interactions through to the consumer generates a new behavioural approach where motivation to transact delivers a suite of consumption consumer-assessing processes. This leads to the consumer

reflecting across their satisfaction, trust and loyalty transactions gratification suite [20][21]. With these links in place e-commerce and m-commerce are both achievable.

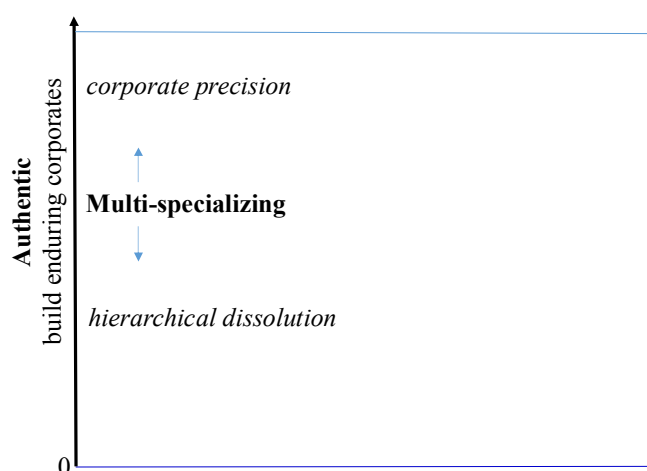


Figure 3: Authentic CL digital age positioning

Figure 3's CL authentic approaches to digital age leadership applied internally are designed to build an enduring corporate. Here, as new processes or operations or technologies add to the existing systems over-time, the nature of work tasks changes. Often, role assessments lead to a smaller operational workforce, and fewer managers (and levels of management). These can be further refined as shorter communications channels are developed across the corporate [18][19]. Internal and external business systems refinements can deliver higher degrees of corporate precision and so allow the CL to make swifter, more-astute, and more-timely decisions.

DIGITAL AGE CL APPROACHES

Kotter [29] recognized that transformational and transactional leadership were related and could be split into four quadrants based on the degree of change needed and the complexity of the corporation. With these two leadership domains related it is also likely that authentic leadership can be similarly related to transformational leadership and/or to transactional leadership. Hence, as the future corporate digitizes and moves further into the digital age, these three CL approaches can be viewed as operating in combination as shown in Table 2s CL digital age positioning horizons matrix.

Figure 4's 3D space 2 shows that a high-level transactional CL can bring a strong values-based perspective to the corporate. In the CLs pursuit of future commercial and transactional business solutions a behaviorally-focused and consumer-focused approach can be delivered - displaying integrity, trust, and loyalty to both the corporate and the workforce. In this approach the CL can generate complex ideas through the co-creation of workforce and consumer initiatives [25].

From a business renewal or transformational perspective this same CL can be digitally attuned – adding selected digital age IoT pursuits into their precise business change practices. They can move the corporate into an Industrie 4.0 technologies driven approach, and can support this drive by renewing the corporate with emergent innovations that are developing internally into commercially valuable corporate achievements.

This CL can use their background capabilities and experiences to generate multi-specialist approaches that ensure the corporate's workforce remains appropriately levelled and suitable for the changing transformational and transaction emergent approaches. This precision focused approach is a multi-specialist dimensional approach, and it applies across the corporate and it is throughout its value chain.

The degree to which they engage each of these positioning skills may vary from CL to CL. For example a different CL may deem that their corporate only needs to deliver strategies that fit within Figure 4's 3D space 1. This is also a cheaper, less-complex and quicker-to-implement strategic solution. Thus each CL can potentially map their corporate into a unique 3D strategic position - one that they devise as being able to generate a net profitable and net competitive position in the timeframe they select.

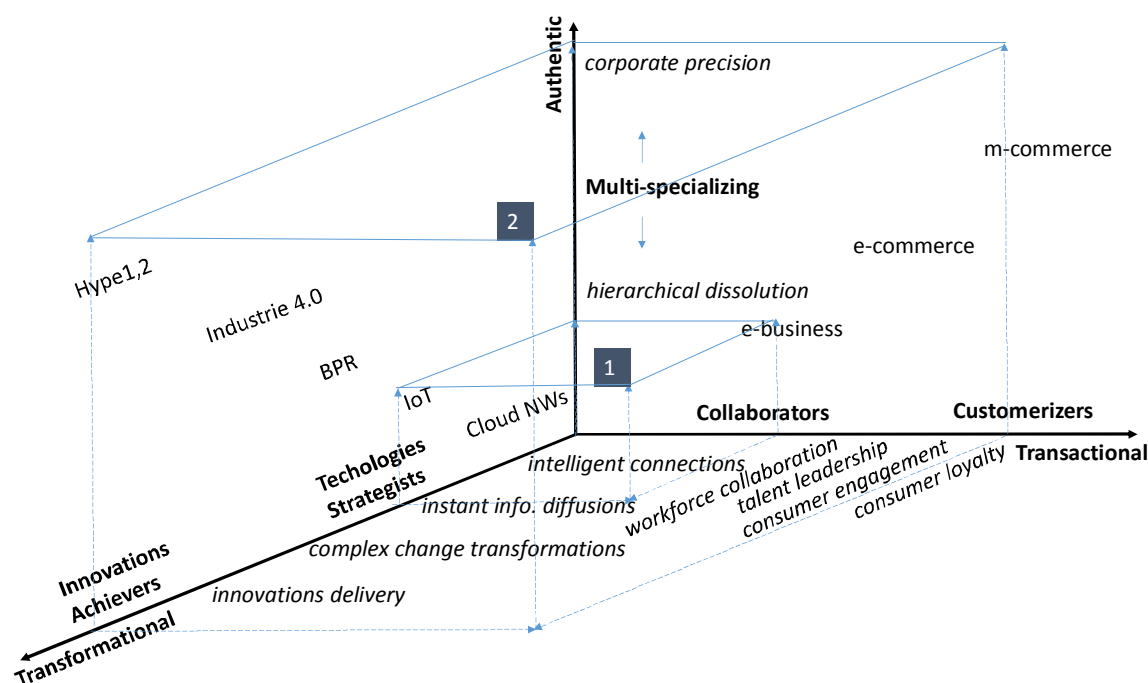


Figure 4: CL digital age positioning horizons matrix

CONCLUSION

This paper suggests as the corporate progresses into the digital age its CL can operate from a transformational, a transactional, an authentic or as a matrix-combined approach. It further suggests digital age corporate leadership is best considered from a matrix-combined leadership approach. Here, the CL can enlist Figure 4 to locate a unique future strategic positioning point. This 'CL digital age positioning horizons matrix' target should be both applicable and aligned to the CLs and the corporate's capabilities. It should help clarify the complexities and the dimensions of digital age leadership. In conjunction with a skills audit it should clarify where the corporate needs to up-skill or the redefine its human capital requirements. Thus, the CL can find a unique strategic positioning point that is applicable to their corporate, and to their chosen strategic directions, within the digital age.

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The Value of Backers' Word-of-Mouth in Screening Crowdfunding Projects: An Empirical Investigation

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ABSTRACT

Reward-based crowdfunding is an emerging financing channel for entrepreneurs to raise money for their innovative projects. How to screen the crowdfunding projects is critical for crowdfunding platform, project founder, and potential backers. This study aims to investigate whether backers' word-of-mouth (WOM) is a valuable input to generate collective intelligence for project screening. Specially, we answer three questions. First, is backers' WOM an effective signal for implementation performance of crowdfunding projects? Second, how do the WOM help screen projects during the fund-raising process? Third, which kind of comments (positive or negative) is more effective in screening crowdfunding projects? Research hypotheses were developed based on theories of collective intelligence and WOM communication. Using a cross section dataset and a panel dataset, we get the following findings. First, backers' negative WOM can effectively predict project implementation performance, however positive WOM does not have that prediction power. The prediction power of positive and negative WOM differs significantly. One possible reason is that negative WOM does contain more information of project quality. Second, project with more accumulative negative WOM tend to attract fewer subsequent backers. However, accumulative positive WOM is not helpful for attracting more potential backers. We conclude that negative WOM is useful for project screening project, because it is a signal of project quality, and meanwhile it could prevent backers make subsequent investments.

Keywords: Reward-based crowdfunding, word-of-mouth, project screening, collective intelligence

INTRODUCTION

Traditionally the best fund-raising options for start-ups in the seed or early stage are business angel and their family members or friends (Tomczak and Brem, 2013). However, only a very small percent of entrepreneurs can actually get funds from angel investors (Pope, 2011). Crowdfunding, a novel financing channel based on the Internet and online social network, to somewhat extent has filled the gap of traditional business angels (Zheng et al., 2014a). According to the return forms to investors, crowdfunding includes diverse models, such as donation-, lending-, equity-, and reward-based crowdfunding (Ahlers et al., 2015; Belleflamme et al., 2014). This study focuses on reward-based crowdfunding in which backers get product or service produced by the founder as rewards for their investments. The report released by Massolution in 2015 stated that reward-based crowdfunding is one of the primary crowdfunding models with a growth of 84 percentages in 2014, and that reward-based crowdfunding is the largest category in terms of overall number of platforms. The statistics on Kickstarter, a famous reward-based crowdfunding platform in US, show that 100,386 projects have received 2.21 billion dollars from 10,313,215 backers in the Kickstarter platform by February 17, 2016.

Although crowdfunding has gained rapid growth, it has its own challenges and drawbacks. For instance, some projects show higher level of challenges or risk of failure in the implementation process. Mollick (2014) found that complex projects are more likely to deliver rewards late, and large-scale crowdfunding projects with high funding targets often experienced delays. For the founders, testing products and getting feedback from potential backers is one of their motivations to start a crowdfunding project. Thus, how to screen the right projects is critical for platforms, founder, and backers. Collective intelligence embedded in the crowds themselves is widely recognized as the power to screen projects. For example, Mollick and Nanda (2016) found that the backers in crowdfunding platform and offline experts make similar funding decisions.

Except funding decisions, other input such as electronic comments also contribute to screening the right projects. To facilitate backers' comments, most of crowdfunding platforms build online community for backers to post their comments. Active participation could enable backers to enjoy the fun of belonging to a crowdfunding community (Gerber et al., 2012), called community benefit (Belleflamme et al., 2014). In addition, studies in marketing and electronic commerce indicate that online word-of-mouth (WOM), a signal of product quality, could help consumers make better choices (Wang and Yu, 2015). From backers' WOM, we could derive their ratings of the crowdfunding projects. The research on collective intelligence also found that crowds' rating is a one effective approach to filter ideas (Klein and Garcia (2015). However, the value of backers' electronic WOM gains little attention in crowdfunding filtering. To investigate the role of backers' WOM in screening projects, this study aims to answer three questions: 1) Is backers' WOM an effective signal for implementation performance of crowdfunding projects? 2) How does the WOM help screen projects during the fund-raising process? And 3) Which kind of comments (positive or negative) is more effective in screening crowdfunding projects?

To answer these questions, we developed research hypotheses based on research on collective intelligence and WOM communication, and conducted an empirical study in Demehour which is a famous crowdfunding platform in China. As

positive and negative WOM are typical valences, we ignore the neutral comments. Project implementation performance was measured as delivery timeliness (Mollick, 2014) and product quality (Zheng et al., 2014b). Firstly, we conducted a cross-section data analysis on logistic regression to see whether backers' WOM works as a signal of project implement performance. Secondly, a fixed-effect regression model was used to analyze the approach in which WOM screens projects in the fund-raising step. In both cross-section and panel data analyses, we compared the different roles of positive and negative WOM to answer the third question.

The structure of the paper is as follows. First, we review the relevant literature in crowdfunding. Second, we then develop the research hypotheses. Third, we present the research design, data, and results. Finally, we discuss the implications for research and practice, and conclude the study.

LITERATURE REVIEW

Crowdfunding was initially coined by Howe (2008) as a kind of crowdsourcing, which refers to utilizing the power of crowd to get ideas, feedback, and solutions to solve business problems (Belleflamme et al., 2014). Crowdfunding is defined by Belleflamme et al. (2014) as "involving an open call, mostly through the Internet, for the provision of financial resources either in form of donation or in exchange for the future product or some form of reward to support initiatives for specific purposes". This concept covers several kinds of crowdfunding models including reward-, equity-, donation-, and lending-based crowdfunding.

Compared with traditional business angel investment, reward-based crowdfunding has its own characteristics. First, the capital raised by crowdfunding is relatively smaller (Belleflamme et al., 2013). Second, the backers or investors in crowdfunding are often active to contribute time and expertise which allow entrepreneurs to extract more value (e.g., comments or constructive ideas) in crowdfunding community (Belleflamme et al., 2013; Zheng et al., 2015). Third, crowdfunding often takes the form of pre-ordering (i.e., advanced purchase) model although most of the products are not completely developed. The entrepreneurs describe the products and list the rewards for the backers who would like to obtain the products before they are released to market (Belleflamme et al., 2014). Forth, the backers pay more in the pre-ordering process than the traditional consumers who wait and buy the final products in the market (Belleflamme et al., 2014). These characteristics show that backers' participation, especially their constructive ideas, is valuable for founders. However, the role of backers' electronic WOM in project screening does not gain enough attention.

The research on backers' collective intelligence, fund-raising performance, and project implementation in crowdfunding are closely related to this study. The theoretical studies have debuted in academia (e.g., Mollick and Nanda, 2016). The widely accepted idea is that collective intelligence in the crowds helps screen the projects. The focus variable of collective behaviour is funding decision. However, there is a dearth of studies concerning the other inputs such as electronic WOM.

A variety of studies have shed light on the fund-raising stage for additional insights. For instance, entrepreneur's social capital plays an important role in fund-raising process (e.g., Mollick, 2014; Zheng et al., 2014a). Crowdfunding project difficulty, team experience, and project planning were found play important roles in improving project implementation performance (Zheng et al., 2014b). The number of an entrepreneur's fans or friends in online social networks is a significant predictor for funding success (Mollick, 2014; Zheng et al., 2014a). Compared to fund-raising process, fewer studies have focused on project implementation (Mollick, 2014; Zheng et al., 2014b). We posit that projects screening is prerequisite for funding success and product quality. Thus it is critical to explore how to filtering crowdfunding projects.

THEORETICAL HYPOTHESES

The online community in crowdfunding platform is one kind of consumer community in which backers expresses their feelings, provide ideas, and seek information from founder. We focus on two categories of backers' comments – positive and negative WOM - as positive and negative are important attributes values of WOM valence. Most of the studies in WOM have investigated the impact of extremely positive or extremely negative WOM (Cheung and Thadani, 2012). Backers' positive WOM in crowdfunding emphasizes or praises the strength of crowdfunding project, whereas their negative WOM highlights or criticizes the weakness of the product or service. Except valence, volume (information quantity) also has received much attention in WOM research (Cheung and Thadani, 2012). Marketing research found that the number of reviews (volume) is significantly associated with product sales (Duan et al., 2008).

Crowdfunding community could be seen as an information or intelligence aggregation tool about project quality (Zwass, 2010). By analyzing the information in the community, backers could infer the success possibility of crowdfunding project, and the founder could receive useful market information about the product or service. Thus, backers' electronic WOM is an effective signal for the implementation performance of crowdfunding projects. In addition, more volume of information makes WOM more credible and powerful (Duan et al., 2008) to predict implementation performance which was measured with complaints of product quality and delivery timeliness. Thus, we propose that

H1a: a project with more positive WOM tends to receive fewer complaints of product quality and delivery timeliness.

H1b: a project with more negative WOM tends to receive more complaints of product quality and delivery timeliness.

From a co-creation perspective, crowdfunding is one approach for founder to utilize crowd intelligence for beta testing of their

products in their early stages (Zwass, 2010). Compared with positive WOM, negative WOM is more useful for crowdfunding projects which need negative feedbacks to identify limitation or solutions. Klein and Garcia (2015) also found that crowds are better at eliminating bad ideas than identify good ideas, which suggests that crowds' criticism is one important approach to generate collective intelligence. In addition, the backers who have close relationships with the founder are less likely to criticize the project, and the strangers may post negative WOM when they found weak points of crowdfunding projects. Jeppesen and Lakhani (2010) found that in crowdsourcing solvers with high technical and social marginality may be good at solving problems as they have different perspectives and heuristics. As for crowdfunding, the backers who are social distant from the founder might provide better feedbacks though they are negative WOM in most cases. Thus, we propose that negative WOM contains more information about project quality, which could make better prediction of implementation performance.

H2: compared with positive comments, negative WOM has more prediction power for the complaints of product quality and delivery timeliness.

As the second research question is how the WOM help screen projects, one possible approach is that the negative (positive) WOM could impede (motive) subsequent investments during the fund-raising process. Studies on the adoption of WOM have shed much light on the effects of WOM on consumers purchase decisions (e.g., Cheung and Thadani, 2012; Wang and Yu, 2015). For instance, Wang and Yu (2015) found that positive WOM will have a strong positive effect on a consumer's purchasing intention, and negative WOM will have a strong negative effect on intention to purchase. It is proper to identify the effects of WOM in dynamic approach by investigating the effects of accumulative WOM on investments in subsequent periods (e.g., next day). Based on the prior studies on individual level (Cheung and Thadani, 2012), we could derive the aggregate effect of WOM on project level so we hypothesize that:

H3a: a project with more accumulative positive WOM tends to attract more subsequent investments.

H3b: a project with more accumulative negative WOM tends to attract fewer subsequent investments.

Marketing research on WOM communication found that consumers tend to weight negative information more than positive information (Cheung and Thadani, 2012). The rule of "bad is stronger than good" works across a broad range of psychological phenomena as bad impressions and bad stereotypes are quicker to form (Baumeister et al., 2001). Park and Lee (2009) found that compared with positive WOM, negative WOM has a stronger effect. In crowdfunding, backers also react more strongly to the negative WOM. Thus, we propose that

H4: compared with positive comments, negative WOM has a stronger effect on subsequent investments.

RESEARCH CONTEXT AND DATA

We conducted an empirical study on Demohour (www.demohour.com), which is the first popular reward-based crowdfunding platform in China. One of the famous projects in Demohour is animation movie "big fish begonia" which hit the screen in 2016 and earned 0.55 billion Chinese Yuan (approximately 0.09 billion dollars) at the box office. From 2011 to 2014, Demohour operated as an integrated platform covering diverse categories of crowdfunding projects such as arts, technology, food, movie, publication, etc. Then, Demohour transformed from an integrated website to a vertical platform which focuses on the area of smart hardware.

When posting their projects in Demohour, founders are required to describe their projects and set a list of reward (investment) options. All of the backers are allowed to comment on any project that draws their attention. If backers favor one project, they can choose one reward option and transfer money to the platform. The crowdfunding model in Demohour works in an All-or-Nothing way – pledge will be transferred to the founder if and only if the total amount of money pledged by the backers is larger than or equal to the fund-raising goal. If one project failed to reach its goal, all the pledged money will be refunded to the backers. If one project is successfully funded, the founders will start their projects and deliver the products or service to the backers according to their reward options once the project is completed. If the backers cannot receive the reward on time as promised by the founders, or receive defective products, they are free to comment or complain in the crowdfunding community.

The dataset used in this study falls into the period in which Demohour operated as an integrated platform. The funding records in our dataset started from July 1, 2011 and ended on July 2, 2014. The dataset includes detailed information about project, founder, investment, backers' electronic WOM during the fund-raising step, and backers' WOM regarding project implementation performance. All of backers' WOMs are in text format. We coded the textual WOM as the following categories – positive WOM, negative WOM, delivery late, and defective product. Project performance was measured with delivery late and defective product. Two researchers were trained as data coders by following procedures suggested by Maxwell (2008) to ensure inter-rater reliability. After the two coders finished the independent coding, the research team met to discuss disagreements between the two coders and chose a mutually agreeable coding mechanism (Qu et al., 2008). We excluded the projects which did not complete the fund-raising step. At last, the resulting sample included 845 projects among which 396 projects failed to reach the fund-raising goal. Table 1 presents the summarized statistics for all projects. Except binary variable and title length, all the other variables were log transformed as they are highly skewed.

Table1. Descriptive statistics of sample projects

Variable	Observations	Mean	Std. Dev.	Min	Max
goal (Yuan RMB)	822	17616.06	62421.13	200	1208130
pledge (Yuan RM)	845	26743.22	115331	17	1709502
fund_ratio	845	4.307503	59.36567	0	1709.5
positive WOM	845	43.71243	127.4155	0	2063
negative WOM	845	1.957396	5.563769	0	86
delivery late	845	0.247337	1.614253	0	38
defective product	845	0.697041	2.904165	0	34
reward categories	845	7.363314	3.805936	1	35
project description length	845	1772.075	1114.722	128	13589
reward options	845	7.363314	3.805936	1	35
project title length	845	19.35621	6.677381	1	38
		percentage			
funding success					
fail	396	46.86			
success	449	53.14			
colon					
No	800	94.79			
Yes	44	5.21			

METHOD AND RESULTS

Empirical model

To answer the first question, we built a logistic regression model as follows to test whether WOM works as an effective signal for implementation performance.

(1) The dependent variable refers to whether or not one project gets a complain of delivery timeliness and/or product quality. and are the key variables, i.e., number of positive and negative WOM. Mollick (2014) found that product delivery would be more likely to delays if one project is excessively overfunded. So, the ratio of pledge over goal was included in model 1. At last, we posited that fund-raising goal and description length are proxy variables of project complexity which may lead to failure of project implementation. So, we included fund-raising goal and project description length.

To approach the second question – how the negative (positive) WOM impede (motive) subsequent investment during the fund-raising process, we developed regression equation 2.

(2) The dependent variable in model 2 is the number of backers who pledged in project i on day t . refers to the accumulative numbers of backers who pledged in project i before day t . are the time varying attributes of project i . Except $PastPositiveWOM_{i,t-1}$ and $PastNegativeWOM_{i,t-1}$, other time varying attributes come from Kuppuswamy and Bayus (2013). We also included time invariant variables such as goal, reward categories, and project description length and title length. The error term is decomposed as time invariant part and time varying part. The key variables used in this study were summarized in Table 2.

Table 2 key variables in empirical model

Category	Variable	Brief description
	<i>BackersAdded_{it}</i>	Number of backers who pledge in project i on day t
	<i>PastBackers_{i,t-1}</i>	The numbers of backers of project i before day t
	<i>PastBackersRelative_{i,t-1}</i>	the ratio of the cumulative number of backers backing project i before day t to the total number of backers required to reach project i's goal
Time varying attributes	<i>PastPositiveWOM_{i,t-1}</i>	The cumulative number of positive word of mouths for project i before day t
	<i>PastNegativeWOM_{i,t-1}</i>	The cumulative number of negative word of mouths for project i before day t
	<i>PosFunded_{i,t-1}</i>	1 if the project i is fully funded before day t and 0 otherwise
	<i>DayofWeek_{it}</i>	Day in the week, 1 is Monday, 2 is Tuesday, ..., and 7 is Sunday
	<i>FundingTime_{i,t-1}</i>	Ratio of the cumulative number of days that have elapsed for project i up to day t to the length of project i's funding cycle in days
	<i>FirstWeek</i>	1 if project i is in the first week of its funding cycle on day t (0 otherwise)
	<i>LastWeek</i>	1 if project i is in the final week of its funding cycle on day t (0 otherwise)
	<i>PastProjectUpdates_{i,t-1}</i>	The cumulative number of project updates for project i before day t
Time invariant variables	<i>Goal_i</i>	Fund-raising goal (Yuan RMB)
	<i>Duration_i</i>	Fund-raising duration (Day)
	<i>TitleLength_i</i>	The number of words in the title
	<i>Colon_i</i>	1 if the title of a project has a colon, 0 otherwise
	<i>DescriptionLength_i</i>	The number of words in the project description
	<i>RewardOptions_i</i>	The number of reward categories
	<i>FundRatio_i</i>	The ratio of total pledge over goal
	<i>Complain_i</i>	1 if backers complain about delivery or product quality, and 0 otherwise
	<i>DeliveryLate_i</i>	1 if backers complain about delivery, and 0 otherwise
	<i>DefectiveProduct_i</i>	if backers complain about product quality, and 0 otherwise

Hypotheses testing

Based on the dataset of projects which were successfully funded, we ran model 1 three times with binary variables: *Complain_i*, *DeliveryLate_i*, and *DefectiveProduct_i*. The results are listed in Table 3. We found that positive WOM does not significantly predict implementation regardless of whether one project receives at least one complaint about delivery timeliness or product quality. Thus, H1a is not supported. The results indicate that project with more negative WOM would be more likely to receive complains of implementation performance, suggesting that H1b is supported. To test hypotheses 2, we compared the absolute values of the coefficients by conducting Wald Tests. The result shows a significantly different effects between positive and negative WOM (chi square (1) = 22.1, $p < 0.001$). So H2 is supported - compared with positive comments, negative WOM has more prediction power for implementation performance. As for the control variable, we found projects with high fund ratio and fund-raising goal would be more likely to receive complains on implementation performance. To check the robust of the findings, we ran ordinary least square models with complains number as dependent variables. The results of OLS confirmed the findings of logistic regressions.

Table 3 logistic regression result

	(1) Complain	(2) DeliveryLate	(3) DefectiveProduct
LN_PWOM	0.0419 (0.37)	0.0647 (0.49)	-0.00682 (-0.06)
LN_NWOM	0.911*** (5.43)	0.487** (2.80)	0.850*** (4.96)
LN_fund_ratio	0.563** (2.86)	0.720*** (3.56)	0.709** (3.52)
LN_goal	0.198 (1.80)	0.244 (1.88)	0.241* (2.03)
LN_project_description_len	0.141 (0.71)	0.0990 (0.44)	0.291 (1.37)
Constant	-5.293** (-3.15)	-6.088** (-3.14)	-7.083*** (-3.89)
N	449	449	449

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Based on a Hausman type test (Allison 2005), the fixed-effects model is preferred for our dataset. In addition to fixed effects regression, we also ran an OLS regression using the pool data as a comparison. To check the robust, we replaced *PastBackers* with *PastBackersrelative* and ran another fixed effects regression (Kuppuswamy and Bayus, 2013). All the results of panel data

analysis are listed in Table 4. Because OLS regression cannot exclude the confusing effects of unobserved project heterogeneity, the results of OLS about positive and negative WOM cannot answer the second question. Thus, we turn to fixed effects regression which could remove any unobserved, time-invariant heterogeneity across projects. The results indicate that accumulative positive WOM does not help attract more subsequent backers. So H3a is not supported. However, negative WOM will prevent subsequent backers from making investments. Thus, H3b is supported. To test the different effects, we found that negative WOM has a stronger effect on subsequent investments ($F(1, 817) = 8.9, p < 0.01$). Thus, H4 is supported. Additionally, we also found the diffusion of responsibility effects – the negative effects of accumulative backers (Kuppuswamy and Bayus, 2013). Control variables in the first week and last week also have significant effects on subsequent investment, which could lead to a bathtub shaped pattern of backer support over the funding cycle (Kuppuswamy and Bayus, 2013). Finally, we found that on weekends backers are less likely to make investments.

Table 4 results of panel data analysis

	(1) – OLS regression LN_backersadddit	(2) – fixed effects regression LN_backersadddit	(3) - fixed effects regression LN_backersadddit
LN_pastpositivewomit1	0.0360*** (8.42)	-0.00233 (-0.12)	-0.0313 (-1.53)
LN_pastnegativewomit1	0.0744*** (9.46)	-0.127** (-3.01)	-0.0947* (-2.15)
LN_PastBackersit1	0.353*** (78.59)	-0.175*** (-8.40)	
LN_PastBackersrelativeit1			-0.260*** (-3.85)
firstweek	0.503*** (32.42)	0.132*** (5.35)	0.119*** (4.97)
lastweek	0.257*** (21.90)	0.250*** (14.05)	0.280*** (16.31)
postfundedit1	-0.0124 (-1.04)	-0.190*** (-4.40)	-0.171*** (-3.57)
LN_fundingtime	-0.371*** (-49.76)	-0.118*** (-6.16)	-0.190*** (-11.83)
LN_pastprojectupdatesit1	0.00143 (0.33)	0.00197 (0.08)	-0.00480 (-0.18)
weekDummy1	0.162*** (10.81)	0.124*** (11.68)	0.130*** (12.38)
weekDummy2	0.210*** (14.10)	0.153*** (13.90)	0.161*** (14.61)
weekDummy3	0.205*** (13.73)	0.159*** (14.02)	0.164*** (14.41)
weekDummy4	0.202*** (13.58)	0.167*** (14.53)	0.171*** (14.82)
weekDummy5	0.170*** (11.44)	0.142*** (12.87)	0.145*** (13.01)
weekDummy6	0.000705 (0.05)	0.000780 (0.08)	-0.000884 (-0.09)
LN_goal	-0.000807 (-0.22)		
Ln_project_description_len	-0.0583*** (-8.08)		
project_name_len	0.00150* (2.44)		
colon	0.00839 (0.47)		
LN_rewardcategories	0.0669*** (7.05)		
Constant	-0.973*** (-17.38)	1.047*** (13.63)	0.579*** (11.67)
N	30695	30695	30695

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

CONCLUSION

In this study, we empirically investigated the value of backers' WOM in screening project in crowdfunding. We obtained two interesting findings, as follows. First, backers' negative WOM can effectively predict project implementation performance,

however positive WOM does not have that prediction power. As such, the prediction power of positive and negative WOM differs significantly. One possible explanation for this finding is that negative WOM contains more information of project quality, as the negative WOM could help the founders find the limitations and improve their products. Second, projects with more accumulative negative WOM tend to attract fewer subsequent backers. However, accumulative positive WOM is not helpful for attracting more potential backers. In this approach, we could conclude that negative WOM is useful for project screening project, because it is a signal of project quality as it could prevent backers from making subsequent investments.

The findings of our study have several theoretical implications. First, we offer a new approach to screening project. Except the collective intelligence embedded in backers' funding behaviors (Mollick and Nanda, 2016), their WOMs are also helpful to generate wisdom of crowd. In particular, negative WOM includes more valuable information of project quality. This finding also confirmed that crowds are good at eliminating bad ideas (Klein and Garcia, 2015). Second, we extend the study on the dynamics of crowdfunding backers (Kuppuswamy and Bayus, 2013). Negative WOM was identified as one important factor affecting subsequent backers funding decisions. Third, we extend the research on WOM communications in the crowdfunding context. We confirmed that backers react more strongly to negative WOM.

The findings also provide substantial implications for practice. First, for crowdfunding platforms to reduce project failure, it is necessary to deeply leverage the value of backers' WOM which is useful for project screening. For instance, instead of just presenting textual WOM, platform could try to present the meaning and volume of WOM in a creative way (e.g., words cloud) which is easy for backer to understand. Second, as the negative WOM is closely related to implementation performance, the founder should pay more attention to negative WOM and find solutions to address backers' criticisms. Finally, for backers it is always an effective way to screen project by ignoring the project which has too much negative WOM.

There are several limitations in this study. First, we did not study the effect of WOM content which may be also influential for others' decisions (Wang and Yu, 2015). Second, as we could not obtain the project categories information, future research could test our findings by including project categories in the model.

ACKNOWLEDGEMENTS

We gratefully acknowledge the support of Natural Science Foundation of China (71302186, 71502145) and Fundamental Research Funds for the Focal Universities in China (JBK160933).

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OPTIMAL OUTSOURCING STRATEGY: A STOCHASTIC OPTIMIZATION APPROACH

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ABSTRACT

As the production capacity of a company over a certain period of time is limited, enterprises must carefully consider product line development or outsourcing options. Unlike traditional studies that use static or comparative static analyses to determine optimal production strategies, this paper proposes a stochastic optimization model that can be used to determine optimum quantities of multiphase development or outsourcing. The proposed model can be used as a decision framework for future production allocation in high-tech industries that face uncertain demands. It can also be used as a financial projection tool.

Keywords: Production decision, outsourcing, stochastic models, stochastic optimization

INTRODUCTION

Ever since the Industrial Revolution, production manufacturing constituted an important subject of management theory and practice, with the earliest investigations focusing on ways to maximize production capacities or minimize costs of in-house production. This initial decision-making model laid the foundations for production decision-making studies that did not seriously consider supply and demand statuses or assume that demands are greater than supplies (namely, by “producer orientation” and not by “demand orientation”). Since the 1970s, however, as international market demands have become increasingly volatile and as the international production system moves towards the division of labor and specialization, production management research continues to expand. Outsourcing (production outsourcing) constitutes a major important shift characteristic of these accelerating trends.

Though outsourcing has been in practical operation for a long time, it only became well known after Prahalad and Hamel (1990) proposed the concept of corporate core competence. The purpose of outsourcing is to allow a company to subcontract non-core, auxiliary functions or operations to external specialized firms through the signing of business contracts to use these firms’ expertise and strengths to improve the overall firm efficiency and competence. Via outsourcing, a company can not only reduce operating costs, focusing resources on the development of core strengths, on the fulfillment of customer demands, and on increasing competitiveness in the market. Rather, a firm can also fully use external resources to compensate for shortcomings in its own capabilities. Meanwhile, outsourcing can also allow a company to maintain management and business flexibility and diversity. The latter is especially instrumental in allowing a company to adapt to today's ever-unpredictable business demands (Kremic, Tukel, and Rom, 2006; Moon, 2010; Razzaque and Sheng, 1998; Saouma, 2008).

Courtney, Kirkland and Viguerie (1997) identified four levels of environmental uncertainty (“a clear-enough future,” “alternate futures,” “a range of futures,” and “true ambiguity”) and corresponding decision-making techniques. Information that can be obtained at Level One is relatively adequate and comprehensive and uncertainties are at the lowest levels, and thus, the manager can use traditional analytical tools (for example: market research, five forces analysis, value chain analysis) to

determine tactical strategies. At Level Two, it is understood that several possible outcomes may result, but there is no way to identify which condition will occur in the future. Therefore, various value models are designed for each possibility, and the decision analysis framework is used to assess the risks and benefits of different plans. Level Three uses several key variables to determine feasible future ranges, though the feasible range is too wide and tends require more comprehensive definition for tactical strategies to be determined. Aside from analysis tools used for Level Two conditions, there is also a need to plan for each scenario to supplement demand forecasts and analyses. Finally, as Level Four is characterized by mutual effects of numerous sources of uncertainty—creating the most ambiguous and unpredictable environment of all the levels—and presents the highest levels of uncertainty, system simulation methods must be employed to simulate possible decision schemes.

From 2000 onwards, the high-tech industry's global supply chain system has entered Level Four's "true ambiguity" phase. Over the past five years, market demands have become more unpredictable, and product life cycles have shortened rapidly. These circumstances have driven the high-tech industry to cite more rigorous mathematical models to attempt to address the challenges of a highly uncertain environment. The purpose of this research paper is to employ a system stochastic simulation technique to optimally solve the high-tech industry's optimal allocation ratio for in-house production or outsourcing and to further use sensitivity analysis and scenario simulation methods to examine effects of changes in each random variable on enterprise profit maximization.

The remainder of the paper is organized as follows. Section Two presents a review of the literature on production decision-making. Section Three describes stochastic programming specifications of the optimal in-house production and outsourcing method proposed in this study. Conclusions and recommendations are presented at the end of the paper.

LITERATURE REVIEW

Traditional economics classifies the market and further investigates decision-making behaviors produced in different markets. The market is typically separated into two main categories: a complete competitive market and an incomplete competitive market. The latter can be subdivided into an oligopolistic market and monopolistic market. As complete competitive and monopolistic markets belong to the two extremes of the market, fewer subjects can be examined, and thus, only production behaviors found in an oligopolistic market garner special concern.

Oligopolistic markets include a small number of companies, so few that each company's decisions have an effect on the other companies. The three main oligopolistic enterprise competition model include the Cournot, Bertrand, and Stackelberg models. These models typically assume that the market includes two representative companies. Namely, by first simplifying the market as a duopoly to investigate competition and production decisions, models can then be applied to study several companies. The Cournot model assumes that the duopolistic market includes two companies of equal status that produce homogeneous products. Both parties face the same demand curve. When the companies determine their own outputs, they both naively believe that the competitor will not change production quantities and will pursue the goal of profit maximization, though the market price of the product is still determined based on the combined outputs of both companies. The Bertrand model assumes that two companies in a duopolistic market produce homogeneous products and face the same demand curve. The company that enters the market first sets the price according to its production capacities and profit maximization goals. The second company that enters soon after only needs to set a slightly lower price and waits to make a clean sweep of the entire market. As a result, the two companies compete on prices until the profits of both parties are zero. The Stackelberg model assumes that the leading company in a duopolistic market knows that the other company will engage in production according to the Cournot model. As a result, the leading company uses a naïve company output as a given in its own output

decisions and then determines its own output level based on the principle of profit maximization.

The aforementioned traditional production models examine enterprise competition and production decisions primarily from the perspective of static analysis or comparative static analysis. Primary variables considered include demand, price, and cost. These models also use optimization mathematics to derive a perfect closed solution form under conditions of maximum profit. Though these traditional models are elegant and well formulated, perspectives used in these models and factors under consideration appear to extend beyond one's reach due to processes of dynamic evolution. This paper builds on traditional analysis models by employing dynamic analysis perspectives and by considering the evolution of each variable at different times. Namely, variables considered in the model have been afforded additional fitness via stochastic processes or time series models. Variable dynamic behavior paths can then be further generated via the Monte Carlo simulation method. Finally, companies can determine optimal production allocation status levels for a dynamic environment using the stochastic programming method and can then project expected profit levels. The next section provides a detailed description of the stochastic model setup, estimation, and simulation and the optimization model approach.

MODEL

System Setting

It is assumed that a high-tech company implements just-in-time (JIT) manufacturing producing two types of products (Assumes that this company produces only after receiving an order, and therefore only an inventory system that can be ignored exists in the system (Hutchins, 1999)): high-end products and low-end products. The primary investment limits on these two products are the operating hours of the machinery and equipment. To better conform this based on real phenomena, assume that the demands, prices, and costs of both types of products are uncertain. Furthermore, the company's production capacity is limited. The company may be unable to simultaneously meet demands for the two types of products, or the production costs of outsourcing may be cheaper than those of in-house production. Therefore, production decisions include two alternative plans for in-house production or outsourcing. However, due to the presence of trade secret factors, only low-end products are outsourced. Thus, as a rational decision-maker, we expect to be able to arrive at the optimal production allocation combination in the preceding scenarios using initial profit maximization as a guideline for future production over a certain period.

To obtain the optimal production allocation level, we must first define variables and parameters of the system to facilitate subsequent mathematical formula display, simulation, and solution. We assume that there are n high-end products and m low-end products, and variables in the system include seven uncertainty vectors : market demand for the high-end product ($Q_H(t) = [Q_H^1(t), \dots, Q_H^n(t)]$), market demand for the low-end product ($Q_L(t) = [Q_L^1(t), \dots, Q_L^m(t)]$), market prices for the high-end products ($P_H(t) = [P_H^1(t), \dots, P_H^n(t)]$), market prices for the low-end products ($P_L(t) = [P_L^1(t), \dots, P_L^m(t)]$), costs of in-house high-end product production ($V_H(t) = [V_H^1(t), \dots, V_H^n(t)]$), costs of in-house low-end product production ($V_{L1}(t) = [V_{L1}^1(t), \dots, V_{L1}^m(t)]$), and low-end product outsourcing payment costs ($V_{L2}(t) = [V_{L2}^1(t), \dots, V_{L2}^m(t)]$). We assume that the company uses activity-based costing (ABC) and can effectively sum up the cost driver. Therefore, there is no need to differentiate between changing and fixed costs (Cooper and Kaplan, 1991, 1992; Kaplan and Anderson, 2004). Furthermore, system parameters include the known fixed number of hours spent on in-house high-end product productions ($T_H = [T_H^1, \dots, T_H^n]$), hours spent on in-house low-end product productions ($T_{L1} = [T_{L1}^1, \dots, T_{L1}^m]$), and the upper limit of company employee, machinery and equipment operating hours (T_E). Finally, decision variables include the company's in-house high-end products production quantities ($Q_H^S(t) = [Q_H^{S1}(t), \dots, Q_H^{Sn}(t)]$), the company's in-house low-end product production quantities

($Q_{L1}^S = [Q_{L1}^{S1}(t), \dots, Q_{L1}^{Sm}(t)]$), and the company's outsourced low-end product production quantities ($Q_{L2}^S = [Q_{L2}^{S1}(t), \dots, Q_{L2}^{Sm}(t)]$).

The equation for the profit $\pi_H(t)$ at time t of in-house high-end product production is:

$$\pi_H(t) = [P_H(t) - V_H(t)] Q_H^S(t)^T \quad (1)$$

The equation for the profit $\pi_{L1}(t)$ at time t when the company decides to engage in in-house low-end product production is:

$$\pi_{L1}(t) = [P_L(t) - V_{L1}(t)] Q_{L1}^S(t)^T \quad (2)$$

The equation for the profit $\pi_{L2}(t)$ at time t when the company decides to engage in outsourced low-end product production is:

$$\pi_{L2}(t) = [P_L(t) - V_{L2}(t)] Q_{L2}^S(t)^T \quad (3)$$

The equation for the overall profit can be determined by adding the three aforementioned equations:

$$\pi(t) = \pi_H(t) + \pi_{L1}(t) + \pi_{L2}(t) \quad (4)$$

With different types of the outsourcing partner, the company may have different constraints. Here we consider three types of outsourcing partners. The first type is most flexible; it can accommodate all of the outsourcing request dynamically. Below is the corresponding formulation for the expected profit with three constraints (production resource boundary equation, high-end product demand boundary equation, low-end product demand boundary equation)

$$\max_{\{Q_H^S(t), Q_{L1}^S(t), Q_{L2}^S(t)\}} E_0 \left[\sum_{t=1}^T \pi(t) \right]$$

Subject to:

$$\begin{aligned} Q_H^S(t) T_H^T + Q_{L1}^S(t) T_{L1}^T &\leq T_E \\ Q_H^S(t) &\leq Q_H(t) \\ Q_{L1}^S(t) + Q_{L2}^S(t) &\leq Q_L(t) \\ Q_H^S(t), Q_{L1}^S(t), Q_{L2}^S(t) &\geq 0 \end{aligned} \quad (5)$$

The second type is that the outsourcing partner shares 100α percent of the market demands of the low-end products for the planning periods. Where $\alpha = (\alpha_1, \dots, \alpha_m)$. The following is the corresponding formulation, which is similar with above, but change the decision variables:

$$\max_{\{Q_H^S(t), \alpha\}} E_0 \left[\sum_{t=1}^T \pi(t) \right]$$

Subject to:

$$\begin{aligned} \alpha Q_L(t) &= Q_{L2}^S(t), & [\text{constant percent of outsourcing}] \\ Q_H^S(t) T_H^T + Q_{L1}^S(t) T_{L1}^T &\leq T_E \\ Q_H^S(t) &\leq Q_H(t) \\ Q_{L1}^S(t) + Q_{L2}^S(t) &\leq Q_L(t) \\ Q_H^S(t), Q_{L1}^S(t) &\geq 0 \\ 0 &\leq \alpha \leq 1 \end{aligned} \quad (6)$$

Finally, we consider that outsourcing partner has limited production capacity. They only can produce constant amount β of the low-end products. Where $\beta = (\beta_1, \dots, \beta_m)$. The third type of the equation may be the following:

$$\max_{\{Q_H^S(t), \beta\}} E_0 \left[\sum_{t=1}^T \pi(t) \right]$$

Subject to:

$$\begin{aligned} Q_{L2}^S(t) &= \beta, & \text{for all } t = 1, \dots, T & \quad [\text{constant amount of outsourcing}] \\ Q_H^S(t) T_H^T + Q_{L1}^S(t) T_{L1}^T &\leq T_E \\ Q_H^S(t) &\leq Q_H(t) \\ Q_{L1}^S(t) + \beta &\leq Q_L(t) \\ Q_H^S(t), Q_{L1}^S(t) &\geq 0 \end{aligned} \quad (7)$$

The first type is more flexible so that the company can make dynamic decision in different time period. However, the others' outsourcing strategies are determined at the beginning of production. In section 4, we will compare the numerical results of these 3 formulations.

STOCHASTIC MODELS

Stochastic Processes

To portray (adapt) the dynamic behaviors of the N stochastic variables in the system, where $N = 3n + 4m$, we assume that $Y(t) = (Q_H(t), Q_L(t), P_H(t), P_L(t), V_H(t), V_{L1}(t), V_{L2}(t))^T$ obey a multivariate diffusion process:

$$\frac{dY(t)}{Y(t)} = \mu dt + \sigma dZ \quad (8)$$

where parameters $\mu = (\mu_1, \dots, \mu_N)^T$ and $\sigma = (\sigma_1, \dots, \sigma_N)^T$ are the corresponding stochastic variables average and fluctuation parameter, respectively. dZ is a multivariate correlated Brownian motion with a correlation matrix ρ , where

$$\rho = \begin{bmatrix} 1 & \rho_{12} & \dots & \dots & \rho_{1N} \\ \rho_{21} & 1 & \ddots & \ddots & \vdots \\ \rho_{31} & \rho_{32} & 1 & \ddots & \vdots \\ \vdots & \ddots & \ddots & \ddots & \vdots \\ \rho_{N1} & \dots & \dots & \dots & 1 \end{bmatrix}$$

Then, the covariance matrix of dZ for any $t > 0$ is

$$\begin{bmatrix} \sigma_1 & 0 & \dots & 0 \\ 0 & \sigma_2 & \ddots & \vdots \\ \vdots & \ddots & \ddots & \vdots \\ 0 & \dots & \dots & \sigma_N \end{bmatrix} \begin{bmatrix} 1 & \rho_{12} & \dots & \rho_{1N} \\ \rho_{21} & 1 & \ddots & \vdots \\ \vdots & \ddots & \ddots & \vdots \\ \rho_{N1} & \dots & \dots & 1 \end{bmatrix} \begin{bmatrix} \sigma_1 & 0 & \dots & 0 \\ 0 & \sigma_2 & \ddots & \vdots \\ \vdots & \ddots & \ddots & \vdots \\ 0 & \dots & \dots & \sigma_N \end{bmatrix} dt \equiv \Sigma dt.$$

we define X_i as the difference between \log of Y_i at time $t + \Delta t$ and t :

$$X_i = \log(Y_i(t + \Delta t)) - \log(Y_i(t)) \quad (9)$$

Assume that $X = (X_1, \dots, X_N)^T$, By Ito lemma and Euler scheme, we may find out that

$$X \sim N(a\Delta t, \Sigma\Delta t) \quad (10)$$

And

$$Y_i(t + \Delta t) = Y(t)e^{X_i}, \text{ where } i = 1, \dots, N \quad (11)$$

where $a(t) = [(\mu_1(t) - \sigma_1^2(t)/2), \dots, (\mu_N(t) - \sigma_N^2(t)/2)]^T$. These can be estimated through a maximum likelihood estimation (MLE) of historical data.

NUMERICAL EXAMPLE

Summary of the Data

In the numerical examples, all model parameters are calibrated to XYZ company's historical data. XYZ is a listed high-tech company in Taiwan stock exchange. We consider six products: three high-end products and three low-end products. The dataset contains monthly data for 3 and half years from January 2013 to June 2016. In table 1, basic statistics of high-end products are shown (selling volumes, unit costs of products and outsourcing, unit prices of products, and gross margins). Table 2 shows basic statistics of the low-end products. The planning period is usually three to six months. Therefore, only the most recent data are used to calibrate model parameter.

Table 1: Basic statistics of high-end products

HIGH-END	2016 JAN	2016 FED	2016 MAR	2016 APR	2016 MAY	2016 JUN	mean
Product A							
selling volumes	497212456	471055544	495395000	620313000	364258000	486444000	312750238
unit prices	0.03434	0.03352	0.03659	0.03004	0.04825	0.03735	0.07402
unit costs	0.02652	0.02559	0.02798	0.02373	0.03571	0.02597	0.06170
gross margin	22.79%	23.65%	23.53%	21.00%	25.99%	30.48%	17.50%
Product B							
selling volumes	5276093	5385626	7600268	6155204	7456890	6146433	5946211
unit prices	1.03006	0.73952	0.72842	0.86031	0.78104	0.73905	0.94160
unit costs	0.95548	0.69017	0.63963	0.78175	0.69383	0.61868	0.80909
gross margin	7.24%	6.67%	12.19%	9.13%	11.17%	16.29%	13.89%
Product C							
selling volumes	3930000	3156000	4176000	3146000	4805500	3888000	4818109
unit prices	0.26841	0.26301	0.23723	0.24257	0.22261	0.21209	0.23945
unit costs	0.18091	0.19818	0.17038	0.17146	0.16185	0.16210	0.18401
gross margin	32.60%	24.65%	28.18%	29.32%	27.30%	23.57%	23.07%

Table 2: Basic statistics of the low-end products

LOW-END	2016 JAN	2016 FED	2016 MAR	2016 APR	2016 MAY	2016 JUN	mean
Product D							
selling volumes	5416052	6202618	7826216	6372328	7088606	7317137	6946402
unit prices	8.02337	7.97404	7.68956	8.20980	8.39786	7.82231	7.144754
unit costs	7.13934	6.99579	6.76713	7.16182	7.33053	6.77423	6.464520
outsourcing costs	7.49318	6.73784	5.91800	8.26479	8.72830	7.69675	6.651563
gross margin	11.02%	12.27%	12.00%	12.76%	12.71%	13.40%	9.45%
Product E							
selling volumes	36748470	33385188	53915405	44602348	47309328	56189450	34239668
unit prices	0.15031	0.15463	0.15248	0.14292	0.14759	0.13732	0.162635
unit costs	0.13741	0.14119	0.13975	0.13150	0.13375	0.12708	0.147037
outsourcing costs	0.14761	0.11099	0.13554	0.11299	0.15670	0.12679	0.151876
gross margin	8.58%	8.69%	8.35%	7.99%	9.38%	7.46%	9.47%
LOW-END	2016 JAN	2016 FED	2016 MAR	2016 APR	2016 MAY	2016 JUN	mean
Product F							
selling volumes	1385000	3023150	3370320	1659858	2496750	3716600	3740527
unit prices	1.94627	1.85428	1.80117	1.78164	1.85138	1.54654	2.59394
unit costs	1.83381	1.70948	1.69750	1.68682	1.75340	1.47279	2.46617
outsourcing costs	1.64386	1.58941	1.75173	1.76445	1.45952	1.72184	2.49815
gross margin	5.78%	7.81%	5.76%	5.32%	5.29%	4.77%	5.12%

CONCLUSIONS AND RECOMMENDATIONS

The Sixteenth International Conference on Electronic Business, Xiamen, December 4-8, 2016

This paper introduced stochastic process models and a time series model for measuring production decision-making variables and proposed a stochastic programming model that can determine optimal multiphase in-house production or outsourcing quantities. Decision-makers can establish parameters of system modeling by estimating historical data or by making subjective judgments of trends. Then, to go one step further, this approach combined with Monte Carlo simulation can generate multiple dynamic routes that can measure the variables. In the end, by substituting these routes into the stochastic optimization model proposed in this paper, optimal quantities of in-house production or outsourcing can be obtained.

As the high-tech industry has faced extremely uncertain demands since the end of the 20th century, traditional static and comparative static production decision models can no longer effectively serve as a basis for production decisions on allocation. Therefore, the model proposed in this paper can be used to improve the quality of high-tech company decision-making by allowing for the determination of production allocation levels and can serve as the basis for future financial forecasts.

Extensions of this research may add matrix decomposition mathematical principles (e.g., Cholesky decomposition or singular value decomposition (SVD)) to the methods described here and may further transform the stochastic variables that decisions must address into linked stochastic variables to better reflect conditions of practical decision making.

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Ability Discovery and Weak Centralized Based Crowdsourcing Service Release System in Social Network

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ABSTRACT

Crowdsourcing developed rapidly for its inspiring public abilities. But how to effectively find qualified participants and how to find and prevent malicious workers may be the main difficulties to ensure the crowdsourcing quality. In this paper, the related theories of social network were used in crowdsourcing services, the task publisher (Seeker) was regarded as the network center, his Abilities Set (AS) would be quantified and his Friends Abilities Matrix (FAM) would be generated according to the communication between them, thus his social network was re-constructed. Subsequently, some friends that conformed to the ability requirements of the task would be chosen to be the task receivers (Solvers). The natural trust relationship in the social network was fully used to build a crowdsourcing service release system on weak centralization. By using the social network, even the privacy information needn't to be shared with others, the system could help the seeker find solvers accurately in the seeker's own social network according to task demands, and then help to reduce fraud and invalid data. The simulation experiments showed that the release system could help the seeker discover his own abilities, construct the FAM, and select the appropriate solvers precisely and automatically.

Keywords: Social Network, Abilities Discovery, Crowdsourcing, Fog Computing, Friends Abilities Matrix

OVERVIEW OF CROWDSOURCING

Crowdsourcing refers to a company or organization outsources some work which should be done by employees in the past to non-specific (and usually large) network of the masses freely and voluntarily [1]. The idea of crowdsourcing got wide attention and was broadly used in more and more companies. Such as Uber, Amazon's Mechanical Turk, Drops A Car (in China) and so on. Crowdsourcing can integrate the mass wisdom to complete a task in a quick and low cost way, it embodies the collaboration spirit of "One For All, All For One". It is seem as a new form of organizing productivity under the background of "Internet plus".

The main classifications of Crowdsourcing tasks

According to the data size of the uplink and downlink, the tasks can be divided into the following four types as shown in table 1. The downlink refers to releasing the tasks, while uplink refers to the collection of task results.

Table 1: Task classifications and typical applications according to data traffic

Type	Uplink traffic	Downlink traffic	Typical Application
I	<i>small</i>	<i>small</i>	<i>Questionnaire survey, Vote.</i>
II	<i>big</i>	<i>small</i>	<i>Collection of pictures and videos.</i>
III	<i>big</i>	<i>big</i>	<i>Compilation of pictures and videos.</i>
IV	<i>small</i>	<i>big</i>	<i>Label of pictures and videos</i>

Main frameworks of Crowdsourcing services

At present, the main architecture of crowdsourcing service is Centralization, namely the seekers and the solvers exchange data through a server, as shown in figure 1a. But the architecture will not work when the natural disasters such as earthquake, typhoon lead to malfunction in processing center, or when the information can't be sent to the processing center in the

wilderness. A no centralized routing strategy was proposed by Zhao Dong etc.[2], as shown in figure 1b. In the architecture, the tactic of "**Carrying—Storage—Foreword**" and the opportunistic meet between the mobile terminals were widely applied in this architecture to transfer tasks or bring the results back.

With the diversification of crowdsourcing tasks, the abilities of the participants become diversified and the number of the participant is also increasing. The type II, III or IV in table 1 will consume big data flow either for the seekers or the solvers. Especially, when the participants all use mobile network to release task by flooding way and the solvers are asked to transfer the results back instantly, a great data traffic cost will be generated, at the same time, the total energy consumption will increase greatly. No centralization framework tried to solve the class II and III in table 1, but the trust issues between the nodes is a big problem.

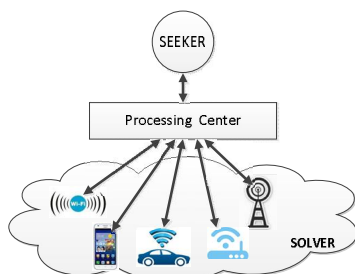


Figure 1a. Centralization

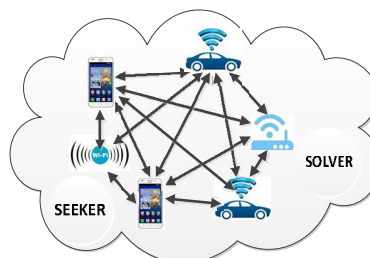


Figure 1b. No Centralization

So we planned to use the social relations between nodes and build tasks distribution trust chain, but some global information sometimes need to be shared to each participating in the chain. Therefore, we proposed the weak centralization framework for crowdsourcing, as shown in figure 2. The weak centralization means few data will be sent to processing center except for "tasks/abilities classification, keywords table, honesty index, results evaluation", these information can be calculated and updated in a sampling time according to the demands. In fact, it is very difficult to obtain the social relations between friends and friends because of privacies; weak centralization framework is expected to avoid the problem in the largest extent. Just according to the interactive behaviors with his friends which he can get easily, each participant can re-construct the social network whose center is himself. The more suitable potential solvers are selected to execute or push forward the task, this framework is more feasible in reality.

In this framework, the fog computing [3-5] was introduced in. As the same as the no centralization, the seekers and the solvers were in the same set and they could communicate or collect data through the opportunity network. According to the technical characteristics of the fog computing, fog center could exchange the global data between the mobile sensors supervised by the fog in a certain region, as shown in figure 2, the fog 1 and fog 2 were able to handle or exchange the terminal data in their respective scope. Data exchange between fogs would be finished in the processing center. Then the load of processing center was greatly alleviated.

ABILITIES DISCOVERY AND TASKS RELEASE BASED ON SOCIAL NETWORK

In view of the above problems, we planned to use the social relations of the participants, their friend abilities can be found and quantitated automatically, and then the natural trust relationship in the social network was fully used.

Social Network

Social network is formed by some nodes and the connections between the nodes. The interaction between individual members within the social network will form relatively stable relations, and then influence people's social behaviors [6-9]. As shown in figure 4, A participant node can be denoted as, where n_i means the attributes of the node. The social network can be denoted as G , where N_i means the friend nodes of central node n_i , where

Where w_{ij} means the strength degree between i and j , 0 means i doesn't have the ability.

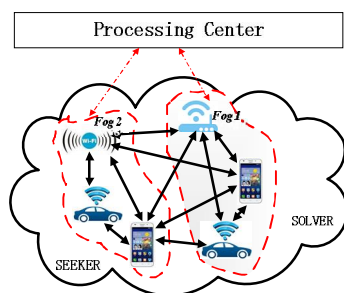


Figure 2: Week Centralization

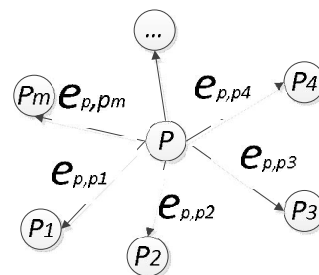


Figure 3: Schematic Diagram of Social network

The abilities discovery based on content in social network

Each node has its own properties, such as hobbies, professional competence, etc., at the same time, the node usually has a judgment to the abilities of all his friends, such as what kind of friend were interested in what subject, what kind of friend was suitable to do what task, and so on. We agreed: i was called as a node in social network and a task publisher in crowdsourcing system, i had n_i friends. Task publishers (Seekers) and task receivers (Solvers) were called participants.

Definition 1.[Abilities Set (AS)]. It is a set with all kinds of abilities to complete a crowdsourcing task. We agreed: the abilities set is AS in our system. AS was a global factor that should be shared in the processing center.

Definition 2.[Abilities Subset (ASS)]. It is composed by one or all of the elements from the AS .

Definition 3.[Abilities Value (AV)]. It is a digital denotation corresponding to the AS . We denoted it as AV_i . For example: AV_i means the abilities of node i , the original value is set by w_{ij} between 0 and 1, the default value is zero.

Definition 4.[Qualities Factor (QF)]. It is the comprehensive valuation given by all friends of a solver after the solver finished a crowdsourcing task. It can be denoted as QF_i . Hypothesis H_1 is the total task number that the friend j invited i to do, after completion, gives QF_j valuation according to the performance of every task, the valuation is marked QF_{ij} , QF is denoted as:

where, w_{ij} means the weight of the task of j the friend i , QF_{ij} .

Definition 5.[Honesty Index (HI)]. It is a weighted average of the QF evaluated by all of a solver's friends. We denoted it as HI_i , it is a global variable. For example, HI_i means the overall evaluation that all friends of node i gave to i :

where, w_{ij} means the weight of the friend j to node i , generally, it can be set by 1.

Definition 6.[Friend Abilities Vector (FAV)]. A seeker, as the central node in his social network, gives the AV s for one of his friend based on the AS according to communications. For example, the FAV that node i give to his friend j can be denoted as:

Definition 7.[Friends Abilities Matrix (FAM)]. The FAM of a node is a matrix composed by all of the node's FAV s. For example, the FAM of node i can be denoted as:

Re-constructing the Social Networks for the Participant

As discussed above, we can re-define the node i in the social networks as a triple:

Where HI_i means the HI , AV_i means the AV s, FAM_i means the FAM .

Computing and updating the AVs

(1) Normalization of the initial AV s for node i :

(2) Dynamic updating AV s of

Algorithm 1. Dynamic Updating the AV s

```

Do while  $k \leq n$ ;
  Do while  $j \leq m$ ;
    .....(8)
  End Do;
End Do;
```

Where t_k means the sampling times, t_{ij} means communication times between i and his friend j on ability i . The AVs will update once time in every sampling period, t_k and t_{ij} .

Computing and updating the FAM

- (1) Initialization of the FAM, it can be set by 0;
- (2) Dynamic updating FAM of

Algorithm 2. Dynamic Updating the FAM

```

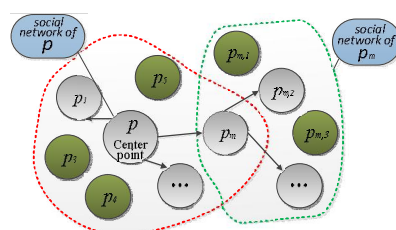
Do while  $k \leq n$ ;
  Do while  $j \leq m$ ;
    .....(9)
  End Do;
End Do;

```

where, t_k means the total communication times between node i and his friend j , and t_{ij} means the times on the ability/topic i . As the formula 3 and algorithm 1 and 2 discussed above, node i can re-construct itself as the following form:

Quick Task Release Mode Based Abilities Coverage.

After algorithm 3, the CNs of i was determined, then i could push the task forward to the CNs, as shown in Fig 4, the social network of i was surrounded by the red dotted line, the CNs of i maybe $\{j\}$ so i didn't push the task to $\{j\}$ whose backgrounds were green. The friends received the task could complete the task, also could release the task in his social network by the same way. According to the "six degree separation", theoretically, the task could be sent to anybody in the world by transferring 6 times [10-13]. Every time, we just let the participant push the task to i friends in his social network, (the value of i could be changed according to demands). As a result, the release accuracy of the system would be higher than random release, so the friends could avoid interference by irrelevant information



The First Release The Second Release
Figure 4. The Task release mode based on social relationship

EMULATION

Wechat is the most popular mobile instant chat software, Until March 2016, the number of the monthly active users reached 762 million, 39% more than that of last year [14]. Our system is based on the Wechat data, at the same time, in order to avoid privacy leakage, the system only permits the users to analyze the contents and records of themselves.

Assumption: In the emulation, we roughly divided the tasks that were suitable for crowdsourcing in our lives into 10 types/abilities, there were denoted as $A=\{1,2,\dots,10\}$. Node i had 100 friends named from 1 to 100, the communication times between i and his friends were between 5 and 500. At the first, several topics randomly were selected from the 10 topics; the probability density of the topics obeyed the Poisson Distribution. Then the FAM of i was shown in table 2. Just 10 friends were included in the table because of the paper length, the number in the table means the communication times with different friends on different topics in a sampling cycle. In fact, this table is FAM of i , it was also can be denoted as FAM_i (formula 6 and 10).

Table2:FAM of i (10 friends)

Abili ties Friends	1	2	3	4	5	6	7	8	9	10
1	60	41	84	156	25	58	27	85	136	60
2	69	7	64	73	65	108	140	89	41	186
3	97	71	40	144	25	126	27	57	106	134
4	120	82	70	163	98	126	66	174	67	118
5	95	75	7	54	22	94	82	62	79	114
6	51	11	20	53	44	69	43	36	44	50
7	298	29	181	140	56	142	19	252	269	104
8	86	106	30	124	37	74	50	24	111	69
9	83	50	54	27	40	24	55	12	34	61

10	79	59	50	5	28	72	50	42	47	60
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Abilities Discovery

The data in table 3 just covered one sampling period, in fact we also counted the communication times in 5 sampling periods. the AVs of could be calculated by algorithm 1, the differences between one sampling and 5 sampling were shown in fig 5, just No. 10 and No. 86 friends were randomly selected to do statistic.

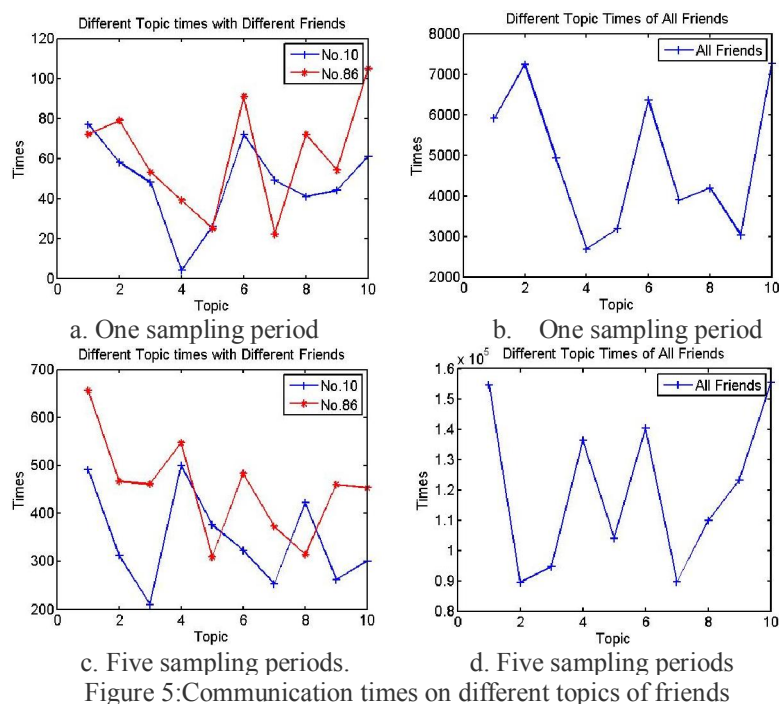


Figure 5: Communication times on different topics of friends

As the 4 figures shown above, we could find that fig a was similar to fig c, and fig b was similar to fig d. It implied that AVs of is relatively stable, and the node would like to communicate the topic that he was interested in.

CNs Selection

As a seeker to release a crowdsourcing task, should select ASS and the weight of ASS in the system. In the experiment, ability 7 and 10 were selected to generate a task respectively, and the CNs can be found by algorithm 3. The results were shown in table 3.

Table 3: The Selection result of CNs with single ability	
Topic/ability No.	CNs
7	(42, 65, 82, 12, 60, 71, 36, 88, 30, 59)
10	(12, 34, 51, 88, 62, 74, 95, 17, 70, 65)

The simulation showed that the system could successfully count the communication times according to the AS, and calculate the AVs and FAM, at the same time they could be updated according to the sampling period. To any task generated in the system, the center of the network could find out the CNs correctly by matching the abilities demands and his friends. The CNs could repeat this procedure not more than 6 times, and then the task could be pushed forward rapidly, widely and precisely.

RELATED WORK

Crowdsourcing has attracted wide attention in the world since it was proposed about 10 years ago. Yuen etc.^[15] concluded the research progress of crowdsourcing from applications, algorithms, performances and database; Kittur etc.^[16] expounded the challenges of the crowdsourcing from 12 aspects such as the principle, cooperative work, inner regulations, real-time response, primary applications etc., and then indicated the development direction in the future. Shamir etc.^[17] analyzed the consistency of artificial classification and annotations, and a method was proposed to control the crowdsourcing quality by supervised machine learning; Zhao etc.^[18] summarized crowdsourcing from information, technologies, public and organization, and then indicated the deficiencies and the possible development objects. On the aspect of task transfer, considering the mobility of the mobile terminals, Tuncay etc.^[19] proposed opportunistic encounter to release task in a distributed way; Hua (Jonathan) Ye^[20] analyzed the crowdsourcing intentions based on cost theory and the resource-based view and validates using survey data from 161 organizations, the results indicated that the low cost, brand visibility, and access to specialized skills were the positive factors, but codification costs and evaluation costs were negative factors that influenced firms' crowdsourcing intentions.

CONCLUSION

We believe, participant coverage should be extended to the “location, attributes, background knowledge, social relations, and credibility”. The system can discover participants' abilities dynamically and automatically from the communication between the seeker and his friends by analyzing the content, time, records in his social network, and then the AVs, FAM, HI can be calculated out. So the social network of the seeker can be re-constructed. Using the natural trust relationship implied in the social relations, the system can push the task to the potential participants more precisely and quickly than release randomly, because people always prefer to complete and transfer the task from his social network. The simulation results verify the effectiveness of the system.

ACKNOWLEDGMENT

This research was supported by the funds from Fund project:

- (1) Natural Science Foundation of China (No. 61172090, 61472316, 61502380)
- (2) Key projects of science and technology plan in Fujian province, "Key techniques of task assignment and results collection on mobile crowd sensing based on trustable interaction" (No. 2016H0029)
- (4) Projects for Young Teacher in Fujian province 2015: "Research on Integration development of Mobile E-commerce and Inner location based on iBeacon" (No. JA15401).
- (5) Key Projects of Quanzhou Technology Bureau in 2014: "Study on integration application and development mode for mobile E-commerce and the key technologies of IOT" (No. 2014Z131).
- (6) Natural Science Foundation of Fujian Province (No. 2015J01286).

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UNDERSTANDING THE DRIVER'S CONTINUOUS INTENTION OF ONLINE CAR BOOKING SERVICE

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ABSTRACT

Based upon commitment theory, this study explores the effect of organizational commitment on drivers' continuous intention to provide online car booking service. We further investigate the antecedent factors of the drivers' organizational commitment. Online survey is utilized to collect data from the drivers who are providing service current from various companies in China. The results show that affective commitment and normative commitment serve as the crucial determinants to affect drivers' continuous intention. Besides, social interaction ties with company, with customers, drivers' rewards, as well as their sense of self-value cultivate their organizational commitment perception. We then propose our theoretical and practical implications according to the findings of this study.

Keywords: Online car booking service, organizational commitment, social interaction ties, rewards, sense of self-value, continuous intention.

INTRODUCTION

In 2015, Premier Keqiang Li announced the guidance for promoting Internet+ action plan, the development of Internet+ convenient traffic is one of the crucial domains in this plan. Following this guidance, online car booking service has rapidly expanded in many areas in China. Especially, in July 2016, Chinese government gave the car booking service legal status. This provides a new developing opportunity for related companies who operate online car booking business, such as Didi, Uber, Yidao, etc. Obviously, the success of the online car booking business requires abundant drivers to provide their services to the customers actively and continuously, it will also determine the survivals of the related companies. Consequently, exploring the determinant factors of the drivers' continuous intention to provide online car booking service is an important and interesting research topic in electronic commerce domain. However, according to our best knowledge, seldom of previous studies have been conducted to investigate this issue; therefore, this study will endeavor to fill in this research gap. We plan to explore the crucial impact factors which may determine the drivers' continuous service intention with empirical data. We consider the findings of this research will not only provide practical implications to the practitioners of this business, but also can provide significant theoretical contributions to electronic commerce researchers, since this study will help them further understand the operating mechanism of this new business mode.

In current online car booking business mode, the contract relationship between the drivers and the companies is loose. The drivers' service intentions are based upon voluntary principle, which are out of the companies' control; they can easily join in any companies' platforms to provide service, and also can freely leave them without any legal risk. Therefore, we regard these platforms as loose virtual organizations. Previous studies [6][21] consider that in a loose virtual organization, the members' intentions and behaviors will be determined by their emotional connections to it. And Allen and Meyer [1][15] consider that members' emotional and psychological connections to the virtual organization can be measured by their organizational commitment. Many prior studies [19][24] also have empirically confirmed that organizational commitment would significantly affect members' intentions and behaviors in various kinds of virtual organizations. Following this viewpoint, this study predicts that the drivers' organizational commitment to the platform will determine their intentions to provide online car booking service. Furthermore, Allen and Meyer [1][15] also believe that various kinds of variables, which may derive from the organizational structure, work experience, organizational socialization, etc., can serve as the potential antecedents of organizational commitment, thus, this study will also try to explore what factors can be the impact factors to affect drivers' commitment perception in online car booking virtual organizations.

The rest part of this paper is organized as follows. First we introduce the theoretical background of this study. We then propose our research model and hypotheses. Then we introduce the methodology of this study. Next we will describe the data analyses and the statistic results. Finally, we will discuss the theoretical and practical implications of this paper.

COMMITMENT THEORY

Organizational commitment is defined as "the psychological and emotional state that binds the individual to an organization" [16]. Allen and Meyer [1][2] consider that organizational commitment contains 3 dimensions, named as affective, continuance and normative commitment. The affective commitment indicates the organization members' affective or emotional attachment to the organization, and the strongly committed individuals will identify with, involve in, and enjoy membership in the organization [7][17]. Continuance commitment implies that organization members committed to a course of action because they

consider that they can get some benefit if to do so, and will bear a cost without this action, or because of the lack of alternatives [9]. And the normative commitment means that organization members perceive a moral obligation to pursue the course of action, they believe it is the right thing they need to do [23]. Various previous studies [3][7][19] have already confirmed the significant effects of these 3 dimensions of commitment on individuals' intentions and behaviors in various research contexts, thus approved the validity of commitment theory. Therefore, this study will utilize this theory as the theoretical foundation, to test how the organizational commitment affects drivers' continuous intention to provide online car booking service.

RESEARCH MODEL AND HYPOTHESES

Based Upon Allen and Meyer's [1][2] commitment theory, this study predicts that the 3 dimensions of organizational commitment will significant affect drivers' continuous intention to provide online car booking services to the customers. In the virtual organizations such as online car booking companies (e.g., Didi, Uber, Yidao, etc), the drivers' affective commitment reflects their emotional connections to the organizations, it is the psychological force which binds the drivers to the organizations [7]. Thus, if the drives perceive a strong affective commitment to the companies, they consider they are a part of the organization, thus, they may have a strong continuous intention to provide online car booking service to the company's customers. The drivers' continuance commitment is the perception regarding their cost-based calculation, they will balance their benefit and cost before making leaving or continuance decision. If they have already invested much time, energy, or money in a company, they will perceive a high continuance commitment; they may suffer high economic or social cost if they stop to provide online car booking service through the company's platform [4]. Thus, we conjecture that continuance commitment will positively affect their continuous intention to provide service. Finally, we predict that drivers' normative commitment also can significant affect their continuous intention, this is because that normative commitment implies the drivers' sense of moral obligation, if they perceive strong moral obligation to the company, they are more likely to from a strong intention to continue to cooperate with the company and provide online car booking service to the customers since they consider that they ought to do so [11]. Thus, we propose the following hypotheses.

H1. Affective commitment has a positive effect on drivers' continuous intention to provide online car booking service.

H2. Continuance commitment has a positive effect on drivers' continuous intention to provide online car booking service.

H3. Normative commitment has a positive effect on drivers' continuous intention to provide online car booking service.

Organizational commitment represents the members' emotional connection to the organization, Allen and Meyer [1][15] believe it can be cultivated through various kinds of variables, such as the organization' structure and socialization, and members' work experience, etc. Following this line of research, and based upon the actual characteristics of online car booking business mode, this study proposes that the drivers' social interaction ties with the company, with the customers, and with other drivers, their rewards through this work, as well as their sense of self-value, to be the antecedent factors to affect their perception of organizational commitment.

Social interaction ties indicate the strength of the relationship, such as the amount of time spent and the frequency of communications, between or among different kinds of actors in an organization [8]. Previous studies [18][22] have empirically confirmed that the social interaction ties can be the significant impact factors to affect individuals' psychological and emotional connections to the organizations, and finally determine their intentions and behaviors in it. Following this viewpoint, this study predicts that the drivers' social interaction ties will affect their organizational commitment. We consider that strong social interaction ties will help them identify with their membership in the company; these ties will also let them suffer high cost since they will lose their social capital if leaving the company; besides, drivers with strong interaction ties may also perceive strong moral obligation to provide their service continuously. In general, we predict social interaction ties have significant effects on all of the 3 dimensions of commitment.

Especially, in online car booking business mode, there are various kinds of actors, such as the company, the drivers as well as the customers. Consequently, the drivers can build, maintain and develop social interaction ties with the company, with other drivers, as well as the customers. Therefore, in this study, we propose that driver's social interaction ties with the company, with other drivers, as well as with the customers will be the antecedent factors to affect their affective, continuance and normative commitment perception.

H4. Social interaction ties with company have positive effects on drivers' affective commitment (H4a), continuance commitment (H4b), and normative commitment (H4c).

H5. Social interaction ties with other drivers have positive effects on drivers' affective commitment (H5a), continuance commitment (H5b), and normative commitment (H5c).

H6. Social interaction ties with customers have positive effects on drivers' affective commitment (H6a), continuance commitment (H6b), and normative commitment (H6c).

Rewards indicate the benefits drivers obtained for their contributions in the company [12], such as increased payment, bonuses, job security, etc. Obviously, high rewards will let the drivers perceive they may suffer high cost if they stop to cooperate with the company and no longer provide online car booking service to the customers. Therefore, we predict rewards will strongly associate with drivers' continuance commitment. Finally, we consider that the drivers' sense of self-value will strongly affect their normative commitment. Sense of self-value indicates that the drivers perceive their work and service is valuable to the organizations and other people [5]. If they perceive a high self-value of their work, they may feel a strong moral obligation to continue to provide their service, thus, their sense of self-value may increase their normative commitment to the company.

H7. Rewards have positive effects on drivers' continuance commitment

H8. Sense of self-value has positive effect on drivers' normative commitment.

Figure 1 shows the research model of this study.

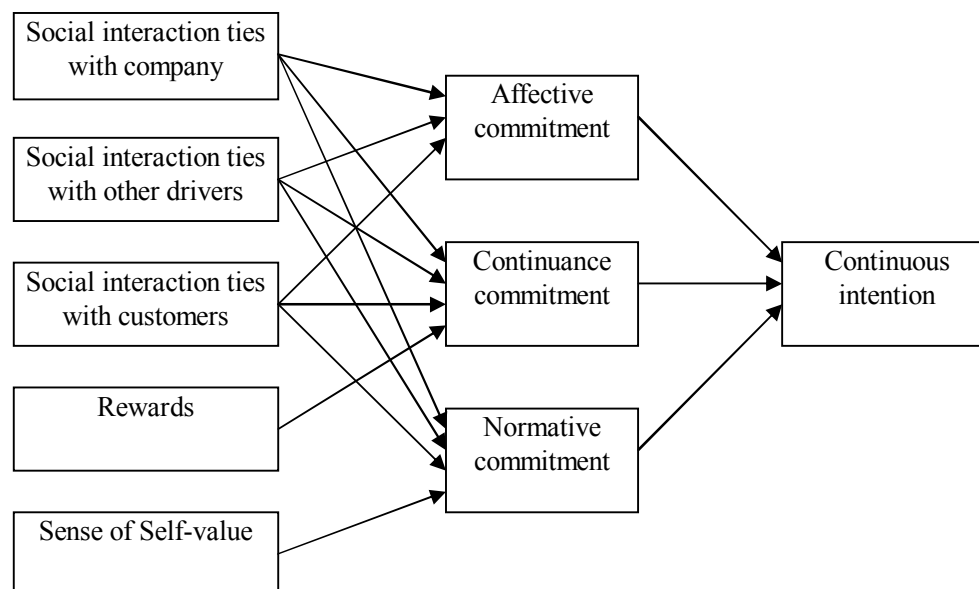


Figure 1: Research Model

METHODOLOGY

Online survey is used to collect data from the drivers who are now providing online car booking service from various companies such as Didi, Uber, Yidao, etc. We believe the field data from the drivers can improve the reality of the findings of this study. The questionnaire items for each construct in our research model are adapted from previous studies [1][5][8][12][14][19] with slight amendment to fit our research context. We employed 12 undergraduates to help us contact with the drivers and invite them to fill in the questionnaire, each driver who agreed to join in would get 20 RMB reward. This data collection work lasted 1 month, finally we get 233 samples, they are from more than 20 cities in mainland China, and more than 90% of them are from Didi and Uber.

DATA ANALYSIS AND RESULTS

Confirmatory factor analysis (CFA) is utilized to test the measurement model. Fornell and Larcker [10] suggest that Cronbach's alpha, composite reliability, average variance extracted (AVE), and item loadings can be utilized to assess the convergent validity. As shown in table 1, we confirmed that the values of Cronbach's alpha are larger than 0.8, the composite reliability values are larger than 0.9, the AVE values are larger than 0.7, and the loadings of all the construct items are larger than 0.8. These results confirm the high convergent validity of our data. We further tested the discriminant validity of the constructs in our research model. Table 2 shows, the AVE square roots of all the constructs are much higher than the cross-correlations; it approves the high discriminant validity.

Tables 1: Psychometric properties of measurements

Construct	AVE	Composite Reliability	Cronbach's Alpha	Item	Item Loading
Social interaction ties with company (SICO)	0.850	0.945	0.912	Item1	0.915
				Item2	0.927
				Item3	0.924
Social interaction ties with other drivers	0.812	0.956	0.942	Item1	0.872
				Item2	0.914

(SID)				Item3	0.900
				Item4	0.908
				Item5	0.911
Social interaction ties with customers (SICU)	0.736	0.933	0.910	Item1	0.874
				Item2	0.855
				Item3	0.813
				Item4	0.896
				Item5	0.849
Rewards (RWD)	0.788	0.937	0.910	Item1	0.855
				Item2	0.912
				Item3	0.908
				Item4	0.876
Sense of Self-value (SSV)	0.809	0.944	0.922	Item1	0.908
				Item2	0.903
				Item3	0.888
				Item4	0.899
Affective Commitment (AC)	0.752	0.924	0.890	Item1	0.878
				Item2	0.882
				Item3	0.830
				Item4	0.878
Continuance Commitment (CC)	0.791	0.938	0.912	Item1	0.901
				Item2	0.917
				Item3	0.879
				Item4	0.859
Normative Commitment (NC)	0.793	0.939	0.912	Item1	0.903
				Item2	0.907
				Item3	0.905
				Item4	0.898
Continuous Intention (CI)	0.816	0.947	0.925	Item1	0.900
				Item2	0.930
				Item3	0.908
				Item4	0.821

Table 2: Square root of AVE and cross-correlations

	SICO	SID	SICU	RWD	SSV	AC	CC	NC	CI
SICO	0.922								
SID	0.438	0.901							
SICU	0.622	0.349	0.858						
RWD	0.493	0.180	0.441	0.888					
SSV	0.399	0.526	0.401	0.346	0.899				
AC	0.604	0.310	0.604	0.562	0.548	0.867			
CC	0.586	0.261	0.545	0.485	0.309	0.556	0.889		
NC	0.582	0.287	0.604	0.593	0.422	0.739	0.618	0.891	
CI	0.562	0.444	0.572	0.524	0.638	0.749	0.499	0.778	0.903

Smart PLS 2.0 [20] was utilized to test the hypotheses in our research model. In general, the 3 dimensions of commitment explained 67.2% of the variances of continuous intention, and the 5 independent variables explained 45.1%, 43.1% and 45.9% of the variances for affective, continuance, as well as normative commitment respectively. These results approved the validity of our research model.

We find that affective commitment and normative commitment can significantly affect drivers' continuous intention, with $\beta=0.391$, $P<0.01$; $\beta=0.510$, $P<0.01$ respectively, this confirms our H1 and H3. However, continuance commitment has no significant effect on continuous intention, thus H2 is not supported. Besides, we find that social interaction ties with company can significantly affect all of the 3 dimensions of commitment, with $\beta=0.364$, $P<0.01$; $\beta=0.330$, $P<0.01$; $\beta=0.317$, $P<0.05$ respectively, thus H4 is supported; social interaction ties with other drivers have no significant effect on all the 3 dimensions of commitment, thus H5 is not supported; social interaction ties with customers can significantly affect all of the 3 dimensions of commitment, with $\beta=0.371$, $P<0.01$; $\beta=0.249$, $P<0.05$; $\beta=0.357$, $P<0.01$ respectively, thus H6 is supported. Rewards can significantly affect continuance commitment, with $\beta=0.214$, $P<0.05$, thus H7 is supported. Sense of self-value can significantly

affect normative commitment, with $\beta=0.193$, $P<0.05$, thus H8 is supported. All the analyses results are summarized in table 3.

Table 3: Hypotheses test

Path	β	T	Hypotheses
AC→CI	0.391**	3.015	H1 (supported)
CC→CI	-0.034	0.398	H2 (not supported)
NC→CI	0.510**	4.146	H3 (supported)
Dependent variable: CI, $R^2=0.672$			
SICO→AC	0.364**	2.887	H4a (supported)
SID→AC	0.021	0.247	H5a (not supported)
SICU→AC	0.371**	3.284	H6a (supported)
Dependent variable: AC, $R^2=0.451$			
SICO→CC	0.330**	2.388	H4b (supported)
SID→CC	-0.009	0.091	H5b (not supported)
SICU→CC	0.249*	2.000	H6b (supported)
RWD→CC	0.214*	1.743	H7 (supported)
Dependent variable: CC, $R^2=0.431$			
SICO→NC	0.317*	2.199	H4c (supported)
SID→NC	-0.078	0.669	H5c (not supported)
SICU→NC	0.357**	2.751	H6c (supported)
SSV→NC	0.193*	1.706	H8 (supported)
Dependent variable: NC, $R^2=0.459$			

Note: * $P<0.05$, ** $P<0.01$

DISCUSSION AND CONCLUSION

This study utilizes commitment theory [1][2] as the theoretical foundation, to test how the organizational commitment affect drivers' continuous intention to provide online car booking service to the customers. According to our best knowledge, this is the initial study which adopts commitment theory in this new electronic business mode. We consider it is the most important theoretical contribution of this study. It can help electronic commerce researchers understand how organizational commitment affects drivers' continuous intention. We find that affective commitment and normative commitment can significantly affect the drivers' continuous intention, whereas continuance commitment has no effect. In general, it confirms the Allen and Meyer's [1][2] declaration that organizational commitment can be the crucial determinant of individuals' subsequent intentions and behaviors in a virtual organization, thus approves the validity of commitment theory in our new research context. The findings of this study also demonstrate that different dimensions of organizational commitment may have different effects.

We also explore the antecedent factors of the 3 dimensions of organizational commitment. We find that social interaction ties with company, and with customers, have significant effects on all the 3 dimensions of commitment, whereas social interaction ties with other drivers cannot affect the organizational commitment. We consider this is the second theoretical contribution of this study. We confirm the crucial role of social interaction ties since they can help drivers cultivate their organizational commitment to the company; however, not all kinds of social ties are effective. This finding implies that in some complex electronic business modes which involve various kinds of actors, social interaction ties with different actors may have different effects on individuals' intentions or behaviors. Therefore, exploring the crucial social interaction ties in these complex electronic business modes is an interesting and important research topic for electronic commerce researchers.

We also approve the significant role of rewards on drivers' continuance commitment perception, as well as the sense of self-value on their normative commitment perception. This is the last theoretical contribution of this study. These findings demonstrate that the drivers' material and spiritual satisfactions also serve as the key determinants to affect their organizational commitment perception, which will finally affect drivers' continuous intention to provide online car booking service.

This study also has some practical implications for the companies involving online car booking business. The findings of this study empirically confirm the crucial role of affective commitment and normative commitment on drivers' continuous intention to provide online car booking service. Thus, the managers of online car booking companies need to adopt relevant strategies to cultivate these 2 dimensions of organizational commitment. This study also identifies the significant antecedent factors of these 2 dimensions of commitment, which will guide the managers to implement corresponding tactics. First, they can design various kinds of communication channels for the drivers to contact with the company's staff as well as the customers. Such as, they can incorporate instant messenger into their websites or APP, it will facilitate the communication among the drivers, customers and the company. Besides, they can appreciate the drivers for their service to the customers in various patterns of manifestation, which will improve the drivers' sense of self-value. In general, we believe adopting these tactics will effectively cultivate the

drivers' organizational commitment, through these ways to encourage them to provide online car booking service continuously.

In conclusion, this study utilizes field data collected from the drivers in various companies in China; to explore what factors can affect their continuous intention. We confirm the crucial role of organizational commitment in our research context. We also identify the key antecedent factors which can cultivate the drivers' commitment perception. The finding of this study will help scholars understand the mechanism of drivers' continuous intention to provide service; it also can guide the managers to implement precise management strategies to keep the drivers, and finally ensure the survival and development of the online car booking companies.

ACKNOWLEDGEMENTS

This work is supported by the Fundamental Research Funds for the Central Universities (Grant No. JBK 120505; JBK 160133).

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CONTRACTING FOR IT OUTSOURCING WITH ASYMMETRIC INFORMATION

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ABSTRACT

IT outsourcing allows a business to reduce the cost of IT service delivery and improve the quality of IT service by taking advantage of the service provider's economics of scale and technical expertise. However, the successful outsourcing of IT service is hampered by lack of guidance on how to design incentive contracts to encourage performance of the service provider, especially in the presence of information asymmetry and incentive divergence. In this article, we identify and characterize two asymmetric information factors: asymmetric effort information and asymmetric capability information. Depending on whether the service provider's effort information and capability information is symmetric or not, we consider three information scenarios and characterize optimal incentive contracts for each scenario. We also introduce the concept of information value to quantify the adverse effects of the two asymmetric information factors. The results provide theoretical support for designing incentive contracts that mitigate the adverse effects of asymmetric information, and recommend effective guidance for activities so as to reduce the degree of information asymmetry.

Keywords: IT outsourcing, contract design, information value, principal-agent model.

1 INTRODUCTION

IT service outsourcing refers to a company contract with external service provider for the provision of part or all of its information service needs rather than deliver them internally as was their practice [1]. With rapid development of information technology and economic globalization, IT outsourcing become a popular practice over the last two decades, it can reduce the cost of information systems service delivery by taking advantage of the service provider's economics of scale and specialization, and enhance service quality by using the technical expertise of the service provider, and improve business performance by better aligning IT strategy with business goals and allowing a focus on her core competency [2, 3]. Because of the advantages above-mentioned, companies have increasingly sourced many of their IT activities, the IT outsourcing market has seen rapid growth. The worldwide IT services market will reach \$929 billion in 2016, with outsourcing contributing 60% of market growth in constant currency, the market will reach \$1.1 trillion in 2020. However, the results of these outsourcing arrangements have been mixed [4, 5], while some firms have achieve their goals, other had various degrees of failure. A survey by Lacity and Willcocks find that 80% managers report an unsatisfactory outcome with their outsourcing services [6]. Gupta argue that outsourcing may lead to uncertain level of IT service [7], and the service delivery may not have met the client firms' expectations [5, 8]. Many firms terminate contracts and decide to backsource an outsourced process, or search new service providers and write new contracts [9].

The successful outsourcing of IT services is hampered by lacking guidance on how to design IT outsourcing contracts to encourage and reward good performance of the service provider, especially in the presence of information asymmetry and incentive divergence [10, 11]. A frequent problem the client faces in service outsourcing is the fact that they lack perfect information about her service provider, the information asymmetry between the client and service provider may lead to loss of control and opportunistic behavior [5]. As a result, how to design effective contracts to mitigate the asymmetric information risk become important item to the success of IT outsourcing. In this article, we identify two factors that cause asymmetric information risk. First, the client firm may not contract on the effort spending on the IT outsourcing project, that is, the client

firm may lack the information of the investment of the service provider. Second, the client may not know the service provider's capability information. Our objective is to characterize the adverse effects of each asymmetric information risk factor and to design contracts that maximize the client's profit by mitigating asymmetric information risk.

The first factor of asymmetric information risk is that the client and the service provider may not contract on effort, i.e., the investment to the project is unverifiable. First, the inputs of IT service outsourcing project are not freely verifiable, especially intangibility of the knowledge input, technology input, and human resources. Hence, firms cannot contract upon it. Second, it is difficult and costly for the client to monitor the action of the service provider and there may be some loss of control related to the direct supervision of the service provider, resulting in the client lacks information about the service provider's effort. Third, the firms cannot identify every possible contingency in advance. Thus, they cannot write a comprehensive contract that defines what to do in every possible contingency. The above three reasons result in the effort information asymmetry between the contracting parties. The second factor of asymmetric information risk is the service provider's private capability information. The service provider's capability information includes, for example, his R&D capability, technology capability, qualification, knowledge, experience, reputation, personnel quality and management capability [4]. The client may not know the service provider's capability because the capability components are difficult for outsiders to assess.

We introduce the concept of information value to measure the adverse effects of the above two asymmetric information risk factors. Information value arises as the difference between a decision maker's profit in the absence of information relative to what can be obtained in its presence. The information considered in this paper is classified into capability information and effort information. In the light of whether capability and effort information can be verified and contracted or not, there are four scenarios of information: (1) {symmetry, symmetry}: symmetric capability information and symmetric effort information, i.e., the client has the information about the service provider's effort and capability; (2) {symmetry, asymmetry}: symmetric capability information and asymmetric effort information, i.e., the client has the information about the service provider's capability but does not have the information about the service provider's effort; (3) {asymmetry, asymmetry}: asymmetric capability information and asymmetric effort information, i.e., the client does not have the information about the service provider's effort and capability; (4) {asymmetry, symmetry}: asymmetric capability information and symmetric effort information, i.e., the client has information about the service provider's effort but does not have the information about the service provider's capability. We also note that we will not study scenario (4), i.e., asymmetric capability information but the effort is verifiable, in this scenario, the client can observe the effort level of the service provider, but due to unobservability of capability information, she is unable to choose the appropriate effort level to contract on, so the effort information is useless and this scenario does not yield additional insights and can be reduced to scenario (3). Therefore, in the following analysis, we will not study scenario (4) and we will only analyze performances of scenario (1), (2) and (3) respectively. Based on definition of value of information from Banker and Kauffman, the value of effort information is the client's payoff in scenario (1) minus her payoff in scenario in (2), and the value of capability information is the gap between the client's profit in scenario (2) and her profit in scenario (3).

In this article, in addition to identifying the asymmetric information risk factors, we quantify and compare their impact on the client's profits and IT service quality. We propose a moral hazard model under asymmetric effort information and an adverse model in the presence of asymmetric capability information. And we design contracts to mitigate their adverse effects and identify the key trade-offs between the value of information and the cost for the execution of information disclosure activities. We propose three respective contracts for the above-mentioned different information settings and analyze the impact of key parameters on the value of information. The results show that both the value of capability information and the value of effort

information increase in the quality sensitivity and capability level, but with regard to the degree of risk aversion of the service provider and the uncertainty of quality, they show opposite effects, the value of capability information decreases in the degree of risk aversion and quality uncertainty while the value of effort information increases in them. Furthermore, we find that the ex ante belief about the service providers capability type has important influence on the value of cost information. The results of this paper provide theoretical support for designing outsourcing contracts under asymmetric information, and point out conditions under which the client should pay attention to the risk of information asymmetry and recommend effective guidance for making trade-off between the value of information and the cost of information disclosure activities.

The paper is organized as follows. We review the related literature in the next section. Section 3 presents the basic model, gives the first-best solution in symmetric information setting (scenario (1)), and relates the design of contracts under asymmetric information settings (scenarios (2) and (3)). We report the insights derived from numerical analysis in section 4. Finally, we provide concluding remarks and directions for further research.

2 LITERATURE REVIEW

Three streams of literature yield key insights regarding the contract design in IT outsourcing arrangements: transaction cost economics (TCE) perspective, principal-agent perspective and real options perspective. Each of these literature streams is reviewed as follows.

TCE addresses the assumption that market and, by extension, the contract are the most efficient mechanism to govern all transactions [12]. TCE argues that there are at least three major characteristic of transaction that determine the magnitude of transaction costs, including transaction-specific investments, uncertainty and complexity and reputation [13]. From the point of TCE the internal provision should be preferred when the transaction costs of securing a product or a service from external source are high. The IT outsourcing has received considerable attention from the transaction cost perspectives. Kern and Willcocks argue that the external sourcing of information services is characterized by high transaction costs. Specifically, these observers point to the difficulty of writing efficient contracts in the presence of considerable technological and business uncertainty [14]. Poppo and Zenger study the relationship between formal contract and relational exchange arrangements, argue that in the context of IT outsourcing that formal contracts and relational governance function as complements[15]. Grover et al. argue that while there is a positive relationship between outsourcing of less asset-specific transactions with success, outsourcing of more asset-specific interactions results in unsatisfactory outcomes. Kern and Willcocks identify seven categories of contractual issues that facilitate management control of outsourcing relationship, including service description and exchanges, service enforcement and monitoring, financial exchanges, financial control and monitoring, key vendor personnel, dispute resolution, and change control and management [14]. Gopal et al. study the determinants of contract choice, the determinants they consider are require uncertainty, projects size and potential resource shortages [10]. Kalnins and Mayer examine the impact of uncertainty, measurement issues and prior relationship on the contract structure [16]. Goo et al explore factors that influence the duration of IT contract, they conclude that while relationship-specific investments and the extent of substitution is positive related to IT contact duration, demand uncertainty and vendor opportunism leads to short contract duration [17]. The above researches based on transaction cost economics have generally provided helpful explanations in the trade-off between integration and nonintegration, that is, insourcing and outsourcing, but they lack the design and analysis of performance incentives in bilateral contracts, especially in the face of information asymmetry. Comparing to the above researches based on TCE, our research focus on designing and analyzing the incentive contracts for IT outsourcing in the presence of information asymmetry and characterizing the adverse effects of information asymmetry, so our research can better analyze the economic benefits of outsourcing and provide guidance in designing contracts for IT outsourcing with information asymmetry, and points out

conditions under which the client should carry out activities to reduce the risk of information asymmetry.

In addition to researches based on transaction cost economics, another literature stream of contracts in IT outsourcing has primarily been studied through the viewpoints of principal-agent theory. Principal-agent theory focuses on contract design to mitigate incentive divergence between contracting parties. Elitzur and Wensley utilize a principal-agent approach to construct a moral hazard model, they focus on designing and analyzing contracts in the setting with asymmetric effort information, i.e., the effort expended by the service provider in providing the outsourced service is not freely verifiable [18]. Bryson and Ngwenyama develop an approach to analyzing outsourcing risks and structuring incentive contracts based on principal-agent theory [5]. The outsourcing risks considered are shirking and opportunistic bargaining, shirking results from asymmetric effort information, and opportunistic bargaining refers to a service provider's ability to demand higher than market prices. Ren and Zhou study contracting issues in an outsourcing supply chain, they propose different contracts depending on the observability and contractibility of the service provider's effort [19]. Dey et al present a contract-theoretic model considering information asymmetry and incentive divergence to analyze how software outsourcing contracts can be designed. Depending on whether the effort spending on the software development can be verified and contracted or not, they design and analyze three types of contracts: fixed-price contract, time-and-materials contract and performance-based contract [20]. Roels and Karmarkar study contracting issues arising in collaborative services, such as IT outsourcing, they provide different contracts depending on whether the efforts are verifiable or not, they analyze fixed-fee contract when the vendor's efforts can not be contracted but the client's efforts are verifiable, and time-and-materials contract when the vendor's effort are verifiable but the client's efforts are not, and performance-based contract when both efforts are not verifiable [21]. Fitoussi and Gurbaxani examine the incentive contract design with multiple objectives in IT outsourcing, and in their model the efforts associated with the objectives cannot directly be observed by the client [11]. Elitzur et al consider the information system outsourcing projects as a double hazard problem, in their model the success of the information system outsourcing projects depends on the efforts of both client and service provider, which are not freely verifiable and directly contractible [22]. The above researches mainly focus on the moral hazard due to the unobservability and uncontractibility of the service provider's effort, but in practical IT outsourcing, not only exists the moral hazard problem with asymmetric effort information, but also exists the adverse selection problem when the client can not acquire the service provider's private information such as capability information. In contrast to these prior studies, this paper presents a more comprehensive consideration of the asymmetric information factors involved in designing the contracts, not only the asymmetric effort leading to moral hazard problem, but also the asymmetric capability information leading to adverse selection problem is taken into account, and also we analyze the adverse effects of each asymmetric information risk factor. Through considering different information scenarios depending on whether the effort information and capability information is symmetric or not, we can provide more comprehensive advising for designing outsourcing contracts under asymmetric information. Through quantifying and analyzing the adverse effects of information asymmetry, we can recommend effective policies for making trade-off between the value of information and the cost of information disclosure activities.

The third stream of literature on IT outsourcing contracts is from the perspective of real options, which examines contracting issues subject to irreversible outsourcing investment and uncertainty. Real options theory focuses on optimal investment decision making in the framework of irreversibility and uncertainty [23]. Jiang et al and Yao et al study the contract selection and outsourcing timing in the presence of cost uncertainty [24, 25]. Two papers apply real option approach respectively analyze the impacts of demand uncertainty and sourcing flexibility on IT outsourcing contracts [26, 27]. These articles mainly concentrate on the contracting issues with uncertainty risk, however, they neglect the important risks of information asymmetry in IT outsourcing.

To summarize, the existing contracting researches based on transaction cost economics focus on the trade-off between insourcing and outsourcing, the researches based on principal-agent theory primarily concentrate on the moral hazard due to the asymmetric effort information, the researches based on real options theory only pay attention to the uncertainty in IT outsourcing. In this paper, we look at IT outsourcing as a problem that not only has asymmetric effort information coupled with moral hazard but also involves asymmetric capability information coupled with adverse selection. We quantify and compare the two asymmetric information factors' impact on the client's profits, and design contracts to mitigate their adverse effects.

3 BASIC MODEL

3.1 Model Components

3.1.1 Input and Output

Input is the service provider's effort, denoted by e . We assume the cost function of effort is $C(e) = \frac{1}{2}e^2$, i.e., the cost of providing effort level e . The quadratic form implies increasing marginal cost of effort level, division by 2 is for notational ease in subsequent analysis.

We use service quality to measure the output of service provider's work, denoted by q . We model service quality as a function of the vendor's capability θ and effort e and denotes as:

$$q = f(\theta, e) + \varepsilon,$$

where $\frac{\partial f}{\partial \theta} > 0$, $\frac{\partial f}{\partial e} > 0$, $\frac{\partial^2 f}{\partial \theta \partial e} \geq 0$. $\frac{\partial f}{\partial \theta} > 0$ and $\frac{\partial f}{\partial e} > 0$ imply the service quality increases with the service provider's effort and capability. $\frac{\partial^2 f}{\partial \theta \partial e} \geq 0$ implies that the effect of efforts on quality improvement is stronger if the service provider's capability is higher. ε is the uncertainty associated with service quality. We model ε as a normally distributed random variable with zero mean and variance σ^2 . For ease of mathematical treatment, we simplify $f(\theta, e) = \theta e$, so we can get

$q = \theta e + \varepsilon$. The utility of service to the client increases with the service quality level, the expected utility of the client can be expressed as

$$V = \mu q = \mu(\theta e + \varepsilon),$$

where μ is the client's sensitivity to service quality. μ represents the client's valuation of service quality and is closely related to the importance, functionalities and complexity of the service[20], the higher value of μ implies the service quality is more important for the client.

3.1.2 Contract Type

Generally, there are two classes of outsourcing contracts, fixed fee and incentive [5, 20]. In a simple fixed fee contract, a predetermined price is paid to the service provider and he is responsible for all the risk of cost overruns, in practice however, the service provider can engage in opportunistic bargaining, that is he may pressure the client to pay the overruns if he is the unique service provider and there is no option of switching [5]. Another type of fixed fee arrangement is a time and materials contract, also known as cost plus contract, requires the client to pay the service provider the cost of efforts plus a profit. The above two types of fixed fee contract require the effort spending on the IT outsourcing project are freely verifiable, that is, the effort information is symmetric so the client can pay the fixed fee according to the cost of effort. However, in reality the client usually

lacks information about the effort of the service provider [20], what is more, the output of service may influence by outside uncertainty that beyond the service provider's control [11, 20], so the service provider's effort can not be inferred from the output, so adoption of fixed fee contract may lead to poor performance. The second type, incentive contracts, attempts to share risks and rewards between the client and the service provider. In this type of contracts, the payoff to the service provider is tied to the performance of the IT service, generally they specify incentives for various levels of performance.

In the presence of information asymmetry, we consider incentive contracts so as to provide effective incentives to the service provider. In these contracts, the client agrees to pay the service provider a portion of the agreed upon fixed price ensuring the participation of the service provider and additional incentive payments for various levels of performance so as to induce the service provider to perform at higher levels (exert more efforts). Following Holmstrom and Migrom's model, We consider an incentive contract from where the payment from the client to the service provider is expressed as

$$W(q) = \varpi + \beta q,$$

where ϖ is the fixed part of the payment, β is the incentive payment per level of performance, $\beta \in [0, \mu]$.

We assume the service provider is risk averse and his utility function is $U(x) = -e^{-rx}$ [28], where $r > 0$ is the service provider's coefficient of absolute risk aversion and $x = W(q) - C(e)$ is the service provider's net payoff—the realized compensation minus the cost. The client is risk neutral and so seeks to maximize the expected value of profit, $\pi_c = V - W$.

Given the contract $W(q) = \varpi + \beta q$, the service provider's problem is

$$\max_e -e^{-r[\varpi + \beta\theta e - \frac{1}{2}e^2]} \int_{-\infty}^{\infty} e^{-r\beta\varepsilon} \phi(\varepsilon) d\varepsilon,$$

where $\phi(\varepsilon)$ denotes the normal density function. The service provider's certainty equivalent is

$$CE(\varpi, \beta) = \varpi + \beta\theta e - \frac{1}{2}e^2 - \frac{1}{2}r\beta^2\sigma^2.$$

For notational convenience, we replace $CE(\varpi, \beta)$ by π_s in the subsequent sections, i.e., $\pi_s = CE(\varpi, \beta)$.

3.1.3 Description of Contracting Game

We model the contracting process as a Stackelberg game, in which the client offers a contract to the service provider and the service provider makes the choice of effort level. The timing of the game is modeled as follows: (1) the client offers the contract $W(q)$; (2) the service provider accepts the contract if its certainty equivalent profit π_s is larger than his reservation utility, denoted by $\pi_R \geq 0$, or rejects the contract otherwise; (3) After the service provider has accepted the contract, he chooses the appropriated effort level e ; (4) events beyond the service provider's control ε occur; (5) the effort e and the noise term ε determine the output q ; (6) the project is completed, the quality of service q is realized and released to the client; (7) the

service provider receives the monetary payment specified by the contract; see Figure 1.

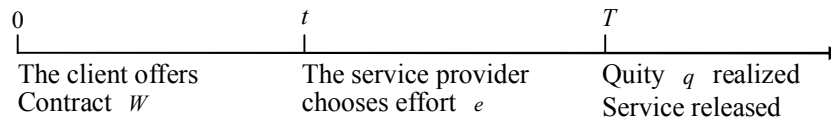


Figure 1. Timing of the model

3.2 First-best contract under symmetric information

As a benchmark, consider the first-best solution, as if both the effort information and capability information is symmetric between the client and the service provider (that is, scenario (1)). In this situation, the client is able to choose the service provider's effort so as to maximize her profit. The client's contracting problem is

P1

$$\max_{\varpi, \beta, e} \pi_C = (\mu - \beta)\theta e - \varpi \quad (1)$$

$$s.t. \quad \pi_S = \varpi + \beta\theta e - \frac{1}{2}e^2 - \frac{1}{2}r\beta^2\sigma^2 \geq \pi_R. \quad (2)$$

The constraint assures that the service provider's expected profit is no less than his reservation profit π_R . Solving program 1, we can obtain the following proposition 1.

PROPOSITION 1. The first-best results under symmetric effort and capability information are as follows: (a) The optimal

Contract $W^{FB} = (\varpi^{FB}, \beta^{FB})$ where $\varpi^{FB} = \pi_R + \frac{1}{2}\mu^2\theta^2$, $\beta^{FB} = 0$; (b) the optimal effort level $e^{FB} = \mu\theta$; (c) The

service provider's expected profit $\pi_S^{FB} = \pi_R$. The client's expected profit $\pi_C^{FB} = \frac{1}{2}\mu^2\theta^2 - \pi_R$, increasing in θ and μ .

The proofs of this and all the subsequent propositions and lemmas are given in Appendix.

Proposition 1 characterizes the optimal contract terms and shows that when both the effort information and capability information are symmetric, the results are the same as integrated firm, i.e., equal to the results of solving $\max_e \{\mu\theta e - \frac{1}{2}e^2\}$.

The channel does not lose efficiency due to outsourcing. The client is effectively the only decision maker. Hence, she can squeeze out all channel profits and leave the service provider with just enough profit to ensure his participation. We use the results under symmetric information as benchmarks for the rest of the paper.

3.3 Optimal choice of contract under asymmetric information

We now turn our attention to the optimal choice of contract when the capability information θ and effort information e can not be always verifiable and contractible. Scenario (2) and (3) must be considered. When the service provider's effort level can not be contracted on, the problem reduces to a standard principal-agent model. The transfer payment W can only be a function of what is contractible, namely the performance q . Given the contract payment $W(q) = \varpi + \beta q$, the service provider's problem is to maximize $\varpi + \beta\theta e - \frac{1}{2}e^2 - \frac{1}{2}r\beta^2\sigma^2$. When $\beta = 0$, this problem equals to maximize $\varpi - \frac{1}{2}e^2$, it is easy

to see the optimal effort level of the service provider is $e = 0$, which does not meet the client's objective, so in the asymmetric information context, the scope of β is $(0, \mu]$. $\beta = 0$ implies the client will not provide the contract payment and the service provider get reservation utility π_R from the outside opportunity.

3.3.1 Symmetric Capability Information and Asymmetric Effort Information

We now examine the contract performance under symmetric capability information but asymmetric effort information, that is, the client has information about the service provider's capability but lacks information about the service provider's effort spending on the IT outsourcing project. The client chooses the contract that maximizes her expected profit, subject to the service provider's participation constraint (4), ensuring that the service provider obtains a certainty equivalent profit at least no less than its reservation utility, and the incentive compatibility constraint (5), which defines the noncooperative Nash game of effort choice. According, the service provider's problem can be formulated as follows:

P2

$$\max_{\varpi, \beta} \pi_C = (\mu - \beta)\theta e - \varpi \quad (3)$$

$$s.t. \quad \pi_S = \varpi + \beta\theta e - \frac{1}{2}e^2 - \frac{1}{2}r\beta^2\sigma^2 \geq \pi_R \quad (4)$$

$$e^* = \arg \max \left\{ \pi_S = \varpi + \beta\theta e - \frac{1}{2}e^2 - \frac{1}{2}r\beta^2\sigma^2 \right\}. \quad (5)$$

We denote the equilibrium contract solution as (ϖ^*, β^*) and the service provider's best response as e^* . The equilibrium contract, the service provider's strategy and their respective expected utility are derived as follows:

PROPOSITION 2. Suppose that the capability information is symmetric, but the effort level information is asymmetric, the contract $W^* = (\varpi^*, \beta^*)$ and service provider's choice of effort e^* constitute a Nash equilibrium, where ϖ^* , β^* and

e^* are given by $\varpi^* = \pi_R - \frac{\mu^2\theta^4(\theta^2 - r\sigma^2)}{2(\theta^2 + r\sigma^2)^2}$; $\beta^* = \frac{\mu\theta^2}{\theta^2 + r\sigma^2}$, increasing in μ and θ but decreasing in r and σ^2 ;

$e^* = \frac{\mu\theta^3}{\theta^2 + r\sigma^2}$, increasing in θ and μ but decreasing in r and σ^2 . The client's optimal profit is such that

$\pi_C^* = \frac{\mu^2\theta^4}{2(\theta^2 + r\sigma^2)} - \pi_R$, increasing in θ and μ but decreasing in r and σ^2 . The service provider's optimal utility

$\pi_S^* = \pi_R$.

The proposition characterizes the optimal contract terms, the resulting effort level and profits. Which shows that with high quality sensitivity, high capability, low degree of risk aversion and uncertainty, the client is prone to provide more incentive for the service provider and as a result get higher IT service quality and more profit. In summary, a high capability increases the

client's profit, however, with high degree of risk aversion and quality uncertainty, the client's profit will decrease. And more importantly, the proposition enables us to quantify the impact of the service provider's capability. Note that in practice the service provider can improve his capability by investing in new technologies and recruiting IT experts. The proposition can be used to quantify how such activities impact resulting profit when the capability of service provider is known to both parties.

Comparing the results under symmetric capability information and asymmetric effort information with those under symmetric information, we have the following result:

PROPOSITION 3. In the setting with symmetric capability information and asymmetric effort information, the service provider would invest lower effort compared to the first-best solution, resulting in a lower service quality and the client's expected profit.

Proposition 3 suggests that in the setting with symmetric capability information and asymmetric effort information, the service provider does not have an incentive to provide effort at the first-best level.

PROPOSITION 4. The value of effort information can be calculated as

$$\kappa_e = \pi_C^{FB} - \pi_C^* = \frac{r\mu^2\theta^2\sigma^2}{2(\theta^2 + r\sigma^2)} \quad (6)$$

The effort information value κ_e increases in μ , θ , r and σ^2 .

Proposition 3 and 4 characterize the effects of the first asymmetric information risk factor (asymmetric effort information). Specially, proposition 4 quantifies the adverse effects of the first asymmetric information risk factor, i.e., the value of effort information. In some cases, to minimize the adverse effects of asymmetric effort information, the client firms may contract on effort through costly monitoring and supervising, or may invest in monitoring and coordinating mechanisms. Generally, the client can setup an organizational unit to coordinate the interactions between its end-users and the service provider and to supervise the service provider's action[5]. This unit may be costly depending the size and complexity of the outsourcing service. Also, the client firms can introduce hierarchical governance structure to reduce opportunistic behavior by the service provider [29]. When the client firm wants to take the above activities to mitigate the adverse effects of the asymmetric effort information, she should make the trade-off between the cost of these activities and the value of effort information. The value of effort information κ_e provides an upper bound of such activities. Furthermore, the comparative static analysis of κ_e gives conditions under which the client should pay attention to the risk of asymmetric effort information, with high importance of quality, high capability of the service provider, high risk aversion of the service provider and high uncertainty of quality, it is worth carrying out such activities, but with low importance of quality, low capability of the service provider, low degree of risk aversion and uncertainty, the client is better off not carrying out such activities.

3.3.2 Asymmetric Capability Information and Asymmetric Effort information

In this subsection, we address a setting in which both the capability information and effort information is not symmetric. Here, in addition to the asymmetric effort information, we consider the inefficiency due to private capability information. Assume a service provider that can be of two types: a high-capability service provider with capability θ_H and a low-capability service

provider with capability θ_L , where $\theta_H > \theta_L$. In this scenario, the service providers know which type they belong to, but the client lacks the information, she merely knows the proportion of low-capability type in the outsourcing market is p and high-capability type is $1-p$, i.e., the belief is such that the service provider has low-capability with probability p and high-capability with $1-p$.

In order to facilitate the analysis, we define a new function. Substituting Equation (B3) (see the Appendix B) into Equation (4), we write the service provider's profit as functions of the contract parameters, i.e., $\pi_s = \varpi + f(\beta, \theta)$, where $f(\beta, \theta) = \frac{1}{2}\beta^2\theta^2 - \frac{1}{2}r\beta^2\sigma^2$, $\beta \in (0, \mu]$. When $\beta = 0$, according to the above analysis, in asymmetric information setting, the client would refuse to do business with the service provider, thus $\varpi = 0$, $f(0, \theta) = \pi_R$. From the above analysis, we get

$$f(\beta, \theta) = \begin{cases} \pi_R & \text{if } \beta = 0 \\ \frac{1}{2}\beta^2\theta^2 - \frac{1}{2}r\beta^2\sigma^2 & \text{if } 0 < \beta \leq 1 \end{cases} \quad (7)$$

The following lemma establishes an important property of $f(\beta, b)$ that we will use in the analysis.

LEMMA 1. The function $f(\beta, \theta)$ has increasing differences in θ , that is $f(\beta_2, \theta) - f(\beta_1, \theta)$ is increasing in θ for $0 < \beta_1 < \beta_2 \leq \mu$. Thus, a high-capability service provider values an increase in the per-unit incentive payment more than a low-capability service provider does.

Before offering a contract, the client can ask the service provider to report his capability and next she can offer the contract characterized in the previous section. However, if the client asks for the service provider's capability information report, the service provider may misreport his private information and uses his information advantage to get extra profit except the reservation profit. Hence, the client needs to design a truth-telling mechanism to credibly obtain the service provider's private capability information while maximizing her profit. According to the revelation principle [39], through designing the optimal menu of contracts $\{(\varpi_L, \beta_L), (\varpi_H, \beta_H)\}$, the client can reveal the true type of the service provider. The client solves the following problem

P3

$$\max_{\{(\varpi_H, \beta_H), (\varpi_L, \beta_L)\}} E[\pi_c] = p[(\mu - \beta_L)\theta_L e_L - \varpi_L] + (1-p)[(\mu - \beta_H)\theta_H e_H - \varpi_H] \quad (8)$$

$$s.t. \quad \pi_{SHH}^{**} = f(\beta_H, \theta_H) + \varpi_H \geq f(0, \theta_H) = \pi_R \quad (9)$$

$$\pi_{S_{LL}}^{**} = f(\beta_L, \theta_L) + \varpi_L \geq f(0, \theta_L) = \pi_R \quad (10)$$

$$\pi_{S_{HH}}^{**} = f(\beta_H, \theta_H) + \varpi_H \geq \pi_{S_{HL}}^{**} = f(\beta_L, \theta_H) + \varpi_L \quad (11)$$

$$\pi_{S_{LL}}^{**} = f(\beta_L, \theta_L) + \varpi_L \geq \pi_{S_{LH}}^{**} = f(\beta_H, \theta_L) + \varpi_H. \quad (12)$$

The individual rationality constraints (9) and (10) ensure that both service provider types participate in transaction. The incentive compatibility constraints (11) and (12) ensure that service provider chooses the contract intended for his type.

The proposition below presents the client's optimal contracts menu and the resulting optimal profits and efforts in the setting of asymmetric capability information.

PROPOSITION 5. Suppose that neither the capability information nor the effort information is symmetric, the high-capability service provider optimally chooses the contract $W_H^{**} = (\varpi_H^{**}, \beta_H^{**})$, where the incentive payment is not distorted (that is, $\beta_H^{**} = \beta_H^*$). The low-capability service provider optimally chooses the contract $W_L^{**} = (\varpi_L^{**}, \beta_L^{**})$, where the incentive payment is distorted downward (that is, $\beta_L^{**} < \beta_L^*$). The contract parameters satisfy

$$\varpi_H^{**} = \pi_R - \frac{\mu^2 \theta_H^4 (\theta_H^2 - r\sigma^2)}{2(\theta_H^2 + r\sigma^2)^2} + \frac{\mu^2 \theta_L^4 (\theta_H^2 - \theta_L^2)}{2(\theta_L^2 + r\sigma^2 + T)^2}; \quad \varpi_L^{**} = \pi_R - \frac{\mu^2 \theta_L^4 (\theta_L^2 - r\sigma^2)}{2(\theta_L^2 + r\sigma^2 + T)^2};$$

$$\beta_H^{**} = \frac{\mu \theta_H^2}{\theta_H^2 + r\sigma^2}; \quad \beta_L^{**} = \frac{\mu \theta_L^2}{\theta_L^2 + r\sigma^2 + T},$$

where $T = ((1-p)/p)(\theta_H^2 - \theta_L^2)$. The service provider's optimal effort e_L^{**} and e_H^{**} are $e_L^{**} = \frac{\mu \theta_L^3}{\theta_L^2 + r\sigma^2 + T}$;

$e_H^{**} = \frac{\mu \theta_H^3}{\theta_H^2 + r\sigma^2}$. The client's optimal profit is $\pi_{C_L}^{**} = \frac{\mu^2 \theta_L^4 (\theta_L^2 + r\sigma^2 + 2T)}{2(\theta_L^2 + r\sigma^2 + T)^2} - \pi_R$;

$\pi_{C_H}^{**} = \frac{\mu^2 \theta_H^4}{2(\theta_H^2 + r\sigma^2)} - \frac{\mu^2 \theta_L^4 (\theta_H^2 - \theta_L^2)}{2(\theta_L^2 + r\sigma^2 + T)^2} - \pi_R$. Where $\pi_{C_i}^{**}$ denotes the client's optimal profit when the service provider is type i . The service provider's optimal equivalent profit is

$$\pi_{S_L}^{**} = \pi_R; \quad \pi_{S_H}^{**} = \pi_R + \frac{\mu^2 \theta_L^4 (\theta_H^2 - \theta_L^2)}{2(\theta_L^2 + r\sigma^2 + T)^2}.$$

Where $\pi_{S_i}^{**}$ denotes the service provider's optimal equivalent profit when his type is i .

Proposition 5 suggests that with the contracts menu $\{(\varpi_H^{**}, \beta_H^{**}), (\varpi_L^{**}, \beta_L^{**})\}$, the client is able to identify the service

provider's type. The next proposition further characterizes the behavior of the optimal effort level and contract parameters under the contract menu $\{W_H^{**}, W_L^{**}\}$.

PROPOSITION 6. (a) Both e_L^{**} and e_H^{**} are increasing with μ and their respective capability level θ_H and θ_L but decreasing with r , σ^2 ; (b) Both β_L^{**} and β_H^{**} are decreasing with r , σ^2 but increasing with μ and their respective capability θ_H and θ_L , furthermore, β_L^{**} is decreasing with capability gap between low-capability parameter and high-capability parameter, where the capability gap $x = \theta_H - \theta_L$; (c) $\partial\beta_H^{**}/\partial p = 0$, $\partial\beta_L^{**}/\partial p > 0$. The client's ex ante belief of service provider's type would have no impact on the high-capability type service provider's optimal incentive payment, but would influence the low-capability type service provider's optimal incentive payment. The more accurate the client's judgement of low-capability type is (that is, the higher p), the larger the incentive payment to the low-capability type becomes, i.e., the larger the proportion of low-capability type in the market, the less distortion; (d) $\beta_H^{**} - \beta_L^{**} \geq 0$, $\partial\Delta\beta_{HL}^{**}/\partial x > 0$, where $\Delta\beta_{HL}^{**} = \beta_H^{**} - \beta_L^{**}$. The high-capability type service provider's incentive payment is higher than the low-capability type service provider's, and moreover, the incentive payment gap between the low-capability type provider's and the high-capability's increases in the capability gap.

Comparing the results in the setting of asymmetric capability information and asymmetric effort information with those in the setting of symmetric capability information and asymmetric effort information, we have the following proposition:

PROPOSITION 7. (a) The high-capability service provider would invest the same effort but the low-capability service provider would invest lower effort, resulting in a lower expected service quality; (2) The equivalent profit of low-capability type service provider would keep the same, but the expected profit of the client would be lower. The high-capability service provider would obtain an information rent in addition to reservation utility.

Proposition 7 characterizes the effects of private capability information. When the service provider belongs to high-capability type, the only difference from the symmetric capability information situation results is the information rent that the service provider obtains. In order to distinguish the different capability type service provider, the client distorts the low-capability service provider incentive payment β_L^{**} downward, which results in a lower effort level and service quality and a reduction in the client's expected profit.

PROPOSITION 8. Comparing the client's payoff in the presence of capability information with that in the absence of capability information, the value of capability information can be stated as

$$\kappa_c = E[\pi_c^*] - E[\pi_c^{**}] = \frac{p\mu^2\theta_L^4T^2}{2(\theta_L^2 + r\sigma^2)(\theta_L^2 + r\sigma^2 + T)^2} + \frac{(1-p)\mu^2\theta_L^4(\theta_H^2 - \theta_L^2)}{2(\theta_L^2 + r\sigma^2 + T)^2} \quad (13)$$

Consistent with κ_e , κ_c increases in μ , but on the contrary, κ_c decreases in r and σ^2 while κ_e increases in r and σ^2 . Moreover, κ_c is increasing with the capability gap x .

The above proposition quantifies the effect of the second asymmetric information risk factor on the client's profit. In some cases, the client may acquiring the service provider's capability information through writing a comprehensive request for information (RFI) or contract that includes detain information of the service provider's capability information, such as whether the service provide get CMM (Capability Maturity Model) or CMMI (Capability Maturity Model Integration) certification, and which CMM or CMMI level have they achieved. Also the client can obtain the service provider's private information through a auditing the service provider by hiring internal or external experts. If the client prepares to carry out such activities, it should ensure the cost of such activities is lower than the value of capability information. Furthermore, the value of capability information points out condition under which the client should pay attention to the asymmetric capability information, with high importance of quality, low risk aversion of the service provider, low uncertainty of quality and large difference between the low-capability type service provider's capability and the high-capability type service provider's capability, such information disclosure activities deserve to be carried out.

4 NUMERICAL ANALYSIS OF INFORMATION VALUE

Next, we compare the effects of the two asymmetric information risk factors, that is, we compare the value of effort information, with the value of information on the service provider's capability. Through numerical analysis we want to figure out which of the two asymmetric information risk factors affects the system more, and when does one asymmetric information risk factor play a important role than the other, and when should the client pay more attention to these asymmetric information risk factors.

In this section, we analysis the relation between the relevant parameters and the value of information described in proposition 4 and proposition 8. Further, we show the impact of five key parameters on the value of information, including (1) the quality sensitivity parameter, μ , (2) the capability level of high-capability service provider, θ_H , (3) the risk aversion measurement parameter, r , (4) the uncertainty measurement parameter of quality, σ^2 , (5) the client's ex ante belief, p . First, we purposely select a set of baseline parameters: $\mu = 1$, $r = 0.1$, $\sigma^2 = 0.2$, $\theta_H = 2\theta_L$, $\theta_H = 0.5$, $p = 0.5$, $\pi_R = 0$. Then for each scenario, we vary one parameter at a time over a wide range of value and calculate two statistics—the value of effort information κ_e and the value of capability information κ_c , resulting in Figures 2-6.

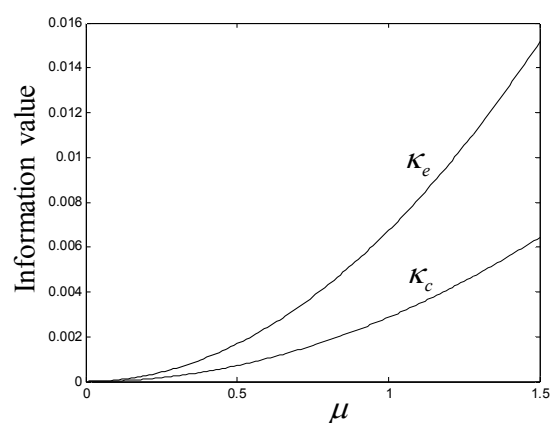


Figure 2. The impact of μ on κ_e and κ_c .

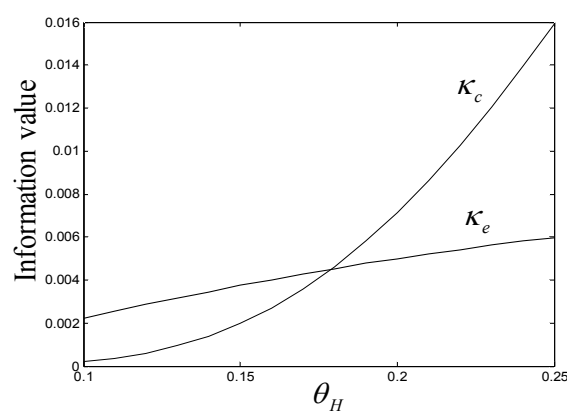


Figure 3. The impact of θ_H on κ_e and κ_c .

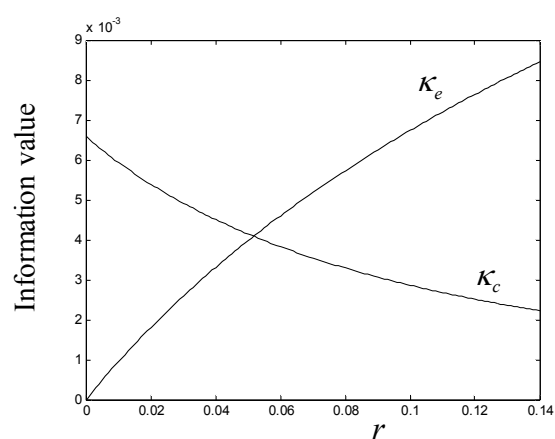


Figure 4. The impact of r on κ_e and κ_c .

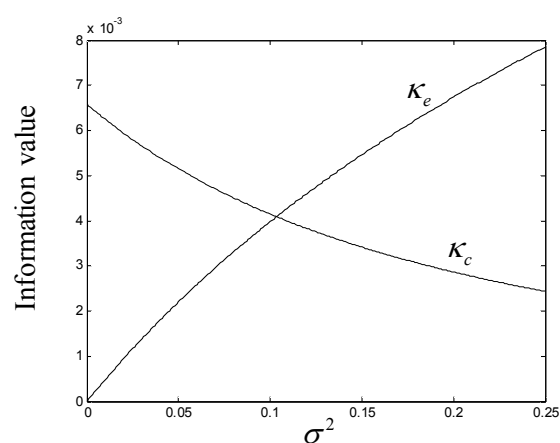


Figure 5. The impact of σ^2 on κ_e and κ_c .

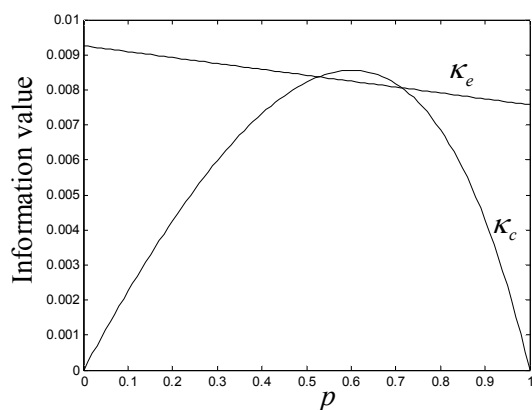


Figure 6. The impact of p on κ_e and κ_c .

Figure 2 and figure 3 illustrate the comparisons as functions of μ and θ_H , respectively. We observe that both the value of capability information and the value of effort information increase in μ and θ_H , a high importance of quality and a high capability level generally lead to high value of information on effort and capability, i.e., high adverse effects of the two asymmetric information risk factors, which shows that when the IT service quality is important for the client and the capability of the service provider is high, the client can consider taking measures to reduce the degree of information asymmetry, such as build an organization unit to collect the service provider's capability information and monitor the actions of service provider.

Figure 4 and figure 5 illustrate the comparisons as functions of r and σ^2 . We observe that while the value of effort information is increasing with r and σ^2 , the value of capability information is decreasing with them. The first factor of asymmetric information risk (the asymmetric effort information) is significantly more important than the second factor (private capability information) when the degree of risk aversion of the service provider and the uncertainty of quality is high, and the second factor of asymmetric information risk is more pronounced when the degree of risk aversion and quality uncertainty is low. These findings suggest that with low degree of risk aversion and quality uncertainty, the client ought to sign an expensive comprehensive contract containing detailed capability information of the service provider but unnecessary to strictly monitor the action of the service provider. Figure 6 illustrates that κ_e is monotonically decreasing in p , that is, as the proportion of low-capability type service provider increase, the value of effort information is decreasing, which indicates that when most service providers are belonging to high-capability type, the client can invest in monitoring mechanism to get the service provider's effort information. Note that the impact of p on the value of capability information κ_c is inconsistent with the result of κ_e , κ_c is concave in p , and its maximum value is obtained when p near 0.5, which is the maximum uncertainty level of the client's judgment. As the client's judgment of service provider becomes more and more accurate, that is, p is closer to 0 or 1, the value of capability information decreases. In the extreme, when $p = 0$ or $p = 1$ (this means that the client know clear what the type of the service provider is, i.e., for the client, there is no uncertainty of capability type), the value of κ_c reduces to zero. The above analysis indicates that when the portion of the two types of service provider in the outsourcing market is almost the same, the client suffers large loss due to asymmetric capability information, but when most service providers belong to one type, not knowing the service provider's capability information does not cause a large reduction in the client's profit.

5 CONCLUSIONS

The client firm may lack the information about the service provider's private capability and the effort exerting on the IT outsourcing service project. Depending on the verifiability and contractibility of the service provider's effort and capability information, we consider three information scenarios and analyze contracts for each scenario. Specially, a moral hazard model under asymmetric effort information and an adverse selection model under asymmetric quality cost information are proposed, and we characterize the optimal contracts that mitigate the asymmetric information risk. Also, we quantify and compare the two

asymmetric information risk factors' impact the client's expected profits, i.e., the value of effort information and the value of capability information. Our research results offer the following managerial insights:

First, our results provide useful insights on incentive contract design in different information settings. When both effort information and capability information are symmetric, the client firm only need to provide the fixed payment to the service provider because she can make the decision of effort choice for the service provider. When the effort information is asymmetric, she can not make the decision of effort choice for the service provider, due to the opportunism behavior of the service provider, she should provide a incentive payment to induce the service provider to exert effort, also she need to make the trade-off between incentive and insurance, because of the quality uncertainty risk, she need to pay an insurance for the service provider, that is, the fixed payment. When the capability information is asymmetric, compared to the symmetric capability information, for screening the types of the service providers, the client provides information rent for the high-capability service provider, to reduce this rent, the client distorts the low-capability service provider per-unit incentive payment. With regard to the fixed part of the payment, we can see in the scenario where both the effort information and capability information are symmetric, the service provider's fixed payment are constituted by her reservation profit and compensatory for her effort, but in the scenario where the effort information is asymmetric (scenario 2), because the service provider shares risk of uncertainty, the client provides risk compensation for him. Under asymmetric capability information, in order to ensuring the service provider chooses the different contract, the client adds information rents in the fixed part of payment.

Second, our results point out conditions under which the client should pay attention to the risk of information asymmetry and provide effective guidance for making the trade-off between the information value and cost of acquiring information. We find that both the value of capability information and effort information increases in the quality sensitivity and the capability level, but with regard to the degree of risk aversion of the service provider and the uncertainty of quality, they show contrary results, the value of capability information decreases in the degree of risk aversion and uncertainty of quality while the value of effort information increases in them. Furthermore, we find that the ex ante belief about the service provider's cost type has important influence on the value of capability information. In summary, with high capability of service provider, high importance of the IT service quality, high risk aversion of the service provider and high uncertainty, the adverse effects of asymmetric effort information are high, the client can take measures to obtain effort information, such as investing in monitoring and coordinating mechanisms and introducing hierarchical governance structure. With high capability of service provider, high importance of the IT service quality, high uncertainty of the judgment related to the service provider's type, but low degree of risk aversion and quality uncertainty, the adverse effects of asymmetric of capability information are high, the client can take actions to acquire the service provider's private capability information, such as writing comprehensive request for information (RFI), term sheet and request for proposal (RFP), and carrying out in-depth investigations of the service providers' capability information including business experience, management capability and technical capability, and auditing the service provider by internal or external experts.

If the cost of activities reducing the adverse effects of the two asymmetric information factors is extremely large, the client can consider building strategic partnership with his service provider. A strategic partnership contains provisions for sharing risks and rewards associated with outsourcing, and aliens goals of the client and the service provider (Klepper and Jones, 1998), hence under strategic partnership the service provider would like to sharing information and the adverse effects of asymmetric information can be mitigated even can be eliminated. Saunder et al. (1997) argues that partnership arrangements are more successful than pure supplier relationships. However, viewing a relationship as a partnership can be dangerous because it may lead to a loose contract, in part because the client thinks of the outsourcing vendor as a partner when in fact he is not.

Consequently, the possibility for "opportunistic behavior" by the vendor exists (Lacity and Hirschheim, 1993). So there needs to be a careful consideration before utilize the partnership. And the results of our research can contribute to helping the client in deciding whether to build strategic partnership by comparing the value of information and potential risk of strategic partnership. Future research could analyze the contracting dynamics arising in the environment of repeated games between the client firm and the service provider, and consider the new foundation for the theory of incentive contracts, such as relational contracts. Another one is to study the impact of the service providers' growing power. To model this change, one may analyze a relationship in which the service provider offer the contract. Finally, empirical investigation of the asymmetric information risk factors discussed in this article is also a promising research.

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APPENDIX A Proof of Proposition 1

Noting that the reservation constraint, Constraint (2), must bind, we can substitute it into the objective function, giving us an unconstrained optimization problem:

$$\max_{\beta, e} \pi_c = \mu\theta e - \frac{1}{2}e^2 - \frac{1}{2}r\beta^2\sigma^2 - \pi_R. \quad (\text{A1})$$

Equation (A1) indicates that we have transformed our problem into a joint expected profit maximization problem. The first-order condition for (A1) is $\partial\pi_c / \partial e = \mu\theta - e$ and the second-order condition for (A1) is $\partial^2\pi_c / \partial e^2 = -1 < 0$. Therefore, the objective function is concave in e and the first-best effort level is $e^{FB} = \mu\theta$. Because $\partial\pi_c / \partial\beta = -r\beta\sigma^2 < 0$, the optimal solution of incentive payment is $\beta^{FB} = 0$. Substitute e^{FB} and β^{FB} into Equations (A1) and (2), we find ϖ^{FB} , π_s^{FB} and π_c^{FB} .

APPENDIX B Proof of Proposition 2

Using standard backward induction, we first examine the service provider's problem in Equation (5). The first-order condition for the problem is

$$\frac{\partial\pi_s}{\partial e} = \beta\theta - e = 0. \quad (\text{B1})$$

The second-order condition for the problem is

$$\frac{\partial^2\pi_s}{\partial e^2} = -1 < 0. \quad (\text{B2})$$

Therefore, the objective function in Equation (5) is concave. From Equation (B1), we get

$$e^* = \beta\theta. \quad (\text{B3})$$

Next, we examine the client firm's problem in Equation (3). Clearly, the participation constraint condition for the service provider must be binding because the client firm can choose the lowest possible fixed payment to maximize π_c . Thus,

$$\varpi = \frac{1}{2}e^2 - \beta\theta e + \frac{1}{2}r\beta^2\sigma^2 + \pi_R,$$

which, after substitution, simplifies the client firm's problem to

$$\max_{\beta} \pi_c = \mu\theta e - \frac{1}{2}e^2 - \frac{1}{2}r\beta^2\sigma^2 - \pi_R.$$

Because the client firm can anticipate the service provider's strategy in designing the optimal contract, we substitute e^* from Equation (B3) into the client's problem and derive the first-order derivative as

$$\frac{d\pi_c}{d\beta} = \mu\theta^2 - (\theta^2 + r\sigma^2)\beta.$$

The second derivative of the client's objective function is

$$\frac{d\pi_c^2}{d\beta^2} = -(\theta^2 + r\sigma^2) < 0.$$

Thus, the client's objective function is concave, solving $d\pi_c / d\beta = 0$, we get the unique following solution

$$\beta^* = \frac{\mu\theta^2}{\theta^2 + r\sigma^2} \quad (\text{B4})$$

Finally, after substitution, we get

$$\varpi^* = \pi_R - \frac{\mu^2\theta^4(\theta^2 - r\sigma^2)}{2(\theta^2 + r\sigma^2)^2}, \quad \pi_S^* = \pi_R, \quad \pi_c^* = \frac{\mu^2\theta^4}{2(\theta^2 + r\sigma^2)} - \pi_R.$$

APPENDIX C Proof of Proposition 3

$$\frac{\mu\theta^3}{\theta^2 + r\sigma^2} < \mu\theta,$$

it's thus clear that $e^* < e^{FB}$, and the expected quality in this setting with symmetric capability information and asymmetric effort information is lower when compared to the first-best quality.

APPENDIX D Proof of Proposition 4

The proof follows from substituting π_C^{FB} from proposition 1 and π_C^* from proposition 2. From Equation (6), it is easily to prove that $\partial\kappa_e / \partial\mu > 0$, $\partial\kappa_e / \partial\theta > 0$, $\partial\kappa_e / \partial r > 0$ and $\partial\kappa_e / \partial\sigma^2 > 0$.

APPENDIX E Proof of Lemma 1

From Equation (7), we have

$$\partial(f(\beta_2, \theta) - f(\beta_1, \theta)) / \partial\theta = \theta(\beta_2^2 - \beta_1^2) > 0, \text{ for } 0 < \beta_1 < \beta_2 \leq \mu.$$

APPENDIX F Proof of Proposition 5

Noting that lemma 1 implies $f(\beta_L^*, \theta_H) - f(0, \theta_H) > f(\beta_L^*, \theta_L) - f(0, \theta_L)$. Adding ϖ_L^* to both sides, we get

$$f(\beta_L^*, \theta_H) - f(0, \theta_H) + \varpi_L^* > f(\beta_L^*, \theta_L) - f(0, \theta_L) + \varpi_L^*. \quad (\text{F1})$$

According to Equation (11) and Equation (F1), we have

$$f(\beta_H^{**}, \theta_H) + \varpi_H^{**} - f(0, \theta_H) \geq f(\beta_L^{**}, \theta_H) + \varpi_L^{**} - f(0, \theta_H) > f(\beta_L^{**}, \theta_L) + \varpi_L^{**} - f(0, \theta_L) \geq 0,$$

thus, Constraint (9) is redundant. Constraint (10) is binding at optimality, otherwise, decreasing both ϖ_H and ϖ_L by the same amount would increase the client's expected profit while not affecting Constraints (9), (11) and (12). Constraint (11) is binding, otherwise, decreasing ϖ_H by a small amount would increase the client's expected profit while preserving Constraint (11), and not affecting Constraint (10) and (9). From binding Constraints (10) and (11), we get

$$\varpi_L^{**} = \pi_R - f(\beta_L^{**}, \theta_L), \quad (F2)$$

$$\varpi_H^{**} = \pi_R - f(\beta_H^{**}, \theta_H) + f(\beta_L^{**}, \theta_H) - f(\beta_L^{**}, \theta_L). \quad (F3)$$

Substituting Equations (F2) and (F3), the Constraint(12) becomes

$$f(\beta_H^{**}, \theta_H) - f(\beta_L^{**}, \theta_H) \geq f(\beta_H^{**}, \theta_L) - f(\beta_L^{**}, \theta_L). \quad (F4)$$

According to lemma 1, this constraint is satisfied. Thus, Constraint (12) is redundant at optimality. Substitute Equations (F2) and (F3) into Equation (8), the service provider's objective becomes

$$\begin{aligned} \max_{\beta_H, \beta_L} E[\pi_c] = & (1-p)[(\mu - \beta_H)\theta_H e_H + f(\beta_H, \theta_H)] + p[(\mu - \beta_L)\theta_L e_L + f(\beta_L, \theta_L)] \\ & - (1-p)[f(\beta_L, \theta_H) - f(\beta_L, \theta_L)] - \pi_R. \end{aligned} \quad (F5)$$

Because the client firm can anticipate the service provider's effort level, we substitute $e_H = \mu\beta_H\theta_H$ and $e_L = \mu\beta_L\theta_L$ into Equation (F5) and derive the first-order derivatives as

$$\frac{\partial E[\pi_c]}{\partial \beta_H} = (1-p)[\mu\theta_H^2 - \beta_H(\theta_H^2 + r\sigma^2)],$$

$$\frac{\partial E[\pi_c]}{\partial \beta_L} = p[\mu\theta_L^2 - \beta_L(\theta_L^2 + r\sigma^2)] - (1-p)\beta_L(\theta_H^2 - \theta_L^2).$$

The second-order derivatives are:

$$\frac{\partial^2 E[\pi_c]}{\partial \beta_H^2} = -(1-p)(\theta_H^2 + r\sigma^2) < 0,$$

$$\frac{\partial^2 E[\pi_c]}{\partial \beta_L^2} = -p(\theta_L^2 + r\sigma^2) - (1-p)(\theta_H^2 - \theta_L^2) < 0.$$

Therefore, the optimal solution is unique, solving $\partial E[\pi_c] / \partial \beta_L = 0$ and $\partial E[\pi_c] / \partial \beta_H = 0$, we get

$$\beta_H^{**} = \frac{\mu\theta_H^2}{\theta_H^2 + r\sigma^2}, \quad (F6)$$

$$\beta_L^{**} = \frac{\mu\theta_L^2}{\theta_L^2 + r\sigma^2 + T}. \quad (F7)$$

Where $T = ((1-p)/p)(\theta_H^2 - \theta_L^2)$

Compared β_H^{**} and β_L^{**} to β_H^* and β_L^* , we can easily see that $\beta_H^{**} = \beta_H^*$ and $\beta_L^{**} < \beta_L^*$. Then we substitute β_H^{**} and β_L^{**} into Equations (F2) and (F3), the solution of ϖ_L^{**} and ϖ_H^{**} can be obtained. We then substitute β_H^{**} and β_L^{**} into $e_H = \beta_H \theta_H$ and $e_L = \beta_L \theta_L$, e_H^{**} and e_L^{**} can be obtained. $\pi_{S_H}^{**}$ follows from Equations (7), (F3) and (F6). $\pi_{S_L}^{**}$ follows from Equations (7) and (F2).

Finally we substitute β_L^{**} , β_H^{**} , e_L^{**} , e_H^{**} , Equations (F2) and (F3) into $\pi_{C_H} = (\mu - \beta_H)\theta_H e_H - \varpi_H$ and $\pi_{C_L} = (\mu - \beta_L)\theta_L e_L - \varpi_L$, then $\pi_{C_H}^{**}$ and $\pi_{C_L}^{**}$ can be obtained.

APPENDIX G Proof of Proposition 6

From proposition 4, the proof of this proposition is straightforward and thus can be omitted.

APPENDIX H Proof of Proposition 7

Comparing the results in this setting with the symmetric capability information and asymmetric effort information results, it is clear to see that

$$e_L^{**} < e_L^*, \quad e_H^{**} = e_H^*. \quad (H1)$$

$$\pi_{C_L}^{**} < \pi_{C_L}^*, \quad \pi_{S_L}^{**} = \pi_R = \pi_{S_L}^*. \quad (H2)$$

$$\pi_{C_H}^{**} = \pi_{C_H}^* - \Delta R, \quad \pi_{S_H}^{**} = \pi_{S_H}^* + \Delta R. \quad (H3)$$

Where ΔR denotes information rent of high-capability service provider, the value of ΔR is given by

$$\Delta R = \pi_{S_H}^{**} - \pi_{S_H}^* = \frac{\mu^2 \theta_L^4 (\theta_H^2 - \theta_L^2)}{2(\theta_L^2 + r\sigma^2 + T)^2}. \quad (H4)$$

Appendix I Proof of Proposition 8

The value of information of service provider's capability arises as the difference between the client's expected payoff under symmetric and asymmetric capability information scenarios, i.e., the difference between the client's expected payoff in scenario (2) and scenario (3). Let $\pi_{C_L}^*$ and $\pi_{C_H}^*$ denote the client's profit in the setting of symmetric capability information and asymmetric effort information, with a low-capability and high-capability service provider, respectively. From proposition 2, $E[\pi_C^*]$ is given by

$$E[\pi_C^*] = \frac{\mu^2}{2} \left[\frac{p\theta_L^4}{\theta_L^2 + r\sigma^2} + \frac{(1-p)\theta_H^4}{\theta_H^2 + r\sigma^2} \right] - \pi_R. \quad (11)$$

From proposition 5, $E[\pi_C^{**}]$ becomes

$$E[\pi_C^{**}] = \frac{p\mu^2\theta_L^4(\theta_L^2 + r\sigma^2 + 2T)}{2(\theta_L^2 + r\sigma^2 + T)^2} + (1-p) \left(\frac{\mu^2\theta_H^4}{2(\theta_H^2 + r\sigma^2)} - \frac{\mu^2\theta_L^4(\theta_H^2 - \theta_L^2)}{2(\theta_L^2 + r\sigma^2 + T)^2} \right). \quad (12)$$

From Equations (11) and (12), we obtain the value of capability information as

$$\kappa_c = E[\pi_C^*] - E[\pi_C^{**}] = \frac{p\mu^2\theta_L^4T^2}{2(\theta_L^2 + r\sigma^2)(\theta_L^2 + r\sigma^2 + T)^2} + \frac{(1-p)\mu^2\theta_L^4(\theta_H^2 - \theta_L^2)}{2(\theta_L^2 + r\sigma^2 + T)^2}. \quad (13)$$

From Equation (13), we can easily prove that $\partial\kappa_c / \partial\mu > 0$, $\partial\kappa_c / \partial r < 0$, $\partial\kappa_c / \partial\sigma^2 < 0$ and $\partial\kappa_c / \partial x > 0$.

Heterogeneity Based Solvers' Segmentation In Crowdsourcing

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ABSTRACT

Multiple facets of factors were examined to be drivers for crowdsourcing intention. However, there is limited research that has studied whether this factors-intention link is uniform for all solvers or not in detail. In fact, the present studies have identified three different segments that are internally consistent and stable. The comparison between the results of two different solutions, single-class and prediction-oriented-segmentation, confirms the existence of unobserved solver segments. The three established segments are "Self-leading solvers", "External-driving solvers" and "Dual-driving solvers". These results point the way for factors-based segmentation in intention initiatives and reflect the importance of a multidimensional conceptualization of factors, comprising motivation, perceived sponsor's and platform's support components. The paper expands and deepens the application of the heterogeneity theory in the study of crowdsourcing usage behavior and offers implications for organizers to recognize the solvers more clearly and get directions for more valid strategies.

Keywords: Crowdsourcing, Solvers, Participation Intention, Heterogeneity Theory.

INTRODUCTION

Growing businesses face a large set of problems, such as improving the innovation performance while at the same time reducing the costs, using the collective intelligence effectively. To overcome these challenges, opening up their innovation activities to crowds has been viewed as a genuine opportunity for companies. With the development of internet and the improvement of consumers' capacity to acquire knowledge, this solution becomes a reality. Recently, a new model for problem solving, defined by Jeff Howe as crowdsourcing[22], has gained substantial interest in the practice and literature.

The vast majority of research on crowdsourcing has found that groups are remarkably intelligent and often smarter than the smartest people in them[33]. Page [28] points that the problem benefits by having a number of individuals from cognitively diverse perspectives offering their solutions, even if those individuals are not themselves experts. Accordingly, in order to continue applying the crowdsourcing model, a coherent set of conditions for making a successful crowdsourcing arrangement is needed. This involves understanding the factors that influence the crowd to participate in these creative problem-solving activities. With some existing research findings begin to explain the factors that induce high level of intention to participate in crowdsourcing[2][26] [29][34][36][42], however, only a few studies have explicitly accounted for the role of heterogeneity in the cognition of solvers on the importance of these factors. Additionally, an aggregate analysis of factors and its relation to intention may result in misleading parameter estimates and target-lacked strategies.

Against this background, the present study examines the factors contributing to high intention from the angles of solvers, sponsor and platform through a series of online questionnaire surveys. Furthermore, this study adds examinations on unobserved heterogeneity regarding the factors-intention link for the purpose of solver segmentation, a needed supplement to the existing quantitative portrait on crowdsourcing. The segments we identify differ regarding their perceived important factors and associated effects on intention towards the crowdsourcing participation.

The present study will be beneficial to scholars and managers. Factors summarized from the integration of three perspectives bring implications for future research. The application of heterogeneity theory in the area of crowdsourcing expands a new insight into the intriguing landscape of existing data on factors in crowdsourcing generally. Knowledge regarding different solver groups will help crowdsourcing organizers tailor more targeted and effective incentives. Furthermore, determining which factors drive high intention will be helpful for organizers to develop solvers attraction programs. This study also contributes to the study of unobserved heterogeneity, which is still an under-research area.

CONCEPTUAL BACKGROUND AND MODEL DEVELOPMENT

In this section, the theoretical framework that guides the empirical study is discussed. The literature on solver heterogeneity and the practicability of segmentation based on the factors-intention link and the empirical methods adopted for this research are introduced in detail.

Prior Literature On Solver Heterogeneity

The conception of heterogeneity has drawn a substantial of attention in the area of consumer behavior. Smith [30] is the first author who has pointed the importance of market segmentation. He made an assumption that a heterogeneous market was consisted of a number of smaller homogeneous markets with different preferences. Since its introduction, the heterogeneity has become a hot concept in both marketing theory and practice. Many works have discussed the segmentation based on various factors, focusing on the demographic characteristics as well as life-style, personality and usage information[17]. However, the work of segmentation based on these obvious variables would be easy to understand and determine, but might not provide the best explanatory power. As a consequence, many scholars realized the need to recognize the role of heterogeneity on the customer perceptions and expectations in order to develop firm strategies [13]. Similarly, Blasco,

Velazquez and Saura [5] estimated the effect of customer heterogeneity on the relationship satisfaction-loyalty and obtained the result that there had been three latent segments where the strength of causal relationships differed. They pointed that there was an overestimation of the impact of customer satisfaction on loyalty and the enterprises might fall into the trap of satisfaction if heterogeneity were ignored. Floh et al. [17] used the finite mixture analysis based on the perceived value-loyalty intentions link and recognized three classes of customers: rationalists, value maximizers and functionalists. They pointed that perceived value influenced behavioral intentions, but the effects differed in magnitude depending on the consumer segment.

In the application of crowdsourcing, the heterogeneity of solvers has also been recognized. Boudreau and Lakhani [6] discussed the best form of crowdsourcing for a given situation and pointed that a well-functioning crowd was loose, decentralized and varied in skills, experience and perspectives. In the opinion of Brabham [8], diversity of crowd in gender, sexuality, race, nationality, economic class, etc. were important because these unique identities shaped their worldview. Crowd was better at producing differing superior solutions because the ideas might consider the unique needs of diverse constituencies. Lakhani and Wolf [25] used the k-means cluster analysis to figure out whether there were any natural groupings of individuals by motivation type. They identified a four-cluster solution with the best balance of cluster size, motivational aggregation, stability and consistency. They made a clear conclusion that the F/OSS community had heterogeneous motives to participate and contribute.

In general, extant researches account for the solvers' heterogeneity from the perspective of demographic information and motivation. There is limited research that has considered the effect of influencing factors on participation intention. In other words, prior work has identified solver segments based on motivation factors while the effect of above and other factors have been neglected.

The Influencing Factors-Participation Intention Link

Participation intention

Intention is used to express how much effort an individual is willing to exert in order to perform the intended behavior [1]. In the context of crowdsourcing, the "participation intention" is defined as 'the behavior intention of a solver who expects to participate in the crowdsourcing activities and the subjective probability of solver's exposure to the problem-solving situation' [27]. Factors affecting the participation intention can be summarized from the angle of process. According to Howe [22] and Brabham [9], the process of crowdsourcing starts from companies operating problems or challenges to the crowd based on broadcasting. Individuals in the crowd offer solutions to these problems. In the end, while the individual providing the winning solution is rewarded some form of a bounty, often in cash, the companies take these ideas into exploitation and sometimes profit by selling finished products back to the crowd. For solvers, contacting aspects involved in the process are the developer itself, the task and platform. So, except for solvers' motivation, the sponsor and platform can also be drivers.

Extrinsic motivation and intrinsic motivation

Drawing upon the works of Deci, Koestner and Ryan [12] and Zheng, Li and Hou [41], extrinsic motivation was defined as the motivation to work for something apart from and external to the work itself, such as reward or recognition from other people. Intrinsic motivation indicated the motivation to participate in an activity for its inherent satisfactions rather than for some separable consequences. When intrinsically motivated, people would act for fun or challenges entailed rather than pursuing external products, pressures or rewards [12]. In early studies, solvers' motivation research focused on the area of open source software projects. Sub dimensions included user need, enjoyment, reputation, developing skills, the love of community, reciprocity, sense of efficacy, vocational development, altruism, etc. [24][25][27].

In the area of crowdsourcing, current research results on motivation give more attention to external interests. Brabham [8] indicated that the desire to make money, to develop individual skills, and to have fun were the strongest motivations for participation at iStockphoto. Another research in Threadless showed that the solvers were motivated by the opportunity to make money, the opportunity to develop one's skills, the potential to take up freelance work, and the love of community at Threadless [7]. Feng and Huang [16] used the grounded theory method to summarize the solvers' motivation of crowdsourcing. They found that solvers' motivation could be divided into intrinsic, extrinsic, and internalized extrinsic motivation and they were mutually reinforcing each other.

Taken together, this discussion suggests that factors in perspective of solvers lie in motivation, including extrinsic and intrinsic motivation. The extrinsic motivation could be explained in two dimensions: external stimulus and personal interests. The two sub dimensions for intrinsic motivation are enjoyment, sense of achievement. This literature and research findings are summarized in the following hypotheses.

Hypothesis 1 (H1). A solver's extrinsic motivation is positively driven by external stimulus (H11) and personal interests (H12), and it has a positive significant effect on the participation intention (H13).

Hypothesis 2 (H2). A solver's intrinsic motivation is positively driven by enjoyment (H21) and sense of achievement (H22), and it has a positive significant effect on the participation intention (H23).

Factors in respect of sponsor

Researches generally recognize that factors in respect of sponsor can be accounted by two dimensions: task design and

sponsor's reputation.

Various explanations suggested to account for the effect of task design on participation have been made by Füller [15] and Zwass [43]. Boudreau and Lakhani [6] indicated that a proper description of problem, appealing prizes and opportunities, a well-prepared scoring system, explicit terms and technical specifications were essential to promote a contest in crowdsourcing. Zheng, Li and Hou [41] suggested that contest autonomy, variety, and analyzability were positively associated with intrinsic motivation, whereas contest tacitness was negatively associated with intrinsic motivation. They found that crowdsourcing contest tasks should preferably be highly autonomous, explicitly specified, and less complex, as well as requiring a variety of skills. Shao et al. [29] argued that higher awards, easier tasks, longer duration and lower competition intensity led to a higher number of solvers. Higher awards, longer duration and higher difficulty level of tasks attributed to higher ability level of winners. In the work of Chandler and Kapelner [10], it was found that the more meaningfully a task had been framed, the more likely to participate the workers been.

Previous studies on sponsor's reputation have shown that the nature of sponsor is of importance to intention and solvers are more willing to trust corporate sponsor [40]. Jones and Leonard [23] suggested that third party recognition had an effect on individual's trust in C2C e-commerce. Similarly, sponsor would increase the security sense and enhance participation intention of solvers by providing the authentication information through the platform [29][42]. Xu and Wang [38] found that the enterprise sponsor who provided adequate authentication information could attract a higher number of solvers. A higher sponsor's credit rating and more seasonable payment led to a higher number of solvers as well as higher ability level of solvers. Additionally, a good image of sponsor can also be an important driver of intention [31].

All these ideas will be summarized in the following hypothesis.

Hypothesis 3 (H3). Perceived sponsor's support is positively driven by task design (H31) and sponsor's reputation (H32), and it has a positive significant effect on the participation intention (H33).

Factors in respect of platform

As defined by Geiger, Rosemann and Fieft [19], platform referred to information systems that assimilated human and computational agents to facilitate the process of outsourcing a task and aggregating ideas from the crowd. In principle, functions embedded in the web-based platform could bring the solvers additional value. Furthermore, for crowdsourcing platform to support these salient functions, a good condition of resources support and website experience have to be in place [19][35].

In the light of Doan, Ramakrishnan and Halevy [14], a good condition of resources support could enhance the capacity of a platform to attract participants, including having an evaluation system to monitor the quality and credibility of the contributions, assuring compensation or reward to the contributors, and maintaining a balance between openness and privacy. Additionally, various examinations have revealed the positive relationship between platform's support and the performance of solvers. Gong, Guo and Fang [20], for example, indicated that the huge amount of available tasks needed a task recommendation system for solvers to find the "right" task to accomplish. Sun et al. [32] showed that the platform environments, reflected by reliability, creativeness, communication mechanism, study behavior among solvers and recommendation, were important drivers to the successful rate of solvers.

Further, the website experience can directly affect the efficiency of completion process. The system's quality, embodied in the web design, operation convenience, platform stability and the validity of the link, plays an important role in participation intention [37]. In addition, the high level of platform's usability can lead to a higher degree of participation [35].

Thus, conditions of platform may influence individual's intention to be a solver. The following hypotheses summarize this argument.

Hypothesis 4 (H4). Perceived platform's support is positively driven by conditions of environmental resources (H41) and website experience (H42), and it has a positive significant effect on the participation intention (H43).

Model Development

Figure 1 shows the conceptual model for this study. The model reveals the above mentioned factors-intention link and helps exploring the moderating role of unobserved heterogeneity in enhancing participation of sponsors and solvers in the crowdsourcing task. This framework integrates research issues at the intersection of work motivation, task seeking and web-based system characteristics. The focus of this research is recognizing the role of heterogeneity in the solvers' cognition of the factors' importance.

Underlying the conceptual framework, four two-order latent variables are established, measured by two one-order latent variables respectively. Except for the participation intention, all the latent constructs are measured in a formative way. This can be justified by examining typical items used in this study.

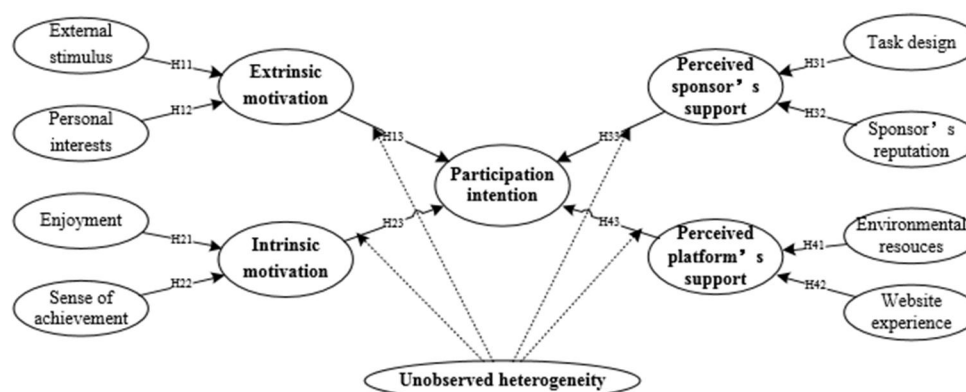


Figure 1: Conceptual model of participation intention in crowdsourcing

METHODOLOGY

Data Collection And Sampling

We test the model shown in Fig. 1 by designing a study that consists of three rounds of investigation. Firstly, we check the face validity of the scales that are adapted from prior validated instruments by inviting many crowdsourcing scholars and managers to discuss and resolve the inconsistency and ambiguities in the formulation.

Secondly, we publish a preliminary survey with a small number of people regardless of their crowdsourcing experience to detect misunderstandings of the items. Subsequently, 162 solvers complete the survey. Based on the pre-survey data, we conduct an exploratory factor analysis with SPSS 19.0 to evaluate the effectiveness of the individual items. Principle component analysis reveals that the model with four two-order variables is better than the one with eight one-order variables. The factor loadings on the intended constructs all are well above 0.575, with no cross-loadings higher than 0.5. The exploratory factor analysis reveals a simple factor structure for this study. The data confirms the multidimensional conceptualization of factors.

Thirdly, a formal online survey is conducted among the people who have attended at least one task at the Witmart (<http://www.witmart.com/>). Witmart is a crowdsourcing contest platform in China which was founded in 2006. By September 1, 2016, there have been 10 million registered solvers and 5 million sponsors. This platform created a 7 billion transaction amount and occupied 80% of the market share in 2015. On this typical platform, we published a task to conduct the survey. In the demand description part, we indicated that the nature of the task was a research project that aimed to explain the difference of solvers' cognition. Participants in the task would get the reward after we have given a pass to their certification of filling in questionnaire. A total of 252 persons participated in the survey. Since only fully completed questionnaires with more than 3 minutes filling time are considered to be valuable in our analysis, the final dataset comprises 239 observations. Sample statistics are shown in Table 1. We can get the features of these participants: young, highly-educated and highly-earned.

Table 1: Sample statistics

Characteristics	Frequency	Percentage	Characteristics	Frequency	Percentage
Gender			Education		
Male	117	49%	High school	33	14%
Female	122	51%	2-3 years of college	67	28%
			4 years of college	126	53%
			Graduate school	13	5%
Age			Income(RMB)		
≤ 18	1	0%	≤ 1000	33	14%
19-25	84	35%	1001-3000	62	26%
26-35	137	57%	3001-5000	74	31%
36-45	17	7%	≥ 5001	70	29%
≥ 46	0	0			

Path Model Estimation And Results Assessment

We choose the PLS approach to model estimation because its formal premise embodies a greater range of flexible applications [21]. Furthermore, the aim of our research is to determine the effect of formative latent factors. Accordingly, the PLS approach is more suitable in this regard. However, since the lack of good-of-fit measures in PLS path modeling, a catalogue of non-parametric criteria is needed to assess partial model structures. At first, model assessment focuses on the measurement models and only if the computed latent variable scores show evidence of sufficient reliability and validity is it worth pursuing the evaluation of inner path model estimates [21]. In accordance with the steps in PLS path model evaluation from outer model to inner model, we use the SMARTPLS 3.0 to the following results.

Assessment of the reflective measurement model

Criteria for reflective measures are composite reliability(over 0.7)[3], factor loadings and average variance extracted (AVE over 0.5). Additionally, for any latent variable, the square root of AVE should be higher than its correlation with any other latent variable[18]. Results show that all factor loadings lie well above the suggested threshold value of 0.7. With a value of 0.745, the AVE is highly satisfactory. The highest correlation value is 0.762, which is lower than the square root of AVE value 0.863. Composite reliability is at 0.921. Accordingly, a high level of reliability exists in our reflective measurement model. Taken together, all the requirements for the reflective measurement model for the endogenous latent variable “participation intention” have been achieved.

Assessment of the formative measurement model

In a well-fitting formative measurement model, all the measurement path loadings should be significant. In addition, the convergent validity should be assessed by creating a reflective factor parallel to the formative factor and the formative factor should be correlated and be able to predict values of the reflective factor[11]. Table.2 shows that all path loadings in the exogenous latent variable’s measurement models are significant [$p < 0.01$, two-side test; the results are obtained by applying a bootstrapping procedure]. All the path coefficients between the eight formative factors and theirs corresponding reflective ones are at 1.00, passing the standard of 0.9. Hence, all the formative measurement models have satisfactory reliability and validity. We also need to check if the level of multi-collinearity is a critical issue. In the formative measurement models, the highest variance inflation factor (VIF) has a value of 2.951, lower than the threshold 4.0. As a consequence, the multi-collinearity does not pose a problem in this study.

Table2: Significance of path loadings

Path	T-value	path	T-value
ES1→External stimulus	15.516	TD1→Task design	13.679
ES2→External stimulus	7.559	TD2→Task design	10.105
ES3→External stimulus	7.231	TD3→Task design	7.058
ES4→External stimulus	14.538	TD4→Task design	7.253
ES5→External stimulus	15.26	TD5→Task design	6.733
PI1→Personal interests	14.061	TD6→Task design	6.803
PI2→Personal interests	16.684	TD7→Task design	10.26
PI3→Personal interests	11.625	SR1→Sponsor’s reputation	2.748
EN1→Enjoyment	11.393	SR2→Sponsor’s reputation	3.442
EN2→Enjoyment	16.478	SR3→Sponsor’s reputation	12.218
EN3→Enjoyment	17.684	SR4→Sponsor’s reputation	9.738
SA1→Sense of achievement	19.514	SR5→Sponsor’s reputation	20.876
SA2→Sense of achievement	15.359		
SA3→Sense of achievement	6.886	ER1→Environmental resources	16.859
SA4→Sense of achievement	11.818	ER2→Environmental resources	17.01
WE1→Website experience	18.6	ER3→Environmental resources	16.844
WE2→Website experience	16.43	ER4→Environmental resources	21.886
WE3→Website experience	14.966	ER5→Environmental resources	21.745
WE4→Website experience	21.194	ER6→Environmental resources	13.002

Hypotheses testing: the structural model

All the hypotheses are tested in PLS with the software SMARTPLS 3.0. The central criterion for the assessment of structural model is the coefficient of determination R^2 . With a value of 0.681, the R^2 of the endogenous latent variable “participation intention” lies at a very satisfactory level, which means that our research model explains 68.1 percent of the variance in participation intention. As shown in Table.3, External stimulus and personal interests have significant effect on extrinsic motivation. Therefore, H11 and H12 are supported. On the other hand, extrinsic motivation is significantly associated with participation intention, which explains H13. Furthermore, H21 and H22 can be confirmed for that we find that both enjoyment and sense of achievement are important drivers of intrinsic motivation. However, H23 is not verified because the intrinsic motivation has no influence on participation intention. The antecedent factors of perceived sponsor’s support and perceived platform’s support are found to be positively related, which highly prove H31, H32, H41, and H42. Both the perceived sponsor’s support and perceived sponsor’s support exert positive effect on participation intention, which verify H33 and H43.

The process of verifying relevant assessment criteria in respect of the PLS approach concludes at this point. Our analysis suggests that all measures used are reliable and valid and the path from intrinsic motivation to participation intention should be deleted. Consequently, we get the correct model (shown in Fig.2) and some implications to explain and increase the participation intention of solvers can be derived from the analysis results.

Table 3: Hypotheses testing

Path	Coefficient	T-value	Hypotheses	Significance level
External stimulus→Extrinsic motivation	0.657	21.995	H11	p<0.001
Personal interests→Extrinsic motivation	0.444	14.374	H12	p<0.001
Extrinsic motivation→Participation intention	0.184	2.347	H13	p<0.1
Enjoyment→Intrinsic motivation	0.531	17.766	H21	p<0.001
Sense of achievement→Intrinsic motivation	0.576	19.938	H22	p<0.001
Intrinsic motivation→Participation intention	0.001	0.016	H23	not significant
Task design→Perceived sponsor's support	0.649	28.017	H31	p<0.001
Sponsor's reputation→Perceived sponsor's support	0.468	17.216	H32	p<0.001
Perceived sponsor's support→Participation intention	0.147	1.733	H33	p<0.1
Environmental resources→Perceived platform's support	0.551	22.842	H41	p<0.001
Website experience→Perceived platform's support	0.516	19.873	H42	p<0.001
Perceived platform's support→Participation intention	0.567	7.176	H43	p<0.001

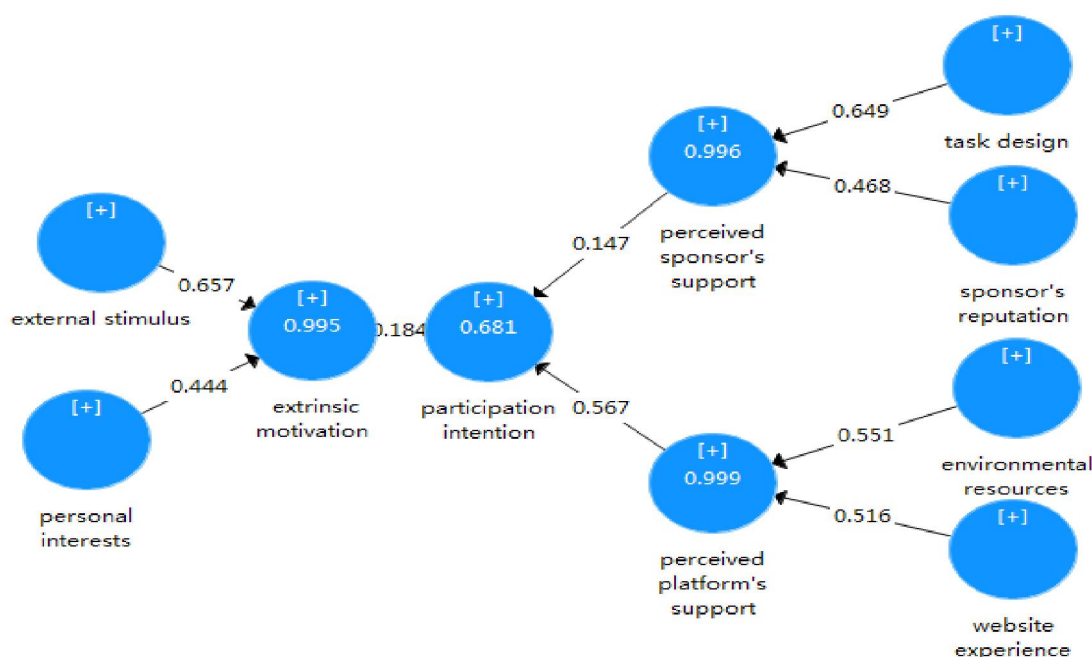


Figure 2: Correct model of participation intention in crowdsourcing

Groups RecognizingBased On Prediction-Oriented-Segmentation

Model estimation

To examine the role of heterogeneity, we selected a prediction-oriented segmentation method. Researches show that the technique is superior to PLS-TPM and REBUS-PLS since (1)an explicit PLS-specific objective criterion has been used to form homogeneous groups; (2) it includes a new distance measure that is appropriate for PLS path model with both reflective and formative measures and is able to uncover unobserved heterogeneity in formative measures; (3) it ensures continuous improvement of the objective criterion throughout the iterations of the algorithm (hill-climbing approach)[4].

Technically speaking, prediction-oriented segmentation method is on the basis of a distance measure, which can identify proper observations to form homogeneous groups. Within a group, there is a norm: the shorter the distance of observationito group g, the higher the predictivity of observationiin group g. Firstly, we should calculate the conceptual difference between observation i's membership in its current group k ($k = g; k, g \in G$)and its distance to an alternative group g ($k \neq g; k, g \in G$). For each endogenous latent variable b($b \in B$), the group-specific prediction of the endogenous latent variable scores (\hat{Y}_{big}) through linear combinations between the latent variable scores of its direct predecessors ($Y_{abik}^{exogenous}$) with the corresponding structural model path coefficients (P_{abg}) is calculated, as shownin Equation 1.

$$\hat{Y}_{big} = \sum_{a_b=1}^{A_b} Y_{abik}^{exogenous} \times P_{abg} \quad (1)$$

Secondly, the difference between the predicted value \hat{Y}_{big} and the current group's latent variable scores Y_{bik} is expressed in Equation 2.

$$e_{big}^2 = (\hat{Y}_{big} - Y_{bik})^2 = (\sum_{a_b=1}^{A_b} Y_{a_bik}^{exogenous} \times P_{a_bg} - Y_{bik}^{endogenous})^2 \quad (2)$$

Thirdly, we can get the new prediction-oriented PLS-POS distance measure by Equation 3.

$$D_{kig} = \sum_{b=1}^B \sqrt{\frac{e_{big}^2}{\sum_{i=1}^{I_k} e_{big}^2}} \quad (3)$$

The smaller the value of D_{kig} , the higher the predictivity of observation in group g . However, calculating the group-specific residual term in models with formative measures requires an extension of the group-specific residual e_{big}^2 in the distance measure, shown in Equation 4. The x_{a_bjik} value of derives from the manifest variable scores and π_{a_bjg} demonstrates the corresponding measurement model's formative weights.

$$e_{big}^2 = (\sum_{a_b=1}^{A_b} \sum_j^J x_{a_bjik} \times \pi_{a_bjg} \times P_{a_bg} - Y_{bik}^{endogenous})^2 \quad (4)$$

Determining the number of groups

Based on the PLS-POS method and correct model, we carry out a series of POS models with $K=2, 3$ segments (we have calculated model solutions with more than 3 groups, but topped since the group size became too small to calculate), to explore the number of groups and group probabilities.

According to Becker et al. [4], the aim of PLS-POS is to maximize the sum of the endogenous latent variable's R^2 values. Table 4 shows the R^2 values for each solution. We select the model with $K=3$ as the final solution for the following reasons: first, the Average Weighted R^2 clearly favors a three-group solution. Second, with the increase of the value of K , most of the R^2 values of each segment presents positive trend.

Table 4: Comparison of R^2 for models with $k=2,3$ groups

Constructs	Original Sample R^2	K=2		
		Average Weighted R^2	POS Segment 1	POS Segment 2
Participation intention	0.681	0.76	0.707	0.941
Extrinsic motivation	0.995	0.993	0.996	0.991
Perceived sponsor's support	0.996	0.997	0.996	0.998
Perceived platform's support	0.999	1	1	1

Constructs	Average Weighted R^2	K=3		
		POS Segment 1	POS Segment 2	POS Segment 3
Participation intention	0.874	0.862	0.857	0.955
Extrinsic motivation	0.995	0.994	0.997	0.992
Perceived sponsor's support	0.996	0.996	0.996	0.998
Perceived platform's support	1	1	1	1

Results

Based on the $K=3$ solution and the estimation of each segment we get the path coefficients results and sample statistics for each segment on the basis of final partition information, presented in Table 5. As a consequence, we find that solvers are heterogeneous and there are three groups of them. In the overall model, three critical direct predictors of participation intention are all shown to be important drivers. However, in the three POS models, the three main coefficients are in stark contrast. Path coefficient value of extrinsic motivation to participation intention is positively significant in group 1 and 3, conversely, negatively related in group 2. Similarly, group 1 and 2 both suggest that the perceived sponsor's support positively associated with participation intention but group 3 shows a different result. Furthermore, perceived platform's support have a strong effect on participation intention in group 2 and 3 but not significantly associated in group 1. These differences also show effect on the explained variance. The R^2 of classes 2 and 3 are significantly higher than that of the single-class solution. In addition, these differences verify the assumption that a homogeneous sample does not hold when measuring the link between factors and participation intention in crowdsourcing.

Table 5: Multi-group results

Path (coefficients)	Group 1	Group 2	Group 3
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External stimulus→Extrinsic motivation	0.7***	0.596***	0.68***
Personal interests→Extrinsic motivation	0.418***	0.465***	0.43***
Extrinsic motivation→Participation intention	0.675***	-0.295***	0.793***
Task design→Perceived sponsor's support	0.626***	0.564***	0.602***
Sponsor's reputation→Perceived sponsor's support	0.494***	0.516***	0.452***
Perceived sponsor's support→Participation intention	0.209***	0.411***	-0.276***
Environmental resources→Perceived platform's support	0.639***	0.629***	0.664***
Website experience→Perceived platform's support	0.415***	0.449***	0.411***
Perceived platform's support→Participation intention	0.134	0.74***	0.591***

Characteristics		Group 1 (97)		Group 2 (107)		Group 3 (35)	
Gender		Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
	Male	48	49%	50	47%	19	54%
	Female	49	51%	57	53%	16	46%
Age							
	≤18	1	1%	0	0	0	0
	19-25	35	36%	37	35%	12	34%
	26-35	56	58%	58	54%	23	66%
	36-45	5	5%	12	11%	0	0
	≥46	0	0	0	0	0	0
Education							
	High school	8	8%	20	19%	5	20%
	2-3 years of college	30	31%	28	26%	9	36%
	4 years of college	56	58%	51	48%	19	54%
	Graduate school	3	3%	8	7%	2	--
Income(Monthly consumption for students)(RMB)							
	≤1000	17	18%	14	13%	2	6%
	1001-3000	18	19%	28	26%	16	46%
	3001-5000	36	37%	29	27%	9	26%
	≥5001	26	27%	36	34%	8	23%

DISCUSSION

Drawing upon an emerging research interest in participation behavior of crowdsourcing (e.g. Shao et al. [29]; Terwiesch and Xu [34]), we have established and examined a research model that tests the factors influencing a solver's participation intention. In addition, we investigate the effect of heterogeneity on the relationship factors-intention and summarize three segments for solvers.

Factors influencing solvers' intention embrace three critical components: extrinsic motivation, perceived sponsor's support and perceived platform's support, consistent with previous studies (e.g., Li and Wang [26]; Wang [36]; Xu and Wang [38]). Furthermore, perceived platform's support is found to have a strongest effect and has an obvious dominant characteristic-regardless of the heterogeneity. The intrinsic motivation is not significantly associated with participation intention. Although this finding contradicts several studies (e.g. Boudreau and Lakhani [6]; Zheng and Hou [40]; Zheng, Li and Hou [41]), we can give some reasonable explanations, gained from later interviews with some solvers. The platform we proposed for data collection questionnaire survey is Witmart. Most of the tasks in Witmart belong to bidding types and the direct result of bid-winning is to get a sum of money. Consequently, solvers are willing to be the member for receiving the bounty when they finish specific tasks, not challenge or a sense of accomplishment and so on.

At the same time, the effect of heterogeneity on the factors-intention link has been verified by identifying the following three groups:

Group 1-Self-leading solvers

Respondents in group 1 give substantially highest weight to extrinsic motivation, and, therefore, are called self-leading solvers. To gain a high willingness to participate crowdsourcing from this group, the fitness between the participation and their own motivation is of predominant importance. In terms of demographic characteristics, they are the youngest and are evenly divided by gender. Most of them have a bachelor degree and belong to middle income class. In summary, the self-leading solvers are stepping into the initial stage of the struggle for life after the undergraduate studies. The reasons for them to be solvers in crowdsourcing are to improve the utilization value of spare time, to flourish personal skills, to learn new knowledge

and to look for new stimulus outside formal work. Activities organized by sponsor and platform have a low attraction to this group. This type of solvers is one of main forces to accede to crowdsourcing participants.

Group 2-External-driving solvers

For members in group 2, in contrast, perceived support of sponsor and platform are both relevant in forming participation intention towards the crowdsourcing task. Hence, members of this class are called external-driving solvers. However, the extrinsic motivation is shown to be negatively related to the participation intention. For this group, the high intention is induced by recommendation of sponsor's and the sense of community or addiction to a brand of a platform. As far as population information, they are women dominated, older, educated and highly-earned when compared to other groups. In summary, external-driving solvers are mature, experienced, rational, skilled and belonging to the higher level of education and income group. The most important reason to participate is to expand the knowledge base and to capture the modern fresh elements. This group represents the largest class in the analysis.

Group 3-Dual-driving solvers

Members in this group concentrate on the extrinsic motivation and perceived platform's support when evaluating the participation intentions towards crowdsourcing, and, therefore, are called the dual-driving solvers. But conversely, perceived sponsor's support is of no influence. This group is more responsive to their own demands and the attraction established by platform. Both inside and outside factors work. They are men dominated and most of them are 26-35 years old. They are experienced, but have a lower level of education and income. In the process, they know more about practices than theories on crowdsourcing. They focus on those tasks that are within their own means to enhance the utilization of spare time and gain a small extra income. These solvers are not the main crowd.

All these differences indicate that the cognition of solvers is of great difference. Assuming a homogeneous sample may provide a misleading view of solvers. Managers should recognize the segments of solvers more clearly and establish more valid strategies.

CONCLUSIONS

Implications For Research

The present study contributes to the literature in several ways. First, this study is one of the first studies considering the heterogeneity of solvers. Previous studies examine the factors-intention link based on the homogeneous assumption, using a model with regression coefficients reflecting merely the 'midpoints' of given factors (e.g. Shao et al. [29]; Zheng and Hou [40]). Our study, however, summarizes specific cognitive and demographic differences among three sub groups. More importantly, the application of heterogeneity reveals some important implications for future crowdsourcing research.

Second, the current study is also one of the first to recognize the dominant player in the crowdsourcing market. Based on the summary of crowdsourcing process, we suggest that except for the motivation of solvers, the sponsor and platform also have effect on solvers' participation intention. Using the exploratory factor analysis, we find eight one-order influencing factors and theirs corresponding two-order variables. The dimensions we examined can pay some useful reference for future researches.

Implications For Practice

The findings of the present study can also highlight some crowdsourcing design elements for organizers. First, the platform is the dominate player of the three in the crowdsourcing market. For companies, a proper platform with high level of popularity and brand attractiveness is an important move to gain sufficient human resources.

Second, solvers are heterogeneous. Companies should deliver targeted signals according to the type of solvers and task characteristics. If there are middle level requirements of skills for a task but financial support is limited, the self-leading solvers are the optimal choice. In the process, organizers should pay attention to pass these signals, including competitive bounty, high level of credit, and flow experience of website and so on. If there are high level requirements of skills and the financial support is adequate, the extrinsic-driving solvers should be attracted. The important signals that should be delivered including utilization of spare time, good image of sponsor, completeness and robustness of the website's basic functions and so on. If tasks are simple but need collective labors based on limited costs, the dual-driving solvers are the ones they need. In the process, organizers should emphasize on utilization of spare time, transparent rules, good reputation and so on.

Limitations And Outlook

Although this study has strengths, some limitations exist here. First, the variable "participation intention" is measured by solvers' perceptions, which can not be treated as equal to the individual's actual participation. Future research may collect objective data about individual's participation and extend the model in the present study to explore the effect of these influencing factors on participation intention and actual participation. Second, the study does not model or empirically test mediating variables, such as trust, satisfaction and so on, which still provides some insights for further studies. Third and finally, to be able to extend the subjects investigated beyond the context of our nation, future research on crowdsourcing is needed. Future studies should comprise subjects with various nationalities and cultural background in order to gain a deeper and more comprehensive understanding of the participate behavior in crowdsourcing.

ACKNOWLEDGEMENT

This work is supported by the Program of National Nature Science Foundation of China under Grant No.71672128.

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Crowdsourcing Based Business Model Innovation and Consumer Engagement

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ABSTRACT

The development of ICT caused changes in business approaches and models as well as various new phenomena such as crowdsourcing, gamification, big data, and internet of things. The present paper provides analysis of crowdsourcing and how it contributes to business model innovation as well as consumer engagement. Based on the analysis consumer engagement dimensions are defined and application opportunities of crowdsourcing in business model context are determined. These constructs are integrated and empirically tested in Lithuanian market defining what is a level of consumer engagement in crowdsourced activities used for business model innovation.

Keywords: business model innovation, consumer engagement, crowdsourcing.

INTRODUCTION

The development of ICT caused changes in business approaches and models as well as various new phenomena such as crowdsourcing, gamification, big data, and internet of things. These phenomena are based on the assumption that ICT use is increasing among companies and consumers and as consequence, consumers will be actively using ICT based solutions. However according to various empirical research the digital environment is characterized by active content use and low consumer engagement in various activities.

Crowdsourcing seems to be attractive to companies as it enables them to delegate various tasks to the large crowd of unidentified people [15]. This approach can be very important to business model innovation as well as for achieving competitive advantage. Recently companies such as Kickstarter, Uber, Kiva, Threadless, Kluster successfully adopted crowdsourcing approach.

As various crowdsourcing platforms appear companies innovating business models are facing two options: to use outside crowdsourcing platforms or to implement crowdsourcing by themselves. Despite of the choice companies face a challenge: how to engage consumers in crowdsourced activities?

Having in mind that both crowdsourcing based business model innovation and consumer engagement concepts are relatively new, the present paper will analyse crowdsourcing and how it contributes to business model innovation as well as consumer engagement. Therefore, the research problem might be formulated as following: what kinds of engagement are facilitated by using crowdsourcing in different business model elements? To answer this question several research objectives will be addressed:

- To provide literature review on crowdsourcing based business model innovation and consumer engagement;
- Empirically assess the level of consumer engagement in crowdsourced activities used for business model innovation.

Research methods

Theoretical background review is based on systematic and comparative analysis of scientific and practical sources. The primary data was collected through an empirical online survey in Lithuania.

CROWDSOURCING

J. Howe introduced term *crowdsourcing* in 2006 [12]. The term was specifically used to describe users' activities for content creation. Web 2.0 technology penetration facilitated content co-creation and consumer generated content growth. [12] described crowdsourcing phenomenon as "the act of a company or institution taking a function once performed by employees and outsourcing it to an undefined (and generally large) network of people in the form of an open call". This definition provided wider perspective compared to terms as *customer made*, *content co-creation* or *user generated content*.

[3] defined crowdsourcing as "an online, distributed problem-solving and production model". In later research [4] defined crowdsourcing as "a strategic model to attract an interested, motivated crowd of individuals capable of providing solutions superior in quality and quantity to those that even traditional forms of business can".

[8] carried out extensive studies of crowdsourcing phenomenon and proposed integrated definition, covering various aspects of crowdsourcing. According to them, crowdsourcing might be defined as "a type of participative online activity in which an individual, an institution, a non-profit organization, or company proposes to a group of individuals of varying knowledge, heterogeneity, and number, via a flexible open call, the voluntary undertaking of a task."

According to [4], there are four crowdsourcing deployment approaches: knowledge discovery and management, distributed

human intelligence tasking, broadcast search and peer-vetted creative production. [8] suggest companies need to consider several important issues before using crowdsourcing within the company:

- Who forms the crowd?
- What the crowd has to do?
- What does the crowd get in return?
- Who is initiator of the crowd?
- What type of process is used to implement crowdsourcing?
- What type of call is going to be used?
- Which medium is used for crowdsourcing?

According to [24] “the concept of crowdsourcing has so far been discussed as enabling new forms of business models”. Business model is widely accepted concept defining companies’ business logic. The *Business Model Canvas* described in [16] is widely used by researchers, consultants and practitioners. Several initiatives were made to identify interrelations between crowdsourcing and business models. [7] proposed Crowd Business model framework which identifies 22 categories of crowdsourcing services and 8 business models. [19] in their research suggested several different types of crowdsourcing based business models: intermediary model, citizen media production model, digital good sale model, collaborative software development model, product design model, peer-to-peer social financing model, consumer report model, knowledge base build model, collaborative science project model. On the other hand, [1] suggested that companies can use value chain concept in order to understand which part of the activities can be crowdsourced.

BUSINESS MODEL INNOVATION THROUGH CROWDSOURCING

The business model concept besides describing generic business logic, helps companies to understand how they can compete in the market and develop competitive advantages. Competitive advantages can be developed internally by using own resources and externally by using resources outside of the company such as partners or consumers. Crowdsourcing is increasingly considered to be a way for engagement of company with external partners, particularly consumers, in order to enhance certain aspect of business model [2].

From perspective of Business Model Canvas [16] 9 business model building blocks must be considered as important. However, not all the building blocks can be aligned with crowdsourcing though some of them already are widely associated with crowdsourcing. Crowdsourcing relates to task undertaking, thus such Business Model Canvas building blocks such as Customer Segments, Key Partners and Cost Structure depend on decision which company makes, but do not refer to a certain process or task to implement this decision. All these building blocks can be heavily affected by crowdsourcing. For instance, users can become *key partners* (e.g. in case of Facebook users are the main content creators / sharers), users can help reach *new segments*, and typically it is expected for crowdsourcing to reduce *costs* [25].

From the point of Revenue Streams building block in Business Model canvas, crowdfunding as a specific case of crowdsourcing might be identified with companies such as Kickstarter, Fundable, IndieGoGo being good examples of such crowdsourcing. From the point of view of other Business Model Canvas building blocks, companies have been already actively using crowdsourcing:

- Users are engaged directly and have the opportunity to contribute solution-based information to innovation processes, which have turned out to be a successful way for the development of new products or services [24]. This refers to Value Proposition building block. Fiat Mio project demonstrated how crowdsourcing of a firm’s product development activities can be implemented.
- Users can act as agents of the company sharing information about company and building brand awareness. Skype successfully crowdsourced marketing activities through viral marketing using users as marketing agents facilitating software spread between users. This refers to Channels building block.

Crowdsourced activities vary and there are many opportunities to engage consumers in company activities for identifying opportunities of business model innovation. Innovation of business model by using crowdsourcing is based on tasks performed by large crowd of unidentified people. Therefore, besides understanding crowdsourcing applicability in business model perspective it is important to gain understanding about consumer engagement: why and how consumers engage with the

company?

USER ENGAGEMENT

The engagement concept has been studied in various disciplines, such as philosophy, psychology, sociology, and political sciences [26]. Recently engagement concept also has been addressed by other social science disciplines such as management, marketing, HRM. Engagement concept refers to “enhanced predictive and explanatory power of focal consumer behaviour outcomes, including brand loyalty” [11].

Engagement subjects and engagement objects define the nature of engagement. From the point of marketing discipline researchers aim to understand and to explain consumer behaviour in different situations. In the context of our research, we are trying to understand how engaging are crowdsourcing based business activities.

Although the engagement concept is analysed from perspectives of various disciplines, [6] suggest that the concept of consumer engagement may vary depending on different interpretations of it, and, therefore, suggest three approaches:

- Consumer engagement as a psychological process that leads to the formation of loyalty.
- Consumer engagement as behavioural manifestation from a customer toward a brand/company that goes beyond purchase behaviour.
- Consumer engagement as motivational psychological state.

The dominating area of engagement research is brand engagement. These studies aim to understand why and how consumers engage with brands and many descriptive and qualitative research studies carried out in this area in order to identify potential antecedents and consequences of consumer engagement with brands and brand communities. Such interest is explained by earlier research [9] demonstrating consumer engagement is directly and positively related to satisfaction, trust, affective commitment, loyalty and other relationship constructs. Research also demonstrates significant associations of engagement with self-brand connections and brand usage intentions. These constructs are considered to be the consequences of consumer brand engagement.

Despite the growing interest empirical research on consumer engagement are rare. In the last years research [11] [5] [21] focused on the development of scales of consumer engagement.

Another important research trend is related to the dimensionality of consumer engagement. The two broad perspectives to engagement varies in the research: consumer engagement can be considered to be a unidimensional [10] or multidimensional [5] [11] [21]. The researchers referring to unidimensional view to engagement suggest that one dimension is identified as the dominant one. However, there is no agreement which dimension is dominated one. Some researchers emphasised the importance of cognitive dimension, while others suggest emotional dimension is the most significant one. [11] noted, that that cognitive, emotional and behavioural dimensions are most commonly identified in scientific literature related to consumer engagement studies:

- Cognitive dimension: consumer's level of engagement object related through processing, concentration and interest in specific object (business enterprise, brand, online social network, brand community).
- Emotional dimension: a state of emotional activity also known as the feeling of inspiration or pride related to and caused by engagement object.
- Behavioural dimension: a state of consumer behaviour related to engagement object and understood as endeavour and energy given for interaction.

The multidimensional perspective aims to combine different dimensions in order to represent consumer engagement construct in more detail. The recent research of the engagement concept [21] [17] [18] supported the idea that the conceptual essence of consumer engagement is best revealed by multiple dimensions. Therefore, it can be concluded that consumer engagement is a multidimensional construct defined by cognitive, emotional and behavioural dimensions and it is important to define what dimension plays the dominant role in different crowdsourced business model activities.

RESEARCH DESIGN

As mentioned earlier, paper aims to empirically assess the level of consumer engagement in crowdsourced activities used for business model innovation and Figure 1 depicts overall generic research approach employed in this paper.

To achieve the above aim of research: (1) a quantitative online survey method was chosen for data collection from consumers; (2) qualitative analysis of crowdsourcing activities identified by respondents; (3) mapping crowdsourced activities from (2) and level of consumer engagement based on data gathered from (1). Though survey covered wider array of questions and target populations, only aspects related to research presented in the paper will be discussed in detail.

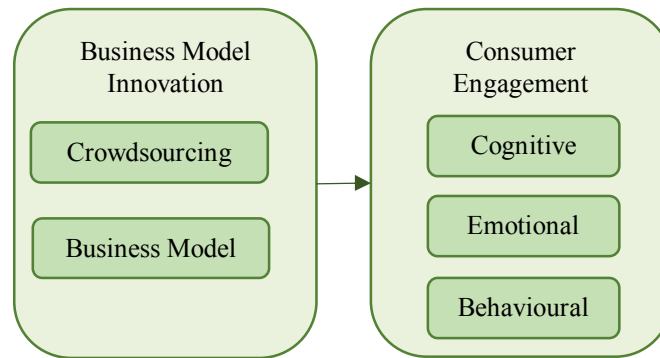


Figure 1: Research model

The research survey consisted of multi-item 5-point rating scales, from 1 meaning “Totally disagree” to 5 meaning “Totally agree”, respectively. A scale of 11 items was used for consumer engagement (based on [21] [11]). The reliability of scales was tested with Cronbach alpha coefficients and tests indicated high internal consistency of developed scales, with the coefficients ranging from 0.870 to 0.943 (see Table 1).

Table 1: Reliability of measurement scales

Scale	No. of items in a scale	Cronbach alpha coefficient
Consumer engagement	11	0.943
Cognitive engagement	3	0.870
Emotional engagement	5	0.908
Behavioural engagement	3	0.911

The target population in this research are people, who are/were engaged in some crowdsourced brand/company activities anytime in the past six months. As mentioned, survey was dealing with wider array of questions, therefore, no specific brands or activities there indicated to respondents. The respondents for this survey were selected by non-probability convenience sampling method.

All the cases for which respondents identified engagement with brands were manually checked and classified. Cases were attributed to ones as crowdsourced activities if respondents indicated that (1) they were actively contributing to some value creation for the brand (i.e. designing a label); (2) indicated a brand that had recently one widely known engaging crowdsourced activity, but no other engaging activities as of recent; (3) did not specify a brand at all but described contributing to some value creation for the brand.

Analysis of the above crowdsourced activities was carried out by identifying the brand and the specific crowdsourced activity. Later was then analysed (if possible) in order to identify which building block of Business Model Canvas [16] it is related most strongly.

For mapping crowdsourced activities and level of user engagement, types of crowdsourced activities were identified for each respondent and comparison of means of each engagement dimension was performed.

RESEARCH RESULTS

Survey was distributed in Lithuania in spring 2015. Total of 750 respondents answered the survey questions. However, only 5.20% engaged in some crowdsourcing activities of some brands or companies. Therefore, data analysis and research results are based on answers from 39 respondents. Respondents who engaged in crowdsourced activities were mostly females (about 82%) and of average age of 29 years.

36 of these respondents indicated specific company or brand they engaged with through crowdsourced activities (see Table 2). 3 respondents described engaging with unspecified brand by contributing to some value creation (i.e. stating “designing a logo for


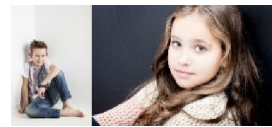

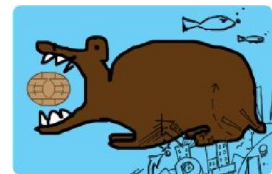

a new company”, “creation of new beer in some brewery”).

Table 2: Crowdsourcing cases identified in the survey data

Code	Company	Brand / product	N	%
C1	UAB “Suslavičius-Felix”	Ketchup “Suslavičius”	27	69%
C2	“FERRERO spa”	“Kinder Chocolate”	3	8%
C3	UAB “SKINIJA”	Socks for children	2	5%
C4	AB “Swedbank”	Youth bank card ZOOM	2	5%
C5	Hesburger	Burger	1	3%
NA	No specific company / brand / product indicated		4	10%

Table 3 summarises the case analysis of crowdsourced activities identified from survey data. As seen from descriptions, consumers in Lithuania are most often engaged in creative tasks crowdsourced by companies (such as designing a label, logo, product, and creating a recipe). This might imply consumers do not find other kind of tasks engaging or do not perceive performance of such tasks as active engagement with companies.

Table 3: Crowdsourcing case analysis

Code	Description	
C1	Users were invited to create a design of a new label for ketchup brand “Suslavičius”. Gamified application was used for design development. 14000 users participated in the activity and company chose 5 designs to be used on the produce. [22]	 <p><i>Ketchup with Selected label designs</i></p>
C2	Users were invited to submit photos of their children to be chosen a new local face of Kinder Chocolate. Selection was made online and one photo of boy (out of 250) and one of girl (out of 335) were chosen [13]	 <p><i>Selected children</i></p>
C3	Company organises annual sock design competition for children. Designs are evaluated by design experts. In ten years over 60000 sock designs created by children were submitted and 55 of them there produced as socks and tights for children. [20]	 <p><i>Socks produced based on some of selected designs</i></p>
C4	Young users of bank cards in the youth program ZOOM of AB “Swedbank” were invited to create design of bank cards. Best design was selected by voting of other program participants. Competition was organised several times since 2008. Winner designs were used for a while on new bank cards issued in the program. [23]	 <p><i>One of selected designs</i></p>
C5	Facebook fans of Hesburger were invited to build new recipe for a burger using gamified application. 2027 recipes there submitted and winner recipe was voted up by 1368 peers and was offered to clients as one of meals in Hesburger restaurants soon after. [14]	 <p><i>Burger with winning recipe</i></p>

Alignment of the identified cases with Business Model Canvas is presented in Table 4. Though theoretical analysis indicated crowdsourcing could be applied in six out of nine building blocks of Business Model Canvas, the cases identified from survey data are most strongly related to three of them: Value Proposition, Key Activities, and Key Resources.

Table 4: Crowdsourcing case mapping with Business Model Canvas

Business model Innovation	Cases	N*
<i>Value Proposition</i> : Ideas for new services or products.	C3, C5	4
<i>Key Activities</i> : Design of product labels, packaging, etc.	C1, C4	30
<i>Key Resources</i> : Human resources (new faces for advertising).	C2	5

* Answers of respondents with unspecified cases were added based on description

Analysis of survey data shows that overall consumer engagement in crowdsourced activities is not high (2.911, meaning below 3 points that meant “neither agree, nor disagree” for statements on multi-item scales used in the survey). However, engagement varies across different engagement dimensions and in different types of crowdsourced activities.

It should be noted, that highest consumer engagement was found for crowdsourcing activities related most strongly to Key Resources building block of business model (3.564). Respondents perceived cognitive engagement most prominently (3.102), while other types of engagement were not recognised as strongly. Level of emotional engagement in crowdsourcing activities related to Value Proposition building block of business models is worth noting as well (3.150). This might be associated with heightened emotional state of consumer who get involved in development of the product rather than just packaging or other external features of product.

Table 5: User engagement in crowdsourced activities

Business model building block		Cognitive	Emotional	Behavior	Engagement
Key Activities	Mean	2.977	2.833	2.522	2.788
	Std. Deviation	0.926	0.935	0.031	0.908
Key Resources	Mean	3.800	3.680	3.133	3.564
	Std. Deviation	0.767	0.889	0.691	0.551
Value Proposition	Mean	3.166	3.150	2.666	3.023
	Std. Deviation	0.333	0.251	0.720	0.343
Total	Mean	3.102	2.974	2.615	2.911
	Std. Deviation	0.895	0.916	0.971	0.860

Low values of behaviour engagement might be due to nature of statements used in multi-item scales in the research. These statements are mostly related to participation in brand community. Though statements show strong internal consistency of scale (see Table 1), crowdsourcing itself typically does not involve participation in brand community, therefore consumers might have valued it down as they did not get as much involved in brand community as in crowdsourced activity itself.

CONCLUSIONS

Crowdsourcing is an increasingly popular way to perform various tasks and business activities. It can be applied for different business functions or business model blocks, such as development of Value Proposition, maintaining of Customer Relations and distribution Channels, Key Resource acquisition and performing Key Activities. Successful application of crowdsourcing could result in business model innovation as well as to gain desired benefits.

As for successful crowdsourcing active consumer engagement is crucial, companies need to understand different types of engagement, such as cognitive, emotional, and behaviour. Theoretical analysis allows us to assume that engagement dimensions might varyingly dominate overall consumer engagement in different context. Therefore, is important to define what dimension plays the dominant role in different crowdsourced business model activities.

Empirical research helped to identify five crowdsourcing cases used in business models of Lithuanian companies that surveyed consumers engaged with. Case analysis of those crowdsourced activities revealed that those are most strongly related to three out of six building blocks of Business Model Canvas, namely Value Propositions, Key Activities and Key Resources. The analysis of survey data indicates that overall engagement in crowdsourced activities is rather low. However, consumers felt most engaged in crowdsourced activities related to Value Propositions and Cognitive Engagement is dominating one out of the three engagement dimensions.

Authors of the paper recognise several limitations of the research presented, such as: small sample of cases analysed and small number of respondents engaged in crowdsourcing activities. This resulted in only three of possible six building blocks of Business Model canvas being analysed. Larger sample and cases covering all six building blocks could provide more conclusive results.

ACKNOWLEDGMENT

The research was supported by ENVISION project funded by EC.

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Real-time Routes Design Research of DIY tour Based on Greedy Algorithm

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ABSTRACT

Compared with group tour, DIY tour is characterized by flexible time arrangements and uncertain routes planning. This paper has mainly employed partial greedy algorithm based on time series in designing real-time routes in DIY tours. As restaurant and accommodation are featured by time window constraint, thus the design is divided into several time partitions in line with 24-hour clock, and each partition has its tour behaviors including sighting, restaurant and accommodation. In each partition and its joint, the paper has availed partial optimal strategy of greedy algorithm so as to complete the overall routes design.

Keywords: DIY tour routes design, real-time, greedy algorithm, partial optimum strategy.

INTRODUCTION

Recently, DIY companion tour has increasingly become the prevailing trend of people's travel mode. However, as the present DIY tour is still at its start-up stage, there are problems such as information asymmetry, inexperienced tourists, and high time cost and so on. Therefore, a tour routes designing system that combines operation modes of traditional travel agencies and DIY tour's advantage of flexibility is in urgent need, so that we can respond to emergencies timely and design optimal routes for DIY tourists. This paper has drawn several time- and multipoint-orientated problems, made choice and combination based on greedy algorithm, and obtained customers' optimal tour routes.

REAL-TIME ROUTES DESIGN FOR DIY TOUR

Determine types of time partitions

Time constitutes the most important limited factor in designing DIY tour routes. To take into account of tourists' food, accommodation and sightseeing, maximum benefit should be achieved in limited time with the premise of meeting all inhomogeneous demands. To ensure real-time performance of tour routes design, tourists' remaining time must be timely counted, so that the corresponding tour activities can be arranged. Therefore, This paper has drawn the chart 1 for time partition of DIY tour and determined specific partition types according to tourists' tour periods.

If the tour period starts from 9 am. to 6 pm., then the corresponding time partition type is $S_1-R_1-S_2-R_2$. If from 1 pm. to 10 pm., then $S_2-R_2-S_3-A$. If from 8 am. to 3 pm., then $S_1-R_1-S_2$. And so the rest.

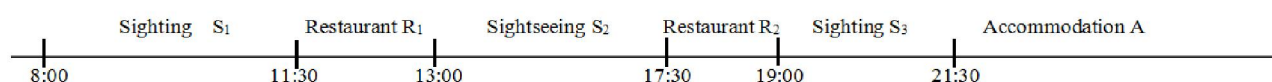


Chart 1: Time partition chart for DIY tour

Referent indexes in designing DIY tour routes

The design of DIY tour routes is a personalized recommendation based on tourists' status. This paper has drawn several time- and multipoint-orientated problems and guided the design by partial optimum principle of greedy algorithm. In the design, The paper has included rigid and flexible indexes as referent indexes. Rigid index is also named determined index, which plays an irreplaceable part in routes design, such as sightseeing period, start place, transportation, destinations (scenic spots, hotels and restaurants). Flexible index is also subsidiary index, which includes tour types, number of tourists, tour budget,

preferable scenic spots, restaurants and accommodations, etc. it provides data sources for DIY tour design.

Table1: Referent indexes in designing DIY tour routes

Type of Indexes	Indexes	Functions
Rigid Indexes	Period	to determine types of time partition
	Start place	to determine the start and ending sites
	Transportation	to obtain time and distance and profit values
	Targeted sites	to determine optimal sites of routes design
Flexible Indexes	Tour Types	Recommended sites for food, shelter, sightseeing and shopping
	Budgets	one of important limitations for tourists' travel plan
	Preferable sites	to re-filter certain sites in making choices
	Number of tourists	the optimal choice for scenic spots, restaurants and hotels
.....		

Routes design guided by greedy algorithm

Compared with traditional travel agencies, DIY tour is characterized by flexible time arrangements and uncertain routes planning. The survey analysis has it that DIY tourists pay more attention to satisfaction than completion in the process of sightseeing, which creates the possibility of temporary changes in DIY tour. As for tourists, the biggest problem is to make the optimal choice in case of temporary changes, rather than how to plan the following routes.

Therefore, the paper is targeted at solving problems in line with tourists' psychological demands in the real process of travel. The greedy principle is aimed at dividing the whole process into several procedures, getting access to the target from one initial solution and making partial optimal choices rather than whole- targeted.

DESIGN PROCEDURE FOR GREEDY ALGORITHM

In line with the flexible indexes of routes design, the paper has chosen several assemblies of demand points, obtained the maximum partial profit and get the final complete route according to time partition.

Firstly, according to user's flexible indexes, I have selected several demand points from the database and constituted an assembly S/R/A that complies with user's demand.

Secondly, in accordance with the with the start point and time, every partition should have a corresponding demand point assembly.

Thirdly, when a user has input a pinpoint, figure out if the pinpoint has the maximal yield point, if so, the pinpoint is the partial maximum solution; and if not, the demand point will be the partial maximum solution.

Fourthly, take accord with the ending time of every demand point and set it as the start time of next demand point, repeat the third procedure until time is completely distributed.

Finally, I have designed a tour route that meets users' demands and preferences, and the route is partially optimized. Detailed procedure is showed in chart 2.

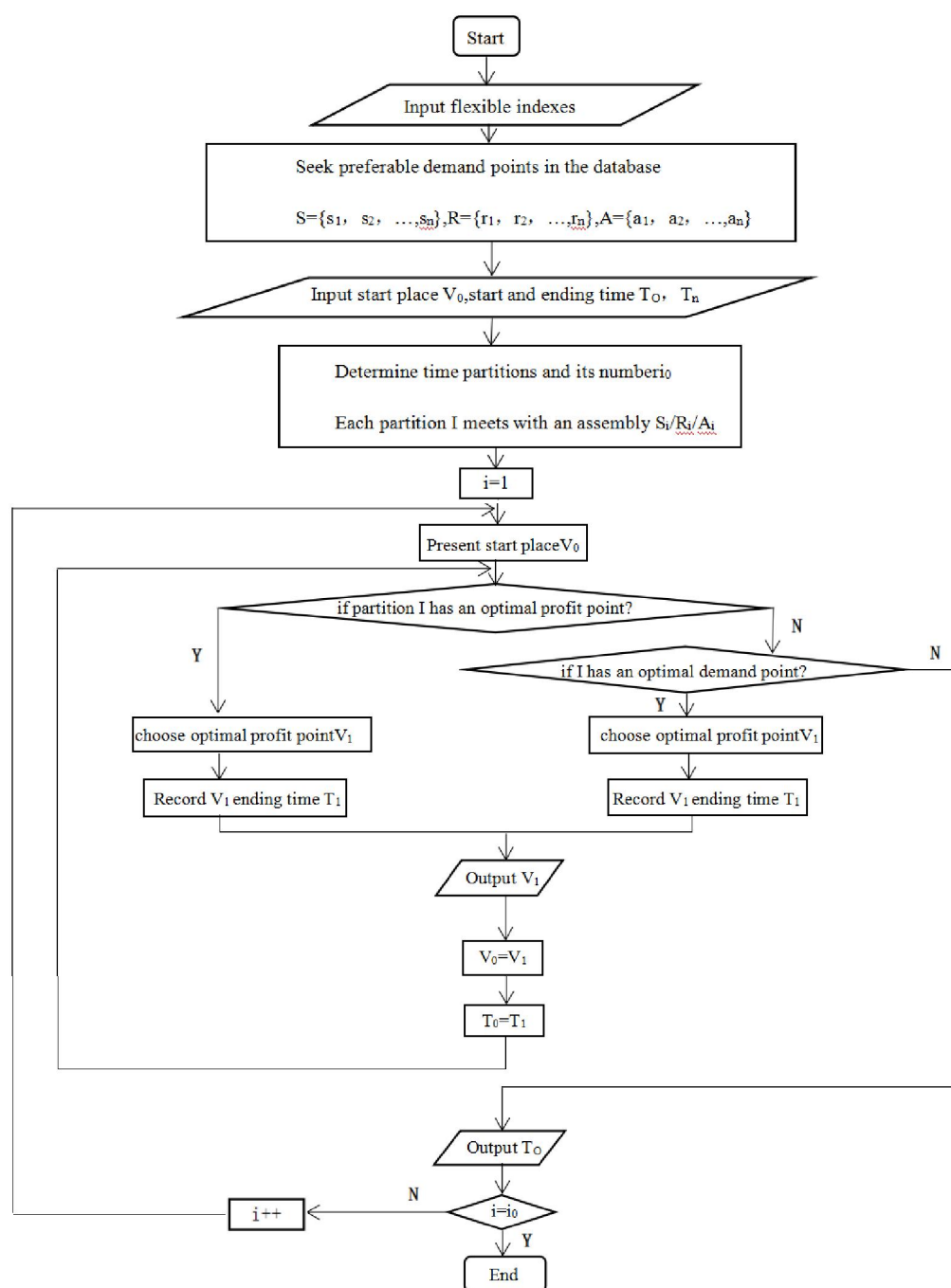


Chart 2: Algorithm procedure of DIY tour routes design

EXAMPLES OF VERIFICATION

This paper has employed simulated case in analyzing the implication of greedy algorithm in tour routes design.

Assuming that a tourist's tour demand is: tour period starts from 8 am. to 1 pm.(time partition S_1-R_1), start place is V_0 , targeted scenic spot is s_4 . According to the flexible indexes, the paper has obtained a assembly of scenic spots and restaurant, $S=\{s_1, s_2, s_3, s_4, s_5, s_6\}$, $R=\{r_1, r_2, r_3\}$. The time intervals for each demand points are as table 2, recommend level and service time are positively correlated as table 3. The latency time among demand points are omitted.

Table2:Start and end place and time intervals for each demand points (unit: hour)

	V ₀	s ₁	s ₂	s ₃	s ₄	s ₅	s ₆	r ₁	r ₂	r ₃
V ₀	0	0.5	0.6	0.2	0.6	1.0	0.8	0.3	0.9	1.5
s ₁	0.5	0	0.8	1.0	1.2	1.2	2.0	0.2	1.8	2.5
s ₂	0.6	0.8	0	0.5	1.8	1.6	1.0	0.2	1.0	3.0
s ₃	0.2	1.0	0.5	0	0.5	0.8	0.3	0.3	0.5	1.2
s ₄	0.6	1.2	1.8	0.5	0	0.2	0.7	0.6	0.3	0.4
s ₅	1.0	1.2	1.6	0.8	0.2	0	2.0	1.4	0.5	0.3
s ₆	0.8	2.0	1.0	0.3	0.7	2.0	0	1.2	0.4	2.0
r ₁	0.3	0.2	0.2	0.3	0.6	1.4	1.2	0	1.4	2.2
r ₂	0.9	1.8	1.0	0.5	0.3	0.5	0.4	1.4	0	0.5
r ₃	1.5	2.5	3.0	1.2	0.4	0.3	2.0	2.2	0.5	0

Table3:Recommend level and service time for each demand point (unit: hour)

Demand point	Recommend level	Service time
s ₁	8.5	0.8
s ₂	7.0	1.0
s ₃	8.6	0.8
s ₄	8.0	1.0
s ₅	6.5	0.5
s ₆	9.3	1.0
r ₁	8.5	1.0
r ₂	7.8	0.8
r ₃	9.5	1.2

In line with the partial optimal principle in tour routes design, this tourist starts from V₀, determines the first scenic spot s₄ and finish sightseeing at 9:36 am., with 1.9 hour surplus time. In terms of time limitation, (sightseeing time + service time ≤ surplus time). The alternate scenic spots include s₃, s₅ and s₆, obtain their per unit time profits and choose the maximum one as s₄. As per unit time profit is satisfaction / (sightseeing time + service time), thus s₆ gets the optimal per unit time profit. The corresponding time is 10:48 and surplus time is 0.7 hours. As there is no follow-up scenic spot meets the time limitation, thus it transits to next time partition. Dinning hour remains 2.2 hours, alternate demand point are r₁、r₂, likewise, the per unit optimal time profit of r₁ and r₂ are 3.86 and 6.5, thus r₂ is the ideal restaurant. As a whole, the overall tour route is completely designed and the targeted design is perfectly completed within every time partition.

CONCLUSION

The research on real-time DIY tour routes is based on the greedy algorithm and is aimed at partial optimum all along the whole process. Its top advantage is easy to complete, it need not backtrack and thus avoids deadlocks. It is only based on the present situation and thus conforms to the balance of speed and profit and gives full play to its advantage. The time partition principle based on sequence effectively solves the problems of diversified demands in DIY tour, so that achieves the optimal partial profit.

However, we should not lose sight of the following disadvantages. Firstly, with regard to fixed point assemblies, the paper has simply used principle of prioritizing fixed point and neglected how to ensure maximum profit for per unit time. Secondly, in the last time partition, the paper fails to omit time cost in choosing optimal demand point and thus results in time surplus. As a whole, the DIY tour routes design and its core algorithm are still feasible and ready to refer, because it will provide with new thoughts and methods for DIY tourists in promoting DIY tour.

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ACKNOWLEDGMENT

This work was supported by Natural Science Foundation of Hainan Province (under No. 613154), National Natural Science Foundation of China (under No.51164008).

A Design Science Approach to Improve Adherence on Exercise Plan via Mobile Application Built by ResearchKit Framework

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ABSTRACT

Introduction

In the modern society, mHealth is an increasingly popular concept, which refers to the use of mobile technology to improve health outcomes and healthcare services at a low cost (Martin, 2012). According to Pew Research Center, in 2015, nearly two-thirds of American adults are now smartphone owners. One-fifth of smartphone owners utilize mobile apps to track or manage health (Fox and Duggan 2012).

With the advance of science and technology, the growing number of applications are developed for self-managed health project. A wide variety of innovative functions are built to help people control diet or sport plan. Those applications provide all sorts of functions or graphical interfaces to assist users record data and keep tracking on their daily report. Currently, low proportion of health-care applications are designed for particular chronic disease group, such as hypertension, type 2 diabetes, coronary heart disease, stroke, osteoarthritis, respiratory problems and so forth. In medical industry, chronically ill patients often need more rigorous and long-term health control than ordinary people.

In the United State, more than one-third of adults are obese and childhood obesity has become an increasing trend (Ogden, Carroll et al. 2015). The most common chronic disease related to obesity is “diabetes”. In 2012, 29.1 million people or 9.3% of the U.S. population have diabetes and 27.8% of people with diabetes are undiagnosed (National Diabetes Statistics Report, 2014). As a consequence, our research is going to realize the performance of self-managed application on specific chronic disease – diabetes.

According to the best diabetes applications of 2016 from ‘healthline’ website, we can roughly categorize those applications’ main functions into four types.

Data collection

Basically, all diabetes applications provide data collection function as foundation. These types of applications pay more attention on how to analyze user data and how to present it more friendly through gorgeous graphics or spreadsheets.

Diabetic patient social group

These kinds of applications designed for diabetic patient to form social groups with a view to sharing information and exchanging useful experience with each other. It focuses more on social effects.

Directions for diet and sport

Some of diabetes applications give professional suggestion on patients’ recipe and provide suitable exercise guideline for diabetic patients to learn and keep updating the newest information.

Device-oriented

Users are able to purchase device such as blood glucose meter and download related application. Device-oriented diabetic managed applications help patient track record more precisely.

However, motivated effects of application for chronically ill patients in compliance with exercise plan according to doctors’ instruction are more crucial than general public. Currently, less application has devoted to strengthen motivated effects so as to help diabetic patients achieve better performance on self-control plan.

There have been several researches refer to the relationship between personality and performance. Discussions that concern personality as a valid predictor of job performance have flourished ever since Barrick and Mount (1991) conducted a substantial meta-analysis on the same topic. Few researches has studied the impact of personality on health managed performance. The Myers-Briggs Type Indicator or MBTI (Briggs-Myers & Briggs, 1985) is a popular and widely used personality analysis instrument. Accordingly, the objective of the research is to take MBTI test as basis to analyze personality and evaluate motivated effects on self-managed plan through mobile application.

During the design process, the research utilizes design science research methodology described by Peffers (Peffers et al. 2007) to construct a mobile application. Design science is of importance in a discipline oriented to the creation of successful artifacts. In 2015, Apple Inc. has introduced ResearchKit open source framework which allows researchers and developers to create powerful apps for medical research. The ResearchKit framework offers a variety of customizable modules that include a survey engine, visual consent flow, and active tasks. Thus, we are able to better design our iOS mobile application via

ResearchKit framework.

Specifically, the research objective is to examine completion rate which stands for the performance of motivated effects based on different notified messages pushed to people with various personality types, different frequency of motivational messages and feedback impact on individuals. Furthermore, we can develop strategies to improve the effectiveness of exercising motivation applications.

Related Work

In order to investigate effects of different messages on users with different personalities, the research refers to psychological theory describes by C.G. Jung (Jung et al., 1957). The essence of the theory is that much seemingly random variation in the behavior is actually quite orderly and consistent, due to basic differences in how people perceive and judge. To make the theory of psychological types understandable and useful, the Myers-Briggs Type Indicator (MBTI) instrument (Myers and McCaulley 1988) is one of the most widely adapted instrument. The Myers-Briggs Type Indicator (MBTI) is an introspective self-report questionnaire. It is a useful tool to indicate psychological preferences in how people make decisions. The test results can be used as the basis of further analysis. The whole results of MBTI test includes eight characteristics and sixteen kinds of personality types. MBTI assesses personality types by considering a person's preferences on four pairs of psychological types: Extraversion and Introversion (E, I) assess attitudes people use to direct their energy. Sensing and Intuition (S, N) refer to two ways of gathering information and understanding situations. Thinking and Feeling (T, F) are two ways in which to organize and structure information and come to a conclusion. Finally, Judging and Perceiving (J, P) describes how you like to live your outer life.

For the sake of narrowing our analysis down, the research takes MBTI test to classified users into two types. We only collect data and distinguish users from selected two types of all result Categories-Thinking and Feeling. Adapting MBTI, we investigate how we can motivate people to exercise using messages designed based on their personality types. As a starting point, we focus on thinking or feeling preferences, as this dimension determine how people make decisions, which is the most relevant to our context. People with thinking (T) personality type prefer applying analytical and logical principles to make objective decisions, following clear and consistent principles. People with feeling (F) personality type may opt to make decisions by reference to their own and others' values, put more weight on personal concerns and the people involved.

Based on these two types, we give specific message to each participant. In line with the theory and empirical evidence, we hypothesis that messages that are logical, making suggestions based on facts and scientific evidence are more effective in motivating thinking type person. While to motivate feeling type person, emotional messages that promote positive values (such as persistence, optimistic, etc) and provide emotional support (such as encouragement, inspiration, acknowledgment, etc) are more effective. Our aim is to verify that users will motivated by messages which meet users' personalities.

Research Approach

The design science research methodology is presented by Pepper (Peppers et al. 2007). There are six stages during the design process including problem identification and motivation, objective of a solution, design and development, demonstration, evaluation and communication. At the design stage, we focus on how message effect differed between participants with different personalities. Building on the design science theory, we developed an iOS application using ResearchKit. ResearchKit is an open source framework introduced by Apple in 2015. For medical research, ResearchKit framework enables our iOS app to become a powerful tool. Developers can use a variety of customizable modules such as informed consent, surveys and active tasks to build useful medical application.

The benefits of using ResearchKit are:

Low cost for large-scale data collection. Any iPhone user anywhere in the world can opt-in for the research by downloading the research application in an Apple store.

Requires minimal programming expertise for application development. ResearchKit is composed of pre-constructed modules that make developing an application a much more efficient and easier task. Three basic modules include informed consents, surveys, and active tasks.

Enables longitudinal tracking of participants. ResearchKit enables researchers to easily "follow" the participants with the application installed in participants' mobile phones.

Provides real-time tracking and feedback. With the mobile application, researchers can track real time status of the participants and give feedback or suggest adjustments based on participants' performances.

Collects many types of data. With the capability of iPhones, researchers can collect many types of data that were not possible to collect in the past, such as participants' location and movement.

The purpose of the application is to help participants schedule personal exercise plan and make sure that they are indeed abide

by the plans. We develop the application as a design artifact according to design science guideline described by Hevner (Henver et al., 2004). Within the search process during design, the instantiation we created to improve adherence is the solution to our research objective.

Artifact

The artifact is the iOS application which provides basic exercise plan list. In the beginning, participants may be asked for signature after viewing the research consent and finish a MBTI survey built by ResearchKit framework. The powerful ResearchKit tool provides consent module for us to implement complicated consent flow. Participants can easily finish online consent rather traditional paper work. The survey module includes lots of questionnaire type so that we can utilize it to classify personality type more convenient. After setting exercise plan, the system pushes notifications with specific message type to remind users according to the MBTI result at scheduling time. In order to make further comparison, we are going to collect results from participants who receive and do not receive messages. The application records all scheduling times and remind users to check whether they complete the sport item at the end of the scheduling day. The system automatically calculates average completion rate of each person and all data is stored for advanced analysis in the future work.

ResearchKit is still a novel method for scientific research projects, and there are many challenges in conducting research using this method. Some of those challenges include: the potential for sampling bias, difficulty in verifying the validity of inputs, and data security and privacy issues. While using Apple's ResearchKit as design framework, we explored the ways to overcome these challenges.

The mobile application offers the following features and materials:

- Study information and patient consent page
- Survey about participants' demographic information, living situation, initial motivation level, and exercise habit
- MBTI survey to determine personality type
- User set daily exercise goal and alarm
- Display of motivational messages and feedbacks
- Survey about motivational level and percentage of exercise goal achieved

Experiment Design

The subjects will be randomly distributed to three groups when first registered personal information on the application. One group with matched messages. Namely, logical messages are sent to subjects who are identified as thinking type and emotional messages are given to users with feeling type personalities. Another group with mismatched messages. That is, logical messages are delivered to subjects who are feeling type and emotional messages are transmitted to users with thinking type personalities. The third group is set as the control group which is composed of both thinking and feeling type subjects. However, people in the control group receive no messages. The research is plan to collect results after subjects continuously use the application for a month. We can further compare completion rates among three groups and even find out factors which may influence final results such as gender, race and so forth.

Phase One Experiment

The subjects will be randomly distributed to three groups when first registered personal information on the application. One group with matched messages. Namely, logical messages are sent to subjects who are identified as thinking type and emotional messages are given to users with feeling type personalities. Another group with mismatched messages. That is, logical messages are delivered to subjects who are feeling type and emotional messages are transmitted to users with thinking type personalities. The third group is set as the control group which is composed of both thinking and feeling type subjects. However, people in the control group receive no messages. The research is plan to collect results after subjects continuously use the application for a month. We can further compare completion rates among three groups and even find out factors which may influence final results such as gender, race and so forth.

Phase Two Experiment

Based on phase one experiment design, we add frequency and feedback factors into the original design. After the subjects are randomly distributed to three groups when first registered personal information on the application, we further randomly assigned frequency type and feedback type to each user in each group. The frequency factor is focus on notification times. We classify notification times into one time and two times groups. Messages with one time notification are pushed at scheduling time set by each user. However, in two times group, the first message is sent 30 minutes before setting time and the second message is pushed at scheduling time just as the way in one time group. Another factor is about feedback message. We also divided feedback type into two groups – with and without feedback. The feedback message contains completion rate of each participant and shows along with the phase one notified message. The results are collected and analyzed to verify if feedback message and notified frequency indeed improve exercise adherence on exercise plan.

Expected Contribution

The clear contribution of this research is the design artifact—the application. The main purpose for the research is to assist chronically ill patients in compliance with exercise plan with a viewing to managing their health condition. This focuses on

validation, evaluation and the challenges of improvement inherent in the evaluation process. Not only can the application help patients with chronic disease improve exercise adherence but it also brings useful information for future research and application development. Developers are able to build more effective and efficient healthcare application base on the findings of the research.

Keywords: mHealth, Design science, Myers–Briggs Type Indicator, ResearchKit

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Dynamic Web Cache Management

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ABSTRACT

Web navigation has been the key issue for information retrieval in e-commerce. Information caching is critical for navigation subject to resource constraints and performance requirement. The research on caching originates from data access to computer memory, to database (e.g. multimedia database), to client/server architecture, and recently to Web navigation. The information access for caching normally is assumed the fixed size of data unit. In this research, we first generalize caching problem for Web navigation by considering information structures. The caching criteria also takes into account Web structure, data usage, and navigation patterns. The preliminary result shows the proposed dynamic caching approach, New Semantics-Based Algorithm (NSA), outperforms the common caching functions and can be applied to broader application domains. Some implications and future directions are discussed in the conclusion.

Keywords: Web Cache, Web Navigation, Website Design.

INTRODUCTION

Cache is normally deemed to be fully available in Web navigation. When the users browser the page visited before, the page is assumed available without the needs to download again. With the growing size of websites and number of visitors, resource constraints and performance requirement are taken into account for Web management. Web cache is essentially crucial for Web navigation. The research on Web navigation can be classified into several areas – principles of web usability [1-3], web personalization and recommendation to enhance the web usability [4-7], techniques to identify usage patterns [8-11], and studies on effectiveness and efficiency of information retrieval [12-15]. The followings are the summary of literature review on cache management.

- (1) Most commonly used traditional algorithms. In order to reduce data traffic and loading time by implementing web proxy cache, various cache replacement algorithms have been proposed. Least Frequently Used (LFU) Algorithm and Least Recently Used (LRU) algorithms, which focus on frequency and recency respectively, are two most well-known examples. Some algorithms combine these two to improve the cache hit rate, e.g. Least Recently Frequently used algorithm [16] and Segmented Least Recently Used algorithm [17].
- (2) Size based caching replacement algorithms. For web proxy cache, the size of the objects and pages is an important factor for the performance of caching algorithms. SIZE algorithm focuses on this issue and evict the largest page. There are other algorithms considered size and other factors. Least Recently Used – MIN (LRU-MIN) algorithm evicts page consider both recency and size, and size adjusted popularity aware Least Recently Used algorithm [17] takes into account size, recency and frequency. Another extension of SIZE algorithm is Greedy-Dual-Size algorithm, without considering frequency, proved better than most traditional algorithms. Its extension Greedy-Dual-Size-Frequency algorithm [19] also includes frequency factor.
- (3) Loading time based caching replacement algorithm. Another important benefit of cache is to reduce loading time for internet user. Latency estimated algorithm [20] aims to estimate time for server connection and data transmission and to minimize loading time for web users. Hybrid algorithm [23], based on latency estimation, considers aging factor counting time interval since last access. MIX [21] algorithm takes into account size, frequency, recency and loading time, and sets weights to each factor.
- (4) Caching replacement algorithms to predict future behavior. Instead of focusing on page eviction based on past accesses, some research projects estimate which cache object will be visited again in the nearest future. Taylor Series Prediction algorithm [22] predicts the time for a page to be visited in the nearest future by time interval between each access. Some approaches adopt computational intelligence, e.g. machine learning [23], to predict the page will be frequently accessed.
- (5) Structural aware caching replacement algorithm. Properties can be associated with Web pages to reflect the corresponding importance level. Least-Frequently-Internal-Request algorithm [24] assumes that the more internal requests (e.g. video, image, download file and links) to other pages, the more likely it will be visited. Some algorithms [25] take advantage of hotlist pages by keeping them in cache to optimize performance. Most of the algorithms mentioned above do not consider the relationship among the objects in the decision of page eviction. In reality, users surf the Internet by successively clicking through links on the webpages. The relationship among cache objects also influence performance matrix for cache algorithms. The Semantics-Aware Replacement Algorithm [26] finds popular pages from mining tools to and decides the page eviction based on the distance to these pages and visit frequency of the pages in cache.

DYNAMIC CACHING APPROACH

The effectiveness of Web navigation is subject to the availability of cache. It is normally assumed that the cache is fully available that there is no need to reload the webpages already visited. In other words, the case represent the situation that cache size is extremely large. The other example is there is no cache at all that all pages need to be reloaded once they are visited no matter how many times they have been visited. Both cases above are the extreme cases that are relatively less sophisticated than the case of limited cache that involves decision of eviction in cache.

Web cache problem is different from traditional computer cache issue from various aspects, such as data size, information structure, and problem objectives.

- (1) Data size. The size of webpages vary - information pages (e.g. pdf files; normally leave pages), portal pages (i.e. web pages with only hyperlinks), and hybrid pages.
- (2) Information structure. The structure is based on the hyperlinks among pages; it can be tree or graph in general.
- (3) Problem objectives. In addition to the traditional criteria (i.e. hit rate and byte hit rate), the objectives may include information volume, advertisement, etc.)

The proposed dynamic caching is basically based on two commonly considered factors, i.e. frequency and recency, as for other caching methods as well. However, the concept “recency” is changed to the expectancy. We uses “popularity” to represent the frequency of page visit in the past and “accessibility” to reflect the potential recency for both the page is accessed in the past and to access in the future. In addition to recency and frequency, the Web structure is another critical factor to be considered.

The fundamental concept is to prioritize the pages for caching on the “distance” to the currently visited page (or “current page” in short).

- (1) Past Pages. For the pages visited previously (i.e. the pages on the path from the root to the current page), the pages closer to the current page (i.e. more recently accessed page) the higher the priority. This is to reflect the easiness to “go back”.
- (2) Future Pages. For the pages to be possibly visited later (i.e. the pages that the current page possibly connects to), the pages closer to the current page (i.e. more accessible pages) the higher the priority. This is to reflect the accessibility in the navigation.
- (3) In the early stage of navigation, it is more likely moving forward to explore than going back. However, once the navigation goes deep in the website, there is higher tendency going back than moving forward.

Take into account popularity (i.e. frequency), it is also important for priority setting. Intuitively, the more popular pages are more possibly visited. One of the structure related properties is the connectiveness. In the following, “connected” means that there is a path between the pages and all the pages on the path are cached already.

- (1) For those cached page, they are given the priority if they are connected from the current page, more closely connected, higher priority.
- (2) For those cached page, they are given the priority if they connect to the popular pages cached, more closely connected, higher priority.

DESIGN OF EXPERIMENT

Overview of Caching Algorithms

When the user visits a web page, the cache algorithm will first search whether the page is in the cache. If yes, a cache hit occurs and the page is accessed from cache; otherwise, the algorithm will check whether there is enough space to cache the requested page. If no, the algorithm will follow the criterion to choose the page(s) to evict. The five algorithms, including the proposed dynamic caching approach, used for the experiment are discussed as follows.

- (1) Least Recently Used Algorithm (LRU). The algorithm evicts pages which has not been visited for the longest time.
- (2) Least Frequently Used Algorithm (LFU). The algorithm chooses the page that least frequently referenced in cache to evict.
- (3) Size Adjusted and Popularity Aware Least Recently Used Algorithm (LRU-SP) [17]. The cache memory is partitioned into multiple sections based on the value of (size / number of times the page has been referenced) defined as ratio T. The pages in each section are queued based on the LRU algorithm. When the user visits the web page, the LRU-SP algorithm checks

whether the page is inside cache memory or not. If yes, firstly increase the number of times it has been visited by 1. The page will be shifted to different section based on the updated ratio T until it is evicted from the section that has the largest ratio T in LRU order.

- (4) Semantics-Aware Replacement Algorithm (SACS) [26]. The algorithm considers the structure of the web site and a list of frequently visited pages. It assumes if a page is closer to those popular pages, it is more likely to be visited in the future. It first compare how far the cached pages to those popular pages in depth value (i.e. the shortest distance in between). The page with larger depth value will be evicted first. For the same depth value, the page are less frequently accessed is evicted first.
- (5) Dynamic Caching Approach - New Semantics-Based Algorithm (NSA). The algorithm considers the structure of the website and assume if the cached page is closer to the currently visited page, it will be more likely to be visited later. The pages with the same distance from the currently visited page, the less frequently visited page will be evicted first.

Dynamic Caching Approach - New Semantics-Based Algorithm (NSA)

The major difference between SACS approach and the proposed NSA approach is SACS focuses on the distance between the cached pages to "popular" pages and NSA also considers the distance between the currently visited page and the cached pages. The algorithm keeps track of access frequency and size of each page cached, the size of remaining cache available, hit rate and byte hit rate, etc.

Upon receiving a new request for page access, beside book-keeping update, the algorithm first checks whether the page is in the cache. If yes, a cache hit occurs; otherwise, the algorithm will check there is enough space to cache the page. If no, the algorithm will follow the criterion to choose the page(s) to evict. Since user navigate the website page by page following the hyperlinks structure, the pages cached closer to the current page visited are more likely accessed later. The algorithm will evict the page with longest distance from the current page. If there are more than one candidate, then evict the one with lowest frequency. The eviction process continues till there is enough memory for the newly accessed page. The algorithm is shown in Figure 1.

```

1  while (remaining cache size < requested page size)
2    get Di for each web page i inside cache
3    for each web page Pi inside cache
4      if (D[i] > temp)
5        temp = i
6        tempfrequency = F[i]
7        temp = D[i] //Evict page with largest D
8      else if (D[i] = temp)
9        if (F[i] < tempfrequency)
10         temp = i
11         tempfrequency = F[i]
12         temp = D[i] //Evict page with smallest F when have similar D
13        end if
14      end if
15    end for
16    evict page which id is temp

```

Figure 1: The eviction algorithm

System Design

An offline simulation platform is developed in C++ and DEV-C++ version 5.11 to simulate the how the five algorithms mentioned earlier work. Algorithm selection and cache size setting are flexible. Access log file and website structure serve as the main input information to simulate cache system, eviction process, and performance evaluation. The structure of simulation system is shown in Figure 2.

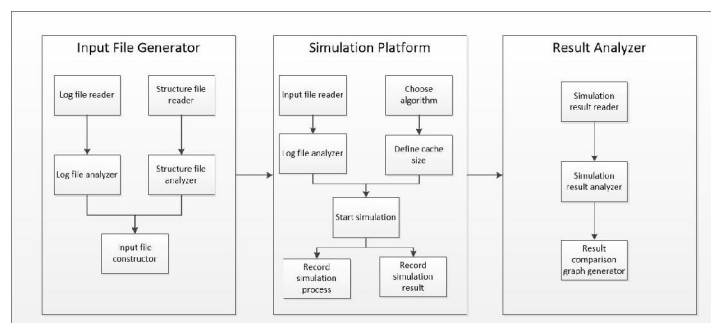


Figure 2: Structure of Simulation System

The performance metrics concerned in the simulation are *hit rate* and *byte hit rate*. Hit rate represents the percentage of the total

requests are handled by cache; byte hit rate measures the number of bytes that transferred from cache as a percentage of total number of bytes of all the requests. These metrics are widely used in various cache replacement algorithms for the comparison of performance. Invalid user access or inaccessible objects, which would have resulted in cache misses, are actually not taken into account for hit ratio or byte hit ratio calculation, which will not affect the accuracy and the reliability of the simulation result. Please refer to Appendix for the detail.

Experiment Data

The input data for the simulation contains two sections: the website structure file which displays the structure of the source website and the access log file which contains user access history. The source website for simulation is from an education institute in Hong Kong (<http://www.fbe.hku.hk>), which contains 29,645 web objects and approximately 900,000 links among the nodes. Besides the structure information, the structure file also covers the size of each nodes as well as their loading time.

The access log file includes all user access logs from March 20th to March 27th, 2016. The log file contains 51,995 user accesses made over that period of time and each entry has user information including IP address of user, time when user made the request, users' target URL and other information as well. To improve the effectiveness and efficiency of simulation, the system generates a standardized input with all the essential information for simulation, including user IP-address, the time of the request, object id which user requests for, the loading time of the requested object and its size. Please refer to Figure 3 in Appendix about simulation procedure.

RESULT AND DISCUSSION

In this section, the simulation result comparison from the proposed dynamic caching approach (NSA) and other caching replacement algorithms are compared on hit rate (HR) and byte hit rate (BTR). The control group includes least frequently used algorithm (LFU), least recently used algorithm (LRU), the size-adjusted and popularity-aware least recently use algorithm (LRU-SP) [17], and semantics-aware replacement algorithm (SACS) [26].

Comparison with LRU and LFU

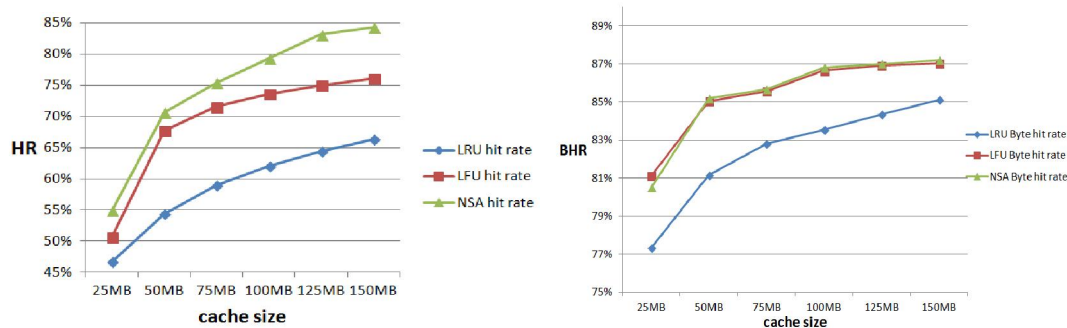


Figure 3: Comparison between proposed approach and LRU/LFU

Figure 3 shows the LRU algorithm performs not as well as others. The possible explanation is that the popular pages lead to the higher importance for frequency than recency. Though the proposed NAS algorithm has a better performance in BR but does not show a significant improvement for BHR, which is possibly due to few large size files with high frequency.

Comparison with LRU-SP

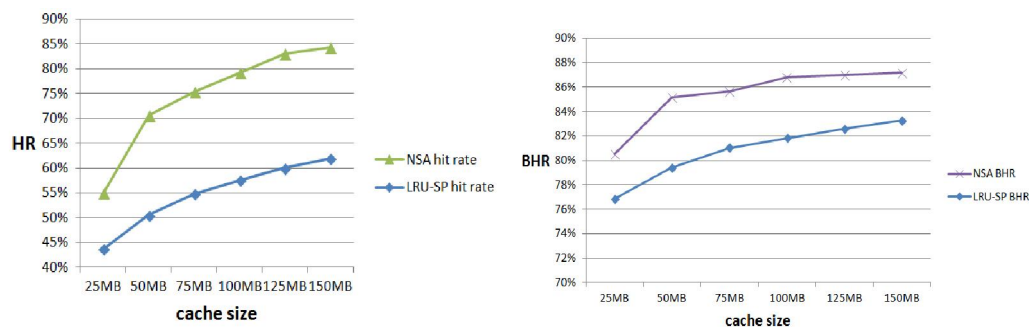


Figure 4: Comparison between proposed approach and LRU-SP

Though LRU-SP algorithm take into account both frequency and recency, it does not consider the relationship among pages. The proposed NSA algorithm outperform in both BR and HBR as shown in Figure 4.

Comparison with SACS

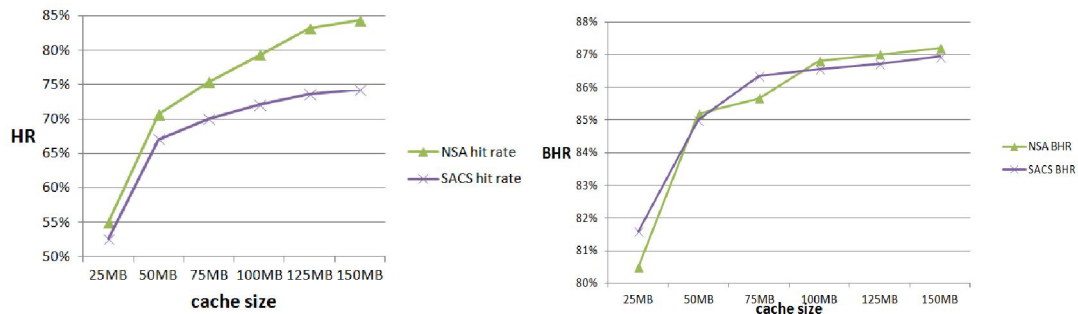


Figure 5: Comparison between proposed approach and SACS

In comparison with SACS, NSA perform better for HR and the gap grows with the increase in cache size. However, there is no significant difference for BHR as shown in Figure 5.

Result Summary

From the comparison between the proposed approach and other methods, it is found that, in general, it perform well for HR, but not particularly better than other for BHR. There are two possible reasons behind: (1) the proposed NSA approach is only the preliminary model of the overall approach described in the section “DYNAMIC CACHING APPROACH”. The further development will be carried for better result; and (2) the website (see Figure 6) used for the simulation has a simple navigation map which connects to most of the entry pages and reduces the impact of depth value.

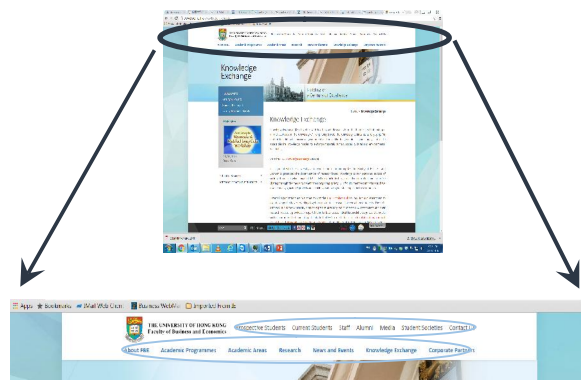


Figure 6: Navigation map in webpages of experiment

CONCLUSION

The study proposes a Web caching approach by taking into account the site structure which is essential for Web navigation. The proposed dynamic caching approach is based on both frequency and recency incorporating with site structure. The experiment result shows the proposed approach basically outperform the other common approaches, i.e. least frequently used algorithm (LFU), least recently used algorithm (LRU), size-adjusted and popularity-aware least recently use algorithm (LRU-SP) and semantics-aware replacement algorithm (SACS), on both hit rate (HR) and byte hit rate (BTR). Besides the result discussed in the previous section, here are some findings.

- (1) **Sensitivity.** The simulation result largely depends on three types of sensitivities – structure sensitivity, data sensitivity, and time sensitivity. Structure sensitivity refers to the website design and organization. As shown in Figure 6, the page design indeed will impact on navigation. The structure issue here is correlated to usability study. Data sensitivity refers to the navigation patterns to reflect how users access the information on web sites. Among all the web pages, only one tenth of them were accessed. In addition, if the page accesses are further classified to portal pages (i.e. mostly links to other pages) and content pages (e.g. the documents and images), the data access might reveal different access patterns. Time sensitivity reveal the criticality of time window of test data. The page access is not uniformly distributed on time line. Some accesses follow the patterns in cycles of various lengths which might not be explicit in the simulation and experiment.
- (2) **Cache size.** The cache size is another decision factor for cache performance. There will be many internal (e.g. structure) and external (e.g. usage) factors to decide suitable cache size. The size should be dynamically adjusted based on needs. How to decide and adjust the cache size will be interesting extension.
- (3) **Eviction Criteria.** The eviction criteria discussed in the simulation is only the preliminary model. The complete model

takes into account both access frequency in the past and potential access in the future based on the structure to reflect the frequency (or popularity) issue. At the same time, both the slack time for last access and lead time for potential future access are considered to decide the weights to reflect the recency (or accessibility) issues. The extended model will be tested for data of longer time window.

There are several limitations and possible future directions as follows.

- (1) The experiment data used in this study is from an educational institute within the time window of one week. The number of user access in that period of week is more than fifty thousand. However, it might not be adequate to show the general situation and access patterns. In addition, though the structure size of the website is not small (i.e. around thirty thousand pages), all pages have a navigation map at the header as shown in Figure 7. The navigation map direct the user to the different categories of pages. This might not be common for other websites in general. The larger size of data set should be considered for experiment in the future. In addition, the data mining and business analytics methods can be applied to explore the possible access patterns. Furthermore, the proposed approach should be applied to various types of websites to validate the generality.
- (2) The methods in the experiment for comparison were chosen as the typical examples to benchmark the performance of the proposed approach. There are indeed many other approaches, such as computational intelligence based method, for Web caching problems. The algorithm in the experiment is the preliminary model of the proposed approach. The next step is to fully implement the proposed approach and to include more representative approaches in the experiment for comparison.
- (3) The proposed method can also be extended to include the size for the decision of caching and eviction. The model also can be tailored for individual users or servers in conjunction with the global caching strategy. In addition, the proposed approach can be the applied to the navigation application, such as navigation guidance.

ACKNOWLEDGEMENT

The research was partially supported by GRF grant (719409E) from the Research Grants Council, HKSAR and HKU-Fudan Joint Research Fund (JRF) 2016. We would like to thank Mr. Chris Cheung for his help with the case study of real world website.

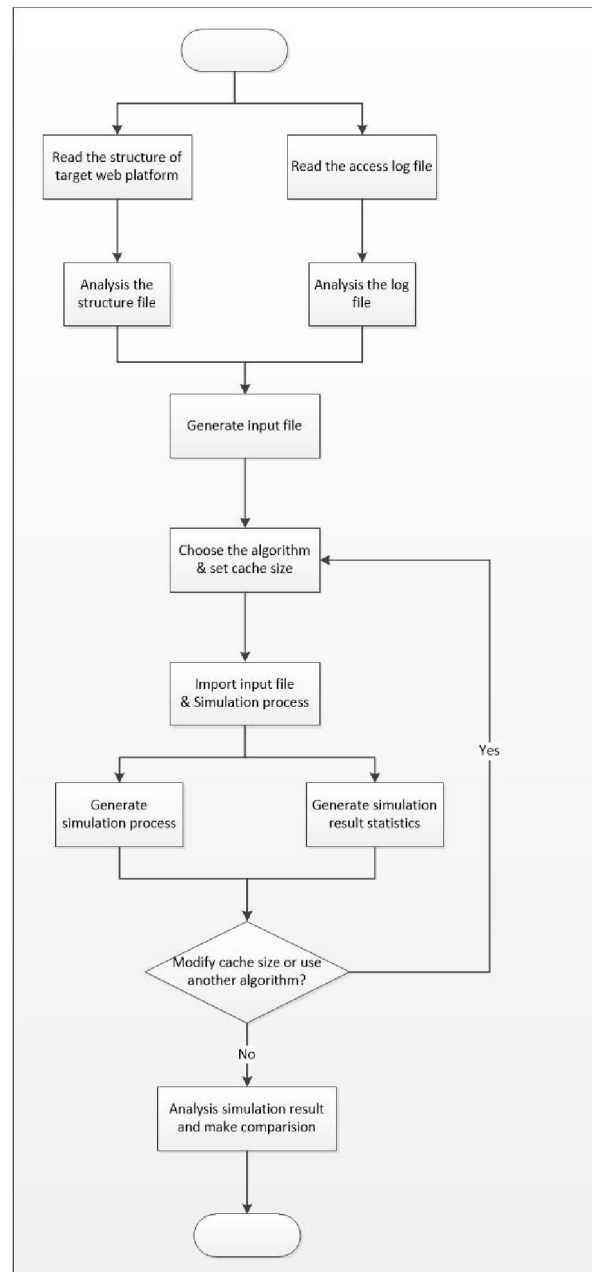
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APPENDIX

Activity Diagram of Simulation Procedure



Research on the Service Model of Higher Vocational E-Commercialized Curriculum Based on Value Network

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ABSTRACT

In the environment of internet and e-commerce, the service of e-commercialized curriculum has gradually begun to develop. This paper introduces the theory of value network to support the service model of e-commercialized curriculum. Firstly, it analyzes the value network theory and its relationship with electronic commerce, and then discusses the existing problems and advantages of higher vocational e-commercialized curriculum. On the basis of these, it takes an analysis on the relationship between the members of value network, constructs the service model of higher vocational e-commercialized curriculum based on value network, and analyzes the value source, organizer, key factors and the integration process of the service model of higher vocational e-commercialized curriculum.

Keywords: Higher vocational curriculum, e-commercialized curriculum, service model, value network.

INTRODUCTION

The rapid development of internet and e-commerce makes information and knowledge unprecedentedly spread, causes profound changes in all areas of society. The change has already penetrated into enterprises, life, government, finance, education and other traditional industries. Utilizing internet cross-border thinking will be the development direction of many industries' future. Education is a typical traditional area, it will also face the transformation of e-commerce and mobile e-commerce, a variety of online education platform is rising. Higher vocational education as an important force in Chinese education also needs to think about the development model under the environment of e-commerce. Curriculum teaching in higher vocational education is the core, and the reform of course system will be the starting point of the reform about higher vocational education. Based on this, it takes the higher vocational course as the research object, utilizes value network theory of network economy to construct the service model system of higher vocational e-commercialized curriculum. Its purpose is to promote the development of higher vocational education and grasp the trend of changes which brought by the internet and mobile internet through reformation of curriculum teaching way.

THE VALUE NETWORK AND ELECTRONIC COMMERCE

The Value Network Theory

Many scholars analyzed the difference between value chain and value network through the industrial structure, Potter proposed value chain concept firstly in the 'competitive advantage', it refers to a commodity or service in creating experiences during the process from raw material to the stages of final product, or a series of work process with some groups to work together. Not every node in the work process can create value, the strategic node in the enterprise value chain can be able to create value truly [1][2]. With the appearance and development of internet, the concept of value chain in e-commerce industry is not applicable anymore, because the value chain emphasizes the value of the segmentation, but e-commerce is not only integrating of the internal service flow, but also including suppliers, customers, partners and other stakeholders of the external process. In this case, it should analyze the business services model by value network [3].

In 1997, Adrian proposed the idea of value network in the 'discovery of profit area', it proposed that due to the increasing demand of customers, the impact of internet and highly competitive market, the enterprise should change from the traditional value chain to value network [4]. Lambert thought value network is a value creation system which takes customer as the center, it combines the advanced strategic thinking and modern supply chain management, instead of traditional supply chain model, which can meet the customers' expectation of convenient, efficient, personalized service and reliability [5]. David and Kirk expounded the meaning of value network in 'value network, break the supply chain, mining hidden profit', it connects the increasing requirements of customers with the flexible, efficient and low-cost commercial services, and utilizes information technology network to distribute products and service rapidly [6]. Creating value, a bigger pie, is fundamentally a cooperative activity involving customers and suppliers that a company cannot accomplish alone[7]. From the value chain to value network, there are two main progress: First, the value network doesn't focus on the value of the segmentation, but focus on value creation and the members in value network. Second, value network not only includes the enterprise, but also covers external stakeholders of enterprise, showing the structure of the network. The members in the network form strategic alliances.

The Application of Value Network in E-commerce Environment

As the core of modern economy, e-commerce has a great influence on the management and operation of enterprises and institutions. A lot of business has been e-commerce, such as purchase e-commerce, sale e-commerce, materials management e-commerce. In addition, the rapid spread of internet information, wide spread and real-time communication provide good

condition for the value network. Therefore, in e-commerce environment, the deconstruction and development of value network has become an important support for analysis on the service model.

In e-commerce environment, the application characteristic of value network mainly as the followings: first, the center of value network moves back, customer becomes the center of value. Strategic center has shifted to information, knowledge and other non-material resources, the focus has shifted from production to market demand. Customers have become conductors of the value network, rather than the passive recipient in the supply chain. Second, collaborative e-commerce applications based on value network. The key point of enterprise is committed to make suppliers, customers and other partners form a network of information value. Its purpose is to encourage all members in value network to play their advantages, so as to meet the needs of customers, and maximize value of the network [8]. Third, informationization and networking. Electronic commerce is an important way to realize network service. Besides internet, the design and application of information business process is also the important issue of value network. The operation model based on business process replace the operation model based on organizational structure, so that it can create a more effective service model [9].

ANALYSIS OF HIGHER VOCATIONAL E-COMMERCE CURRICULUM

In recent years, Chinese higher vocational education has made great progress, it has become the important force in higher education [11]. However, due to the late start of higher vocational education, the curriculum construction is relatively weak, curriculum design concept and implementation methods are in constant exploration. So higher vocational curriculum reform has become the focus and difficulty of the reform in higher vocational education [12]. With the development of information technology and electronic commerce, higher vocational education e-commerce will become a development trend and a new model of course implementation. In 1990s, the concept of network education has been put forward. Although the higher vocational education has not really realized e-commerce, it has also been carried out the reform of network education. During the development process, there are some problems need to be improved, and it can bring many benefits to the higher vocational curriculum reform.

The Problems in E-Commercialized Curriculum

The higher vocational e-commercialized curriculum is still in the primary stage, just stays in the mechanical network and digital level, not really realize electronic commerce. According to current situation, there are some problems in the higher vocational e-commercialized curriculum. First, it is simple to add network technology to the course. Network curriculum of higher vocational education is the embodiment of education informationization, many higher vocational colleges have tried on network curriculum, but most are with traditional network curriculum concept. For example, adding online question answering module of teachers, community forum discussion module, real-time video lectures, but the overall situation is still mechanical stack of technical. It can't really play teaching value and humanistic value of the network curriculum, there is no thinking about how to attract students to learn network courses independently. Second, curriculum development is lack of incentive mechanism. During the process of higher vocational colleges' curriculum reform, teacher is the main participants in teaching reform. Lack of incentive mechanism of persistent, resulting in poor quality of e-commercialized curriculum development, network curriculum become electronic version of traditional books, which is far from the expectations of e-commercialized curriculum. Third, curriculum teaching method is single. In curriculum system of higher vocational education, different nature of course should have different teaching method. For example, public course, general basic course and the theory part of professional course are more suitable for online teaching, however, the practice module of vocational skills course and training course need face-to-face teaching method.

According to the above analysis, in order to solve those problems of higher vocational e-commercialized curriculum, it takes value network as the theory basis, establishes e-commerce service model of higher vocational education curriculum by introducing the third party (the market mechanism) e-commerce platform.

Analysis on the Advantages of Higher Vocational E-Commercialized Curriculum

The benefit to higher vocational colleges

Through e-commercialized curriculum, part of courses is outsourced to the third-party e-commerce platform, which can reduce the face-to-face teaching space. So the colleges can save teaching space to construct practice and training venues, alleviating the pressure of lacking of practical base for many vocational colleges. It not only can converge the society and university teachers resource, solve the problem of teacher shortage, but also can help higher vocational colleges concentrate on its strengthening and optimize its core strengths by the integration model of third-party e-commerce platform. In addition, it can continue to promote higher vocational curriculum teaching and learning reform, meet higher vocational students learning habit need under internet environment. Through interactive binding of face-to-face and online learning, it can enhance learning effect of students. After introducing market mechanism, it can solve the problem of teachers' input and output in the new curriculum design, question answering and continuous improvement.

The benefit to higher vocational college students

Students are in a passive position under the traditional higher vocational education, there is no chance for them to choose teacher.

However, in the online model, students have more right to choose, they can choose their favorite teachers and courses, so that it can enhance students' learning initiative, receive more high-quality course teaching services. In internet era especially the popularity of mobile internet, online learning model is more suitable for students, it can attract students' attention, resulting in a better learning effect. In addition, students' professional learning can also break through the limits of time and space, making learning more effective.

The benefit to third party e-commerce platform

Third party platform can cooperate with higher vocational colleges through establishment of online learning platform and integration of teaching resources. So that it can obtain economic benefits of tuition fees, which is the basis of the third party platform development. According to the principle of network externalization, the more teaching resources the third party platform brings together, the more benefit it will get. So it is easy to form economies of scale, and then promote the sustainable development of the whole industry. The third party platform also can open the service of e-commercialized curriculum to community, to gain revenue by providing skills education, continuing education and other education services. In addition, according to the big data analysis, it can get consumers' habits and related information, and then carry out other internet value-added services.

The benefit to higher vocational education authorities

Higher vocational education authorities are concerned about the quality of higher education and the improvement of teaching efficiency, promoting reform of higher vocational education. Through the higher vocational e-commercialized curriculum, they can promote the reform of higher vocational education following developing trend of time, and improve the quality of teaching. In addition, the support of higher vocational e-commercialized curriculum is the object of national education information construction project, reflecting the intention of the policy.

THE SERVICE MODEL OF E-COMMERCE CURRICULUM BASED ON VALUE NETWORK

The higher vocational e-commercialized curriculum is a kind of educational consumption activities, relating to many members, and the relationship between them is complex. Compared with general e-commerce model, it has its own characteristics besides the logistics, information flow and capital flow. It provides students with a special service based on the will of students, which is not only different from the traditional course education services, but also different from the other e-commerce model. The higher vocational e-commercialized curriculum wants to abandon the impetuous and machinery, goes to the standardization and high-efficiency direction. It wants to get close to e-commerce model with technology, management and operational ethos. The value network is focus on the context within which a firm competes and solves customers' problems[13], it adopts the system of philosophy, in which members face value creation process together, they are responsible for the overall goal of the customer and value network. This structure is conducive to establish association between those members, so as to produce the maximum value, its elasticity is easy to adapt to market uncertainty. The more important thing is that the organizers of value network can meet the individual needs of students and maximize student learning value by integrating the strengths and resources of all the members in network, and then format the win-win outcome in higher vocational education industry.

The integration of resources is common characteristic of e-commerce and value network, which can maximize the value. In the process of vocational e-commercialized curriculum, it needs to integrate all advantages of various colleges and teachers. In order to achieve this goal, it needs to build the third party platform. So this model should include colleges, teachers, students, department of education and the third party e-commerce company. Thinking about the incentive mechanism in value network, the third party should be utilize company's operation way, then it can ensure continuous development of the e-commercialized curriculum services. Construction of the service system is essential for any kind of application model, it takes value network as the basis to build higher vocational education e-commercialized curriculum application model as shown in Figure 1.

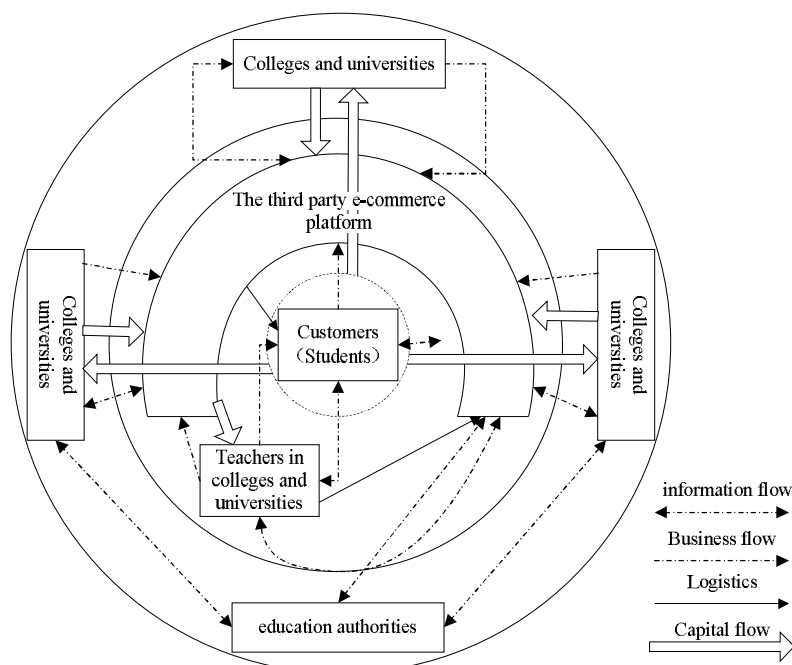


Figure 1 The value network system of higher vocational e-commercialized curriculum service model

The Value Source of Service Model

Customer is the core of industry value network system, and the value source of service model. The choice of customers is the choice of the target market. Customers of service model in the value network have two meanings: first, it is the internal customers of value system, the members in value network node become customer to each other. Second, it is the external customers of value system, they are the users of the product and service in value network, which is usually referred to final customers [11], in the higher vocational curriculum value system, the final customers are learners.

The internal customers of value network

The internal customers of value network can be referred to as indirect customers. In this e-commerce service model, the higher vocational colleges are the internal customers of value network system. Higher vocational colleges are not only the partner of the value network, but also the consumer node. The higher vocational colleges outsource part of the online learning courses to third party platform who conduct the online teaching. Higher vocational colleges need to pay a certain fee for the outsourcing content, and the mode of payment can be operated by the way of cooperative education. Besides this, the third party e-commerce company also can be called the customer to teachers, because teachers provide the original resource and service of teaching to the third party e-commerce company, the third party e-commerce companies need to pay fee to teachers. This can solve the problem that lacking of motivation for teachers, so that the service can be continuously improved.

The final customers of value network

The final customers of value network are the direct customers, the final customers of the service model of higher vocational e-commercialized curriculum are students. In traditional vocational e-commercialized curriculum learning, students have some of learning characteristics, such as poor knowledge, poor classroom teaching reception ability, lacking of concentration, self-centered, they wish have more options and so on. The service model of e-commercialized curriculum can solve these problems, students can study repeatedly in the third party e-commerce platform, and solve the problem of poor knowledge. Network teaching video and strong interaction can attract students' attention. In addition, students can choose their own favorite teacher to teach the course, it can enhance students' learning initiative. Students can also learn through mobile phones and other intelligent terminal devices at anytime, in anywhere, so that they can improve effectiveness of learning. Of course, students need pay the tuition fees to colleges as the ultimate recipient of the service.

The Organizer of Service Model

The organizer of service model is the third party e-commerce platform. The organizer is the central node of this e-commerce service model, its function is to match demand and supply, integrate resources of all members in value network, and assume the role of traditional intermediary. On the other hand, the organizer should increase the value by information coordination. It provides a platform to create value and solve problem of information asymmetry by the integration of course and teaching services. So, the organizer can create and maintain loyalty of customers, organize the internal relationship of value network. It is the integrator and leader of the value network, it can optimize the coordination, so as to ensure that all the elements in value network integrated tightly and consistent high quality services. To realize the extensive sharing of course resources and rapid

spread of e-commercialized curriculum should rely on the integration of the entire industry, not a college or university. No matter the early market research, entire investment, propaganda or service, they all need efforts of the third party e-commerce company to participate in, who can integrate each node resources, and then achieve the service of e-commercialized curriculum [14].

The essential factor for all business model to develop is interests, the third party platform in higher vocational education e-commerce should be able to obtain the expected benefit from this value network, so that it would promote the progress of entire value network system. Electronic commerce industry has the characteristic of network externality; we assume that the higher vocational e-commercialized curriculum also has the strong network effect. Economides proposed the network effect on the market invitation to enter model in the "network externality, complementarity and invitation to enter", it is shown as follow [15]:

$$\Pi = [A + f(S^*)] / 4n - n(S^*)^2 / (2n-1)^2 \quad (1)$$

We regard Π as the equilibrium profit expectations for the third party e-commerce company, where A is a constant, S^* is the expected equilibrium sales, $f(S^*)$ is the network effect function, n is the number of teachers, and the influence of n to third party platform profits are as follow [13]:

$$\frac{d\Pi}{dn} = (S^*)^2 [(2n+1)f'(S^*) - 2n] / \{(2n+1)^2 [2n - (2n-1)f'(S^*)]\} \quad (2)$$

Thus, the profit change direction following the number of teachers will only depend on network effect function $f'(S^*)$, only when

$$2n/(2n+1) < f'(S^*) < 2n/(2n-1) \quad (3)$$

When $d\Pi/dn > 0$, it will increase the profit of the third party e-commerce platform with the increase of n .

According to the above analysis, if there is a strong network effect on the margin, namely $f'(S^*) > 2n/(2n+1)$, the third party e-commerce platform will invite teachers to join the value network. Therefore, under the external conditions of strong network, the third party e-commerce platform will invite more teachers to join this service model, in order to expand the number of products and services to make full use of the role of network externality. The interests of network externality will cause the third party platform to become the organizer of value network.

The Key of Service Model

Service providers

There is no value without service products and service providers, So the service provider is the key to this service model. In higher vocational e-commercialized curriculum service model, teachers are subject of the service. They provide original course resources and teaching services, including teaching video, teaching phonetics, multimedia courseware, online Q&A, sharing the resource and so on. These teaching resources are the prerequisite for development of e-commercialized curriculum.

Service platform

Service platform is the media for service recipient and service delivery channel. Firstly, it needs to process the developed course resources to ensure they can meet students' needs and make sure them be suitable for transmission on the network, to develop the value-added applications for students such as online communities. Secondly, the service platform is learning channel for students. Besides providing suitable course resources for students, it also needs to provide technical support, guarantee efficiency, convenience, safety and practicality of learning in the online platform. Considering that the popularization and application of mobile electronic commerce and smart phone, the third party e-commerce company should develop mobile e-commerce platform and app to meet the full range of online services requirements.

The Higher Vocational Education Authorities

The higher vocational education authorities are education administrative organizations, which are in charge of higher vocational education. They include ministry of education, local education department, education bureau and other relevant departments. These authorities within the jurisdiction of the development, management, inspection, supervision and other duties [16]. The higher vocational e-commercialized curriculum is the application of e-commerce in higher vocational education, the participation and support of the higher vocational education authorities is very important to the success of this model.

Other Members in Value Network Node

In the value network, there are other members to play a supporting role. They provide support for the service model, such as the application software providers, system integrators. They provide software support for the service model of e-commercialized curriculum. In addition, the platform will involve the transfer of capital flows such as payments, transfers and other services, then it need the payment service providers' support. The payment service providers mainly refer to bank, the third party payment service providers who help e-commerce platform to solve the problem of capital flow.

The Integration Process of Service Model

The important issue to success of this service model is that the integration of third party e-commerce company, higher vocational colleges, the university teachers, and then to build a win-win cooperation of the industry value network. The education authorities' supervision is also important in the service model. After all, education is different from general commercial activities, its purpose is not only profit. Although the introduction of electronic commerce on higher vocational education reform, it doesn't mean we can deviate from the essence of education and the rule. The service model of vocational e-commercialized curriculum includes the online teaching model and the traditional teaching model, they are an organic whole, not independent to each other, so that it can create the most effective teaching model in higher vocational college. Colleges and universities need to be responsible for the construction of curriculum system, and determine which courses are need the face-to-face teaching, which are need the online teaching and learning (outsourced). In 2000, the ministry of education issued the opinions on strengthening the work of higher vocational education personnel training ([2000]2), making a clear request of a standard course system [17]. Its course system is set as shown in figure 2.

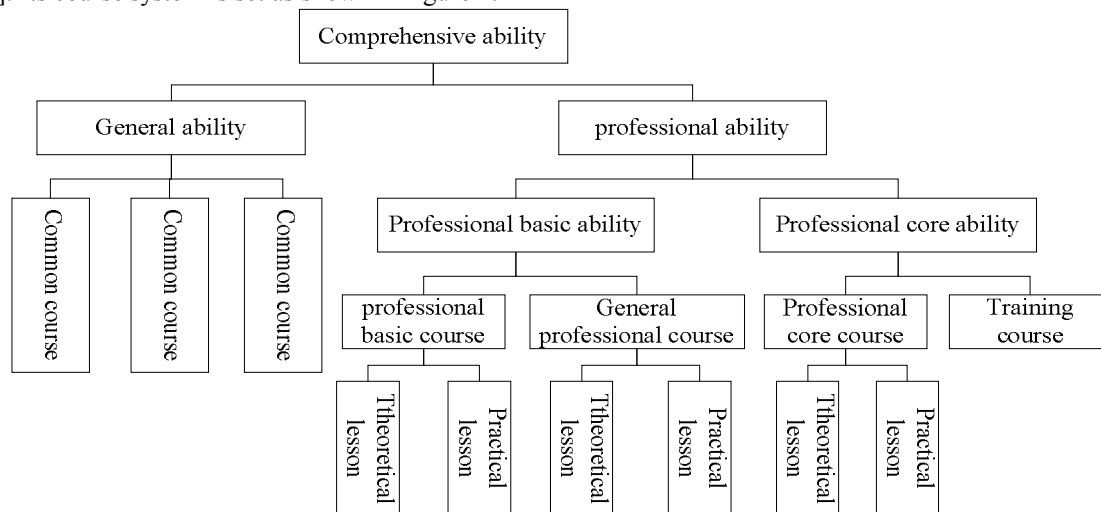


Figure 2 Higher vocational colleges course system based on competency

Generally speaking, the general ability courses are pure theoretical courses such as public basic courses, general courses, they are more suitable for online learning and outsourced to the third party e-commerce company. The professional foundation courses, professional core courses are the B class courses which contain theory content and vocational skills practice, for this kind of courses, the colleges can outsource the theory content to the third party e-commerce course platform, the practice content still take face-to-face teaching way. Only after learning the theoretical part in online platform, students can take part in the practical aspects of the study, so as to ensure the organic combination of online and offline teaching. The training courses take face-to-face teaching, but the training instruction manual should be shared in online platform for students to study. The main process of the entire service is shown in figure 3.

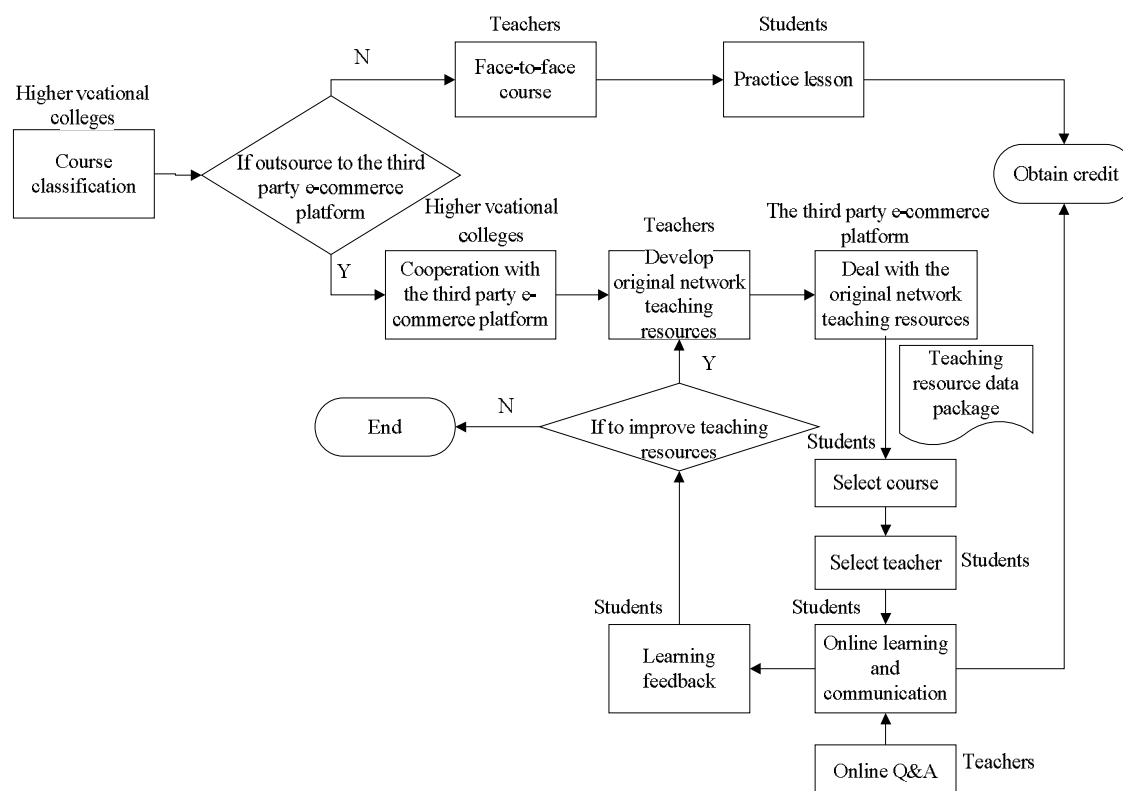


Figure 3 The main process of vocational e-commercialized curriculum service model

CONCLUSION

The construction of the service model of higher vocational college e-commercialized curriculum has an important significance to curriculum reform and teaching reform, meeting the learning needs of higher vocational college students and improving the effectiveness of vocational education. Based on the literature research and data access, using the idea of value network, it takes curriculum teaching system in higher vocational education as the research object, analyzes the industry value network of higher vocational education e-commerce, also the functions and benefits of each node in the value network and the service model process.

The following conclusions can be drawn through the discussion of this paper. Firstly, the service model of higher vocational education e-commercialized curriculum has certain significance to the reform of higher vocational education. Although higher vocational education has network education for a long time, its application has been in the exploratory stage, there is no one perfect, sustainable development model. Therefore, under the electronic commerce environment, this model has practical significance to realize the reform of curriculum teaching. Secondly, higher vocational college students' learning characteristics and learning needs become the internal driving force of higher vocational education e-commercialized curriculum. Through this e-commerce model, it can realize repeat study, selective study and individuality study expectation, improve the whole teaching effect. Thirdly, under the application of value net system architecture and e-commerce, the model can realize the integration of resources advantage of higher vocational education, make full use of the advantages of higher vocational college, social enterprise and teachers in universities, so as to break through the traditional mode of higher vocational education, open up the entire chain of higher vocational education, and then utilize the value of all members in the network.

ACKNOWLEDGMENT

This paper was supported by the item of "2016 Annual key research program of China vocational education society, research on higher vocational course development and service mode with 'internet+' thinking (ZJY16059)". Here, we express our appreciation to all members of this item.

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Effects of Seller Certificates on Buyer's Order Cancellation in the E-marketplace

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ABSTRACT

E-marketplaces are implementing various policies to reduce the information asymmetry between sellers and buyers. One popular way is to issue different kinds of certificates (or seals) for sellers, e.g., a quality certificate for sellers who have a lower product return rate than others or a quick certificate for sellers who dispatch products faster than others. Despite a plethora of previous studies on the role of certificates in the e-marketplace, we have a limited understanding of certificate effects in the post-order stage, where buyers can reverse their purchase decision. Based on the psychological contract violation theory and other related literature, we first explain why seller certificates can take a role in buyers' order cancellation decision. Then, we empirically examine the effects of seller certificates using the large transaction data from a leading e-marketplace in Korea. Our findings are as follows. Given the time elapsed from the order, buyers are less likely to cancel the order when the seller has a quality certificate (for sellers who have lower product return rate than others) or a quantity certificate (for experienced sellers who sold a larger amount of products than others). When the seller has a quick certificate (for sellers who dispatch products faster than others), on the other hand, buyers are more likely to cancel the order. Further, the effects of seller certificates on order cancellation are largely varying across purchase channels (Smartphone vs. PC) and product types (convenience goods, shopping goods, vs. specialty goods).

Keywords: E-marketplace, Certificates, Cancellation, Psychological contract violation, Survival Analysis

INTRODUCTION

E-marketplaces are implementing various policies to reduce the information asymmetry between sellers and buyers. One popular way is to issue different kinds of certificates (or seals) for sellers, e.g., a quality certificate for sellers who have a lower product return rate than others or a quick certificate for sellers who dispatch products faster than others [2].

Previous studies show that the presence of those certificates works as a positive signal for buyers to choose among sellers and make an order. The certificates can decrease buyers' perceived risk on transactions [7] and help to develop their trust on sellers [5], resulting in increasing their willingness to pay for goods and services [3]. By signaling sellers' quality, the certificates can promote more online transactions and benefit the entire e-marketplace [10].

While a plethora of previous studies focused on the positive role of certificates in the e-marketplace, they are more or less limited to investigating the role of certificates in buyers' selection decision among different sellers. Little is known about how the certificates work in the post-order stage where buyers can reverse their decision and cancel the order. As the presence of certificates can increase buyer's expectation on sellers' quality, having the certificates can enhance the choice probability for sellers. However, the expectation-confirmation theory suggests that the increased expectation, at the same time, might aggravate the risk of disconfirmation of buyers' beliefs [9] and trigger more psychological contract violation to buyers [11]. That is, when buyers receive a poor product and service, they are more likely to be disappointed with it and take negative actions such as cancelling the order or returning the product, if it is from sellers with certificates, as their expectation for those sellers is higher.

Furthermore, previous studies tell little about the differential values of certificates across product categories and purchase channels. The role of certificates, which reduces the information asymmetry between buyers and sellers, can depend on the product category, as the amount of information that a buyer needs vary across product categories [8]. We have a limited understanding of category-level effects of certificates because the results of previous studies are based on either a single product category [10] or the aggregated categories [3, 6, 7, 12]. Further, previous studies provide little guidance on how the certificates work in the mobile commerce channel. They focused the role of certificates in the traditional e-commerce where the PC is the medium for buyers to collect product information. Little is known about how the certificates work in the mobile channel, which became popular but has unique characteristics differentiated from the traditional PC channel [1].

To fill this gap and expand our knowledge on the role of certificates in the e-marketplace, we empirically investigate the effects of seller certificates on buyers' order cancellation behavior using the large transaction data from the database of a leading e-marketplace in Korea. Specifically, we focused on the role of three different types of certificates, a quality certificate (for sellers who have lower product return rate than others), a quantity certificate (for experienced sellers who sold a larger amount of products than others), and a quick certificate (for sellers who dispatch products faster than others). We also examine the differential effects of certificates across product categories and purchase channels (PC vs. Mobile Phone).

DATA AND ANALYSIS RESULTS

We obtained the data from the leading e-marketplace in Korea. The dataset contains the entire transactions of 60,000 buyers for more than two years (March 2009–June 2011), in which there are around 2.5 million order records and 11.5 thousand cancellation records. Our dataset also contains the information about purchase channels (PC and Mobile), which allows us to examine the different effect of certificates on order cancellation between purchase channels. Table 1 shows the descriptive statistics on the number of orders and cancellations with each certificate and the average time to cancellation after payment.

Cancellations vary in terms of elapsed time after orders. Further, all orders do not end up to cancellations, which poses the issue of censoring. Considering the different cancellation time and the censoring issue, we employed a Cox proportional hazard (PH) model. Table 2 shows our Cox PH regression results. Given the time elapsed from the order, buyers are less likely to cancel the order when the seller has a quality certificate or a quantity certificate. When the seller has a quick certificate, on the other hand, buyers are more likely to cancel the order. Further, the effects of seller certificates on order cancellation are largely varying across product types (convenience goods, shopping goods, vs. specialty goods).

We also compared the certificate effects on cancellation between purchase channels (PC vs. Mobile Phone) (Table 3). Since buyers who were using the mobile channel for purchases (mobile channel adopters) might be different from buyers who were not (mobile channel non-adopters), we first need to address the issue of buyer heterogeneity to tease out the true channel effect. In this regard, we stratify the customers into three groups using the Recency, Frequency, and Monetary (RFM) scores and compare the results within the stratum. The previous study shows that RFM values are sufficient statistics to summarize purchase histories of each buyer, which provides theoretical justification for the use of these measures [4]. Details of our analysis results and managerial implications will be discussed during the conference.

Table 1: Descriptive Statistics

		Order	Cancellation	Average Time to Cancel After Payment (hours, std. deviation in parentheses)
Quick	1	1260557	44581	20.646(.235)
	0	1271577	70948	49.478(.308)
OK	1	1769157	63801	29.238(.243)
	0	762977	51728	49.594(.365)
Big	1	644432	77298	33.856(.243)
	0	1887702	38231	47.443(.415)
Adopter	Mobile	92160	3937	39.434(1.074)
	PC	1073549	52719	37.947(.317)
	Total	1165709	56656	38.050(.304)
Non-adopter		1366425	58873	38.643(.301)
Total		2532134	115529	38.339(.213)

Table 2 : Cox PH Regression Result

		Product Classification		
Variables	Full Model	Convenience Goods	Shopping Goods	Specialty Goods
Main Variables				
SQ	.199***	.064	.229***	.332***
SOK	-.506***	-.345**	-.421***	-.401***
SB	-.157***	-.119	-.121**	-.044
TP	.394***	.637**	.301*	.434**
UA	.046**	-.082	.044	.198**
Order-specific Control Variables				
OA	8.20e-07***	2.83e-06**	5.49e-06***	4.37e-07***
OQ	-1.701***	-2.366***	-1.225***	-2.070***
OSF	1.06e-4	3.10e-04***	2.26e-04***	4.16e-05**
FT	2.275***	3.377***	1.632***	3.234***
Individual-specific Control Variables				
Sex	.243***	.014	.229***	.074
BYR	.007***	.021**	.012***	-.005

TOP	.046***	.056***	.057***	-.044***
Time Interaction Variables (to address the issue of the violation of proportionality)				
SOK*Day1	0.097	-0.200	.185**	.319
SOK*Day2	0.154*	1.005**	.005	-.160
SOK*Day3	.105	-.612	.101	-.162
SB*Day1	-.185**	-.199	-.211**	-.482**
SB*Day2	.087	-.046	.153	.279
SB*Day3	.179**	.686*	.180**	-.159
TP*Day1	.011	-.609	.168	.222
TP*Day2	.063	.403	.077	-.786
TP*Day3	-.461***	-.493	-.569**	-.354
OA*Day1	-7.88e-09	-1.20e-06	-5.00e-07	2.37e-07
OA*Day2	-3.49e-07	1.43e-05	-1.24e-06	-1.33e-06**
OA*Day3	-6.27e-07**	1.26e-05	-1.38e-06	-7.01e-07
Sex*Day1	-0.45	.021	.095	.409**
Sex*Day2	.118	-.057	-.003	-.029
Sex*Day3	-.193**	-.054	-.151	.154
TOP*Day1	-.072***	-.053	-.083***	-.123
TOP*Day2	.030	-.026	.043	.177
TOP*Day3	.007	-.015	-.011	-.120

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; The dependent variable is the time gap between payment and cancellation, using the hour as a unit. There are seven binary variables in our model: whether the seller has a quick certificate (SQ), whether the seller has a quality certificate (SOK), whether the seller has a quantity certificate (SB), a dummy indicating the mobile phone transaction (TP), whether the user adopted the mobile channel (UA), the user fee type (FT) and sex. Other four continuous control variables and one discrete control variable are Order Amount (OA), Order Quantity (OQ), Order Shipping Fee (OSF), the inverse form of the time between making the order and finishing payment (TOP), and Birth year with the reference 1980 (BYR). Day1, Day2, and Day3 are binary variables which refer to whether the order survived longer than 24 hours, 48 hours and 72 hours respectively, to control for the possible time-varying effects.

Table 3 :Cox PH Regression Result of Different Channels

RFM	3-7		8-10		11-15	
Channel	Mobile	PC	Mobile	PC	Mobile	PC
SQ	0.0707112	0.1699455***	-0.0450148	0.201431**	0.3405733*	0.2347109***
SOK	-1.076964***	-0.3474981***	-0.81484***	-0.2215044*	-0.3574291	-0.4532154***
SB	0.3217223*	-0.2606239***	0.0021598	-0.1569871	0.1768267	0.2136409*
SOK*Day1	0.3626052	-0.2252062	0.2067386	-0.1628965	0.6601216	0.2781616
SOK*Day2	0.6354778	0.2063325	0.3280864	0.0999884	0.4652464	-0.3953958
SOK*Day3	0.2311149	-0.0584457	0.6794119	0.1678273	-1.332679*	0.5330608**
SB*Day1	-0.8147824***	-0.1531402	-0.1706727	0.0355682	-1.232587**	-0.4924972**
SB*Day2	0.2601718	0.2405205	0.3121466	-0.287222	1.636114*	0.1658501
SB*Day3	0.0905939	0.269605	0.1070583	0.1759625	-0.4621598	-0.0241504

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; RFM refers to the aggregate score of recency, frequency and monetary. The score ranges from 3 to 15, representing the most inactive buyers to the most active buyers. Control variables are not shown for expositional brevity.

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Prediction Strategy for E-Commerce Price Negotiation

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ABSTRACT

Automated negotiation plays an important role in dynamic trading online, especially in B2C e-commerce, as it is crucially useful for the online merchants to achieve better trading outcomes and save vast trading cost. To address the critical issue, this paper develops a prediction strategy that using linear regression to predict the opponent's future offer trend, the theoretical model and the algorithm are proposed. To demonstrate the effectiveness of this model, we develop a prototype and conduct computer-computer automated negotiation to make comparison with the previous negotiation strategy model. The experimental result shows that the agent with our newly designed strategy model can significantly increase the agreement rate and joint outcome of the both sides.

Keywords: B2C electronic commerce, automated negotiation, negotiating agent, linear regression.

INTRODUCTION

Negotiation is a process in which parties interact to settle a mutual concern to improve their own status quo. As negotiation is a core activity in human society, it is studied by various disciplines, including economics, artificial intelligence, game theory, and social psychology. The economics and social psychology researchers usually focus on human to human negotiation, while the researchers using artificial intelligence and game theory pay more attention to computer to computer negotiation. Due to the unavoidable space-time limitation of the negotiation, human-human negotiation is a necessary but time-consuming and expensive activity. Therefore, in the last two decades, there has been a growing interest in the automated negotiation systems, which has a promising prospective in future e-commerce. In automated negotiation, the software agents are designed to negotiate on behalf of human negotiators partially (i.e., human-computer negotiation) or totally (i.e., computer-computer negotiation) and to find better outcomes than human negotiators. The potential benefits of automation include reduced time and negotiation costs, a potential increase in negotiation usage when the user can avoid social confrontation, the ability to improve the negotiation skills of the user, and the possibility of finding more interesting deals by exploring more promising portions of the outcome space, which is normally hard to solve by human as there would be implying much calculation that is unaffordable to human.

BACKGROUD AND MOTIVATION

The core problem of the automated negotiation research is the negotiating agent design. In order to obtain a better outcome in negotiation, an agent needs to find out some private information of the opponent (e.g., strategy, tactics, reservation price, deadline, etc) so that the agent can choose an appropriate strategy among all the candidates to deal with the negotiation situation for getting a better deal. However, in competitive bilateral negotiation, a negotiator has little information about their opponent. In fact, the only available information in most cases is the previous offers from the opponent. So the agent needs to predict the opponent's key private information or possible future offer trend based on the previous offers [1]. Most existing prediction approaches are based on machine learning mechanisms, which can be divided into two categories, off-line learning and online learning.

The off-line learning focuses on learning from previous encounters of the negotiation, such as Bayesian learning [2, 3], reinforcement learning [4], neural networks [5], and evolutionary computation [6]. Normally, this approach comprises two steps. In the first step, an estimation function needs to be well trained by training data, which are from the previous encounters. Therefore, the performance of the estimation function is somehow decided by the training result. In the second step, the trained estimation function is employed to predict opponents' behaviours. Since the unavailability of historical interaction data of the past encounter, which benefits the off-line learning, makes it is difficult to obtain private information of opponents, on-line learning methods are proposed to make prediction through the historical offers of current encounter and adapt to the negotiation opponent behaviour. This approach can be summarized to statistical approaches, e.g., linear regression, non-linear regression, and difference based mathematical models. [7] classified agents' negotiation strategies and tactics into time-dependent, resource-dependent and behavior-dependent ones and defined them formally. Based on Faratin's definition, [8] gave a nonlinear regression to predict opponent's tactic family, tactic parameter and next offer. He also gave a heuristic method to estimate opponent's reservation price and deadline. Similarly, [9] proposed a method to adapt the factor of negotiation tactics according to the prediction results of opponent's next offers. [10, 11] gave a difference-based offers prediction method. These prediction-based one-issue bargaining strategies predict private information (tactics, reservation price, deadline, etc.) of opponent before making appropriated counter-proposal based on two assumptions. One is that the opponents offer according to the strategies and tactics models defined by [7], the other is the opponents make consecutively concessions. These assumptions limit the coverage of opponents as it is impossible to enumerate all the offering patterns (model) of the opponent, and there are lots of opponents who do not offer according to any concession patterns, or even take some strategies to prevent their private information to be learned.

According to the analysis of above literatures, in price negotiation environment, it is needed to propose a new self-adaptive strategy that does not depend on any knowledge base about opponents and no need to model the opponents, enabling the agent to accurately and autonomously predict the opponent's future offer trend, and then adapts its concession according to the

observation of the opponent's recent offer and its own recent offer. The remainder of this paper is organized as follows. Section 2 discusses the resear background and why we do this study. Section 3 elaborates the linear regression model for our prediction strategy. Section 4 presents computer-computer negotiation experiment, introduce the experimental design and evaluation measures for the model, and discusses the experimental results and their insights revealed. Finally, Section 5 summarizes the findings, discusses the contributions, and draws the picture of the future work.

BILATERAL NEGOTIATION

This paper focuses on one-issue-price negotiation over product or service between negotiating partners, either agent vs. agent or agent vs. human. The automated negotiation environment is characterized as follows: 1) Only one seller and one buyer are involved in a negotiation process. 2) The negotiation involves one issue (i.e., price). 3) Reserve price, deadline, and offer function of negotiators are private information that cannot be explored by the opponent. That is because the more information known by opponents, the larger probability to be exploited by opponents. Therefore, each negotiator can only observe opponent's past offers. 4) The aim of the buyer (seller) is to buy (sell) the item or service at a price as low (high) as possible. 5) Any offer given by agents cannot be canceled or withdrawn. All of the assumptions are rational and derived from real negotiaon situations. Based on these environmental constraints, a bargaining is formally defined as follows.

Definition 1: A bilateral negotiation BN is a 15-tuple:

$$BN = (Seller, Buyer, Protocol, Strategy, Time, A_x^t, \overline{p_s}, \underline{p_s}, \overline{p_b}, \underline{p_b}, p_{s \rightarrow b}^t, p_{b \rightarrow s}^t, \overline{t_s}, \overline{t_b}, D), \quad (1)$$

where

- *Seller* and *Buyer* are denoted by s and b respectively.
- *Protocol* specifies the rules that govern the bargaining process. The alternating offer protocol is adopted in this paper, which will be illustrated later in this section.
- *Strategy* is a set of bargaining strategies that can be used by agents. Each strategy is an offering function of the negotiator.
- *Time* is denoted by t denoting the number of negotiation round.
- $A_x^t = \{accept, reject, offer, quit\}$ is a set of actions that can be chosen by negotiator x ($x \in (s, b)$) in round t of the negotiation. The system is designed for facilitaitng both human-agent negotiation and agent-agent negotiaiton. The agent is binded with the negotiation system, the agent can quit the negotiation as the time deadline has reached, but cannot reject the opponent's offer, as rejection is a more emotional behavior that could be used by human, therefore, human can reject the agent's offer but cannot quit the system. As a result, the human's action is defined as $A_{human}^t = \{accept, reject, offer\}$, while agent's action is defined as $A_{agent}^t = \{accept, offer, quit\}$.
- $\overline{p_s}$ is the initial price or the highest price that the seller s can offer.
- $\underline{p_s}$ is the reserve price or lowest acceptable price of seller s .
- $\underline{p_b}$ is the initial price or the lowest price that the buyer b can offer.
- $\overline{p_b}$ is the reserve price or highest acceptable price of buyer b .
- $p_{s \rightarrow b}^t$ (or $p_{b \rightarrow s}^t$) is the offer from seller s (or buyer b) to buyer b (or seller s) in round t , which is delimited by the acceptance range of buyer and seller.
- $\overline{t_s}$ or $\overline{t_b}$ represent the maximal number of rounds that seller or buyer is willing to negotiate. $\overline{t_s}$ and $\overline{t_b}$ are generally independent with each other.
- D is the deadline of the system or the negotiation process, which can be regarded as the minimal one of $\overline{t_s}$ and $\overline{t_b}$, i.e., $D = \min\{\overline{t_s}, \overline{t_b}\}$.

Negotiation Strategy

A negotiation strategy is a decision-making model used by the participants to persuade the opponent towards the outcome they desire. Heuristic-based approach is always used to design the negotiation strategy function to implement the concession process. The well-known early work was the work of [7, 12], which mathematically formalized strategies into function families, such as: time-dependent strategy, resource-dependent strategy and behavior-dependent strategy. For these classic negotiation strategies, concession is the main method to eliminate conflict and obtain mutual benefit for both sides in negotiation. An agent concede according to its own offering pattern as well as considering opponent's concession.

Taking the classic time-dependent strategy [7, 12] as an example, it indicates that an agent is likely to concede more rapidly if it needs to reach an agreement by a deadline. The offer price proposed by seller s to buyer b at time t is:

$$p_x^t = \underline{p_x} + (1 - \alpha_x(t))(\overline{p_x} - \underline{p_x}) \quad (2)$$

where $\alpha_x(t)$ is a family of the offer curves that can be defined as:

$$\alpha_x(t) = \exp^{(1 - \frac{\min(t, \bar{t}_x)}{\bar{t}_x})\beta \ln K_x}, \quad (3)$$

where K_x is a constant that determines the value to be offered in the first proposal by agent x . There is actually a family of concession curves, which can be defined simply by varying the value of parameter β determining the convexity degree of the curve. The shape of each concession curve represents a human's possible negotiation offer track. As there are infinite offer curves (corresponding to infinite values of β , one for each curve) in the solution space, theoretically speaking, the model covers the entire possible offer curves the human might choose during the process of negotiation.

The Prediction Strategy

Supposing the offer points of buyer and seller distribute in a rectangular coordinate system, in which the x-coordinate denotes round number (t), while y-coordinate denotes the offer price (p). Each offer point can be expressed as a tuple $(t, p_{b \rightarrow s})$ for buyer or $(t, p_{s \rightarrow b})$ for seller. The linear regression is conducted by seller to model the buyer's offer trend according to the buyer's previous offer points. The regression line is typically stated in the form of

$$p = \alpha + \beta t + \varepsilon, \quad (4)$$

where p is the dependent variable, α is the p intercept, β is the slope of the linear regression line, t is the independent variable, and ε is the random error. Assuming that we observe n pairs of data $(t_1, p_1), (t_2, p_2), \dots, (t_n, p_n)$ from a negotiation experiment, and model in terms of the n pairs of the data can be written as

$$p_i = \alpha + \beta t_i + \varepsilon_i, \text{ for } i = 1, 2, \dots, n, \quad (5)$$

after model is specified and data are collected, the next step is to find "good" estimates of α and β for the linear regression model that can best describe the data. Suppose a and b are the estimates of the α and β respectively, while the estimate of p is \hat{p} . We use the least square method to find parameter estimates by choosing the regression line that is the closest to all data points. So, we are going to find the estimates a and b such that the sum of the squared distance from actual response p_i and predicted response $\hat{p}_i = a + bt_i$ reaches the minimum among all possible choices of regression coefficients a and b , i.e., to minimize the sum of squares

$$\sum_{i=1}^n (p_i - \hat{p})^2 = \sum_{i=1}^n \varepsilon^2 = \sum_{i=1}^n (p_i - a - bt_i)^2 \quad (6)$$

Mathematically, the least squares estimates of the simple linear regression are given by solving the following system:

$$\frac{\partial}{\partial a} \sum_{i=1}^n (p_i - a - bt_i)^2 = -2 \sum_{i=1}^n (p_i - a - bt_i) = 0 \quad (7)$$

$$\frac{\partial}{\partial b} \sum_{i=1}^n (p_i - a - bt_i)^2 = -2 \sum_{i=1}^n t_i (p_i - a - bt_i) = 0 \quad (8)$$

Denote a and b be the solution of the above system, we can describe the relationship between t and p by the regression line $\hat{p} = a + bt$, which is called the fitted regression line by convention. Now it is easy to calculate

$$b = \frac{\sum_{i=1}^n (p_i - \bar{p})(t_i - \bar{t})}{\sum_{i=1}^n (t_i - \bar{t})^2} \quad (9)$$

$$a = \bar{p} - b\bar{t} \quad (10)$$

$$\text{where } \bar{t} = \frac{1}{n} \sum_{i=1}^n t_i, \text{ and } \bar{p} = \frac{1}{n} \sum_{i=1}^n p_i.$$

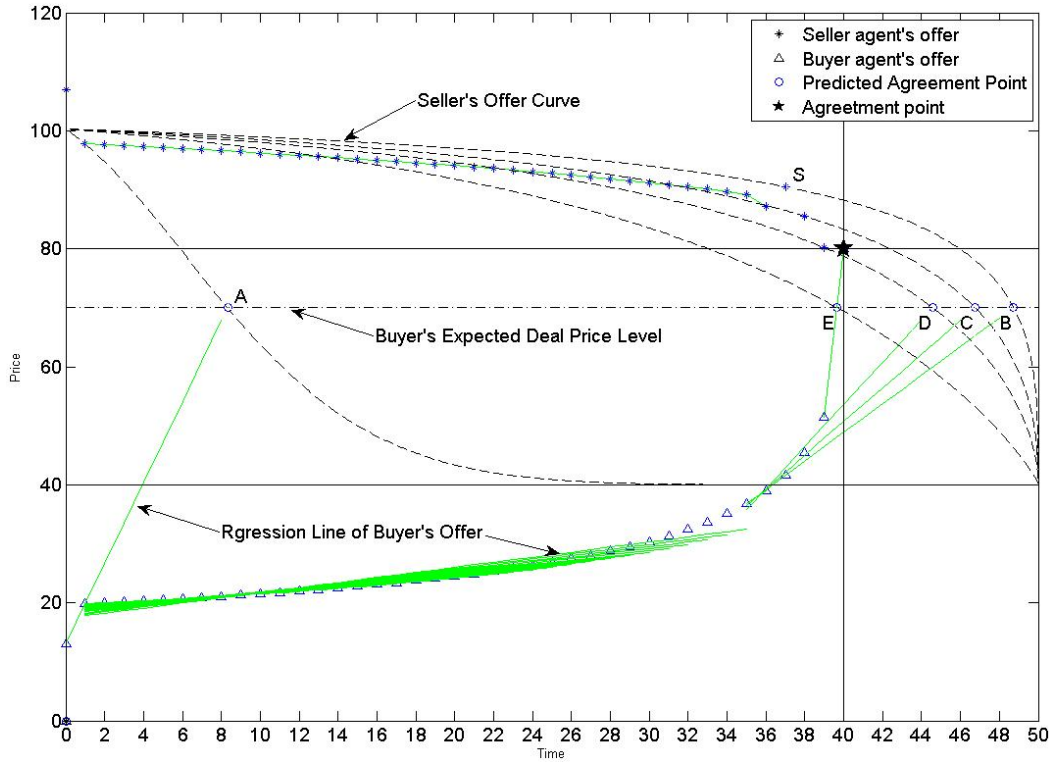


Figure 1: the agent using prediction strategy that embodies a linear regression concession model

Now, we have a regression line $p = a + bt$ indicating the buyer's future offer trend, but how can the agent seller use this regression line to make offer decision? This problem was not solved well by the previous studies [7-9, 11] [13]. As we all know, negotiators usually have a deal price expectation that the negotiator expect to make agreement with the opponent [14, 15], then the agreement would probably be near the intersection between the deal price expectation and the offer trend prediction line. As shown in figure 1, the expected price level is indicated by the dotted line \tilde{p} , and the green lines are the regression line of the buyer's offers. Since this is a segmented linear regression model, the regression lines distribute in different sections of the buyer's offers. The segmented criteria will be introduced in latter section. Some of the regression lines have intersection points (indicated by A, B, C, D, E in the sequence of appearance) with the expected deal price level. Each point is indicated as a tuple (\tilde{t}_i, \tilde{p}) , where $i = 1, 2, 3, 4$. The abscissa of each point is the expected agreement time \tilde{t} as long as the buyer comply with the current offer trend. So, we have

$$\tilde{t} = \frac{\tilde{p} - a}{b} \quad (1)$$

There are two situations for the expected agreement time \tilde{t} , legal and illegal. For the illegal situation, which means the expected agreement time is less than the current time ($\tilde{t} \leq t$), or is larger than the seller's deadline ($\tilde{t} \geq \bar{t}_s$), the seller agent will imitate the slope of the buyer's regression line, and can easily calculate the next offer at time t as

$$p_{s \rightarrow b}^t = p_{s \rightarrow b}^{t-1} - b \quad (12)$$

For the legal situation, which means the expected agreement time is within the time limit, i.e., $t \leq \tilde{t} \leq \bar{t}_s$, since we already know the future possible agreement point, the seller's current strategy should be a time-dependent tactic curve that pass through the predicted agreement point, as the dotted curve indicates in figure 1, but how to generate these curves? The time-dependent strategy model actually defines a family of monotonic functions, which can be depicted as a bunch of offer curves in the negotiation space. The initial intention for using the time-dependent strategy is letting the agent to choose one offer curve at the beginning, and keep on it to the end of the negotiation. However, in our strategy model, the agent need to select one tactic curve that can lead the agent to the predicted agreement point, but not just fix on one tactic curve from the beginning to the end of the negotiation as the previous studies did.

The derivation process for generating the new tactic curve from the known possible agreement point is as follows. As designed in the time dependent tactic model, parameter β solely determines the curve's shape of the negotiation strategy. Since different negotiation strategies correspond to different values of β , the process is actually to select an appropriate value for β . Then we discuss how to get a value for β from a known point (\tilde{t}, \tilde{p}) . According to [7], the offer price proposed by seller s to buyer b at time t is:

$$p_{s \rightarrow b}^t = \underline{p}_s + (1 - \alpha_s(t))(\overline{p}_s - \underline{p}_s) \quad (1)$$

3)

Since the agent's offer price $p_{s \rightarrow b}^t$ is known as \tilde{p} , then we can calculate $\alpha_s(t)$ as:

$$\alpha_s(\tilde{t}) = (\overline{p}_s - \tilde{p}) / (\overline{p}_s - \underline{p}_s) \quad (14)$$

According to Equation (3), we can calculate seller agent's new value of β as:

$$\beta = \ln\left(\frac{\ln(\alpha_s(\tilde{t}))}{\ln K_s}\right) / \ln\left(1 - \frac{\min(\tilde{t}, \overline{t}_s)}{\overline{t}_s}\right) \quad (15)$$

where the $\alpha_s(t)$ has been calculated by Equation (16). Then, we can obtain the agent seller's new negotiation strategy function as:

$$p_{s \rightarrow b}(t) = \underline{p}_s + (1 - \exp^{(1 - \frac{\min(t, \overline{t}_s)}{\overline{t}_s})\beta \ln K_s})(\overline{p}_s - \underline{p}_s) \quad (16)$$

where t is independent time variable and $p_{s \rightarrow b}$ is the dependent offer price variable.

COMPUTER TO COMPUTER NEGOTIATION EXPERIMENT

An negotiation environment is characterized by the number of agents in negotiation, the issues to be discussed, the deadline for reaching an agreement, and the expectations of the agents. Formally, the experimental environment can be uniquely defined by: $[\beta^b, \beta^s, t_{max}^b, t_{max}^s, k^b, k^s, \min_{price}^b, \max_{price}^b, \min_{price}^s, \max_{price}^s]$, i.e., time available to make an agreement (t_{max}^b, t_{max}^s), the initial offer (k^b, k^s), and price the intervals of the buyer and seller. Since it is impossible to discuss infinitely possible environments, we consider a representative in which we can assess an agent's negotiation performance to test our prediction strategy. To this end, the experiments are bilateral negotiations between a buyer and a seller over the single issue of price. Thus, we have $[k^b, k^s, \min_{price}^b, \max_{price}^b, \min_{price}^s, \max_{price}^s] = [0.1, 0.1, 20, 80, 40, 107]$, in which we refer from [7] to set $k^b = k^s = 0.1$ for both agents. Then several groups of experiments will be conducted according to different ranges of β , t_{max}^b and t_{max}^s . More specifically, there are 3 different relationships between t_{max}^b and t_{max}^s , i.e., $t_{max}^b > t_{max}^s$, $t_{max}^b < t_{max}^s$ and $t_{max}^b = t_{max}^s$. In our computer-computer negotiation experiment, the seller agent acting as the online vendor employs our prediction strategy, while the buyer agent negotiates according to a pre-set time-dependent strategy. For analytical tractability, we follow the setting of [7] to set the buyer's β in the interval $0 < \beta < 50$, in which $0 < \beta < 1$ defines competitive tactics, and $1 < \beta < 50$ defines collaborative tactics. At the very beginning, the buyer agent chooses the value of β randomly to set its strategy curve, and then fixes its strategy at this value of β until the end of the negotiation. Meanwhile, the seller implements our prediction strategy to respond to the buyer's offers.

The experiment compares the performance of our prediction strategy and the selection strategy, which has been recently proposed by [16]. The selection strategy is a heuristic-based model derived from the classic time-dependent and behavior-dependent strategy. The selection strategy can dynamically select appropriate tactic among all the candidate time-dependent tactics, hence possesses good flexibility and robustness in treating with the dynamic and inconsistent negotiation behavior of the opponent. The reason why we choose selection strategy as the reference substance is that the selection strategy is innovatively proposed recently and has been proved to be superior to the classic time-dependent strategy.

The experiment is divided into two parts. In the first part, the seller agent employs the selection strategy, while the prediction strategy is used in the second part. The comparison is conducted between the two parts. In each part, the buyer employs time-dependent strategy, but the value of β is generated randomly in two intervals: (0, 1) for competitive tactics, and (1, 50) for collaborative tactics, by which almost all the buyer's possible offer tactics are included. In each interval, the deadline of the buyer and seller are divided into three cases: $t_{max}^b > t_{max}^s$, $t_{max}^b < t_{max}^s$ and $t_{max}^b = t_{max}^s$, in which the exact values of the maximum trading time are also randomly generated in the integer interval [10, 70]. Thus, we need to conduct 12 experiments. In each experiment, we run negotiation 200 times. Therefore there are 2400 computer-computer negotiation simulation will be implemented as Table 1 shows.

Table 1: The experiment design

Seller's Strategy	Selection						Prediction					
Buyer's Strategy	Boulware ($0 < \beta < 1$)			Conceder ($1 < \beta \leq 50$)			Boulware ($0 < \beta < 1$)			Conceder ($1 < \beta \leq 50$)		
Time Relation	$\overline{t}_s > \overline{t}_b$	$\overline{t}_s < \overline{t}_b$	$\overline{t}_s = \overline{t}_b$	$\overline{t}_s > \overline{t}_b$	$\overline{t}_s < \overline{t}_b$	$\overline{t}_s = \overline{t}_b$	$\overline{t}_s > \overline{t}_b$	$\overline{t}_s < \overline{t}_b$	$\overline{t}_s = \overline{t}_b$	$\overline{t}_s > \overline{t}_b$	$\overline{t}_s < \overline{t}_b$	$\overline{t}_s = \overline{t}_b$
Number of Times	200	200	200	200	200	200	200	200	200	200	200	200

The experimental data shows that, as compared to the selection strategy, the adoption of prediction strategy can truly improve the settlement ratio of the negotiation (61.5% vs. 94%) when buyer's strategy is competitive and the seller's deadline is later than the buyer's, but when the seller's deadline is earlier than the buyer's, very low settlement ratio occurs (10.5% and 2.5%). As consistent with the previous study Cao (2015), a short deadline setting cannot be accepted for the agent who adopts the

intelligent strategy like selection and prediction. Finally, when the buyer employs collaborative strategy, there is no significant difference on settlement ratio between selection strategy and prediction strategy.

In order to investigate the effects of the two strategy variables (selection and prediction) on negotiation outcome measures, i.e., finish time (FT), buyer utility (BU), seller utility (SU), utility product (UP) and utility difference (UD), a one-way ANOVA is conducted with the result shows the difference degree over all the five measurement indexes (BU, SU, UD, UP and FT), comparing between the selection strategy and prediction strategy that the seller employs. The result shows, when the buyer employs competitive strategy, the prediction strategy can lead better individual utility for both sides (insignificant when the seller's deadline is later than buyer's) but worse joint outcome (i.e., utility difference and utility product), while no significant effect on the end time of negotiation. When the buyer employs collaborative strategy, the prediction strategy performs significantly worse in individual utility but better in joint outcome and end time of negotiation than the selection strategy. The implication is meaningful for the actual system application. When the negotiation situation is competitive, the prediction strategy can protect the individual benefit though difficult to satisfy the both sides, while when the negotiation situation is collaborative, the prediction strategy can guarantee the both sides to obtain a win-win result without sacrificing more on one side's profit, meanwhile can help the parties to reach agreement quickly.

CONCLUSIONS AND FUTURE WORK

We extend the current technique in automated negotiating agent and propose a linear regression concession model, which can predict the opponents' future offer trend and then dynamically adjust its negotiation strategy in response to the opponent's offer. We developed a prototype of an automated negotiating agent and conducted computer-computer negotiation experiments to validate the performance of the proposed system. The preliminary results are encouraging, when the negotiating software agent employs the linear regression concession model, it can achieve higher settlement ratio, seller utility, and joint outcome than other state strategy. The results demonstrate the potential of our negotiating agent techniques in enhancing the efficiency and effectiveness of the merchants' online transactions and increasing turnover rate as well as decreasing transaction cost.

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A Study on Business Ethics in Internet Commerce

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ABSTRACT

Although the rapid development of Internet commerce has brought new vitality for business model, it brings a lot of business ethics problems. This paper explores the business ethics in Internet environment. Because Information and Internet technology changes faster than business ethics, Business ethics lag arises. This results in ethics problems in Internet commerce. There isn't a particular Internet or e-commerce ethics, and the contents and norm of business ethics in Internet commerce are not fundamentally different from those in traditional commerce. However, the manifestations and scope of ethics issues in Internet commerce are different. The decision-making and implementation of ethics in Internet businesses environment differs from those in traditional businesses environment. The most prominent ethics problems in Internet commerce are online privacy and integrity. The governance of Internet business ethics should be conducted from three levels---institutional ethics, corporate ethics and individual ethics.

Keywords: Internet Commerce, Business Ethics, Online privacy, Ethics Governance.

INTRODUCTION

Wide application of Internet and information technology has brought changes in economic and social life, and has provided new vitality for the development of business models. New business models constantly emerge on Internet, at the same time the Internet business model brought many ethical problems ^[1].

For example, Baidu PPC promotion services which is launched by famous Chinese search engine company have been criticized. Search engine technology was originally used in providing information retrieval services for Internet users who fall into a vast sea of information. Search engine effectively collect, process and present information on the Internet according to user requirement. It is inevitable that companies construct business models and pursuit profits based on search engine technology. Baidu launched the PPC, Google launched ADWORDS. They let search results ranked according to bid. However, both of them abandoned the original criterion that information search results should be presented by its value. Baidu PPC undoubtedly helps Baidu company gain great commercial interests. Baidu's bid ranking contributed to 99% of its total revenue ^[1]. Although Baidu PPC does not violate the law, it undoubtedly violates business ethics in the eyes of the public. People denounced Baidu company because Baidu had provided false medical information in their search results ^[2]. In addition, Internet commerce companies can obtain a large number of users' privacy data. It has become worrisome problem whether companies could use these privacy data in compliance with legal and ethical issues. According to Reuters report, the US Apple employees can access iPhone users SMS, contacts, photos and other personal data through an undisclosed technology, and they don't inform their users ^[3].

Disclosure of these events raised concerns of people in the Internet age. Many Internet business ethics issues emerge, and their effects and consequences are amplified by the Internet. We have to think about business ethics in Internet commerce. Is there unique business ethics in Internet business models? Compared with traditional commerce activities, what are the most worrying business ethics problems in Internet commerce activities? And how to efficiently deal with these ethics problems in Internet commerce?

BUSINESS ETHICS IN INTERNET COMMERCE ACTIVITIES

Ethics is a norm which could manage behavior of individuals or groups, and it verify social norms or individual moral standards ^[4]. Ethics manage all spontaneous human activities, and obviously, it should manage commerce activities ^[4]. Business ethics would form when ethics is integrated into commerce activities. Business Ethics include ethics norms, values analysis and how to apply them in commercial organizations, institutions and activities ^[4]. Business ethics is a branch of applied ethics, which focuses on human commercial activities ^[5]. Business ethics involve not only handling the relationship with employees, leadership, shareholders within organization, but also handling the relationship with suppliers, customers, strategic partners, competitors, society outside the organization. Business Ethics cover all commercial activities from the inside and outside organization. The contents of business ethics involved in Internet commerce are same. But whether ethics issues in Internet commercial activities have its unique feature?

Internet commerce is no essentially different from traditional commerce. Both Internet commerce and traditional commerce include production, trading, purchasing, selling, consultation, cooperation, and so on. Ethics issues involved in Internet commerce are same as those involved in traditional commerce, such as fairness (digital divide), intellectual property, privacy and informed-consent, protection of children, security of information, trust, etc.. From this point, particular e-commerce business ethics does not exist. But ethics issues in e-commerce have different expressions and scope compared with that in traditional brick-and-mortar business ^[6].

Significant differences between Internet commerce and traditional commerce are forms and means of commercial activities. The application of information and network technology is a key feature that Internet commerce differs from traditional commerce. In 1990s, growing concern of business ethics focus on those ethics problems triggered by widely application of advanced information technology. Broadly speaking, Information technology includes computers, telecommunications and Internet technology. People can obtain, manipulate, process and exchange information through Information technology. IT changes the form of commerce activities. IT can even affect the structure and behavior of commercial organizations. For example, IT can enhance the competitiveness of enterprises, then competition become fiercer, then intense competition ask organizations to response quickly and nimbly, in the end this can promote organizational structure flat. When business ethics development is adapted to technology development, there is no business ethics problem. When technology change far exceeds business ethics development, business ethics lag emerges. This lag lies in the difference of culture and technology. The progress of technology may be huge, but the progress of culture, including ethics and moral, is always slow. This ethics lag leads to the lack of explore in E-commerce ethics^[6]. The change and innovation of information technology have brought new values which would collide with old values. The period of collision and reconstruction exactly corresponds with the period of ethics lag, and this ethics lag will damage business system because it would be harmful to agreeing on what is acceptable behavior in business activities^[6]. E-commerce rises rapidly, and the rapid development of technology continually bring new products, services, sales strategy, and business ethics problems^[7].

Whether different manifestations and scope of Internet commerce would lead to different ethics criterion? Both Internet technology innovation and Internet business model innovation are very quickly. In order to grow rapidly in dramatic changes, Internet companies often take some extreme competition strategy. For example, Internet companies often provide their users with free service, in order to gain competitive advantage through network externalities. Whether different ethical rules could be applicable in free services? Should free users accept intrusive advertising, spam, loss of privacy? Obviously, most people cannot accept these even though they are provided with free services. Although the business ethics rules expected by people in Internet commerce are not fundamentally different from those in traditional commerce, the practice of ethics principles and moral standards in e-commerce environment may be different^[6].

Yahoo was prosecuted in France in 2000 because Yahoo's French version allowed French people to access a auction website of Nazi memorabilia. Thus Yahoo France website blocked this Nazi memorabilia website, but people still could browse this Nazi memorabilia website through its US website. Although Yahoo company sued to US court to protest in 2005, its legal struggle is futile and may damage its business according to a related study^[8]. This may affect the reputation of Yahoo. The study suggests that companies should deal with this problem from the point of view of corporate social responsibility standards so that companies avoid those aggressive and anti-social expression^[8]. In the long run, this suggestion undoubtedly is beneficial to the development of enterprises. This example illustrates expression of business ethics in Internet commerce is more complex. Due to the cultural conflict of transregional and cross-border Internet commerce, Internet companies face more complex legal and moral hazard. In the practice of ethical rules in Internet environment, enterprises should be more cautious in the face of moral recommendations and injunctions. Certainly, enterprises' decisions of business ethics may be more complex.

How should Internet companies make decisions about business ethics? Internet service providers can choose to pre-screen and reject any content. Yahoo had claimed that it had right rather than obligation to choose or not choose pre-screen^[8]. However, the most popular search engine in the world, Google, took a completely different strategy. In 2002, Google quietly removed more than 100 controversial websites in its search results list, but it suffered intense criticism because it didn't discuss and explain its decision. Google removed anti-Semitic, pro-Nazi, white supremacist websites from Germany Google and France Google^[9]. Google spokesman announced that Google News would not allow hatred content^[10]. Google consciously avoided that racism spreads through Google website. Google took the initiative to adopt ethical norms of corporate social responsibility^[8]. Basically, Internet companies need to make an plan associated with corporate social responsibility, and they have to strive to balance its business ethics decision in complex Internet commerce environment.

BUSINESS ETHICS PROBLEMS IN INTERNET COMMERCE

According to the preceding, we know the contents and norm of business ethics in Internet commerce are not fundamentally different from those in traditional commerce. But some business ethics problems are more prominent in Internet commerce than in traditional commerce. There are two prominent ethics problems in Internet commerce. One is privacy problem, as a result of misuse of personal information collected by Internet companies, the other is integrity problem owing to digitizing and virtualization means of Internet commerce.

Privacy Problem

Information technology changes information collection, processing, using, exchanging fundamentally. The data of information systems can be easily generated, replicated and saved automatically. In-depth data analysis can be conducted through advanced data analysis and data mining techniques. Internet companies can use these data in a variety of commerce activities conveniently. For example, E-commerce companies can conduct marketing by analyzing a huge amount of user data accumulated in their e-commerce system. Internet commerce has significant advantage of data and information compared with traditional commerce.

If Internet companies can not exploit data and information advantage in compliance with ethics and morality, there will be serious ethics problems.

Whether information technology companies can protect privacy is a problem that people is very concerned about^[11]. The concern about online privacy is increasing with the popularization of the Internet. When people apply to become registered users or shop online, Internet companies can collect their identity card number, address, email, credit card number and other personal identifying information. When people access the website anonymously, companies can collect their click-stream data, IP address and other anonymous information. Companies can use this information to improve service for their customers. However, companies may use this information to send disturbing advertisements and e-mails. Only when people are able to control data collection and subsequent data use, their privacy can be safeguarded^[12].

A large number of disputes caused by online privacy demonstrate that online privacy problem is very serious. In February 2012, Google and some advertising companies monitored and tracked Apple users' web browsing habits without informing these users by bypassing privacy settings of Apple safari browser^[13]. Although Google argued that they didn't collect identifiable personal information, there is no doubt that Google violated users and damaged their right to know. Google violated business ethics of online privacy. Facebook also bypassed privacy protection of IE browser and tracked IE users with cookies^[14]. In China in 2008, 73.27% websites collect personal data exceeding services need, 4.75% websites collect information completely irrelevant to their services, 54.69% Internet users worry about online privacy, 26.43% Internet users believe that online privacy infringement seriously affect their online life^[15].

Because legislation on online privacy is inadequate, Internet companies have excessive discretion of online privacy, online privacy protection depends on companies' ethics and moral standards. Morality hazard would increase, and the complexity of business ethics would increase. Even in the US and EU countries, legislation on privacy is behind technology development^[16]. In the case of inadequate legislation, companies may decide how many privacy choices they are willing to give their users and how many data processing facts they are willing to reveal to their users. Internet companies can exploit the advantage of controlling data, they may ignore user's rights for commercial interests. A study indicate that online privacy just plays a minor role in corporate social responsibility even in Global 500 companies and Forbes top 1,000 IT-related services and products companies^[16]. According to the report of British "Financial Times", the executives and investors in US Silicon Valley finally admitted that they didn't realize global concern about online privacy^[17]. In short, Internet companies ignore business ethics of online privacy, they do not take it as an important issue in their corporate social responsibility.

Moreover, the rapid development of information technology, such as Mobile Internet technology, Cloud technology and Big Data technology, brings online privacy challenges. With the popularity of mobile Internet, various Internet services are extended to smart phones with lots of personal information. The leakage or misuse of personal information will damage users. Cloud technology means better use of resources and more business opportunities, but it may mean greater risk. Cloud technology means that users data security would rely on external. Users' data security will depend on their service provider's security technology capability and online privacy policy. Apple's iCloud allows users store personal information to Apple's servers, but people more worry about data security after Hollywood Pornographic incident^[18]. Accidents of online privacy would influence Cloud services. For example, Snowden event would cause great losses of the cloud service market^[17]. Big Data technology helps people find useful information rapidly from a large amount of data. This useful information can be used in the field of business, economics and public administration. Meanwhile Big Data technology brings online privacy challenges. The essential ethics criterion of Internet privacy is "inform and licensing". Internet companies would inform their users and get permission when they collect users' data. However, Big Data technology use data second time, and "Inform and licensing" of data collection seldom include secondary usage of data^[19]. The main ethics issue of Big Data is whether privacy laws and regulations can promote socially beneficial application of Big Data. In other words, whether Big Data applications are unacceptable to society or culture? What is the ethical boundaries of data analysis^[20]?

Integrity Problem

Integrity means following ethical values and obeying restrictions and regulations^[21]. A honest enterprise would comply with laws and regulations, and would not intentionally infringe benefit of customers, employees, and competitors by cheat, distorting, blackmail. The behavior lack of credibility and integrity would destroy trust, thereby would damage the development of business systems. Online integrity is the extension of social integrity on Internet. Individuals and organizations with integrity would be honest and trustworthy, not release fake information, not infringe the rights and interests of others on Internet.

Credibility and integrity problem has been bothering Internet commerce. Many companies choose to disclose business and financial information on its website, but the authenticity of this information is almost uncensored. A study finds that the credibility and integrity of financial information published on Internet of 100 large European companies is very worrisome^[22]. US data in 2011 shows that there are more than 300,000 complaint cases of Internet fraud for three consecutive years^[23]. According to an investigation of online fraud released by an famous Finnish security organization in 2014, 1 out of every 10 person in the world has become a victim of Internet fraud, victimization rate of Europe is 12%, and victimization rate of U.S. is

up to 20%^[24]. In China, integrity problem is more serious than the United States and Europe due to underdeveloped credit mechanism. February 2011, China.cn of Alibaba Group was exposed that global buyers were defrauded in international trading. In 2009 and 2010, more than 2300 suppliers in China.cn were suspected being involved in fraud, some Alibaba employees acquiesced or even helped these suppliers to evade authentication and verification by taking advantage of loophole in China.cn^[25]. The data show that more than 61 million Chinese Internet users encounter fraud in online shopping in 2011, and this resulted in the loss of more than 30.8 billion yuan according to an estimate^[26]. Integrity problem is harmful to the development of Internet commerce. To combat online fraud and illegal business is difficulty in technique and takes more social and economic costs.

Trust will reduce costs in Internet commerce, but building trust on Internet is particularly difficult compared to in the offline world. Trust is generally defined as the probability that two randomly selected persons will believe each other in a one-time interaction, and economists think that trust will reduce transaction costs^[27]. Empirical data shows that social trust has promoted e-commerce^[28]. Higher level of social trust, higher possibility of economic transactions between people. Trust is a key factor in reducing uncertainty and complexity in Internet commerce, but trust in Internet commerce is more complex. Firstly, technological innovative Internet would increase user's risk perception, and risk perception and trust are important factors that affect consumer behavior. A study on consumer trust and use of online financial services finds that trust in website would affect adopting intention^[29]. The study also finds that transaction security, reputation of websites and company would affect user's cognitive trust^[29]. A study shows that there are two factors of trust in online shopping, the first one is social trust that is consumers' perception of integrity of suppliers, the second one is technical trust that is consumers' perception of supplier capability^[30]. Secondly, virtualization and digitization of Internet commerce activities make trust-building more complicated. Direct face-to-face meeting is key to trust-building, but Internet commerce activities lack this effective interaction. It is difficult for consumers to trust in a unfamiliar online retailer, and it would take more time to build trust online than offline^[31]. In addition, e-commerce experience can promote general social trust^[32]. Anyhow, online trust is more difficult to be built, and the lack of online trust means more ethics risk.

BUSINESS ETHICS GOVERNANCE OF INTERNET COMMERCE

Enterprises must abide by business ethics standards, otherwise the business system can't develop in a healthy way. The behavior in accord with ethics can lay the foundation for mutually beneficial transactions between enterprises, and can promote cooperation. Although there is no strong evidence that ethical enterprises must have more profitability than unethical enterprises, the companies complying with business ethics provide a higher rate of return in stock market in a investigation of performance of socially responsible companies^[33]. Internet commerce has become an important part of current economic system. Therefore, the governance of business ethics in Internet commerce cannot be ignored now.

Business ethics include institutional ethics, corporate ethics and individual ethics^[4]. Institutional ethics refers to economic, political, legal environment of business; corporate ethics refers to activities, policies, structures, etc. of a particular organization; individual ethics refers to individual behavior, decisions, personality etc. in a organization^[4]. Consequently, the governance of Internet business ethics can be carried out from the three levels.

Improve Institutional Ethics of Internet Commerce

Business ethics needs to be institutionalized, and institutionalization refers to force of law and society. There should be rewards and penalties to specific behavior associated with business ethics according to the evaluation of stakeholder^[21]. The institutionalization of business ethics mainly includes two points: (1) obligatory laws and regulations; (2) non-obligatory self-regulation treaty (including industry guidelines, authentication and certification mechanism, etc.) .

In the United States, online privacy protection mostly relies on industry self-regulation. In 1998, US Department of Commerce issued the "Elements of Effective Self-Regulation for Protection of Privacy". The US Congress proposed the "Children's Online Privacy Protection Act of 1998", and the bill does require that websites should inform privacy policy and that websites need parental permission before they collect personal information of children under the age of 13^[34]. The bill was introduced on April 21, 2000. Highly developed Internet technology and e-commerce provide a strong impetus for US economy, so the US government always avoids excessive legal restrictions to online business. As for online privacy protection, the US government advocates industry self-regulation in order to avoid undue restrictions to the market. The Advantage of self-regulation is that the market can resiliently dynamically adjust according to industry regular pattern, thus this can avoid that the development of technology and economy is blocked by obligatory restrictions. There is a lack of uniform standards and powerful enforcement in industry self-regulation pattern, and online privacy infringement cannot be effectively resolved. In subsequent years after the introduction of these bills, online personal information were stolen more and more seriously according to Federal Trade Commission's data^[35] and other survey^[36]. Therefore, the United States turned to strengthen legislation to protect online privacy. In 2012 the United States issued the "Consumer Data Privacy in A Networked World: A Framework for Protecting Privacy and Promoting Innovation in the Global Digital Economy", detailed legal rules and regulations would be formulated and be legislated by the US Congress^[37].

Online privacy protection mainly relies on legislation in EU countries. The EU required its member states to establish a unified online privacy protection laws and regulations through a series of principles, guidelines and proposals. Moreover, the EU makes efforts to turn these into international criterion, and the EU request non-EU countries which have commercial intercourse with the EU to protect online privacy. Although the EU legislation is strict and meticulous, these restrictions may increase the cost of online service providers, even may hinder the development of technology and economy. In addition, the development of Internet technology is so rapid and the legislation always lags behind technology, it would become difficult that adequate online privacy protection can be provided.

Both obligatory laws and non-obligatory self-regulation treaty have advantages and disadvantages. Enhancing legislation is necessary to business ethics in Internet commerce, but the legislation should be circumspect. Hasty enactment of legislation and rigid laws may affect the vitality of Internet commerce. Promoting technology development and economic development need to be balanced in legislation process. In particular, online security and privacy problems incurred by Cloud computing and Big Data technology become big challenges for legislation. How to strengthen legislation without hindering technology development and reasonable application is very important.

In China, the challenges of online privacy and integrity is enormous. Learn from the experience of Europe and US, China needs to enhance both legislation and industry self-regulation in order to establish institutional business ethics of Internet commerce. At present, there is not complete laws of privacy protection in China, specially there is a significant lack of consumer privacy protection. In order to effectively protect online privacy, privacy legislation becomes principal. Meanwhile, industry regulations need to be improved systematically, including verification, evaluation, arbitration, sanctions, dispute resolution mechanisms. The lack of credit system is one of the important reasons for integrity problem in China. Inadequate legislation and poor enforcement lead to low cost of dishonesty, thereby the level of social integrity declines. First of all, establishing social credit system and improve related legislation become a prerequisite to resolve online integrity problem in China.

Owing to virtuality and anonymity of the cyberspace, the evaluation and supervision of online integrity is different from that of offline world. China needs to make more efforts to improve online credit evaluation system and to improve related techniques and methods.

Improve Corporate Ethics of Internet Commerce

Corporate ethics refers to ethical issues involved in organizational structure and behavior, including value orientation, fairness for others, etc. Employees' ethics decision-making in an organization differs from that in their private lives, because it is difficult for individuals to make ethical decisions independent of the pressure of organization. Corporate ethics has a very important impact on their employees. The corporate with a good business ethics can help individuals to make good business ethics decisions.

Corporate ethics is an important part of the corporate culture^[21]. Corporate culture is the explicit expression of corporate values, beliefs and customary rule. Corporate ethics should be consistent with not only laws and regulations but also social values. If a company does not manage its corporate culture effectively and its business ethics deviates from the social ethics norm, then the company will commit social suicide and the company may not achieve sustainable development in the future. Although the vitality of Internet commerce is amazing, the development of Internet companies will be affected if they do not effectively manage their business ethics in the pursuit of success and profits. Moreover, it would be difficult to keep Internet commerce grow healthy and orderly.

Corporate culture is from top to bottom^[21], so is corporate ethics. At the corporate level, ethical norms and guidelines need to be set up. It is necessary for Internet companies to train and supervise their employees about business ethics. In other words, corporate culture should make their employees understand what are acceptable behavior patterns about business ethics. It is very harmful for Internet companies to overlook business ethics in corporate culture. In 2012, Taobao.com corruption scandal not only badly damaged the reputation of Taobao.com but also affect Chinese people's trust on Internet commerce^[38]. Some employees of Taobao.com received bribes from online shop owners and helped them remove consumers' malicious comments and raise credit ratings. Since 2007, many staff of Taobao.com, including some executives, have been dismissed, but corruption remained intensified and it is very difficult to remove corruption thoroughly^[38]. This is because Taobao.com didn't put a high premium on business ethics in its corporate culture, thereby Taobao.com didn't have a system to curb corruption in the beginning. Taobao.com needs a effective supervision and incentives system to improve corporate ethics. In China, the scandal like Taobao.com corruption is not unique, improving corporate ethics in Internet commerce is urgently needed to be solved in China.

Improving Individual ethics of Internet commerce

Although institutional ethics and corporate ethics can restrict employees' behavior, people still have their own values that can affect their activities. So, it is necessary to improve individual ethics of Internet commerce. This include laws, regulations, social

ethics education and training. If the level of society ethics has increased, individual ethics will also be improved in Internet commerce.

CONCLUSION

Information and Internet technology develop very fast, so does Internet commerce. But the culture which includes morality and ethics develops slowly. The different developing rhythm of the two lead to that the pace of technology change is far greater than that of ethics development, then ethics lag arises. This is the reason of business ethics problems in Internet commerce.

There is no particular Internet or e-commerce business ethics, but business ethics in Internet commerce has different manifestations and scope compared with traditional business. Therefore, the practice of business ethics in e-commerce environment has its own characteristics. The two most prominent problems are online privacy and integrity. Especially, Mobile Internet technology, Cloud technology and Big Data technology bring challenge to online privacy protection.

To resolve these business ethics problems, the governance of business ethics in Internet commerce include three levels---institutional ethics, corporate ethics and individual ethics. At institutional ethics level, relevant laws and regulations should be improved, and industry self-regulation self should be enhanced. At corporate ethics level, Internet companies should manage business ethics in corporate culture and should establish a effective ethics supervision and incentives system from the perspective of long-term development. At individual ethics level, governments and society should promote social ethics development by laws, regulations, education and training.

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THE EFFECT PREDICTION OF ACQUIRING NEW CUSTOMERS BASED ON GONGTIANXIA'S DUTCH AUCTION¹

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ABSTRACT

With the development of the Mobile Internet, many E-commerce sites are using mobile applications to promote marketing and to acquire new customers, mobile marketing activities has become one of the best ways to expand market share. Therefore, it's very concerned to study how to acquire new customers effectively in the early stage of entering the market. Gongtianxia's WeChat public platform is committed to attract new customers through Mobile Internet. Gongtianxia adopted two kinds of Dutch auctions, '7-day auction' and '15-minute auction' respectively, which can effectively acquire new customers. This study collected more than 80000 of records, 738 pieces of auction data from June 2015 to December 2015 in Gongtianxia's Dutch auctions, by collecting, sorting and analyzing the auction data, and established a BPNN simulation and prediction model. The prediction model for each auction data can be used to predict the customer number, cost and blowout price in advance of the auction. This study can improve customer-attracting effect of mobile application and make a theoretical complement for Dutch auction as Mobile Internet sale, and enriches the research for acquiring new customers through Mobile Internet.

Keywords: Dutch Auction, Acquiring New Customers, Prediction Model, BPNN

INTRODUCTION

With the popularity of smart phones, mobile commerce becomes a new trend. At the end of June, 2016 China's mobile phone users reached 656 million (CNNIC, 2016). A lot of traditional enterprises are transforming their business to mobile internet, and want to acquire new customers through mobile devices. More and more traditional enterprises have recognized that their customer base is their valuable asset[1][2]. Previous studies have proved that the cost for developing a new customer is 5 to 9 times of that maintaining an existing one, thus new customers consume more business costs than loyal clients. However, gaining new customers is the first step to occupy a certain market share. So, how to develop new customers effectively and efficiently is very worthy of study. Conventional customer developing methods are diverse, such as manual dialing, messages, leafleting and hosting promotional events. These methods required huge capital and time costs but missing the expected customers responses. Enterprises urgently require to explore an effective marketing mode with more customer engagement to attract new customers [3].

Potential customers exploring is a significant activity for enterprise development [4]. Mobile Ecommerce has diverse methods to attract new customers including creating hot topics, advertising through Weibo and WeChat[5]. WeChat Subscription has become to a popular platform for mobile commerce enterprises to attract new customers since WeChat users has been rapidly increasing. However, existing models of data integration, data capturing, cost estimation and prediction performance of attracting customers can not address the need for varied marketing mode of mobile Ecommerce[6][7][8].

Gongtianxia is a B2C E-commerce website was built in 2011, devoted to providing high-quality agricultural products for customers[9][10]. GonTianxia platform classified the agricultural products according to the location such as Shanxi, Yunnan,

¹ Supported by NSFC No.91546125, No.71072147

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Hainan, and Guangxi, which are all Chinese provinces, providing nearly 5000 kinds of local products including snack food, dairy, meat, poultry, grain, condiments, nuts, vegetables and seafood. With the fast development of Wechat, Gongtianxia realized that the use of Wechat platform was a tremendous opportunity to attract new customers. In the end of 2014, Gongtianxia established a WeChat public platform and launched Dutch auctions, which are ‘7-day auction’ and ‘15-minute auction’[11]. ‘7-day auction’ and ‘15-minute auction’ are both descending price auctions with fixed total items number in which the auctioneer begins with a market price which becomes lower as time goes on according to the established rules, until the total items sold out. In ‘7-day auction’ the price will be decreased to next auction price in 10 pm everyday, at the last day the auction price will be decreased to 1 RMB. Likewise, the auction price will be decreased every 15 minutes during 105 minutes, at the last 15 minutes the auction price is 1 RMB in ‘15-minute auction’. But the total items number is fixed, when the items sold out, the auction automatically stop. During an auction, some participants would be willing to accept a certain price if there are still items available until the predetermined bottom price (1 Yuan in this case) is reached. However, blindly waiting for lower prices can lead to missing out on the auction given the limited availability of items. The average deal prices are usually lower than the regular price on the market. Gongtianxia’s Dutch auction lost hundreds and thousands of money, but it acquires almost 300 thousand new customers.

This study of Gongtianxia lays a strong emphasis on how to attract more customers with minimum cost on one auction. Theoretically, this research focuses on comprehensive analysis of online Dutch auction, WeChat marketing and new-customer attracting cost which is effective supplement for previous studies. Existing researches of online auction mainly emphasized particularly on pricing strategy and bidding strategy, ignoring the fact that Dutch auction, as a carrier of network marketing, can help bring new customers[12][13].

The rest of the paper is organized as follows. The next section (Section 2) is a literature review. This is followed by the research methodology in Section 3. We describe our research design and data analysis in the fourth section, and present the research discussion in the fifth section. We conclude the paper in Section 6 with contributions, limitations and directions for future research.

LITERAL REVIEW

Dutch Auction

Descending price auction is also known as Dutch auction, which is named for its best known event, the Dutch tulip auctions. Dutch auction is a type of auction in which the auctioneer begins with a relatively high asking price which is lowered until some participants are willing to accept the price[14]. Dutch auction is also used to describe online auctions where several identical goods are sold simultaneously to an equal number of high bidders[15]. In traditional Dutch auction, bids of increasing value are made until a final selling price is reached, because due to ever-decreasing bids buyers must act decisively to name their price or risk losing to a lower offer [16].

Most current researches on Dutch auction focus on mathematical calculation and experiment analysis. Guerci E. and Kirman A. (2014) proposed an original model of bounded rational behavior for wholesale buyers’ behavior incorporating learning to improve profits [17]. Artyom Shneyerov (2007) found that for optimal revenue-maximizing clock in a slow Dutch auction, where the clock falls over time, the clock is genuinely dynamic and the auction involves delays since the buyers are less patient than the seller [18].

Based on the basic theory of auction, we summarize the characteristics of Dutch auction as follows:

- (1) Dutch auction helps allocate market resources reasonably.
- (2) Dutch auction is conducive to buyers under the information asymmetry between buyers and sellers.
- (3) Dutch auction is a better decision for risk-averse buyers and sellers.

(4) Price methods of Dutch auction can prevent undesirable price discrimination that lessens competition or injures a small competitor.

(5) Dutch auction is a time-saving auction since the auction is concluded once the bidder makes an offer [19][20][21].

Online Auction Marketing

Online auction is defined by some scholars as ‘an auction in which both sides can bargain on the online platform offered by internet service providers’ [22].

Current domestic and international research of online auction was mainly conducted focused on following aspects:

Legal risks. Online auction is a new concept in China, at present there is no explicit laws and regulations as the basis, so it is particularly urgent to do research on the arising legal risks and countermeasure.

Credit evaluation. Yang J. (2007) proposed a new Credit Evaluation Index System based on users’ satisfaction survey, trying to compensate the deficiencies of early studies [23]. Zhou L. A. demonstrated the huge effects of sellers’ reputation on transaction outcomes in online auction marketplace [24].

Bidding strategy. Existed literatures mainly analyzed the dominant strategy in bidding based on the English auction [25].

However, this paper lays emphasis to how online auction attract new customers as a novel network marketing mode. Online auction is a relatively successful form of e-commerce. Both English auction and Dutch auction appeal to customers with low price. Therefore, online auction can easily lead to high-quality traffic and more effective trades, since new entrants in e-commerce market tend to promote their commodities in an online auction. [26].

In the aspect of the fundamental research, most scholars hold that online auction theory has the same foundation as the classic auction theory. Based on economic game theory, data analysis and field experiments are popular as a way of analyzing specific issues of auction. This study concentrates on how Dutch auction, as a marketing tool, brings in new customers. This topic is roughly classified as an auction revenue problem.

One of the major finding of auction theory is the celebrated Revenue Equivalence Theorem (RET) proposed by William Vickrey in 1961 [27]. The Revenue Equivalence Theorem states that any allocation mechanism/auction which meets the benchmark auction model will lead to the same expected revenue for the sellers. This theory is an applied branch of economics which deals with how people act in auction markets. However, it cannot be directly applied to online auctions. This study attempts to address this research gap through the case of Gongtianxia [28].

The Dutch auctions on Gongtianxia WeChat platform can attract customers and turn potential customers to valid ones, and has instructional significance to Customer acquisition management, which is worthy of study.

Generally, most researches on Dutch auction focused on analysis of gaming behavior between bidders and sellers, also expounded bidding strategy based on game theory. Dutch auction as an online marketing tool has been poorly studied; Moreover, most of the researches are only restricted in marketing modes and costs. This paper, based on online Dutch auction as an novel marketing approach, establishes a prediction model of per-customer attracting cost, new-customer quantity and blowout price through the analysis of how quickly new clients are added. Based on this model, it becomes possible for Gongtianxia to attract more customers and minimize the cost at the same time.

RESEARCH METHODOLOGY

Using BP Neural Network for Prediction

The current prediction methods which are comparatively popular and commonly used in academic circles include the following aspects: Causal analysis, such as Regression analysis. Judgment analysis is a qualitative research method that experienced management and operation personnel or experts can make sales forecasts over a certain time horizon relying on experience. SVM (Support Vector Machine) . In machine learning, SVM is a supervised learning model that analyzes data used mainly for classification. It requires full labeling of input data and is only directly applicable for two-class tasks [29].

Several factors have to be considered when selecting an appropriate neural network model. The dependent variables are numerical, thus SVM is inappropriate. Also, we make the correlation analysis by using the statistical analysis software SPSS as a tool, and found no obvious linear correlations between the independent variables. Thus regression analysis is also inappropriate.

Since Gongtianxia provides with available data, training of a neural network model could be supervised. Furthermore, the vector lengths and training set sizes were relatively small. This alleviated pressure to find quick and approximate methods for training. These considerations led to the selection of BPN, popularly called back propagation networks. It can be seen as a device which imitates the brain's functions. During the training process, the network will learn to ignore any inputs that don't contribute to the output. Thus, back propagation can minimize output error by iteratively descending the steepest gradient of the error surface. This is suitable for this case since the variables have multiple data types. Though it cannot reveal the relationships between the independent and dependent variables, repeated tests proved its acceptable error range.

Creating a model which relates input variables to output results has several uses. First, the management can take actions based on the effects that the auction conditions have on selling. Second, we can adopt a piece-wise analysis of input variables for their impact on the final product. Third, the relationship can be inverted so that desired customer-attracting effect can dictate certain auction conditions.

Data Processing and Analysis for Descending Price Auction Introduction for Two Kinds of Auction

Gongtianxia has two different types of auction: '7-day auction' and '15-minute auction', the daily number of new auction is about 1-3.

"7-day auction" form:

- (1) Each auction lasted for 7 days, the price will drop at 22 o'clock everyday, and for 6 times. For each time the price reduction gradient is different, and the price will drop to 1 RMB at the seventh day (also the last day) of the auction.
- (2) The total number of items is fixed for each auction, the number of remaining items displayed in the top of the auction, to show customers the real-time auction merchandise surplus, to gradually reduce the number of items to encourage customers to make a purchase, until the time the auction ends or merchandise sold out.

'15-minute auction' is similar to '7-day auction':

- (1) '15-minute-auction' start at 20:00 o'clock everyday and last for 105 minutes, and the price will drop every 15 minutes for 6 times in total with a different price gradient each time. Until the last time the price will drop to 1 RMB.
- (2) The presentation of the number of remaining items and the end of the auction mode is the same as '7-day-auction'.

AUCTION DATA COLLECTION AND PROCESSING

Data Collection

This paper focuses on the study of descending price auction's pulling effects on new customers, acquired a 191-day auction data from June 2, 2015 to December 9, 2015 for "7-day-auction", 253 times in total, and a 106-day auction data from June 1, 2015 to September 14, 2015 for "15-minute-auction", 485 times in total. Two kinds of auction data collection fields include product name, product information, starting price, starting quantity of a commodity, whether shipping, freight price and every auction price from the beginning of each, the sales records including a purchase of customer name, purchase quantity, the purchase price and the purchase time, a total of about 90,000 auction records. The amount of data is shown in table 1.

Table 1. Two kinds of auction data

Auction type	Auction time	Lasted days	Auction times	Auction records
7-day-auction	2015/6/1~2015/12/9	192	253	24840
15-minute-auction	2015/6/1~2015/9/14	106	485	63446

Independent Variable Selection

Two kinds of auction data collection fields include product name, product information, goods starting price, starting quantity of a commodity, whether shipping, freight, price and every auction price from the beginning of each, the sales records including a purchase of customer name, purchase quantity, the purchase price and the purchase time. While the product name and product information belongs to a text message. All the auction goods are local products, most of which are the food, beverage and supplemented, belonging to the same category of goods. Also, the price differences is not big. Therefore, this study will not consider the situation of divided types of goods.

(1) Auction type

According to Artyom Shneyerov (2014)'s research in the Slow Dutch Auction (SDA), lasting longer is more benefit to business, because business is more patient than consumers in the descending price auction[18]. This paper acquired two different auction types, "7-day-auction" and "15-minute-auction", lasting for different duration, and making the auction type as an independent variable to research.

(2) Starting price

Since this study cannot directly get the cost price of each auction item, and per-customer attracting cost is the cost of capital relative to the normal sale of goods, the price lower than the normal selling price of the auction will be treated as per-customer attracting cost. This study selects starting price as a reference, as the normal selling price, used to calculate the cost to pull new.

(3) Starting quantity

Number of auction items is a very important factor in a descending price auction. Oversupply of certain auction commodity can lead to the redundancy of goods at the end of the auction. If the quantity of an auction commodity is too small, the termination of the auction may occur in advance. How to set up an appropriate number of auctions, in order to ensure the normal auction and motivate consumers to make a purchase is very worthy of study.

(4) Shipping freight

Commodity prices during the descending price auction is tempting, but rational consumers will usually regard commodity transportation as an important reference standard, to decide whether to make a purchase[30]. Thus, whether the goods is "free shipping," or how much freight has also become an important reason for consumers to measure the value of the goods, which affect consumer willingness to buy.

(5) Price reduction gradient

Each auction has a total of the price reduction gradient for seven times, but each time the gradient of the price reduction are different, and at the last time price will be unified down to 1 RMB. The price of each auction after the price reduction will directly affect the cost of pulling new customer purchase behavior. Therefore, setting a reasonable price gradient can effectively improve the auction results. In this study, in order to make the price reduction gradient unified data visualization,

For each auction price statistics have been processed, the i^{th} price reduction gradient is as follows:

$$G_i = \frac{P_i}{P_1} \quad (1)$$

(While P_i represents the price after the i^{th} price reduction, P_1 represents the starting price of the commodity.)

(6) Starting date

According to the starting date and the three dependent variables' scatter plot analysis, we found that there is no clear upward or downward trend between the date and the dependent variable, and the selected data range is small, therefore, this paper does not include date variable as an independent variable to analysis. But some studies show that, for agricultural' regressive auction, there is a phenomenon called "Calendar Effect", existing "iconic point of time", like promotional factors can make the same volume of goods changed significantly. Based on this, whether the starting date is weekend or not is also important.

Dependent Variable Selection

(1) Blowout price

Blowout price is the price that brings the maximum volume of sales for each auction. The forecast for blowout price can guide businesses to push auction information or do other promotions to new customers, in order to improve the success rate of the customer's purchase. Meanwhile, blowout price affects the new customer attracting cost. The higher blowout price is, the lower new customer attracting cost is.

(2) New customer quantity

The customer who purchase on the Gongtianxia platform for the first time is a new customer. The data is collected from June 1st, 2015, so we save the original customer database to May 31, 2015, and there has been a total of 10,293 customers by then. We investigate new customer information from June 1, 2015 appears in every auction for both "7-day auction" and "15-minute auction", and then update the new customer to the original customer database. The second day's investigation will use the updated database, and in the next day the new customers' data calculation methods is the same. In this paper, we use Java program to achieve new customer daily calculation.

(3) Per-customer attracting cost

In this study, we use the starting price as the original price. A price gap due to the descending price mechanism can be considered as marketing expense for every sale. It aims to attract more new customers to buy successfully and maintain old customers to become loyal customers. We use the calculation formula for per-customer attracting cost to calculate every auction's cost as following.

$$C = \sum_{i=0}^n (P_1 - P_i) \times m \quad (2)$$

(While C represents auction cost, m represents every auction's quantity.)

According to the definition of independent and dependent variables, the data need calculation processing, shown in Figure 1.

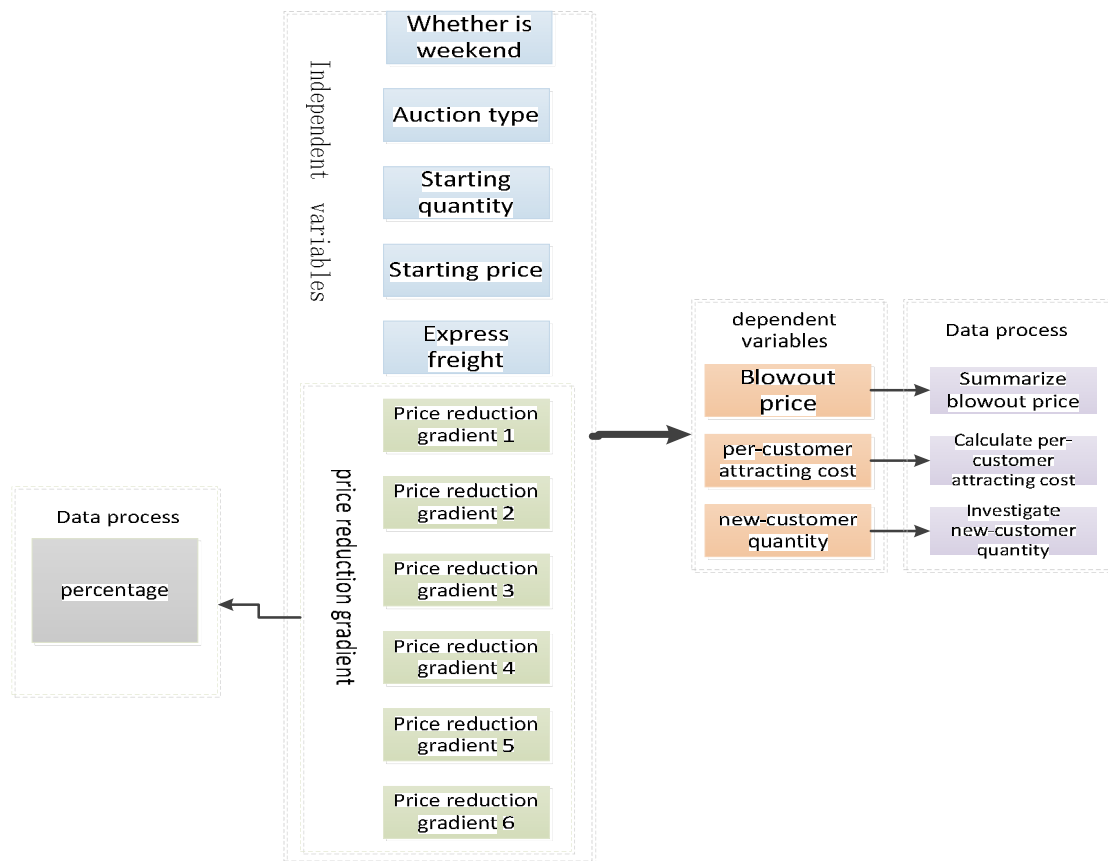


Figure 1. Model Variables

Auction data analysis

"7-day Auction" is Better Than "15-minute Auction"

In a slow Dutch auction, if the auction last longer, the sellers can get more profit, since businesses are more patient than customers[18]. Therefore, this paper use auction data to compare these two types of auctions' per-customer attracting cost and new-customer quantity.

Table 2. Analysis of Per-customer Attracting Cost and New-customer Quantity for Two Auctions

Auction type	Auction times	Total new-customer quantity	Total customer attracting cost	Average of new-customer quantity	Average of new-customer attracting cost	per-customer attracting cost
7-day auction	253	4316	660494	17.0593	2610.648	153.5675
15-minute auction	482	8277	1775729	17.1722	3684.085	214.191

Currency Unit:RMB

From the table, the average of new-customer quantity for "7-day auction" and "15 minutes beat" is nearly same, in the second half of 2015, each auction has pulled around 17 new customers, which shows that two kinds of auctions' pull new effect is approximately the same. But in the case of new-customer pulling effects, 7-day auction's average customer attracting cost and per-customer attracting cost is less than "15-minute auction", that is, "7-day auction" can help businesses save the cost of capital, which is same with Artyom Shneyerov's conclusion.

Free Shipping Has Positive Effects on Auction Effect.

Commodity prices during the auction is tempting, but rational consumers will usually use if shipping goods as an important reference standard, to consider whether to make a purchase [30]. So this paper will use if free shipping as an argument for a more detailed analysis. To make data analysis more regularity, two kinds of auction data integration, increase the amount of data to enable analysis persuasive. Now integrate two auction's data to analyze and calculate.as shown in table 3.

Table 3. Data Analysis for Free Shipping(1)

	Average of new-customer attracting cost	Average of new-customer quantity	per-customer attracting cost
All auctions: 735	3314.59	17.13	196.46
Free shipping auctions:381	2927.74	16.61	176.28
Not free shipping auctions:354	3730.94	17.70	210.81

Currency Unit: RMB

From the table, free shipping has almost no impact on the average of new-customer quantity, Average of new-customer quantity is 17, but per-customer attracting cost is reduced and form polyline. A brief description is that free shipping can reduce per-customer attracting cost.

The starting price of goods usually has some effects on whether the customer to make a purchase. If the starting price is high and the price drop by a big margin, customers will feel encouraged to buy because of the greater perceived benefits for customers. In order to explain the number of free shipping's new-customer quantity is unchanged, and per-customer attracting cost reduction issue, we calculate some other variables, as average starting price, average blowout price, average of purchase times and new customer proportion. As the table 4 below:

Table 4. Data Analysis for Free Shipping(2)

	Average of new-customer attracting cost	Average of new-customer quantity	per-customer attracting cost	Average starting price	Average blowout price	Average of purchase times	New customer proportion
All auctions: 735	3314.59	17.13	193.46	37.55	12.81	149.39	8.57%
Free shipping auctions:381	2927.74	16.61	176.28	44.39	17.81	109.93	16.20%
Not free shipping auctions:354	3730.94	17.70	210.81	30.19	9.60	191.85	5.00%

Currency Unit: RMB

Starting price of free shipping auction is 44.39 RMB for 381 times on average, and is 30.19RMB of not free shipping auction for 354 times on average. This result demonstrate that the starting price of free shipping goods are usually higher, although the starting price is higher but because of the free shipping promotion that the average of new-customer quantity is not significantly reduced, but maintained the same with the level of no free shipping auction. Therefore, free shipping can contribute to new customers to buy higher starting price of commodities.

Variable Correlation Analysis

In this study, we define 11 independent variable: whether is weekend, auction type, starting price, starting quantity, express freight, price reduction gradient 1, price reduction gradient 2, price reduction gradient 3, price reduction gradient 4, price reduction gradient 5, price reduction gradient 6; and 3 dependent variable, per-customer attracting cost, new-customer quantity, and blowout price. This paper uses SPSS to analyze the correlation between the independent variables and the dependent variables. Correlation analysis is associated with two or more of the variable element analysis to measure how closely two

variables related.

This study respectively analyzes the relevance between independent variables and the dependent variables for both “7-day auction” and “15-minute auction”, to see if their relevance is high. The results of correlation analysis of independent variables and dependent variables are shown in the following table.

Table 5. Correlation Analysis Summary Table

R value	Whether weekend	Auction type	Starting price	Starting quantity	Express freight	Gradi ent 1	Gradi ent 2	Gradi ent 3	Gradi ent 4	Gradi ent 5	Gradi ent 6
blowout price	0.003	0.061	0.833	0.261	0.287	0.317	0.403	0.463	0.523	0.569	0.652
per-customer attracting cost	0.195	0.024	0.470	0.677	0.153	0.444	0.479	0.485	0.456	0.415	0.272
new-customer quantity	0.082	0.210	0.067	0.565	0.022	0.394	0.375	0.346	0.328	0.305	0.055

(Categorical variables' correlation analysis use Spearman correlation coefficient. The correlation coefficient with the classified nature is the same with Pearson coefficients.)

The above table shows that the most independent and dependent variables is moderately or weakly correlated, and the significance is not obvious, so this paper use BPNN(BP neural network) model, which doesn't require high correlation to do experiment to find higher accuracy rate for forecast model.

BP NETWORK PREDICTIVE MODEL

Modeling Steps

This study selected BP neural network algorithm to build predictive model, BP neural network (back propagation neural network) is a Multi-layer feedforward neural network. The network topology diagram is shown as following, auction type, Starting price, Starting quantity, Shipping freight, Price reduction gradient and starting date is the input of BPNN, blow out price, new customer quantity and per-customer attracting cost are the predictive value of BPNN. For the forward pass, the input signal coming from the input layer goes through the hidden layer and receives processing until it reaches the output later. The states of neurons in each layer only affects the next level. If the output layer does not output the desired result, then enter the back-propagation phase of errors, adjusting the network weights and thresholds based on the prediction error, to make the BP neural network output closer to the desired output.

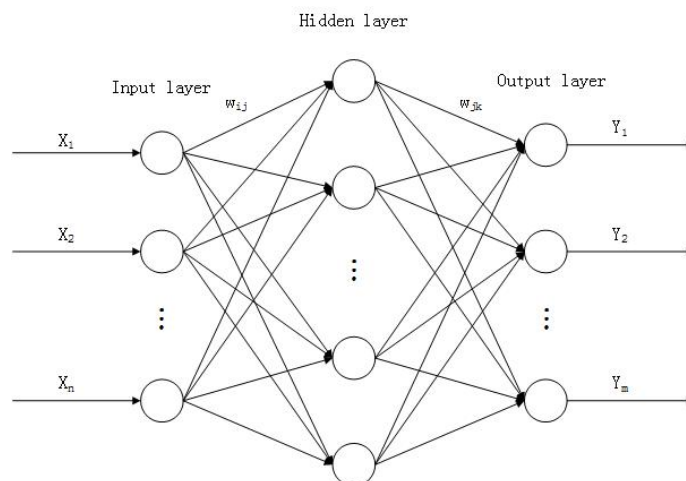


Figure 2. BP network topology

BP neural network can be seen as a non-linear function, the network input and predicted values respectively represent the independent and dependent variables of the function. and are the BP neural network weights, when the input node number is n , output node number is m , BP neural network is expressed from the n independent variables to the m dependent variable function mappings.

BP neural network training process includes the following steps.

Step 1: Network initialization. According to the system's input and output sequence (X, Y) to determine the network nodes in the input layer n , hidden layer l , and output layer m , to initialize the connection weights between the input layer, hidden layer and output layer and , to initialize the threshold of hidden layer a and the output layer threshold b , given the learning rate and neuronal excitation function.

Step 2: Hidden layer output calculation. According to the input variable X , the connection weights between the input layer and hidden layer, and hidden layer threshold a , to calculate hidden layer's output H .

$$H_j = f\left(\sum_{i=1}^n w_{ij}x_i - a_j\right) \quad j = 1, 2, \dots, l \quad (3)$$

While l is the number of the hidden nodes; f is hidden layer activation function.

$$f(x) = \frac{1}{1 + e^{-x}} \quad (4)$$

Step 3: Calculate the BP neural network prediction output O .

$$O_k = \sum_{j=1}^l H_j w_{jk} - b_k \quad k = 1, 2, \dots, m \quad (5)$$

Step 4: Error calculation. Calculate the gap between predicted output and the desired output e .

$$e_k = Y_k - O_k \quad k = 1, 2, \dots, m \quad (6)$$

Step 5: Update the weights. The network update the connection weights w_{ij} and w_{jk} , according to the prediction error .while η is the learning rate.

$$w_{ij} = w_{ij} + \eta H_j (1 - H_j) x(i) \sum_{k=1}^m w_{jk} e_k \quad i = 1, 2, \dots, n; j = 1, 2, \dots, l \quad (7)$$

$$w_{jk} = w_{jk} + \eta H_j e_k \quad j = 1, 2, \dots, l; k = 1, 2, \dots, m \quad (8)$$

Step 6: The threshold updating. According to the network predict error e to update the new network node threshold a, b .

$$a_j = a_j + \eta H_j (1 - H_j) \sum_{k=1}^m w_{jk} e_k \quad j = 1, 2, \dots, l \quad (9)$$

$$b_k = b_k + e_k \quad k = 1, 2, \dots, m \quad (10)$$

Step 7: Determine whether the end of the iterative algorithm, if not finished, return to step 2.

Hidden Layer Node Selection

The selection of the number of the hidden layer node in BP neural network has a great impact on the prediction accuracy: if the number of nodes is too small, it will lead to increased training times, so the network is not very good at learning; if there are excessive number of nodes, the training time will increase, and it will be easy to produce the phenomenon of over-fitting. The optimal number of hidden layer nodes can be determined with reference to the following formula:

$$l < n - 1 \quad (11)$$

$$l < \sqrt{(m + n)} + a \quad (12)$$

$$l = \log_2 n \quad (13)$$

While n is the number of input nodes, l is the hidden layer nodes, m is the output layer nodes, a is an arbitrary constant between 1 and 10. Firstly, referring to experiment formula to determine the approximate range of the number of nodes, and then use trial and error method to determine the real number of the best node.

Performance Function

This paper use the Mean Squared Error (MSE) to describe the prediction accuracy, because the Mean Squared Error is better than The Mean Absolute Error (MAE) to measure the accuracy of the prediction value. The prediction error variance formula is:

$$\text{MSE} = \frac{\sum_{i=1}^n e_i^2}{n} = \frac{1}{n} \sum_{i=1}^n (y_i - \hat{y}_i)^2 \quad (14)$$

y_i represents the desired output, \hat{y}_i represents the actual output.

Model Data and Network

Experimental Data

Experiment uses 735 times ("7-day auction" 253 times, "15-minute auction" 482 times) auction data as the experimental data, select 90% of the data (660 times auction) as training data set, 10% data (75 times auction) as the test data set, each experimental data are randomly selected and normalized process to improve the accuracy of the experiment. The normalized process formula is as following:

$$x_k = (x_k - x_{\min}) / (x_{\max} - x_{\min}) \quad (15)$$

Input Variables

In order to improve the accuracy of prediction models, the experiment will use different combinations of variables. One group of all 11 variables as input variables, which is named as a full-variable model. Another group selects variables that have a weak correlation and above weak correlation with output variables, called variables related models. Thereby selecting a set of minimum error combination of variables as a predictive model input variables is namely the most appropriate combination of input variables to determine the network model.

Each output variable corresponding to the input variables is uncertain and cannot be predicted through using the same BP neural network. As for three different output variables, we establish BP neural network to predict them separately. In this paper, we use per-customer attracting cost forecasting model as an example and do experiments use Matlab R2014a software.

New-customer Attracting Effects Forecast

For per-customer attracting cost forecast model, use the full-variable model and the related variables model to do the experiments separately. We select “trainlm” as training function. And the network hidden layer neurons and output layer neuron transferring function is “tansig”. Because the data is processed after normalization, the input vector and the target vector elements are located in $[-1,1]$, so the transferring function can meet “tansig” output requirements. Codes are as follows:
`net=newff(input_train,output_train,s(i),{'tansig','tansig'},'trainlm');`

Network training parameters are as follows:

`net.trainParam.show = 100;` display the number of steps between the two training, every 100 cycles.

`net.trainParam.mc = 0.9;` network momentum factor.

`net.trainParam.epochs = 10000;` training times.

`net.trainParam.lr = 0.05;` learning rate.

`net.trainParam.goal = 0.001;` desired target minimum error.

The comparison situation of 2 sets of variables predictive model is shown in Table 6:

Table 6. Per-customer Attracting Cost Network Structure Comparison Table

per-customer attracting cost	Hidden node	Training function	MSEvalue
full-variable model	6	Trainlm	0.0028
related variables model	3	Trainlm	0.0016

MSE for related variable model has a value 0.0016, less than full-variable model, so we select the related variables and set the number of nodes as 3. The training function “trainlm” is the per-customer attracting cost’s network prediction model. Fig 3, fig 4 are respectively the error curve and prediction model comparison chart for this model.

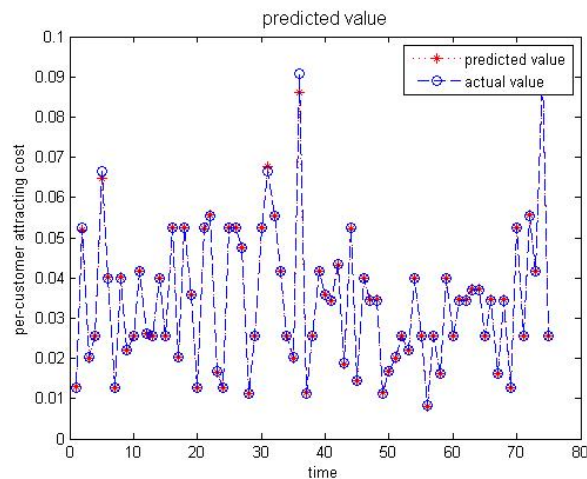


Figure 3. Model Error

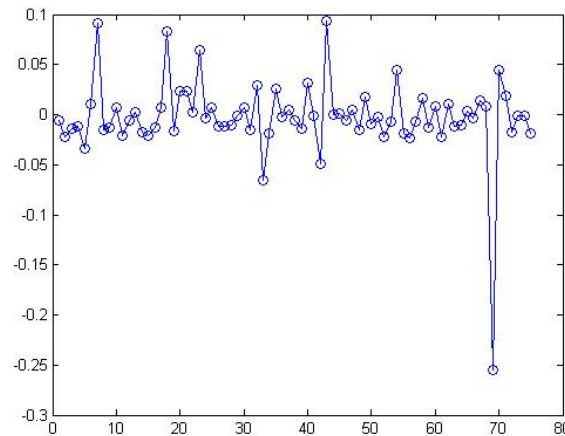


Figure 4. Comparison of Model Predictions and Actual Results

The red markers represent predicted value in fig 4, and blue markers represent the actual value. It can be seen from Figure 4, the prediction results and the actual value are highly fitting, so the prediction error is small. In fig 4, in addition to individual extreme external value, the prediction error is between the basic -0.05-0.05. We guess the reason of extreme values is the amount of data involved in the training of the network is too small.

Related variables model's regression model diagrams are shown in Figure 5, wherein the abscissa is the target value, the vertical axis is the output of the network. In the Figure Training, Validation and All map, data fits very good, because the curves are basically on the diagonal and there is no over-fitting phenomenon. Figure Test has some errors, but the errors are still within an acceptable range. Therefore, using related variables model to predict per-customer attracting cost is better.

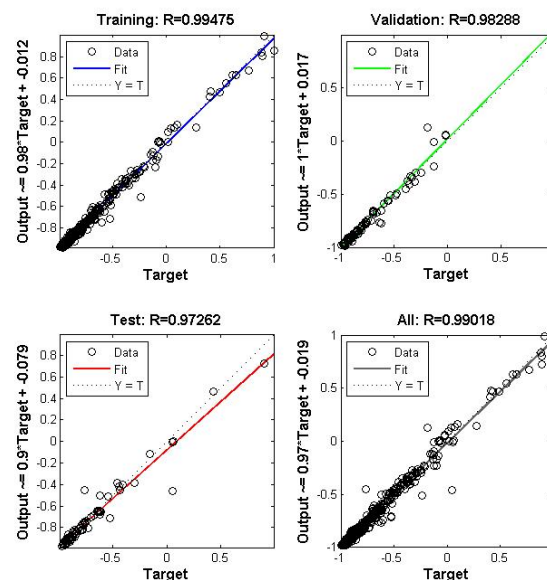


Figure 5. Per-customer Attracting Cost Regression Model

Use the same way to predict the new-customer quantity and blowout price. The results are as follows:

Table 7. Results

Model type		Hidden node	Training function	MSE value
blowout price	full-variable model	5	Trainlm	0.0013
	related variables model	7	Trainlm	0.0031

new-customer	full-variable model	7	Trainlm	0.0162
quantity	related variables model	3	Trainlm	0.0022

Blowout price forecast should use full-variable model, because the number of hidden layer nodes is 5 while MSE is 0.0013. New-customer quantity prediction model should use the related variables model, so the number of hidden layer nodes is 3.

Comparative Experiment

In order to verify the accuracy of BP neural network model to predict the effect, we used multiple linear regression, RBF neural network and SVM regression to do the comparing experiment. The results of MSE are in the following table.

Table 8. Different models prediction error

MSE value	per-customer attracting cost	new-customer quantity	blowout price
BP neural network	0.0016	0.0022	0.0013
Multiple linear regression	0.0849	0.0526	0.0391
RBF neural network	0.1054	0.0192	0.0271
SVM regression	0.0672	0.0456	0.0309

By comparing the experimental discovery, the error of BP neural network prediction model is much smaller than the other three comparison model. The multiple linear regression and SVM regression models are also able to achieve a certain precision, but the nonlinear fuzzy mappings forecast is not as effective as BP neural network. RBF neural network prediction model has larger errors, and its prediction results are easily affected by the number of expansion function and the number of neurons. Thus, the BP neural network prediction model is more accurate and stable.

Conclusion

The auction of Gongtianxia specialty network micro-channel public number use marketing campaign of low price that below cost price to attract a large number of potential customers to make purchase to become sticky customer. this paper use the auction data of Gongtianxia's micro-channel public number from June to December in 2015, to analyze the influencing factors of Dutch auction's pull new effects, include per-customer attracting cost, new-customer quantity, and blowout price. At the same time, we use SPSS software to do the correlation test, and do a more comprehensive analysis of the impact of factors on the auction time and free shipping for pull new effects, the following conclusions:

(1) The average of new-customer quantity for "7-day auction" and "15-minute auction" is nearly same, but 7-day auction's average per-customer attracting cost is much lower, and new customer's purchase number is much more. this is because network purchase's sensible reasons have more proportion than emotional reason, customers need more time to analyze the cost of goods, and thus make a choice when they make purchase on the internet. This means Slow auction or auctions of longer duration are more likely to attract new customers to make purchasing decisions to help businesses reduce the cost of capital, to get more benefit.

(2) Free shipping is almost no effect on the average number of new-customer quantity, but it can decrease the average of per-customer attracting cost, it means free shipping is easier to attract new customer, because free shipping can satisfy customer's expect of network shopping's low price, and make customer more likely to make purchase decision, so free shipping can help businesses reduce the cost of capital, and get more profit.

In this paper, we use BP neural network model to predict blowout price, new-customer quantity, and per-customer attracting cost respectively. These three variables are a measure of the effect of pulling new customer. By changing the number of nodes

in the hidden layer and input variable combinations to do comparative tests, we find the minimized error and get the best effect prediction models. Through comparative experiment to verify the accuracy of BP neural network model, we determine the network structures shown in Table 9:

Table 9. Predictive Model Network Structure for Three Dependent Variables

Prediction variables	variable combination	Hidden node	Training function	MSE
blowout price	all-variable model	5	Trainlm	0.0013
per-customer attracting cost	related variables model	3	Trainlm	0.0016
new-customer quantity	related variables model	3	Trainlm	0.0022

Blowout price, per-customer attracting cost, and new-customer quantity, these three variables predictive value can effectively predict every auction's new pull effect and guide businesses to make reasonable designs about auction type and marketing strategy, in order to improve the ability to attract new customers and effectively lower the cost of capital caused by the descending price auction.

The research of this paper can complement for Dutch auction as Mobile Internet sale, and enriches the research for acquiring new customers through Mobile Internet. The conclusion of this paper can help the companies improve their acquiring new customer strategies in Mobile Ecommerce.

There are also some limitations in this paper, such as limited independent variables, due to the diversity of auction items included in the experimental data. Considering the ability to attract new customers is different, if business wants to improve the accuracy of the prediction, the effect of different commodities can be added into research, which means the auction data can be divided by type of goods. Meanwhile, the auction title's incentive and product images' colors will also have a certain impact to customers. In addition, different auctions have different proportions of new and old customers. Different products and different design of auction type also have different attracts to customer. A more detailed analysis of the kind of merchandise and type of auction will improve the pull-new-customer effect more obviously.

Acknowledgment

This paper support by National Natural Science Foundation of China(No.91546125).

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The Study on the Usability for Tourism Websites of Scenic Spots -Took Hainan Province as the Example

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ABSTRACT

At present, people pay more and more attention on the usability of tourism websites. The websites with poor usability can not bring good experiences for the users. For good scenic spots, good experiences can bring the positive propaganda and poor website experience can made the tourists abandon the trip their destination trip. The paper made the comparison and exploratory research for the web portals of tourist attraction in Hainan. By using the evaluation methodology of correction and elicitation, the writer made sure the index to the websites made by users. The paper analyzed the questionnaires based on 5 categories and 30 indexes, discussed present construction status of tourism website for the scenic spots in Hainan province, searched the relation between the star level and usability for the tourist spots, researched the influences to the trip of travelers caused by website usability and found out the insufficient of trip website construction in the scenic spots of Hainan province to improve the management level for the tourist destination and tourist spot, provide theoretical basis for the plan of trip promotion and improve the quality of traveling experience for travelers. In the paper, the research meanings are as follows:

1. The paper used the method of correction and enlightenment and took the feeling of tourists (who browsed the website) into consideration. By using 5 categories and 31 usability indexes of tourism website, the writer made the modeling and assessment for the tourism websites of scenic spots in Hainan. From five aspects, such as language, page structure and design, information structure, user interface and navigation mark and the whole part, the writer made omni bearing and deep assessment for the tourism websites of scenic spots in Hainan. He knew fully the deficiencies and provided the suggestions and opinions for the construction of tourism website in Hainan.
2. The aim of the paper is researching the relation among star level and usability and so on for Hainan scenic spots and finding the deficiencies for the tourism website usability of Hainan scenic spots to put forward relative improvement measures and helped servers who provided the tourism information to improve the tourism service and provide more convenient, timely and efficient tourism information. It aims to improve the management level for travel destination and scenic spots and provide theoretical basis for the plan of trip promotion.
3. Finding out the influences to scenic spot expectation of tourists made by websites of tourist attraction to understand well the influences to scenic spot propaganda made by the website of tourist attraction.

Keywords: Tourism website, usability, expectation.

RESEARCH STATUS

With the rapid development of the Internet, it is urgent to study the usability of the website. Presently, scholars offered various definitions from the perspective of technology and users but failed to separate the essence of efficiency and satisfaction. Travis (2003) stated that website usability refers to the efficiency, effectiveness and satisfaction of users embraced after browsing the fixed website, realizing the fixed aim and searching the useful information. From the optimization of websites, Wang Qing (2011) defined the usability as the website design could satisfy users' information-searching need and the interaction of interface could support the operation of the website, which involved the security of interaction process, users' performance, learn-ability and users' satisfaction with products. On the premise of gaining the global data, Yuanhong (2010) made a further analysis on the definition of website usability by using the method of cluster and hierarchical thinking; and also, did the website usability experiment in 29 universities in Jiangsu Province. With reference to the literature, the definition of usability in this dissertation is the efficiency, effectiveness and satisfaction of the user to complete a given target.

The enhancement in website usability has a big significance of website construction and scholars evaluate the usability from different points of view. Liu zeng (2009) pointed that focus on the users is the key to construct the website. From the perspective of users, this website offered the usability standard and usability evaluation system standard on base of engineering theory. Based on the engineering theory, we concluded the features of website design and conceive the standard of website usability evaluation. Lei Yinzhi (2011) pointed that the usability degree affects the utilization efficiency of website by quoting the example of e-government website "e-Beijing" and testing the usability. Then put forward that the design concept should be adopted and focus on the users and usability evaluation, so as to boost the propinquity, service efficiency and change the actuality of information-jam in government websites and high charge in website maintenance. With the deepening of the research, there are more and more research methods in website usability. Au Yeung and Law (2004) classified the usability research steps into four parts, which included the evaluation of website usability indexes, questionnaire designing and collecting, questionnaire analysis and offering the improved suggestion.

There are four steps adopted in usability analysis of most website. For example, Abeleto (2002) enumerated 56 indexes of

website usability valuation in his essay, which include five categories, language, website structure design, information structure, user linking navigation and general impression. Tao. Hu and Law amended the conclusion of Abeleto and put 24 indexes of website usability valuation applying to the mainland travel, which includes five categories, language, website structure and design, information structure, users' interface and website navigation indication and the entirety. Sandeep made the usability evaluation of Britain websites by using heuristic approach, consumer survey and tool-testing method. Ke Qing extracted the data from browsing the websites and analyzed the usability in interface information, page view, website construction, website function and browser feelings, which offered a new idea in viability calculation by exploring the usability computing method and value internal.

RESEARCH METHOD

The Modeling Process of Usability Evaluation

Based on the evaluation index of usability for the tourism websites of Chinese Mainland which was put forward by Hu Tao, according to the practical situation and features of Hainan tourism websites, the paper made the modification and put forward 30 evaluation indexes of usability with five dimensionalities which suits to the websites of scenic spots. According to different indexes and the scores made by the tourists who browsed the official websites of scenic spots, in the paper, the writer used the method of likert five scale and got such result- the highest score is five and the lowest score is 1. And then, the writer worked out the evaluation value for the usability of different dimensionality and index and he got the evaluation values of usability for the scenic spots of different star levels and the total valuation values of usability for official websites of Hainan scenic spots. The detailed computing methods are as follows:

The whole evaluation system was consisted by five dimensionalities and every dimensionality has M index; in every dimensionality, we should work out the contribution weight for user satisfaction degree made by the indexes, namely the importance factor, the computing method is as follows:

$$I_r = \frac{\bar{C}_r}{\sum_{i=1}^m \bar{C}_i} \quad (1)$$

r means the index serial number of the index; $r=1,2, \dots, m$

m means the index number of the dimensionality

\bar{C}_r : means the average score of r

\bar{C}_i : means the average score of index I

I_r : means the importance factor of r; $r=1,2, \dots, m$

Importance factor means the contribution degree to the usability of the dimensionality made by the index; in the same dimensionality, the sum of the importance factor of every index is 100%.

For every index, we should average the score, according to the satisfaction degree we got and the computing method for the usability is as follows:

$$U_r = (\bar{C}_r - 1) * I_r * 5 \quad (2)$$

In the same dimensionality, the sum of usability value for all indexes is the usability value of this dimensionality and the sum of the five dimensionalities is the usability value of the tourism website. Based on the evaluation system of usability in this paper, we can make the quantification for the usability evaluation value for every index of every website of every scenic spot and the contribution level of every index; so the computing method for the evaluation value of every dimensionality is as follows:

$$D_i = \sum_{r=1}^m U_r \quad (3)$$

The whole evaluation value of usability for the website

$$H = \sum_{i=1}^5 D_i \quad (4)$$

I means the value number of dimensionality; i equals to 1, 2, 3, 4 and 5

U_r : means the usability evaluation value of r

D_i means the usability evaluation value of I

H means the whole usability evaluation value for the websites of scenic spots

The scope of usability value for every dimensionality is from 0 to 20; the change scopes of the whole usability for websites of scenic spots is from 0 to 100, which meant the different levels respectively; the scope from 0 to 20 means the very poor evaluation for the usability of the website made by the users; the scope from 21 to 40 means poor evaluation for the usability; the scope from 41 to 60 means the usability is on the average level; the scope from 61 to 80 means good evaluation and the scope from 81 to 100 means the usability evaluation for the website of scenic spot is excellent.

AVAILABILITY ANALYSIS FOR THE WEBSITE OF SCENIC SPOT

Availability Analysis

Because most respondents were students, the age scope is from 18 to 25 91. Such people were most and accounted for 91.7%; people whose household incomes per capita below RMB 3,000 accounted for 32.4%; people whose income scope is from 3,001 to 5,000 accounted for 43% and people whose income scope is from 5,001 to 10,000 accounted for 20.6%; such people are least whose income exceeded 10,000 and they accounted for 4%; for most respondents, their network ages are 7 years, 8 years and 9 years; the people number is 201 which accounted for 45.9%; people whose network ages exceeded 10 years accounted for 30.4%; it was decided by the main internet environment background of the respondents and students know the network early than other people; the respondents whose time online exceeded 30 hours accounted for 38.3%, whose time online scope is from 21 to 30 hours accounted for 38.3%, whose time online scope is from 5 to 10 hours accounted for 12.5% and whose time online is less than 5 hours only accounted for 10.1%. It was caused by such situation- nowadays, people usually take along their mobile phones and they always browse the websites to get relevant information, by using the mobile phone at any time and any place.

Table 1: website usability evaluation results

	coefficient of importance	3A	4A	5A
language		14.23	15.94	17.29
1. correct spelling and grammar	0.33	4.63	5.19	5.71
2. using standard language	0.34	5.10	5.53	5.95
3. the title is same with the theme	0.33	4.49	5.22	5.63
page structure and designing		13.11	14.86	16.28
1. the color of characters must be readable	0.14	2.05	2.27	2.45
2. with no horizontal axis	0.13	1.85	2.04	2.15
3. web page with moderate length	0.13	1.79	1.93	2.08
4. images with suitable size	0.12	1.61	1.75	1.91
5. contents with clear division	0.13	1.63	1.87	2.08
6. with few distraction	0.12	1.33	1.60	1.80
7. information of the web page could express the real content	0.12	1.41	1.72	1.98
8. images are not the main way to express information	0.12	1.43	1.68	1.84
information structure		11.13	13.34	15.30
1. be connected with the former site	0.18	1.80	2.13	2.45
2. guiding marks should be clear and available to browse	0.22	2.82	3.16	3.51
3. information should be updated in time	0.18	1.64	2.28	2.61
4. be connected with other relevant travel	0.19	1.95	2.40	2.92

website				
5. matching the images with the description	0.22	2.92	3.36	3.81
User Interface and Navigation		12.89	14.75	16.07
1. internal linking is normal	0.17	2.37	2.72	2.99
2. roller in homepage should not be used	0.16	2.02	2.32	2.51
3. with proper marks of navigation	0.17	2.22	2.47	2.70
4. clicked internal linking should be bold	0.16	1.86	2.14	2.31
5. return button is normal	0.18	2.59	2.87	3.06
6. searching results in website is accurate and usable	0.16	1.82	2.23	2.48
in entirety		10.74	12.32	14.31
1. it is unnecessary for users to learn latest tech	0.15	2.33	2.44	2.63
2. with high display speed	0.14	1.78	1.94	2.12
3. with reasonable arrangement of website content	0.14	1.77	2.00	2.27
4. with new browse tech such as 3D virtual point	0.09	0.56	0.73	0.90
5. network shopping is safe	0.12	1.06	1.28	1.59
6. website could be browsed with various language edition	0.10	0.74	0.93	1.19
7. website could be browsed with various language edition	0.13	1.32	1.55	1.84
8. website with individuation service	0.12	1.18	1.44	1.76
toatal		62.10	71.20	79.24

The evaluation results of usability for the websites made by the investigators were showed in table 1. Language dimensionality got the highest score, among the five dimensionalities. The website average scores for scenic spots of 3A, 4A and 5A were 4.74, 5.31 and 5.76 respectively, which were much higher than the average scores of other dimensionalities. The website of 5A scenic spots got the highest score, 17.29, which higher than the website of 4A scenic spots; The score of usability evaluation for the websites of 4A scenic spots is 15.94 and the score for the websites of 3A is 14.23. The standard language on the website of 5A scenic spots got the highest score, 5.95, which means it can be easily accepted by the visitors. The headlines on the websites of 3A scenic spots were same with the themes and it got the lowest score, 4.49, which means the users are not satisfied with such consistency. The headlines may mislead the visitors. The language used by the websites of 5A scenic spots are most standard.

About the design construction and design dimensionality of pages, the scores were lower universally. The websites average scores of 3A, 4A and 5A scenic spots were 1.64, 1.86 and 2.04 respectively. The part of disturbance term in 3A scenic spots got the lowest score, 1.33, which means for the website construction of 3A scenic spots, the visitors always disturbed by the contents outside the scenic spot propaganda. It included the bad information, such as advertisement. Among the contents of page design and structural dimension, in the scenic spots of 3A, 4A and 5A, the index score of disturbance content is the lowest. In this dimension, the readable index which has clear words and color got the highest score and the scores were 2.05, 2.27 and 2.45 respectively. But the websites of 4A and 5A scenic spots cannot reach the average score for all dimensions and they cannot accept by the people who browsed the websites. About such dimension, the score of official websites of 5A scenic spots was higher than the official websites of 4A scenic spots which was higher than the official websites of 3A scenic spots.

For the dimension of information structure, the average score for websites of 3A, 4A and 5A scenic spots were 2.23, 2.67 and 3.06 respectively. Webpage construction of 5A scenic spots was better than 4A scenic spots which was better than 3A scenic spots. On the official websites of 3A, 4A and 5A scenic spots, the image and text description got the highest scores (2.92, 3.36 and 3.81 respectively). 3A scenic spots usually do not update their website information timely, which made the tourists dissatisfied very much. The score is only 1.64. On the websites of 4A and 5A scenic spots, the index of providing the connection with the old address got the lowest score (2.13 and 2.45 respectively), which means the tourists cannot find the old address on the websites

easily and it would cause inconvenience for the tourists, when the address changed.

For the dimensions of user interface and navigation. The average score for websites of 3A, 4A and 5A scenic spots were 2.15, 2.46 and 2.68 respectively. On the websites of 3A scenic spots, the exact usable index of site search result got the lowest score, 1.82, which means when the sight-seers searched the information on the websites, their questions about route, ticket price, scenery features in the scenic spots cannot be solved totally. On the website of 4A scenic spots, color highlight index for the internal link which was browsed got the lowest score, 2.14, which means the websites did not mark the webpages browsed by visitors and it may make the visitors cannot distinguish the pages they have browsed.

The Influence to Tourists Caused by Website Expectation

From the T test made by spss17.0, we can know for the websites of 3A scenic spots, there are no obvious differences for the visitors, after they browsed the websites compared with them before expectation. Their expectation before browsing usually higher than their expectation after browsing. Compared with the scenic spots of 4A and 5A, 3A scenic spots has lower popularity, which may make the differences are not obvious for the tourists, when they browsed the websites. But when they went to the scenic spots, the differences are obvious between their actual feeling and the expectation for the scenic spots, after browsing the websites. The score about the actual feeling usually is lower than the expectation for the scenic spots, after browsing the websites, which means we must enhance the construction for the scenic spots.

For the tourism websites of 4A scenic spots, there are obvious differences among the expectation to the scenic spots before browsing the websites, the expectation to the scenic spots after browsing the websites and the real feeling for visiting. After the tourists browsed the websites of scenic spots, they usually have higher expectation, which means the website of 4A scenic spots bring more expectation to the visitors and make them like to browse it. But their actual feeling cannot reach their expectation, which means we must enhance the entity construction for the scenic spots.

For the websites of 5A scenic spots, there are no obvious differences for the visitors, after they browsed the websites, compared with their before expectation. The scenic spots of 5A have higher popularity, so visitors expected more, before they browsed the websites, but after browsing the websites, they have a little disappointment, which means we must enhance the website construction for the scenic spots. But there are obvious differences between their actual feeling of visiting and the expectation after browsing. The feeling value is lower than the average expectation value after browsing. There may two factors which caused such situation: 1. the visit experience for the scenic spots cannot make the tourists satisfied, compared with the website propaganda for the scenic spots; 2. the scenic spots of 5A has higher popularity, so before the tourists browsed the websites, they have more expectation. According to the theory of inconsistent expectation, when people expected more, if their actual feeling has differences with their expectation, the scores made by people were lower than its practical value. Above two factors may all cause the actual satisfaction of tourists is lower than the expected value, after they browsed the websites.

CONCLUSIONS AND RECOMMENDATIONS

Summarization and prospect

This dissertation analyzed the usability and expectation of 3A,4A,5A tourist attraction website in Hainan and got the following conclusion.

(1)Total points of usability in 3A,4A,5A tourist attraction website are 62.10,71.20,79.24 respectively, which distribute the range from 61 to 80 and have a high-quality reputation among tourists. The usability satisfaction evaluation in 5A-rate tourists attraction are higher than that in 4A and 3A..

(2)Th most favored part in tourist websites is linguistic dimension, which indicates that websites could advertise the tourist attraction without semantic ambiguity through languages. The entirety dimension gets the lowest mark, which indicates that the tourist attraction has not got the support of advanced tech, multilingual publicity and disadvantageous to construct the international island. Otherwise, detailed indexes such as, fewer unnecessary content, timely information updating, connected with other tourist website and accurate searching results need to be constructed.

(3)The expectation of tourists after browsing the website could affect the sightseeing quality. Tourists' sightseeing quality on Hainan scenic spot usually could not up to the expectation, side-fact states that the sightseeing construction have not reached the satisfaction of tourists and disparity existing between the expectation and practicability. The scenery need to be constructed urgently.

According the above conclusion, three suggestions on website construction of the South China Sea tourist attraction were given in this dissertation:

(1)Simplify the interface and improve the usability of the website. Much unnecessary content in website page could not only make users find the message they want in time, but affect their mood in browsing the website and cause the poor expression of the tourist attraction. Zhong Lina pointed that tourists are more willing to browse the website with suitable length and brief introduction, while at cross purpose, website designers pay much attention to the splendid web page to fuddle tourists with mass information. Tourists are more interested in browsing website with simplified and concise interface.

(2)Pay attention to the details in website design. Known from the data, the construction of Hainan tourist website didn't pay enough attention to the details. It was evaluated with low marks in clicked internal linking, proper navigation and suitable size images, which affected tourists' feeling in browsing the website.

(3)Look at the information transfer towards globalization. Lower marks in accurate searching results and untimely information update during the information transfer lead to the worse performance for tourists to get the information. Committed to construct international tourist island, Hainan tourist's websites are fail to give the support of browsing the page with various language and only with the Chinese permission, which is not helpful to transfer the information.

(4)To support the new tech and boost the tourists' appetite to browse the page. Lack the advanced the tech, which would make tourists feel immersive in scenery and deepen their understanding of tourist attraction, as well as enhance the travel desire.

(5)Enhance travel expectation and offer well reception services. To enhance the travel expectation of tourists in browsing the website, as well as the entity service. Higher expectation, higher service requirements put forward by tourists. Otherwise, tourists would be disappointed with the realistic experience in traveling and the satisfaction of tourist attraction.

In the paper, the study has some boundedness, for example, when calculating the index weight for the availability analysis of website, we should make a uniform standard to make the horizontal comparison and when making the investigation, we may be influenced by the subjective wishes of the respondents, so in future, for the usability study, the supplementary means of artificial intelligence can be added.

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Brand Effect on Customers' Value Perception in Online Customization

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ABSTRACT

This paper investigates the brand effect on customer's value perception in online customization. We argue that though the online customization can add value for the customers, this effect is attenuated by brand because of the obfuscation of the attribution. Specifically, with the presence of brand, the output of customization process may be erroneously attributed to the brand so that the attitude and evaluation on the customization may be lowered because consumers always make decision and attribute the result based on the available and salient information.

Keywords: Online customization, brand, customer value.

INTRODUCTION

Mass Customization has developed rapidly in the last 10 years. So far, online customization has been widely adopted by enterprises and startup companies as a strategy to strengthen their competitiveness (Fogliatto, da Silveira, & Borenstein, 2012). However, it still remains a problem for researchers and practitioners whether customization service is a goldmine for companies (Nikolaus Franke, Keinz, & Steger, 2010). A number of researches have investigated the value of online customization for companies and the customers' willingness to pay for customized products or services (Nikolaus Franke, Keinz, et al., 2010; Nikolaus Franke & Piller, 2004; Nikolaus Franke, Schreier, & Kaiser, 2010; Huffman & Kahn, 1998; Jiang, Balasubramanian, & Lambert, 2014; Jin, He, & Song, 2012; Merle, Chandon, Roux, & Alizon, 2010; Piller, 2004). Both quantitative and qualitative researches suggest that the willingness to pay for self-designed products is much higher than standard products. This may result from the sense of participation and accomplishment derived from the customization process and the preference fit of final customized products. Customers regard themselves as the creators of the products and would like to pay higher price (Nikolaus Franke, Schreier, et al., 2010). Besides, customization allows consumers to express their own images and fulfill their pursuits for uniqueness, which adds value to the customized products (Merle, et al., 2010).

However, we find that most of companies don't charge a premium price for the customization service. For example, Nike provides a customization configurator for customers to design their own shoes. With the configurator, consumers can customize the styles, colors and pictures as well as decide whether to print the logo or sign on the shoes. Nevertheless, a pair of shoes customized by customers based on the Nike Air Max 1 Ultra Fly knit Id sells for 200 dollars, equaling to those without customization. It happens to other customizable products in NikeiD.com. Having spent much on the online customization system, Nike doesn't charge a higher price in spite of customers' higher willingness to pay for customized products confirmed by extant studies. Contrary to the case of Nike, some unbranded products, such as Spread T-shirt, do charge higher prices. Spread T-shirt is a website offering online T-shirt customization service. It sells a Men's Premium T-Shirt for 15.99 dollar, yet the price increases to at least 24.99 dollars if the T-shirt is customized. Thus, we assume that brand influences the value of customization. Specifically, with customization service, unbranded products gain extra values while the value of branded products remains unchanged.

Most of prior researches neglect the role of brand in how customers derive the values from the customization (Merle, et al., 2010). A few studies investigate the differences between branded and unbranded products under the customization conditions (Miceli, Raimondo, & Farace, 2013; Moreau, Bonney, & Herd, 2011). However, we argue that these researches don't consider the general value of brand. Regardless of the customization, the literature has confirmed that most of branded products have higher prices than those unbranded as a strong brand often represents high quality (Bhimrao, 2008; Keller, 1993; Madhavaram, Badrinarayanan, & McDonald, 2005). These papers failed to explain whether the price differences between branded and unbranded customized products is due to the value of the brand itself or due to the combination of customization and brand.

Taken together, specific attention must be given to the following questions: Are customers willing to pay more for customized branded products compared to those standard branded products? If they are, how much would they like to pay for the customization service? Are the answers different when it comes to unbranded products?

LITERATURE REVIEW

The Value of Customization

Merle et al. (Merle, et al., 2010) proposed a conceptual model of the value of online customization. The model divides it into 2 parts: mass-customized product value and co-design process value. The former includes utilitarian value, uniqueness value and self-expressiveness value. Utilitarian value refers to the extent to which a customized product fits individual preferences in terms of the product itself and its technical features. Utilitarian value can be further divided into aesthetic and functional fit. Customers are willing to pay a premium for the customized products because of the perceived utilitarian value (N. Franke & Schreier, 2008). Except the fit between established preference and product, Franke and Hader (Nikolaus Franke & Hader, 2014) found that consumers' preferences were, at least partly, constructed during the process of customization.

Secondly, customization enables customers to display the individuality by the unique attributes of the products. This ability is referred to as uniqueness value and can increase the willingness to pay a premium (N. Franke & Schreier, 2008; Schreier, 2006). Another concept which is related to uniqueness value and deserves to be mentioned is conformity. Hirschman, Belk and Ruvio (Hirschman, Belk, & Ruvio, 2014) found that even in the context of customization, customers still have a need for conformity. In some case of customization, popularity value is more important than unique value (Hagenmaier, 2016).

The third component of mass-customized product value is self-expressiveness value. One can design a product that is most adaptable to his image with the customization program (Merle, et al., 2010). This value focuses on the fits between the products and owners' self-image, while uniqueness value emphasizes the exhibition of one's differences. For example, a sports fan can wear a pair of sports shoes to express his image while the type of the shoes is classic.

Co-design process value consists of hedonic value and creative achievements value. Companies often provide a customization configurator toolkit to support customers (Nikolaus Franke & Piller, 2004; Salvador, De Holan, & Piller, 2009). Hedonic value refers to the pleasure and enjoyment customers obtain when they use the toolkit to interact with companies. Franke and Schreier (2010) showed there is a positive link between hedonic value and the willingness to pay a premium. Creative achievements value refers to the "pride of authorship" that customers attained after using the toolkit to successfully design their own products (Nikolaus Franke, Schreier, et al., 2010; Schreier, 2006). The feeling of attainment makes customers develop a tighter bond with the product, increasing the identification with the product (Atakan, Bagozzi, & Yoon, 2014).

Brand and Customization

Brands and customization have an inherent conflict. The idea of the brand draws together disparate attributes into one specific badge to form a consistent image, while the concept of customization reversely tries to divide a product into different components (Jiang, 2004). Few researches investigate the role of brand in customization, showing that the conclusions differ under different conditions.

Though designed by customers, mass-customized products are still produced in the factories of companies. A company with a famous brand usually can put more resources into the manufacture process. Customers thus are more confident with the quality of branded product. The confidence, combined with the preference fit resulting from the customization, makes customers value of branded customized products more than unbranded customized products (Moreau, et al., 2011). Similar conclusions occur in other researches. Miceli et al. (Miceli, et al., 2013) found that brand is not only a signal of positive comments, but also an explicit way of identity communication. However, combination-based Customization, in which customers can choose the most preferred attribute from the options provided by companies, is an implicit form of identity communication. Thus, the combination of brand and combination-based customization enhances (at least not weakens) the ability of identity communication of the customized products. Compared with unbranded customized products, customers have a higher willingness to pay for branded ones.

However, the aforementioned two papers describe the negative effects of brand from different angle. Moreau et al. (Moreau, et al., 2011) found that the brand has a negative effect on customers' perception and comments when they emphasize the input of individual behavior resources. For instance, when a customer designs a gift for others, the willingness to pay a premium for branded products is lower than that for unbranded products. The reason is that he/she wants others to perceive the effort they have devoted yet the brand weakens the perception by distracting others' attention to it. Besides, the presence of brand has a more significant influence on search products than experience products because the quality matters more in the purchase decision of search products (Jiang, 2004). Miceli et al. (Miceli, et al., 2013) also mentioned the negative effect of the brand from another perspective. They found that brands downgrade customers' evaluation of the products when customers participate in an integration-based customization (a form of customization in which customers integrate the content provided by themselves into the products). This is caused by the conflicts between brands and integration-based customization, because they are both explicit forms of identity communication. Furthermore, this effect is moderated by the consistency between customers' self-image and brands (Miceli, et al., 2013).

HYPOTHESIS DEVELOPMENT

A customer can use brands to express her/his self-identity to relevant others (Escalas & Bettman, 2005; N. Franke & Schreier, 2008). The ability that a brand transmits a clear consistent message to its stakeholders is a critical component of the brand equity (Madhavaram, et al., 2005). Consumers also use brands to diverge from others to make sure that they effectively communicate desired identities (Berger & Heath, 2007). Prior studies suggested that branded products generate higher customer perceived value than unbranded products (Keller, 1993). Brand's impact on the self-expressiveness depends on the brand awareness, which is buried in the consumers' memory (Percy & Rossiter, 1992). Brand recollection and recognition, which are two parts of brand awareness, can assist consumers to retrieve the particular memory node that referred to the brand and make choices decision at point of purchase.

Apart from brands, customization can also increase the customer perceived value through the self-expressive effect (Merle, et al., 2010). Customization provides an opportunity for consumers to express their personality with the self-designed products since they can choose the most preferred attributes from among several options. And the unique self-designed product can also

differentiate the consumers from others (N. Franke & Schreier, 2008).

Corresponding to other studies, we agree that customization can surely increase customers' value perception (Nikolaus Franke, Keinz, & Steger, 2009; Nikolaus Franke, Keinz, et al., 2010; Jiang, et al., 2014; Merle, et al., 2010). However, we also argue that this effect may be attenuated by the presence of brand. This is because of the different approaches in which brands and customization help consumers to express their own image. Consumers' benefit of owning self-designed products that reflects their own images comes from the freedom of choice during the customization process (Merle, et al., 2010). Customers can choose each attribute to design the products matching their self-identity best. Unlike the customized design varying among different customers, each brand conveys a clear consistent image which requires less cognitive resources and less time to perceive. Customers usually use information available to make decisions and attribute the result based on the most salient information (Bettman, Noel, & J., 1975; Gravatt, Lindzey, & Aronson, 1998). Thus the presence of brands will distract customers' attention, weakening the perception of the personalized design.

Specifically, this distraction decreases the perceived value of the customization in two aspects. Firstly, as the presence of brands distracts customers' attention, the value of customization which can reflect customer's image partly attributes to the brands. Secondly, because of the presence of the brand, relevant others may also focus on the brand, and neglect the customized process and effort. Then the customer may be concerned that the brand, not the customization, will get more credit for the behavioral resources expended in designing the products, which in turn impair the customer's attitude to the customization (Moreau, et al., 2011). Therefore, we predict that compared with standard product, though higher value can be derived from customized product, this effect is attenuated by the presence of brand since it obfuscates the customer's attribution. We will conduct an experiment to test this hypothesis.

H1: compared with standard product, the value customers attribute to the self-designed product is higher, and this effect is attenuated by the presence of brand.

EXPERIMENT DESIGN

We selected customized T-shirts as the product category for this study on the basis of several important factors: user knowledge of the product, researchers' access to the primary target market (college students) and product affordability. Subjects were recruited for the study using both advertisements. The advertisement stated that a firm specializing in T-shirts was conducting a marketing research on the customization service. In exchange for participation, those completing the task would receive a 20 RMB reward.

We manipulated two factors between participants: (1) the brand (present vs. absent) and (2) product type (customized vs. standard). When subjects arrived, they were randomly assigned to one of the four groups. Then they were asked to read the instruction shown on the screen. The instructions were the same except that a description on the usage of the customization configurator was included in the instruction for groups of customized products. For the groups of standard products, subjects were required to choose from a series of standard products. For the groups of customized products, subjects were asked to use a configurator to customize their most preferred products. Subjects can select the styles, the colors and pictures printed on the T-shirt. After they completed their tasks, they were required to fill out a questionnaire.

CONCLUSION

Potential Contribution

Brands and customization are both strategies widely adopted by enterprises to deliver higher customer value. However, the combined effect of brands and customization has not been deeply investigated.

Extant studies show that branded products generate higher value than unbranded products in online customization. However, to our knowledge, those researches only examine the influence that a brand has on the customization within the customization setting. Thus, they only investigate the brand effect on the value of customized products rather than the effect on the value of customization. The latter refers to the incremental value when standard products can be customized, while the former takes the value of a brand itself into consideration apart from the value of customization.

By undertaking a study between non-customization and customization settings, our research contributes to the growing literature on the customization by demonstrating that the presence of a brand has a negative effect on the premium which customers are willing to pay for the customized products. We suggest that combination of the customization and brands doesn't generate the '1+1>2' effect. Instead, the presence of brand weakens the positive effect of customization on the products. The negative effect may be influenced by the attributes of brands and products, which needs further researches.

Potential Implication

As the online customization is flourishing, the intended results of this paper may be helpful to the companies which are about to employ a customization strategy. As the prior researches suggest, companies can benefit much from the customization strategy because of the customers' higher willingness to pay for the customized products, and many empirical studies support this idea. However, our results show that this effect differs from the presence of product brands. While the unbranded products may really gain much from the customization process, the companies with strong brand should be cautious to consider the cost

of customization strategy since they may not benefit so much as the companies without strong brand. That's because the customers may attribute the increased value of self-representation to the brand rather than the customization. Therefore, one possible suggestion for these companies is to dilute the brand effect in the customization process such as do not provide the logo.

Another possible approach that the strong branded companies can employ is to emphasize the customization effect. For example, these companies can provide a signature function in customization process, which enables the customers print their names on the customized products. This may arouse the customers' feeling of the ownership of the products so that they realize that they customize these products by themselves. This emotion may lead customers to attribute the increased value of self-representation to the customization process instead brand.

ACKNOWLEDGMENT

This research was supported by the National Natural Science Foundation of China with grant #71331007.

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A Research Growth Study in Big Data field

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ABSTRACT

Responding to the diffusion and growth of big data research, this study adopted the bibliometric approach to describe the growth of the literatures, the distribution of journals, publication countries and subject area. This study collected the relative literature by querying the Social Science Citation Index (SSCI) of ISI Web of knowledge database, where we could collect the big data literatures in academic papers, systematically. Data from citation indexes can be analyzed to determine the popularity and impact of specific articles, authors, and publications. The results provided the distribution of core journals, and described the trends and feature of big data research for researchers interested in this field.

Keywords: Big data, bibliometrics, Social Science Citation Index

INTRODUCTION

Traditional data processing applications, such as data mining, statistical regression, and machine learning techniques are insufficient for big data, a term for data sets that are so large or complex and in the business perspective, big data simple refers to the use of predictive analytics or certain other advanced methods to extract value from data (Wikipedia, 2016). With the development of data science, big data is nowadays a novel method for research, military and business. Research and development of big data has grown very rapidly in recent years (see Figure 1) and becomes increasingly important in practice. This paper investigated the characteristics of big data literature and its implication during 2008 to 2015 by bibliometric approach. The bibliometric method adopts statistical techniques of bibliography counting to evaluate and quantify the growth of literature of a subject. The information includes the journal or other publication title, the authors' name and affiliation, document type, etc. This study used the Thomson Reuters' Citation database of Social Sciences Citation Index (SSCI) on ISI Web of Knowledge website to retrieve data. The query for general search was performed with keywords as big data with double quotation marks ("big data"). Consequently, total 918 bibliographic records were retrieved.

This study aimed: (1) to explore the growth of big data literature; (2) to identify major contributing countries that publish big data papers most; (3) to identify core journals that contain most part of big data literature.

THE GROWTH OF BIG DATA LITERATURE

Figure 1 showed the trend of academic growth from the collecting the literature of big data. In 2008, there were only 4 journal papers related to big data in the ISI web of science data base. Obviously, the tendency of literature growth of big data increased explosively from 2012 in social science.

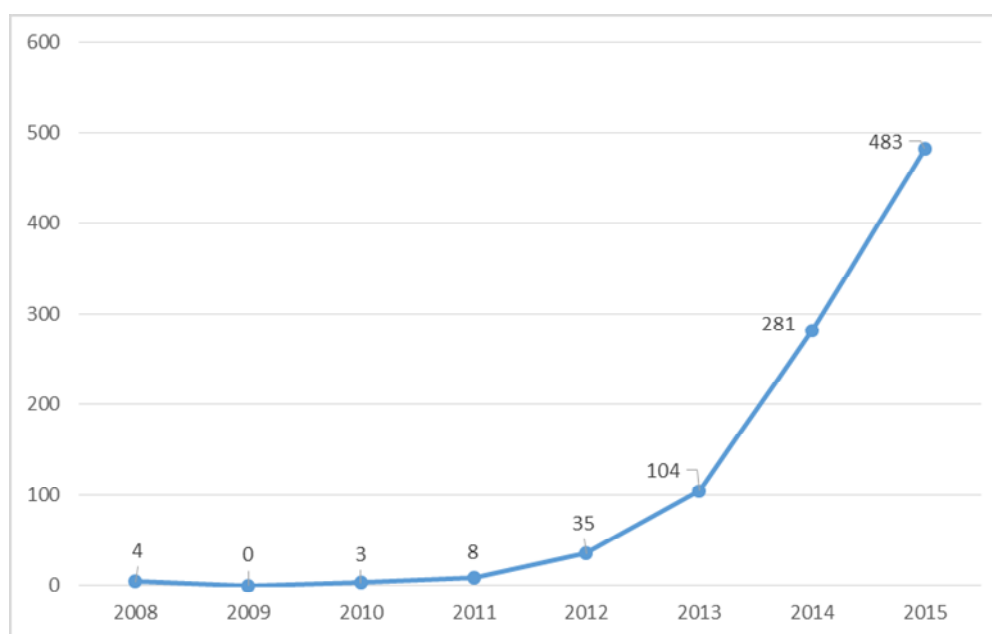


Figure 1: Annual journal production of big data literature

CHARACTERISTICS OF BIG DATA LITERATURE

Country Distribution

There were 45 countries publishing big data literature. Table 1 showed country distribution of big data literature and about 55%

of the big data literature was published from USA. England (14.82%) and People Republic of China (6.76%) contributed the 2nd and 3rd position, and Australia, Germany, Canada, and Netherlands each of them contributes more than 3% among the total literature. The researchers in these countries contributed on big data research has drawn the attention of the world. Additionally, researchers in Taiwan had published 9 (0.98 %) journal papers on big data field collected in this database.

Table 1:Country distribution

Country	Record Count	Percent
USA	507	55.23 %
ENGLAND	136	14.82 %
PEOPLES R CHINA	62	6.76 %
AUSTRALIA	45	4.90 %
GERMANY	41	4.47 %
CANADA	35	3.81 %
NETHERLANDS	28	3.05 %
SOUTH KOREA	27	2.94 %
ITALY	25	2.72 %
SPAIN	23	2.51 %

Subject Area

The mainly concerned area of big data literature includes “BUSINESS ECONOMICS”, “INFORMATION SCIENCE LIBRARY SCIENCE”, “COMPUTER SCIENCE”, “Business & Economics” and “Computer Science”. The major area of big data literature is business economics. However, the result also indicates that big data has been considered as an important issue in information science library science as well as computer science, health care science services and Electronic, that is, big data compose of many knowledge that are interdisciplinary. Table 2 showed the top 15 concerned subject area of big data literature.

Table 2:Subject area of big data literature

Rank	Subject area	Count	Percent
1	BUSINESS ECONOMICS	198	21.57 %
2	INFORMATION SCIENCE LIBRARY SCIENCE	135	14.71 %
3	COMPUTER SCIENCE	124	13.51 %
4	HEALTH CARE SCIENCES SERVICES	74	8.06 %
5	GOVERNMENT LAW	73	7.95 %
6	COMMUNICATION	61	6.65 %
7	GEOGRAPHY	57	6.21 %
8	SOCIAL SCIENCES OTHER TOPICS	57	6.21 %
9	PSYCHOLOGY	50	5.45 %
10	ENGINEERING	43	4.68 %
11	SOCIOLOGY	43	4.68 %
12	ENVIRONMENTAL SCIENCES ECOLOGY	32	3.47 %
13	OPERATIONS RESEARCH MANAGEMENT SCIENCE	32	3.49 %
14	PUBLIC ADMINISTRATION	31	3.38 %
15	PUBLIC ENVIRONMENTAL OCCUPATIONAL HEALTH	31	3.38 %

Keywords

In addition to the analysis of subject area, this study also conducted the keyword analysis. Numbers of keyword from literatures not only reflect the research topic, but also provide a convenient way to search and retrieval. Table 3 also showed top 15

keywords. By collecting the most commonly listed of keywords, the most research issues in big data field from past research are identified clearly.

Table 3:Top 15 high frequency keywords in big data literature

Rank	Keyword (905 kinds)	Count	Percent
1	big data	231	10.7%
2	Social media	33	1.5%
3	Twitter	18	0.8%
4	Privacy	17	0.8%
5	Big Data Analytics	16	0.7%
6	Analytics	12	0.6%
7	Data science	11	0.5%
8	Data	11	0.5%
9	Internet	11	0.5%
10	Data mining	10	0.5%
11	Computational social science	9	0.4%
12	Social networks	9	0.4%
13	Predictive analytics	9	0.4%
14	Ethics	8	0.4%
15	Data protection	7	0.3%

BRADFORD LAW AND CORE JOURNALS

Bradford (1934) proposed a law that numerous relevant papers would be concentrated in a small group of journal titles, and the rest papers would be scattered over the vast account of journals. Therefore, the journals could be divided into three groups according to the formulation and the proportion of the number of journals in each group would be $1:n:n^2$. Through the law, some core journals in the research field could be identified. The Bradford's law has been widely used to study author productivity (Chung, 1994), and journal literature distribution (von Ungern-Sternberg, 2000). In total, there are 457 journals, publishing 918 big data papers. According to zone of Bradford's law, table 4 showed the amount of publication in each group and relevant information listed by the amount of publishing papers. The cumulative number of papers for each group against its ranks for literature of big data was illustrated in figure 2. Table 4 also offered the comparisons of these three zones (3:34:420), which equals to $1: 11.33: 11.33*12.35$. That is, $1: 11.33: 11.33*12.35 = 1:n:n^2$, approximately. The result approached the explanations of Bradford's Law. Table 5 specifies 3 core journals title and top 5 relevant journals title in big data.

Table 4:The distribution of big data literature

	Articles(a)	Journals(b)	Amount of articles (b)*(c)	Accumulated Journals (c)	Accumulated articles (c)
(A)	18	1	18	1	18
Core	17	1	17	2	35
	14	1	14	3	49
(B)	13	2	26	5	75
Relevant	12	2	24	7	99
	11	2	22	9	121
	10	3	30	12	151
	9	3	27	15	178
	8	7	56	22	234
	7	5	35	27	269
	6	4	24	31	293
	5	6	30	37	323
(C)	4	16	64	53	387
marginal	3	29	87	82	474
	2	69	139	151	612
	1	306	306	457	918

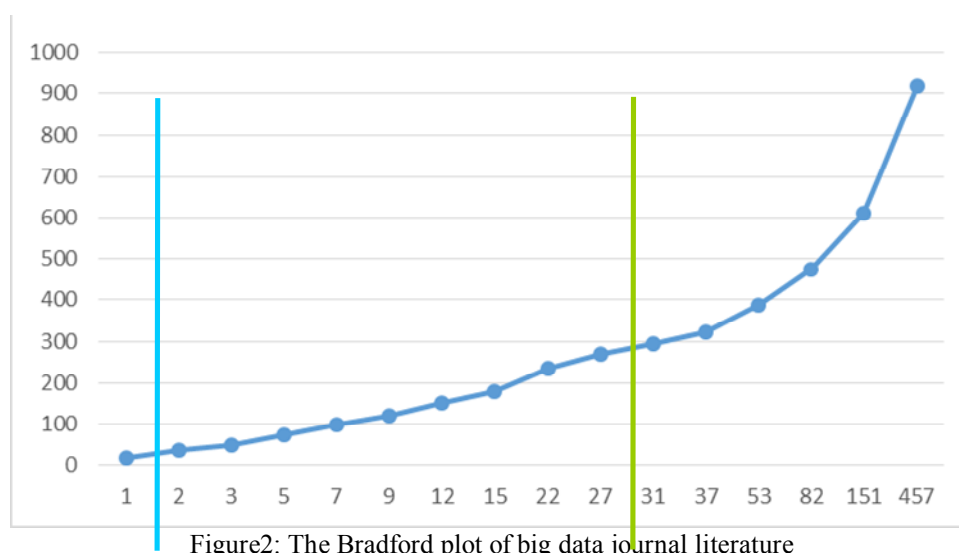


Figure2: The Bradford plot of big data journal literature

Table 5: Core journals and Top 5 relevant journals title

Journal catagory	Journal title	Count	Percent
Core journal	HEALTH AFFAIRS	18	2.0%
	VALUE IN HEALTH	17	1.9%
	JOURNAL OF THE AMERICAN MEDICAL INFORMATICS ASSOCIATION	14	1.5%
Relevant journal	HARVARD BUSINESS REVIEW	13	1.4%
	INTERNATIONAL JOURNAL OF COMMUNICATION	13	1.4%
	COMPUTER LAW & SECURITY REVIEW	12	1.3%
	INFORMATION COMMUNICATION & SOCIETY	12	1.3%
	ECONTENT	11	1.2%

CONCLUSION

This work investigated the growth of big data literature in the Social Science Citation Index (SSCI) of ISI Web of knowledge database, and reviewed some characteristics of big data literature through bibliometric techniques. According to the analysis, there are several finding: First, big data is considered as a important issue that the volume of relevant researches increases dramatically from 2012. Secondly, there are 3 core journals identified by the Bradford law, about 5.4% of big data literature is concentrated in top 3 journals, and the rest 94.6% is widely spread on other 452 journals. Finally, the analysis of the core journals also demonstrates that the big data core journals are high health-medical relevant. This work is the preliminary stage that researchers would probe the trend of big data and future study may adopt the different analysis such as co-citation to get the deeper comprehension and find more useful information behind the big data filed.

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Overview of Academic Studies on Smart Care for the Elderly and Comprehensive Solution Design

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ABSTRACT

Due to historical reasons and urbanization progress, demographic development change has promoted China to enter an aging society and the elders' demand for medical care and health care has increased rapidly. Meanwhile, the rapid development of information technology is driving the "Smart Care for the Elderly" model which is based on the Internet and regards the internet of things as the medium which has gradually developed into a complete a system, and a series of solutions have been formed. This paper started with the analysis of China's elderly population status quo, combed academic studies on domestic and foreign "Smart Care for the Elderly" and applications in recent fifteen years and explored how to build a comprehensive "Smart Care for Elderly" solution with improved functions which incorporates such key elements as information technology and social sciences.

Keywords: Aging, Smart Care for Elderly, Information Technology

Nowadays, China has entered the aging society, facing the problem of "getting old before getting rich" and "aging in a fast pace". The net number of the elderly increased by 8 million to 12 million every year, among which the number of the oldest old increases especially quickly. In February 2011, the Ministry of Civil Affairs announced the "12th Five-Year' Plan for Construction of Social Elderly Care Service System" which mentioned "9073" nursing model. According to the "9073" nursing model, 90% of the elderly will be nursed at home, 7% in communities and 3% in institutions. The issue of elderly care has become a hot topic among the society. There are increasingly prominent problems facing elderly care, such as conservative consumption concept of the elderly, small profit margin for elderly care enterprises, social service resources barriers, lack of a service quality supervision and assessment system, severely insufficient coordination between medical health service and elderly care service, as well as unimproved supporting systems such as insurance, taxation and finance.

The government attaches great importance to problems caused by the aging society. According to "Instruction Opinions about Promoting Combination of Medical Health Service and Elderly Care Service" published by the State Council, by 2020, resources of medical health service and elderly care service will be shared orderly, and a comprehensive network integrating medical health service and elderly care service, covering urban and rural areas, functioning properly and sustainably will be formed by then[1]. Under such social conditions, the academic circle gradually initiates studies on "smart care for the elderly".

STATUS QUO ANALYSIS OF CHINA'S AGED POPULATION

General Growth in Average Life Span

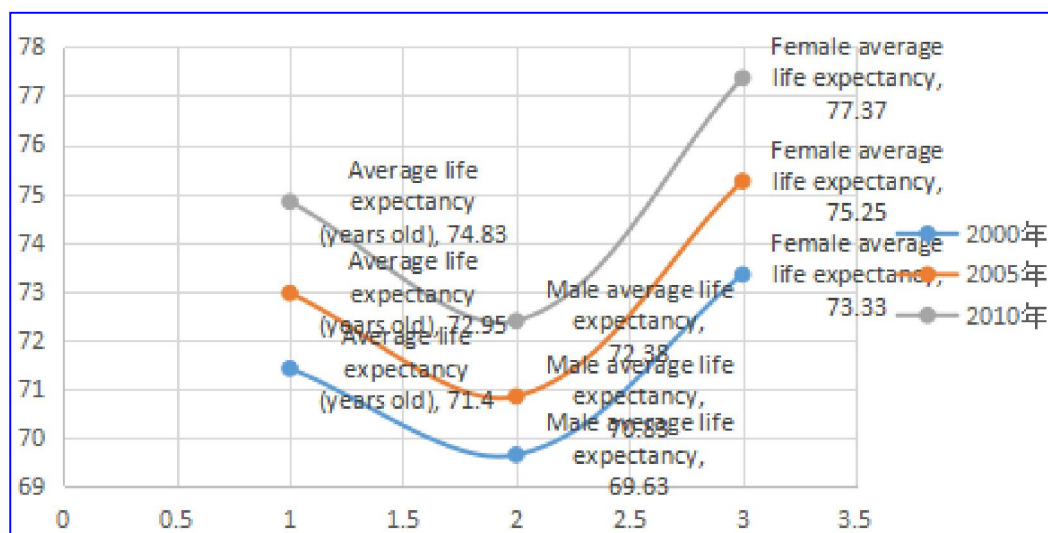


Figure 1: Average Life Span of Population from 2000-2010 (Data source: State Statistics Bureau. Note: Average life expectancy was calculated according to population census data)

According to Fig. 1, the average life span of Chinese population increases by two to three years old every five years. With rapid development of high-tech means of medical service, the number of long-life population will be growing, which will drag China into its aging society.

Fast Increase in the Proportion of Aging Population

In order to have a more graphic view of population structure and development conditions of different age stages, we adopted annual statistical data of the State Statistics Bureau to work out a radar map in terms of the age structure of China's population in recent 20 years:

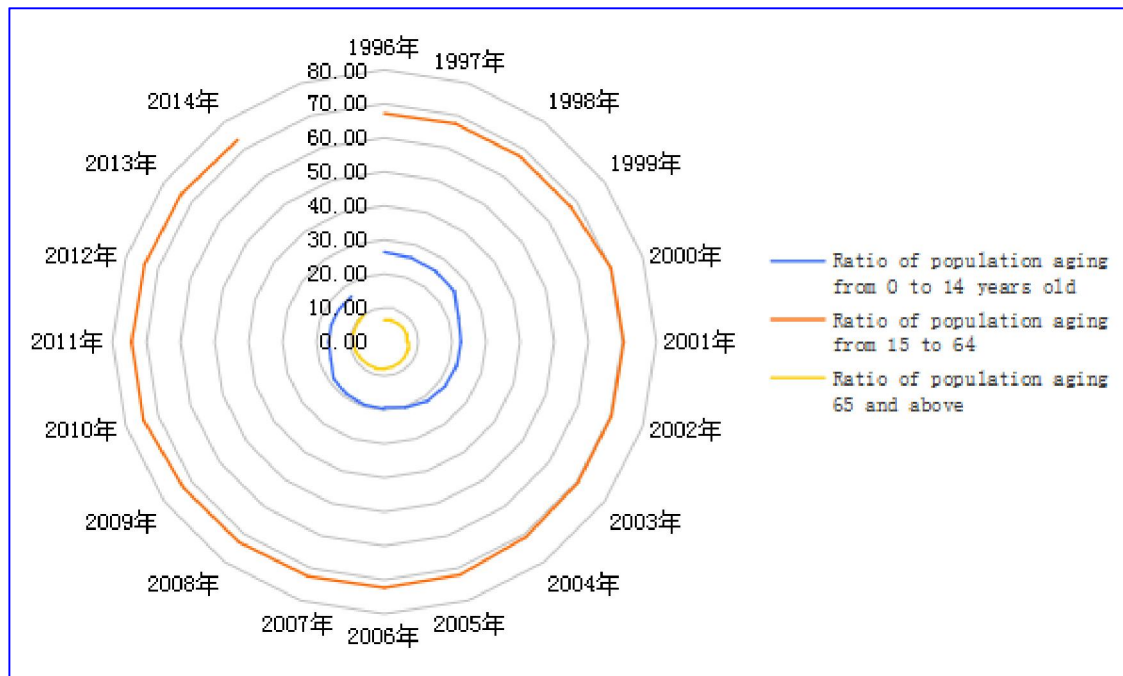


Figure 2: Age Structure Radar Map of Population in Recent 20 Years
(Data source: State Statistics Bureau (retrieved in June 2016))

Thereinto, the population data in 1981 and before came from household statistics; data in 1982, 1990, 2000 and 2010 was inferred based on population census of that year; data of other years was calculated based on annual population sample survey. The total population and the population categorized by gender included military personnel in active service. Military personnel in active service were deemed as urban population.

According to Fig. 2, in recent 20 years, the 0-14 year-old population curve took on an apparent inward trend. At that stage, it's a fact that population showed negative growth. Population aging from 15 to 64 was the major labor force and the data curve demonstrated smooth and slightly inward feature, being relatively stable; the data curve of population aging 65 and above manifested an extremely obvious outward feature, indicating that the increase in the aging population ratio was ascending, which was worth attention.

Anxious Mood for Elderly Care

According to Blue Book of China's Society: Society of China Analysis and Forecast 2016, young and middle-aged groups who were born in 1970s and 1980s are especially anxious about the elderly care, medical care and housing problem. And they are less satisfied with social security than other groups. 33.9% of them hold that social security in nursing and other aspects was not fair or extremely unfair [2]. Their anxiety is apt to trigger social instability, thus we need to attach great importance to it.

Severely Insufficient Function in Whole-Society Elderly Care

By the end of 2014, the number of population aging 60 and above exceeded 212 million, accounting for 15.5% of the total population, which surpassed the total population of Japan. The number of disabled and half-disabled old people reached about 40 million. The demands for medical care, nursing and rehabilitation services quickly rose, thus bringing about immense challenge to China's elderly care and medical systems. According to estimation of OECD, the per capita medical cost of population aging over 65 was about two to eight times greater than that of population aging below 65. Rehabilitation and nursing demands as well as demands for nearby service and door-to-door service would go up dramatically. In the past ten years, the ambulatory treatment utilization rate of the elderly has increased to 49% from 27%, and the hospitalization utilization rate and nursing demand quantity have been rising as well. The ratio of disease burden of the elderly increased to 3.4% in 2013 from 2.1% in 1993. The total sanitation costs accounted for about 50% [3]. The long-term nursing system for disabled and dementia old people is still at an early stage. As a result, it faces many problems such as inadequate theoretical studies, limited special

policies and regulations, non-systematic service items and to-be-established talent team. All these have restrained development and improvement of long-term nursing system [4].

STATUS QUO ANALYSIS OF DOMESTIC AND FOREIGN STUDIES

From 2015 to 2035, China will enter its rapid aging stage. The aging population will increase to 418 million from the current 212 million. Accelerated aging has led to structural shortage in labor force. Smart care for elderly was proposed by British Life Trust Fund for the first time, also known as “full smart senile system”. The system used technologies such as sensor technology, data processing technology, web technology and mobile internet technology to transform traditional elderly care service model and management means, provide sufficient life care, medical nursing and spiritual consolation for the elderly and make them enjoy high-quality and highly comfortable elderly care services [5]. Detailed research fields are as follows:

Studies on the Concept, Connotation and Pattern of “Smart Care for the Elderly”

Studies on the concept, connotation and pattern of “smart care for elderly” were mainly conducted by Chinese scholars: ZUO Meiyun, et. al (2014) put forward for the first time the concept of “smart home elderly care”, explored meanings and patterns of smart elderly care, and analyzed opportunities and problems in the development course of smart elderly care [6-7]. LIU Jianbing (2015) further explained the concept of smart elderly care. He held that realizing social and smart elderly care service was an inevitable choice to solve difficulties such as structural shortage in elderly care service resources and labor-intensive elderly care under the quick population aging background of China [8]. Bierhoff I, et. al (2015) maintained that comprehensive nursing system was a complicated ecosystem and organization, nursing staff, technicians and those being nursed were interdependent; varied demands of those being nursed shall be highlighted [9]. ZUO Meiyun, et. al (2016) viewed community service for home elderly care from the perspective of smart elderly care, and concluded that abilities such as information technology building platform, information integration, decision-making support and standard service could help with benign circulation of community elderly care subjects [10].

Studies in the field emphasized humanistic and social sciences and followed the vein of “smart home elderly care-smart community elderly care-public economics-formulation of government policies”. What’s worth mentioning was that the concept of “smart care for elderly” proposed by scholars such as ZUO Meiyun for the first time in 2014. They started with demand theory and information technology to organically integrate different life demand hierarchies of the elderly and services provided by the smart elderly care platform or components of the platform. In addition, they explained the connotation of “smart elderly care” clearly and was of milestone significance to studies of following scholars.

Studies on Information Technology Application in “Smart Care for the Elderly”

Foreign scholars started early studies on technical aspects: Mynatt E D, et. al (2001) maintained that the elderly’s routine work could be supported by computer technology and enhancement of complicated computing ability [11]. Tapia E M et. al (2004) designed home use sensor equipment in his study to identify human body activities with a detection precision ranging from 25% to 89% [12]. Rammal A et. al (2008) monitored activity, exercise and physiological information through data dynamics in mathematical modeling. He concluded that the system was adaptable and could be duplicated on large scale [13]. Chung S B et. al (2012) worked out an interface system which was composed of language and exercise identification system in this study for disabled people and old people who couldn’t use electronic equipment [14]. Barolli L et. al (2013) designed Smart Box to integrate it with P2P system so as to monitor and control activities of patients and the elderly [15]. Jalal A et. al (2014) studied simulated smart indoor activity data set and MSR Daily Activity 3D data set which could be applicable to the monitoring system for all kinds of old people [16]. Mccarthy M et. al (2015) conducted a study on the consistence between motion sensor data collection and actual conditions. The studied showed that motion sensor data collection needed to be supported by advanced nursing science [17]. Syed Misbahuddin et. al (2016) developed a health nursing system based on the internet of things to help the disabled or the elderly [18]. Burns N B et. al (2016) proposed a SmartCare project which was designed, developed and assessed for the living environment of the elderly, such as three-dimensional and visualized smart apartment (VISMA) and Z-Wave home automatic technology (ZAPS) that provided daily assistance [19].

Chinese scholar ZHU Xiaofeng (2013) applied mobile internet and smart terminal technology to elderly care service through Android technology and established a menu-like community smart elderly care platform for old people [20]. ZUO Meiyun (2014) proposed games for smart elderly care from the perspective of hierarchy of needs [21]. SUN Yimin et. al (2015) designed a smart supporting platform based on care assistive robot which integrated sensor, RFID, RSSI and other hardware facilities as well as robot service system [22]. The utility model patent of CHEN Junbo (2015) was a kind of smart care information equipment based on cloud platform [23]. ZHU Jingyi et. al (2016) combined technologies such as internet of things, RFID and sensor to work out a kind of smart care service platform on the basis of wearable devices [24].

To sum up, relevant domestic and foreign technological studies focus on such fields as “sensor, data mining, cloud computation, software application, smart equipment and data interface”. In recent years, with rapid development of information technology, new technologies such as mobile internet, virtual reality, augmented reality and mix reality have appeared and been applied to smart elderly care solutions based on the internet of things. .

“Smart Care for the Elderly” Solution and Case Study

In terms of smart elderly care solution design and application, well-known companies IBM and NEC, as pioneers, advocated

and introduced a whole set of smart elderly care solutions. IBM put forward the concept of “smart earth” [25] in 2010 and later on proposed the concept of “smart medical care”. It’s oriented towards a greater health system covering multiple aspects such as medicine, nursing, rehabilitation and elderly care. The smart elderly care service system of IBM was a smart elderly care and nursing system which centered on old people and was characterized by coordinated services, whole services, on-demand services and real-time perception [26].

NEC utilized its informationized management experience in Japan’s elderly care industry and introduced a smart elderly care information management platform for elderly care institution operators, NEC i-Care Platform. It’s officially launched in China in 2011. Now it’s applied in institutions such as a large elderly care chain organization in Beijing and Shijingshan Elderly Care Home. NEC smart elderly care solution in 2016 integrated technologies such as big data, cloud computing and sensing, was equipped with systems such as NEC precise positioning system, face recognition system and PBX call center as well as hospitals’ HIS, LIS and PACS systems. It’s a smart elderly care operation informationization solution of “internet + smart elderly care + combination of medical care and elderly care”. In June 2016, NEC tested its home elderly care informationized management platform which was officially released in August [27].

In China, the application of “smart care for the elderly” started with community service for home elderly care in 2010: in 2010, Jiangsu Economic News reported that NandaSoft and IBM cooperated to introduce the home “smart elderly care” program in Gulou District of Nanjing [28]. In 2011, according to Nanjing Daily, the “smart community grateful elderly care” service platform was opened in the future information hall of China Telecom Nanjing Branch [29]. In 2012, Modern Science covered the application of “smart Haidian” in Tsinghua Park street community hospital, Haidian District, Beijing [30]. In 2013, Population and Family Planning reported that the virtual elderly care home in Chengguan District, Lanzhou, Gansu, realized home elderly care [31]. In 2015, as covered in Fujian Daily, Fujian Vserve Technology Co., Ltd. established in 2010 designed the pattern of “internet + elderly care” which integrated systems such as “smart cloud health management”, “smart institution elderly care” and “smart home elderly care”. Its physiological demand orientation for the elderly and its corporate products were quite accurate [32].

Relevant academic studies have successively surfaced since 2013: Kim J (2013), after conducting a survey on 1,188 members of South Korean Gangnam Senior Plaza (GSP), manifested that high satisfaction degree resulted from desirable service facilities, convenient community services and education plan as well as friendly employees and clean equipment. GSP was deemed as the model of welfare services in South Korea [33]. Drobne S et. al (2014) analyzed the community service pattern for the elderly in Slovenia from 2000 to 2010, and developed proper elderly community care services in accordance with the plan, capital and the government’s medical care and social security systems [34]. Hsu M S (2014) described Taiwan’s Ming-Sheng Telecare U-care project in which smart health care services were realized through home gateway or interactive voice system and which could monitor life vital signs on a regular basis. Doctors would give prescriptions according to data. In the meantime, he mentioned that smart care service faced a number of challenges such as payment intention, maintenance ability and legal limitation [35]. WU Leilei (2014) took smart care for elderly in Shangcheng District of Hangzhou, Zhejiang, for example and applied the internet of things in home elderly care service [36]. XU Chao (2015) studied and analyzed concrete initiatives in the science & technology assistive action in Shanghai 96980 community service enter [37]. MAO Yu et. al (2015), based on ITAUT model, built a “one button” service user model, sorted out crucial factors and provided suggestions and countermeasures for smart elderly care service [38]. YUAN Xiaoliang (2016) conducted a survey on Z informationized elderly care service platform of X city and revealed that smart virtual elderly care service was confronted with many problems. Problems included implicit definition of services, improper differentiation of service objects, insufficient supply of supporting facilities and services, impact of traditional concept and hard-to-guarantee service quality, etc. [39].

DESIGN THOUGHTS FOR COMPREHENSIVE SOLUTION TO SMART CARE FOR THE ELDERLY

Further Analysis of Literature Data

Springer Link

It’s found through retrieval of relevant research results that researches related with the key word “old people” focused on the medical field. The quotation times of the key word “the elderly” in papers was 834, ranking the first, followed by the word “old person” with a quotation quantity of 181[40]. Hence, this paper adopted “smart care for elderly” as the English equivalent. For the sake of more vivid analysis, we entered “SmartCare” + “Elderly” to search in Springer Link and the results were displayed as follows:

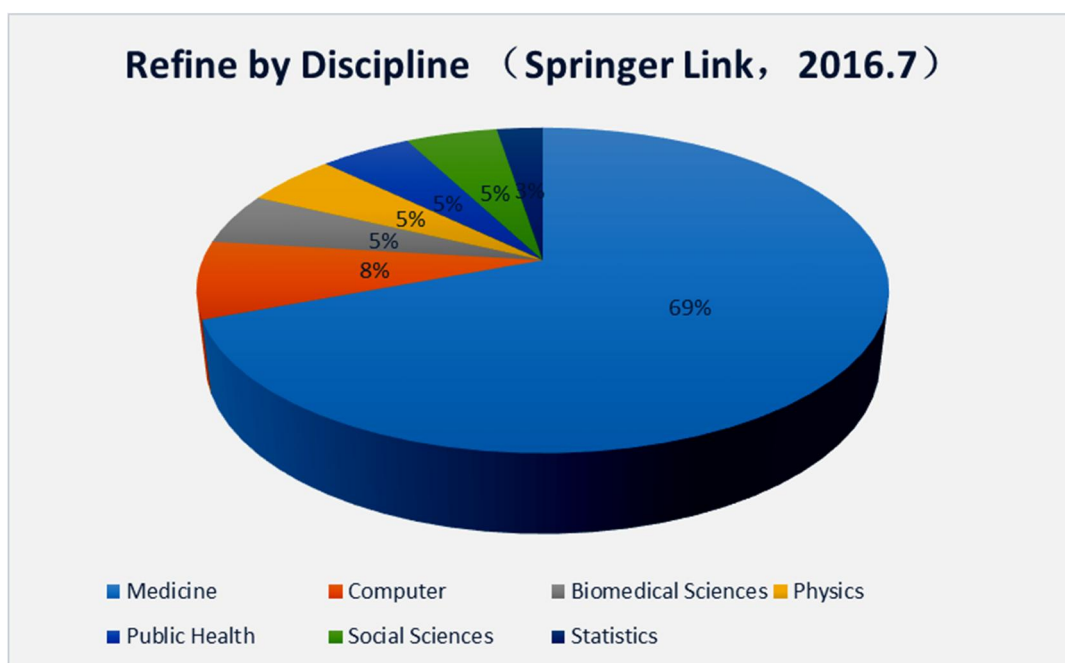


Figure 3: Layout of Relevant Discipline Papers in Springer (Data source: Springer Link Database, July 1, 2016)

As shown in the chart, 69% of foreign papers about “smart care for the elderly” centered on the medical field; 8% were about computer field and the remaining ones were scattered in other fields such as biomedicine, physics, public health, social sciences and statistics..

CNKI

According to annual retrieval data on CNKI theme words, before 2012, research achievements about “smart care for elderly” were touched upon in journal reports of varied elderly care systems. According to these studies, Japanese NEC’s smart community were given greater attention by the media from 2011 to 2013. Starting from 2012, relevant academic papers were successively published. In recent years, the number of publications has taken on an upward trend and the number of published papers in 2016 is expected to exceed 200.

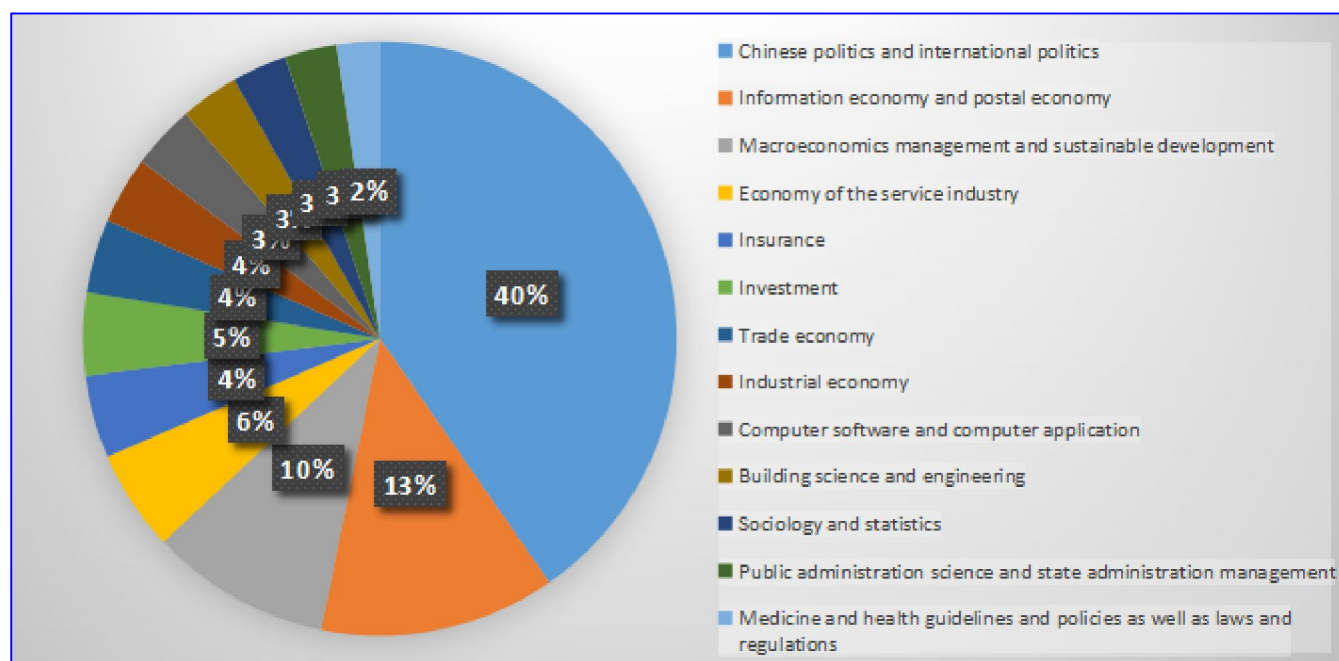


Figure 5: Discipline Retrieval Results in CNKI (Data source: CNKI <http://www.cnki.net>, July 1, 2016)

CNKI results and Springer results are widely different. It shows that 40% of Chinese scholars’ papers are about politics, followed by information economy and macroeconomics; remaining papers mentioned economy of the service industry, insurance, investment, trade economy, industrial economy, computer software, computer application, building science and engineering, sociology and statistics, public administration science and medicine and health policy studies, etc. It means that most of studies on “smart care for elderly” in China’s academic circle are still at the stage of humanistic and social science

while studies on applied sciences such as medicine and computer are just started.

Current research fields basically cover two aspects: first, technical application at an extremely microscopic level, emphasizing information technology field and belonging to the scope of specific functions of the network; second, extremely macroscopic theoretical studies which underline model exploration. Due to great span between the two aspects, it's hard to reach interdisciplinary conclusions. Yet, in actual application and under the greater environment of the internet, how to realize cohesion of relevant functions, construct and improve the smart care system for elderly, especially urgent need of the government for smart care for elderly comprehensive solution cannot be simply solved by technical masters or theoretical masters. Interdisciplinary studies pose higher requirements and challenges for scholars.

Analysis of Existing Problems

At present, Chinese government attaches great importance to the status quo of population aging: on May 27, 2016, the CPC Central Committee Political Bureau held the 32nd collective study on China's aging population situation and countermeasures. The general secretary XI Jinping stressed to make greater efforts to improve the aging policy system, perfect policies such as support and maintenance for the elderly, social assistance, social welfare, social special treatment, livable environment and social participation, strengthen pertinence, coordination and systematicness of policies and systems, promote cohesion of varied policies and systems and consolidate resultant forces of policies [41]. As China has the largest population in the world, Chinese government is the greatest owner of medical health data. With years' construction, it has set up multiple platforms of medical health departments' business data. At the same time, macroscopic policy and environment are favorable. However, the following problems still exist in detailed research fields and applications:

Study Aspect

According to law of development, the academic study of scientific research institutions usually runs ahead of industrial applications. Due to the "trial and error" nature of academic studies, a certain failure rate is allowed for research projects. Nonetheless, products or applications of industries should press closer to market demands and their products should be mature to some extent out of pressure for development and survival. The two of them are both interdependent and contradictory. How to locate their cross part and conduct innovative industry-university-research studies shall be further considered.

System Aspect

First of all, existing health and care competent departments belong to different superiors and are restrained by modularized management system. Accordingly, their platforms cannot share each other's information. Complicated, non-shared and non-standard working procedures have reduced public satisfaction degree. Second, plenty of data are stacked in their own systems and most institutions fail to conduct data mining and analysis so data value is unable to be manifested yet.

Technical Aspect

It costs much to integrate different systems of a platform and there's no unified standard interface and standard system. Medical health systems in local places have been basically formed but a desirable model is in short in terms of extended services and data sharing. Problems exist such as precision of collected data by sensor (degree of closeness between measured value and real value, including precision and accuracy), and contradiction between portability of portable devices and hardware support. Concrete application of new technologies such as mobile internet, virtual reality, augmented reality and mix reality in the smart care for elderly field is yet to be explored. Besides, cloud computing based on the internet has raised higher requirements for software and hardware support.

Security Aspect

Information interaction and supplement between different medical care systems based on the internet as well as the platform service sharing model presented new requirements for smart care for the elderly in terms of security mechanism, management mechanism and empowerment mechanism. On the one hand, many relevant studies shall be conducted, including multi-system data aggregate, privacy protection of data storage, transmission and release, information security technology, data disturbance and anonymity generalization technology in the data storage step, concealment of personal private information, and other key technologies. On the other hand, relevant laws, regulations and policies regarding privacy protection and data security involved in the platform shall be able to avoid leakage of privacy while satisfying information demand, etc.

Solution Design

Based on previous scholars' studies and with combination of industrial application status and development trend, basic principles of solution design are as follows:

Collaborative Innovation Perspective

A solution framework which integrates data collection, data processing and integration, data analysis and data explanation shall be built from such perspectives as old people's psychological and physiological demands; further a set of management mechanism which consists of digital object identification, content aggregation and digital object retrieval should be formulated to realize smart analysis of elderly care data based on the internet, and enhance the coordination efficiency and level of different systems.

Interdisciplinary Perspective

Observation should be conducted from multiple disciplines such as medicine, computer science, electronic information engineering, management, economics and law. Besides, varied information technologies such as the internet of things and data mining shall be utilized to integrate multiple information systems of smart care for the elderly from the public governance perspective. Furthermore, a collaborative mechanism with heterogeneous network shall be designed, and professionalized and scientific analysis shall be conducted to provide comprehensive rational decision-making support for smart elderly care.

Mechanism and System Perspective

Studies should look for the coherence point between information technology and management mechanism, and profoundly probe into key technologies of the smart care for the elderly service platform. Under the prerequisite of improvement in security mechanism, management mechanism and empowerment mechanism, major attention shall be paid to data mining and product design and services for the development of regional smart elderly care industry so as to provide support for decision-making of governments, industries and institutions.

Preliminary design for concrete solutions can be seen in the following chart:

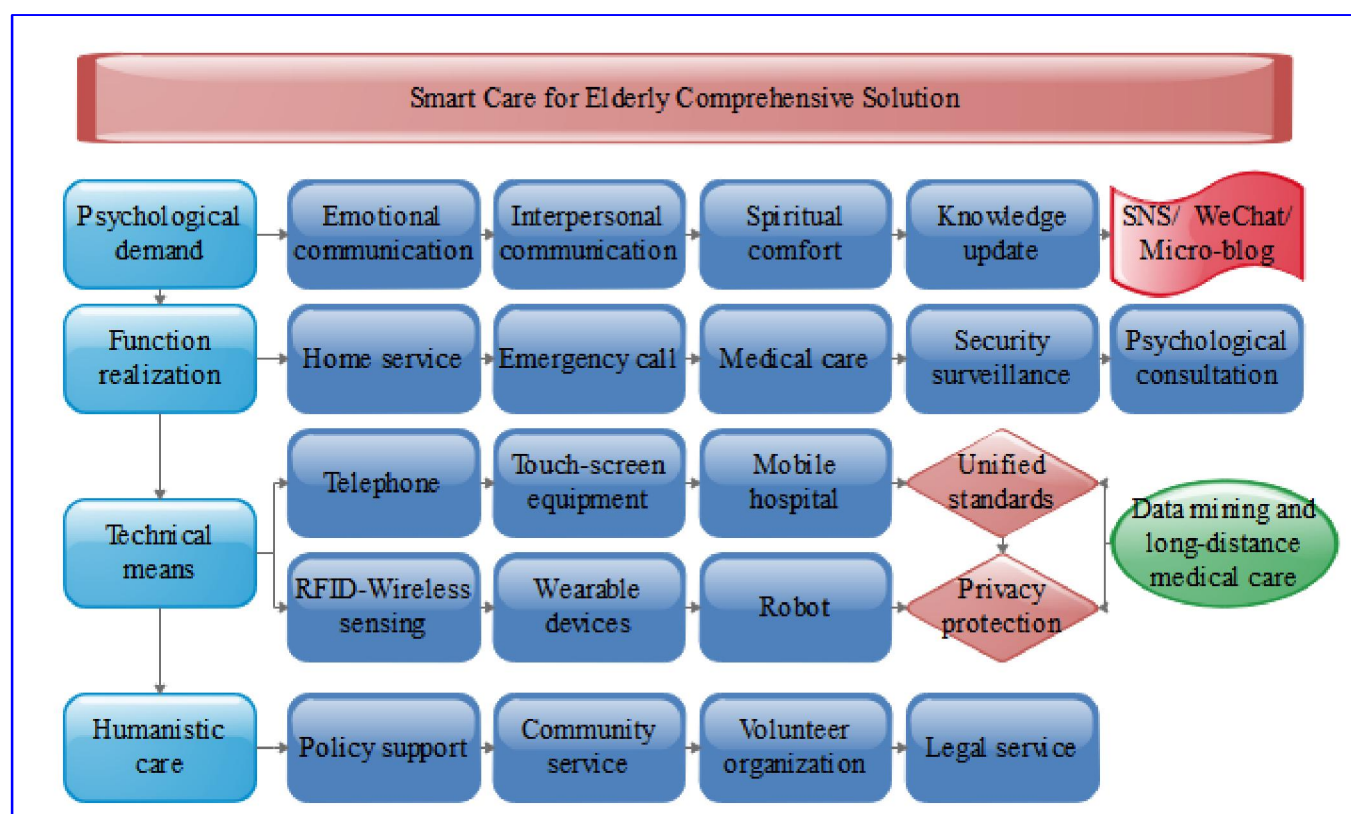


Figure 6: Smart Care for Elderly Comprehensive Solution

The solution stated above sticks to the basic path of platform design: demand analysis, prototype design, system testing and concrete application, etc; it starts with old people's psychological demands (emotional communication, interpersonal communication, spiritual comfort and knowledge update, etc.), and utilizes WeChat and micro-blog to work out functions which meet with old people's psychological demands above (home service, emergency call, medical care, security and health, and psychological consultation, etc.). Under the premise of unified standard and privacy protection, and to achieve the purpose of giving humanistic care to the elderly, ZUO used data mining and long-distance medical means as well as technical means (telephone, touch-screen devices, wireless sensing, wearable devices, robot and mobile hospital) to cooperate with policy support, community service, volunteer organization and legal service..

CONCLUSION

The development of the internet and new technologies has made it possible to have the elderly care service transform to the active service model "centering on patients" from the past passive pattern of seeking services by the elderly. As an important means, smart care for the elderly comprehensive solution combines information technology and humanistic and social sciences, and explores cross application of different disciplines and different technical means. Besides, it discusses varied features and rules in the development course of the elderly care industry, timely monitors, intervenes and manages varied elderly care services. All these are conducive to improving the cognition standard, treatment compliance and self-management abilities of the elderly and their families. By doing so, it will build a favorable interactive scenario and further enhance elderly care validity. Furthermore, it's of great practical significance to perfecting elderly care system of the entire society, gradually addressing the social aging problem and implementing China's elderly care policy of "prevention beforehand".

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APPENDIX

Sponsor: Fuzhou Sci-Tech project 2015-PT-91; Cross-straits vocational education exchange and cooperation program of Fujian Education Department (Fujian textbook 2015-178); National Institute of Vocational Education Fujian Polytechnic research program GZM15001.

Critical Acceptance Factors of Cloud-Based Public Health Records

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ABSTRACT

Personal health records (PHR) is a tool that can be used to assist patients in health management, and cloud-based PHR is expected to effectively integrate medical resources and information, elevate overall healthcare quality, and reduce unnecessary medical costs. This study tends to explore the factors that affect users' intention to use with regard to the Microsoft HealthVault hybrid cloud health system in Taiwan. A research model combined with Unified Theory of Acceptance and Use of Technology (UTAUT) and Task-Technology Fit (TTF) models as well as perceived risks and trust is proposed including 10 hypotheses. After conducting a series survey, in total, 254 valid questionnaires in Taiwan were received. Some preliminary findings are discussed, and it is hoped that this model can be used to explore the key factors influencing usage intent toward the HealthVault.

Keywords: personal health records, technology acceptance, trust, task-technology fit

INTRODUCTION

Personal health records (PHR) is a tool that can be used to assist patients in health management [3] [4] [27]. Because of PHR's characteristics including personal autonomous control, personal uniform recording, ease of sharing of medical information, and high participation by users [8] [11] [34] [39], thus PHR can be applied to medical care. If it is possible to put PHR on the cloud, it would be possible to use the internet to achieve cross-platform data access and storage, which is no longer limited to the computer, but different devices can be used to access and save data. Also, because PHR is a user-centered personal health record, it can be independently managed by the user. In summary of the foregoing, cloud-based PHR is expected to effectively integrate medical resources and information, elevate overall healthcare quality, and reduce unnecessary medical costs. Thus, this study plan to explore the factors that affect users' intention to use with regard to the Microsoft HealthVault hybrid cloud health system in Taiwan, combined with Unified Theory of Acceptance and Use of Technology (UTAUT) and Task-Technology Fit (TTF) models to explore the fit between PHR's task characteristics and HealthVault's technological characteristics, adding perceived risks theory and trust theory to propose the research model. To do so, a research model is proposed and will be discussed later after the literature review.

LITERATURE REVIEW

PHR Personal Health Records

Personal health records (PHR) is a type of record that includes all medical information relating to patients, including personal health information such as dietary habits, exercise, measured biological indicators, medical treatment records, drug administration records, and medical insurance. PHR refers to "an electronic record used to store and share personal health information, and the user has the power to independently manage the record" [7] [8] [11] [20]. PHR is characterized by the following [4] [11] [19] [36]: (1) Life-long recording; (2) Personalized data and sharing controls; (3) Ease of use; (4) User participation; (5) Can save all necessary information; (6) Health education functions. In addition, scholars believe that if only electronic health records (EMR) provided by hospitals are used, there would be problems of accuracy and continuity [36]; various reasons are behind the development of PHR [11] [12].

HealthVault

HealthVault is the platform developed by Microsoft for medical operating systems. Via HealthVault, users can control their personal health information, and share with their families, doctors, and care centers [10]. In recent years, cloud-based services and online services have begun to appear. Cloud-storage systems like Dropbox and Google Drive allow the user to enjoy high-capacity online storage and flexible data access without bearing the costs of infrastructure. HealthVault (2014) pointed out that HealthVault's benefits include organization and usage of health information of users and family members, preparing for treatment and emergency treatment in advance, comprehensive display of user health conditions, and achieving users' health goals.

Combining UTAUT and TTF

In the field of information management, the adoption of information technology has long been a focal point [9] [6] [40]. Venkatesh et al. (2003) proposed the Unified Theory of Acceptance and Use of Technology (UTAUT). UTAUT of Venkatesh et al. (2003) included the four constructs of performance expectancy, effort expectancy, social influence, and facilitating conditions to explain personal intention to use information technology. Goodhue & Thompson (1995) proposed task-technology fit (TTF) primarily to assess the correlation and fit between characteristics of personal tasks and characteristics of information technology, and how these affect usage behavior and performance.

However, UTAUT does not consider technological dimensions. Past studies have shown that under different scenarios and technologies, dimensions produce different effects and significance in behavioral intent and actual usage behavior, but integration of UTAUT and TTF models can make up for the insufficiency in the models. For example, Pai & Tu (2011) used UTAUT and TTF to research the factors that would cause the delivery service business to accept and adopt CRM; the studies showed that effort expectancy, social influence, and task-technology fit would positively affect intention to use. Razeghi & Nasiripour (2014) studied which factors would affect the acceptance and usage of electronic health records by medical care centers, finding that facilitating conditions, characteristics of technology, task characteristics, performance expectancy, effort expectancy, and social influence all have considerable importance. Therefore, this study used an integrated model of UTAUT and TTF to explore intention to use HealthVault.

Perceived risks

Since personal health records contain sensitive data involving personal privacy of users, information security is very important for personal health records [38] [37], which would also affect the intention to use personal health records [5]. Past studies showed: “Users would not use the PHR system when they have doubts about information security” [35]. However, currently the government and society have considered privacy risk and security risks to be important and indispensable issues in information transmission. In past studies on electronic online services and applications, safety and privacy have long been important factors in perceived risks. In sum of the scholars’ research, the study defined perceived risks as “the result of user perception of uncertainty of information technology.”

Trust

According to past studies, trust is an important factor of information technology; after users have established trust, they would be more willing to participate [30]. Trust is also a complex and multifaceted concept; it is an important element in interpersonal interaction and the indispensable basis in commercial relationships. The concept of trust has been applied to many fields, such as psychology, sociology, e-commerce, and knowledge management. Many studies have pointed out that trust would affect intention to use.

Past studies on trust showed that we can understand many different dimensions of trust, including for nations, vendors, and products. However, in their study on e-commerce, Gefen et al. (2002) pointed out that whether consumers trust online retailers would significantly affect whether they are willing to make purchases. This means that in online service research, the willingness of users to use a certain online e-service is dependent on whether there is trust for the system provider.

Like e-commerce, in studies exploring personal health records, Hessels (2014) and Spil & Klein (2014) used the PRIMA model to research the acceptance of personal health records, finding that perceived risks and trust are both key factors. In the study by Li, Gupta, Zhang, & Sarathy (2014) on intention to use personal health records, it was found that perceived risks and trust would affect intention to use, while trust would affect perceived risks. However, the study by Li, Gupta, Zhang, & Sarathy (2014) showed that since research focused on intention to use personal health record systems, trust is based on whether the user trusts the system provider. This meant that in studies on electronic health services, user trust for the system provider would affect whether the user would use the electronic health service. This result is also consistent with that from e-commerce research.

RESEARCH METHOD

Based on the literature, this study proposed the usage of UTAUT, TTF, perceived risks theory, and trust theory to construct 10 hypotheses and a model (see Figure 1) to explore intention to use HealthVault.

Venkatesh et al. (2003) believed that performance expectancy, effort expectancy, social influence, and facilitating conditions are key factors in exploring behavioral intent in the usage of information technology. This study summarized past studies on intention to use PHR, and found that performance expectancy, effort expectancy, social influence, are facilitating conditions key factors affecting usage of PHR [17] [33] [13] [32] [28] [24] [21] [18].

Performance expectancy refers to if using information technology can help users increase performance when executing tasks, then there would be a positive effect on users’ intention to use information technology. Hessels (2014) and Spil & Klein (2014) used the PRIMA model to explore acceptance of PHR, finding that perceived usefulness would significantly affect intention to use. Liu, Tsai & Jang (2013) and Jian, Shabbir, Sood, Lee, Hsu, Ho, Li, & Wen (2012) researched Taiwanese people’s acceptance of PHR, finding that perceived usefulness would affect Taiwanese people’s intention to use PHR. UTAUT’s performance expectancy integrated the construct of perceived usefulness. Therefore, the study hypothesizes that when using the personal health information system, performance expectancy would affect users’ behavioral intent.

H1: “Performance expectancy” has a positive effect on the people’s “behavioral intent” in using HealthVault.

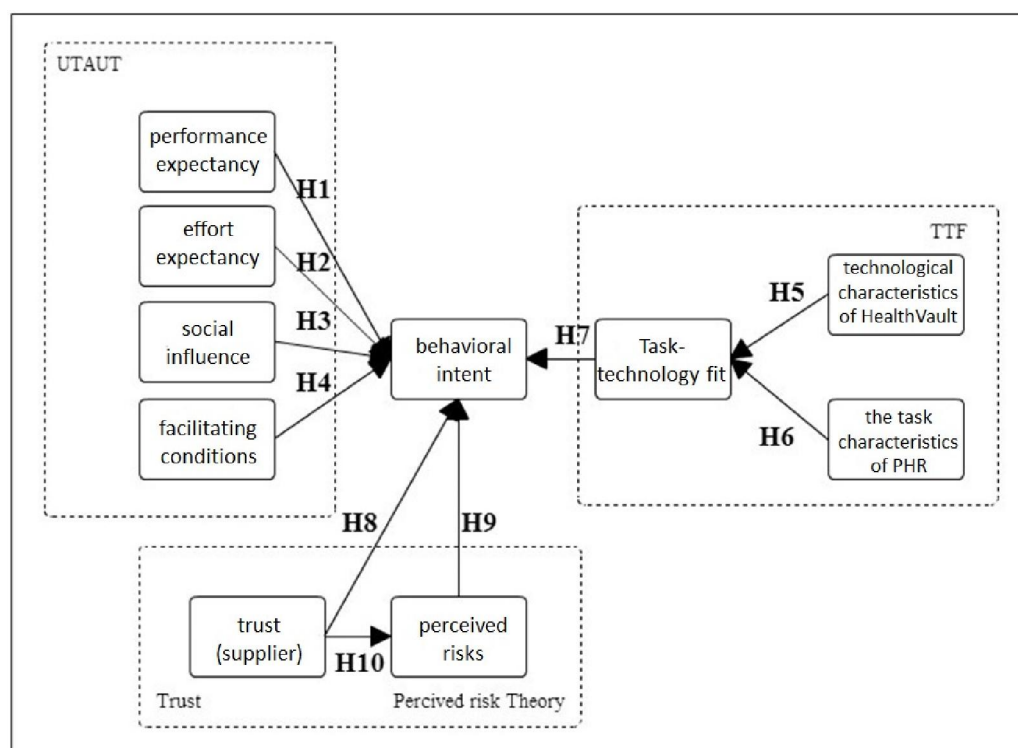


Figure 1: Proposed research model and hypotheses

Effort expectancy pointed out that if information technology is easy to use, then there would be a positive effect on users in their intention to use information technology. Hessels (2014) and Spil & Klein (2014) used the PRIMA model to explore acceptance of PHR, finding that perceived ease of use would significantly affect intention to use. Liu, Tsai & Jang (2013) and Jian et al. (2012) researched Taiwanese people's acceptance of PHR, finding that perceived ease of use would affect Taiwanese people's intention to use PHR. UTAUT's effort expectancy integrated the construct of perceived ease of use. Therefore, the study hypothesizes that when using the personal health information system, effort expectancy would affect users' behavioral intent.

H2: "Effort expectancy" has a positive effect on the people's "behavioral intent" in using HealthVault.

Social influence refers to when users believe that other people think he should use new information technology, then this would have a positive influence on intention to use information technology. Hessels (2014) explored Dutch acceptance for PHR and Spil & Klein (2014) explored why Google Health failed and which potential factors should HealthVault emphasize, pointing out that social influence is a key factor. Gagnon et al. (2014) believed that social norms affect doctors' intention to use electronic health records. Razeghi & Nasiripour (2014) believed that social influence is important in influencing medical care centers' acceptance for electronic health record systems. Jian et al. (2012) studied Taiwanese consumers in personal health record, finding that subjective norms would affect intention to use. Therefore, this study hypothesized that in using personal health information system, social expectations would affect behavioral intent of users.

H3: "Social influence" has a positive effect on the people's "behavioral intent" in using HealthVault.

Facilitating conditions refer to when a user perceives that other people think he should use the new information technology, then there would be a positive effect on intention to use information technology. Hessels (2014) explored Dutch acceptance for PHR and Spil & Klein (2014) explored why Google Health failed and which potential factors should HealthVault emphasize, pointing out that perceived compatibility is a key factor. Razeghi & Nasiripour (2014) believed that facilitating conditions are important in influencing medical care centers' acceptance for electronic health record systems. Therefore, this study hypothesized that in using personal health information system, facilitating conditions would affect behavioral intent of users.

H4: "Facilitating conditions" has a positive effect on the people's "behavioral intent" in using HealthVault.

Goodhue (1988) believed that the fit between technology and task would affect performance. When technological characteristics are better suited to needs in a task, better performance can be produced; therefore, task characteristics and technological characteristics information technology would significantly affect task-technology fit. Aldhaban (2012) integrated UTAUT and TTF to explore user acceptance of smartphone technology, which showed that task characteristics and technological characteristics would significantly affect task-technology fit. Pai & Tu (2011) explored the Taiwanese delivery service industry's acceptance and adoption of CRM, pointing out that task characteristics and technological characteristics would significantly

affect task-technology fit. In research of electronic online services, Zhou, Lu, & Wang (2010) explored user acceptance or adoption of mobile banking, believing that task characteristics and technological characteristics would significantly affect task-technology fit. Since the Microsoft HealthVault is a type of electronic online service, therefore, this study deduces that when using online electronic services, technological characteristics and task characteristics would affect task-technology fit.

H5: “Technological characteristics of HealthVault” have a positive effect on “task-technology fit”.

H6: “Task characteristics of PHR” have a positive effect on “task-technology fit”.

Vessey (1991) proposed the perceived fit model, stating that when the user perceives fit between the tool for the solution and the task to be resolved, it would effectively reduce task complexity and elevate efficiency in resolving tasks. Goodhue & Thompson (1995) pointed out that when the functions of information technology meet user task needs, it is possible for the information technology to be accepted. This means that when information technology is accepted and adopted, it means that there is good fit between information technology technological characteristics and task characteristics.

Razeghi & Nasiripour (2014) indicated that task-technology fit is one of the most important factors that would affect medical care centers’ acceptance for electronic health record systems. Aldhaban (2012) researched user acceptance for smartphone technology, believing that task-technology fit would significantly affect intention to use. Pai & Tu (2011) suggested task-technology fit would positively affect the Taiwanese delivery service industry’s acceptance and adoption of CRM systems. In the study by Zhou, Lu, & Wang (2010) about acceptance and adoption of mobile banking, task-technology fit would positively affect whether users adopt mobile banking services. Zhang, Huang, & Chen (2010) integrated UTAUT and TTF to construct the model framework for acceptance of mobile search, pointing out that task-technology fit is an important factor. Therefore, the study deduced that when using personal health information systems, task-technology fit would affect users’ behavioral intent.

H7: “Task-technology fit” has a positive effect on “behavioral intent” of using HealthVault.

Since PHR contains sensitive data contain sensitive data involving personal privacy of users, information security is very important for PHR [38] [37] and would affect user intention to use personal health records [5]. Srinivasan (2006) pointed out that users would not use the PHR system when they have doubts about information security. In studies on online electronic services, perceived risk and trust are key factors of intention to use [23] [17] [26] [25] [22] [29]. Thus, perceived risk and trust are two critical factors for whether users use personal health record.

Li, Gupta, Zhang, & Sarathy (2014) researched intention to use personal health records, finding that in the context of personal health record, perceived risk and trust would significantly affect intention to use. Other studies showed that when users have perceived risks for the usage of information technology, it would negative affect intention to use information technology. The more trust users have for information technology, there would be a positive effect on intention to use information technology. Therefore, the study deduced that when using the personal health information system, perceived risk and trust would affect the behavioral intent of users.

H8: User “trust” has a positive effect on “behavioral intent” for using HealthVault.

H9: User “perceived risks” have a negative effect on “behavioral intent” for using HealthVault.

Kim, Ferrin, & Rao (2008) pointed out that when using electronic services, because it involves private user information, user trust for information technology would significantly affect users’ perceived risks. Li, Gupta, Zhang, & Sarathy (2014) studied intention to use personal health records, and pointed out that trust would positively affect intention to use personal health records, but it would negatively affect users’ perceived risks. Nicolaou & McKnight (2006) found that in electronic data exchange, trust would significantly affect users’ perceived risks. Therefore, this study deduced that when using personal health information systems, trust would affect users’ perceived risks.

H10: User “trust” has a negative effect on users’ “perceived risks”.

PRELIMINARY FINDINGS

This study used questionnaire surveys to collect statistical data. The questions derived from variables in the dimensions of this research model are all measured by the Likert 7-point scale. In questionnaire design, in order to elevate reliability and validity of the questionnaire, this study chose questionnaire scales suitable to the research purpose and translated them. Then, 4 professionals from academia and industry were invited to revise the pretest of the questionnaire to avoid unclear semantics or inappropriate questions. This study collected questionnaires through online forums and retrieved 280 questionnaires in Taiwan. In order to maintain validity for data analysis and statistics, 12 questionnaires with incomplete answers and errors, ending up with 254 valid questionnaires; the retrieval rate was 90.7%. Based on analysis of the 254 valid questionnaires, in terms of age,

most respondents ranged between 21-30 and 10-20 years of age, with 143 and 82 people in each age group, or 88.6% of the valid sample. In terms of education, most had university educations, at 179 people (70.5%). In terms of gender, 154 were men, at 60.6%, and 100 were women, at 39.4%. In terms of number of visits to medical institutions per year, most visited 0-5 times, at 180 people or 70.9%. In terms of whether they have used HealthVault, 89.4% had not.

The next steps for this research are to conduct a series of analytical processes including factor analysis, discriminant validity measures, and structural equation modeling (SEM) to test if the proposed hypotheses can be supported by the results. The SEM software will be smartPLS 2.0. By testing this proposed model, it is hoped that we can find the key factors affecting users to adopt the HealthVault system.

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A PROBABILITY MODEL FOR ANALYSIS OF ATTACKS ON BLOCKCHAIN

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ABSTRACT

In a blockchain, the longest chain, which has the greatest proof-of-work effort spent in it, represents the majority decision. To change the transaction data of a block, an attacker has to control more computing power than other honest nodes. This situation can happen if the attacker can hack into the systems of honest nodes. To analyze the probability of such event, we propose a probability model for analysis of attacks on blockchain. The model is based on the structure of a peer-to-peer network. We assume the state of each honest node follows a two-state (hacked or normal) Markov chains. A hacked node is assumed to be controlled by the attacker and its computing power belongs to the attacker. On the other hand, the computing power of a normal node belongs to the honest longest chain. We apply the model to study the probability of the majority decision is controlled by the attacker and the duration of such event. In addition, we analyze the magnitude of the loss for such event.

Keywords: Blockchain, the longest chain, blockchain attack, Markov chain, stochastic process

INTRODUCTION

Bitcoin has emerged as the most successful cryptocurrency. According to <http://blockchain.info/charts/market-cap>, the Bitcoin market capitalization is over 100 billion US Dollars as of October 2016. The coins of bitcoin network are created from the network protocol directly, without any central authority involved. Most of these economic value is generated from this innovation. As of October 24, 2016, the bitcoin blockchain wallet user is near 10 millions and daily USD transaction value is more than 120 millions on average (see Fig. 1). The computing power of the bitcoin network is greater than any supercomputer on earth. The current computing power is more than 2000 peta-hash per second (see Fig. 2). Bitcoin is not just a virtual currency, it is a collection of concepts and technologies. Bitcoin was designed by software developers without apparent influence from financial industry or regulators. A key idea in bitcoin network is Proof-of-Work. A mining node shows its Proof-of-Work by solving a difficult cryptography puzzle and get rewarded. Therefore, the probability of receiving reward of each mining node is proportional to its computing power/hash rates.

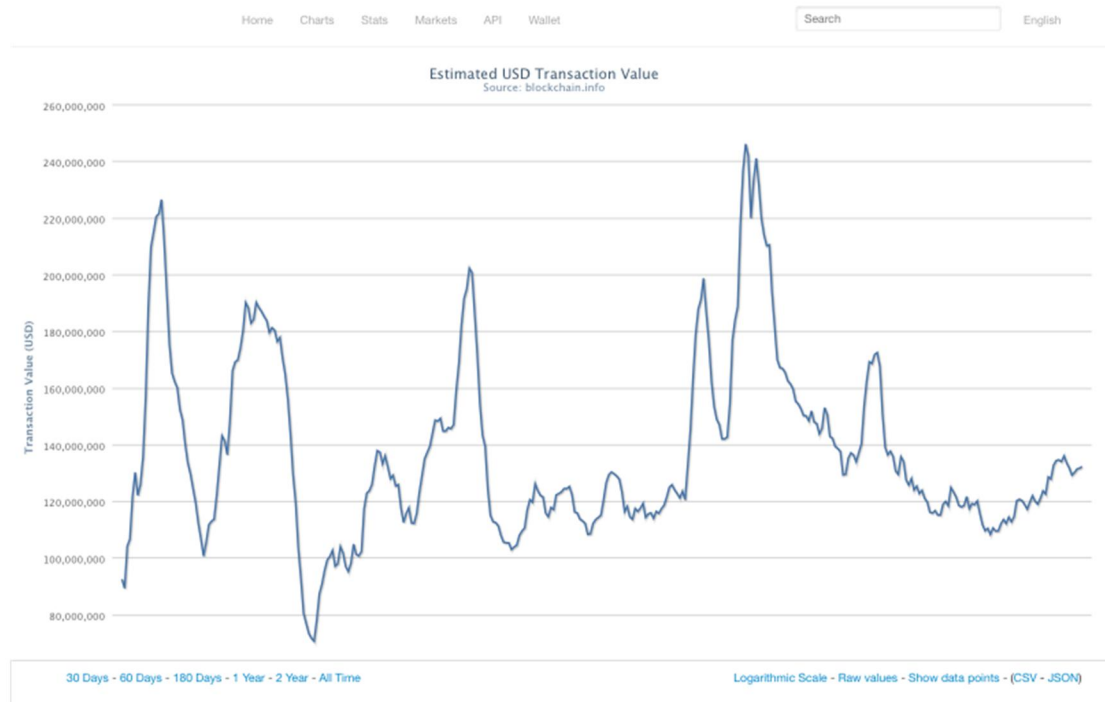


Fig. 1 Estimated daily USD transaction value of bitcoin blockchain

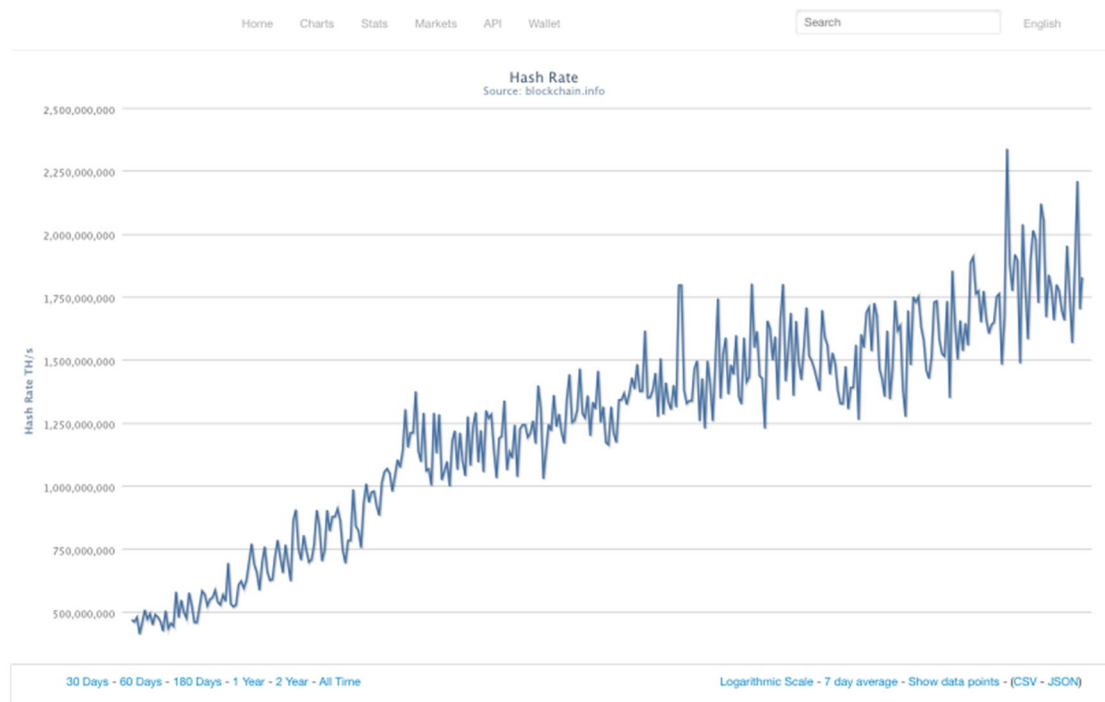


Fig. 2 Hash rate of bitcoin network

Currently, solo miner is very difficult to get rewarded. Mining pools are more likely to get rewards. Solo miner can join a mining pool to share the rewards and diversify his/her risk. Fig. 3 shows the major mining pools and their computing power.

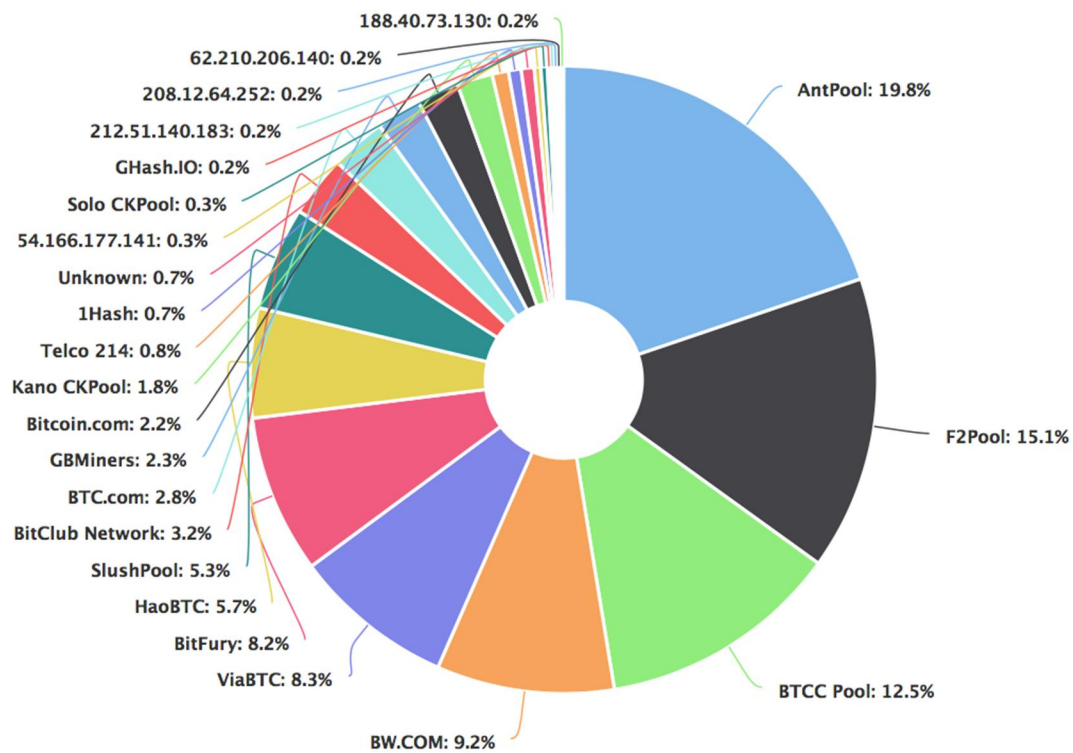


Fig. 3 Major mining pools of bitcoin network

ATTACKERS' MODEL

The basic attacker setup in [6] is as follows: “The race between the honest chain and an attacker chain can be characterized as a Binomial Random Walk. The success event is the honest chain being extended by one block, increasing its lead by +1, and the failure event is the attacker's chain being extended by one block, reducing the gap by -1”. In this paper, we extend the analysis by adding more detailed assumptions. We assume two types of nodes: honest and attacker's. When an attack starts, it will last for N blocks. N can be deterministic or following a discrete random variable such as a Poisson random variable. Assume attacker's node control w of total hash power when the attack begins. During the attacking period, an attacker's node will remain as an attacker's node with probability α when a block is created; and an honest node will remain as a honest node with probability β when a block is created. Based on these model assumptions, the majority decision is a two-state stochastic process (Asmussen and Glynn (2007)). More precisely, let $X_0, X_1, X_2, \dots, X_N$ denote the random outcomes of the created blocks. We assume $X_i = 1$ if it is created by an attacker's node and $X_i = 0$ if it is created by an honest node. It is clear that

$$P(X_0 = 1) = w$$

$$P(X_1 = 1) = \alpha w + (1 - \beta)(1 - w) \equiv \mu_1$$

It can be shown that

$$P(X_n = 1) = \alpha\mu_{n-1} + (1 - \beta)(1 - \mu_{n-1}) \equiv \mu_n$$

for $n = 2, \dots, N$. From above recursion, we can also compute

$$P(X_n = 1) = 1 - \beta - [(1 - w)(1 - \beta) - w(1 - \alpha)](\alpha + \beta - 1)^n$$

for all n .

Since only the double spending attack can incur loss, we assume the random loss L_n is incurred when block n is created by a hacked node or $X_n = 1$. The total loss of such an attack is

$$L = \sum_{n=0}^N L_n I(X_n = 1)$$

From the states of the majority decision, all of the interested quantities can be derived via simulation. The interested quantities are EL and risk measures of L . To estimate such quantities via simulation, computational efficiency is usually an important and practical issue. Fast simulation algorithm for similar network problem can be found in [1] and [3] and fast simulation in financial applications can be found in [2], [4], [5].

CONCLUSIONS

We proposed a probability model to address the importance attacker's issue in standard blockchain protocol. Based on model's parameters, we are able to address the probability of the system of being hacked in a certain time point. Furthermore, we are able to compute the expected loss and extreme loss during an attack event.

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Regional Discrimination in P2P Lending of China

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ABSTRACT

Through empirical analysis of individual micro data from one peer-to-peer lending platform, this paper aims to expand the research on regional discrimination in China's P2P lending market from a new perspective. Descriptive statistics of orders and difference test of success rate show that, for cities of different grades, there is a huge difference in the success rate. The main empirical finding is that under the control of other factors, city grade has a significant positive effect on loan success rate, namely the success rate of cities developing better is higher, revealing the existence of regional discrimination. Further study find the default rate of less developed cities, whose success rate is lower, is relatively higher, which proves the regional discrimination here is a rational statistical discrimination.

Keywords: P2P lending, regional discrimination, success rate, default rate.

INTRODUCTION

Discrimination is a kind of emotional reaction along with behavior appearing among different interest groups. In social sciences, it has both broad and narrow sense. In the broad sense it refers to "differential treatment", including "positive" as well as "negative" discrimination. For example, the policy of care for the vulnerable in sociology is a "positive" discrimination, and job rejection that women suffer is a "negative" discrimination [24]. On the other hand, in a narrow sense it refers to unfair treatment with negative meaning, where the same objects are treated unequally or diverse ones are treated equally [21]. Discrimination in the field of economics is mostly generalized, for economic agents usually have significant differences and think only about themselves.

In the traditional financial market, in order to avoid risk and gain income, investors would consider various factors before making a decision. Due to the factors of family resources, knowledge, investment opportunity and personal investment orientation vary widely, and people's risk bearing capacity being different, coupled with information asymmetry [26], so the investment is fraught with discrimination. And it is largely generalized "negative" discrimination. Pope and Sydnor point out that investors making decisions according to their own subjective feelings and preferences is tasted-based discrimination, and the choice of borrowers on the basis of some statistical results is statistical discrimination [15]. Classic finance presumed that, rational investors will make more multinational investment to spread risk. But in fact, investors punt most of their money on domestic market [8], which is known as "local bias". Ravina's research finds that, in the case of other factors being basically the same, borrowers with good employment records are more likely to win the favor of investors. In addition, credit record and income are usually the most important factors that investors consider [18]. Ghent et al. find that for 30 year adjustable rate mortgages African Americans borrowers face interest rates 12 basis points higher than non-Hispanic borrowers [9]. As Cozarenco and Szafarz say, it is still a challenge for women entrepreneurs to obtain credit [5]. There are grounds to suspect that unfair lending practices make it harder for women than for men to set up a business [23].

Peer-to-peer lending is a newfashioned credit mode where investors lends money to individuals or small and micro enterprises by network platform, which directly matching borrowers and investors [2] [11]. Peer-to-peer lending companies provide services through Internet with low operating costs, and their services are cheaper than traditional financial institutions. Borrowers need to provide qualification information to them, and after verification they set the loan amount, interest rates and deadlines by themselves as required. Only after communication with the platform can they publish the loan demand. Investors consider varieties of information disclosed by borrowers, including credit information, financial information and unverified statements of the loan purpose, before deciding whether to bid as well as the amount. This unsecured financing mode makes it possible for individuals to enter into microfinance. Compared with traditional bank credit, peer-to-peer lending, based on Internet and Web 2.0 technologies, can directly match borrowers with potential investors, reduce information asymmetry risk and facilitate transactions, so it is friendlier to both lenders and borrowers [2] [15].

However, discrimination still exists in peer-to-peer lending. Duarte, Siegel, and Young find that investors are more likely to lend to borrowers who look trustworthy, because they believe such people may have better credit and lower default rates [6]. There is a "herding effect" in Internet loan, that is, most investors tend to bid those that many have bidden [4]. Krumme and Herrero-Lopes point out borrowers with higher credit scores are apt to succeed; meanwhile, investors are expected to earn more [13]. Some scholars believe that the impact of population characteristics on loan is limited [22]. While some other scholars hold the opposite views. Studies have found that it is more difficult for blacks to get financing compared with whites [15] [19], perhaps because blacks have a higher default rate, indicating that this is a statistical discrimination. Recent work points to these characteristics may have unique intersectional effects [16] [20]. Lei, Qin, and Yulin construct a theoretical model to analyze the investment bias in P2P lending towards the use of loan [25]. The results say people prefer loan for production and operation. Li, Mengran, and Zhengwei study the regional discrimination in Chinese credit market [14]. Through an empirical study of a P2P platform, it is found that there is a significant difference in the success rates among each province, which explains the existence of regional discrimination in P2P lending. Subsequently, further investigation finds the default rates of being discriminated provinces are not significantly higher. Finally they conclude that it is a tasted-based

discrimination. Through an experiment, Harkness examine how applicants' variety demographic characteristics affect investors' status assessments and funding decisions in peer-to-peer lending market [10]. The results demonstrate that borrowers' gender and race significantly affect investors' funding decisions, thereby, it is believed that borrowers' status may be a causal mechanism driving lending discrimination.

Regional discrimination is a meaningful and interesting research topic, whether in sociology or in economics. With the research of Li et al. as reference, this paper makes an empirical analysis on the micro data of individual level from Peer to Peer lending, to further explore the regional discrimination in China's P2P lending.

Li et al. explore regional discrimination from a province standpoint [14], they mainly analysis whether the success rates of P2P orders for all the provinces are significantly different, as well as the differences of the default rates between the discriminated provinces and others. The research angle of this thesis is different. This paper has not divide the regions in accordance with the existing geographical regions, such as central China, southern China and other administrative divisions or provinces. Considering the research content belongs to economics, areas in the same province are usually of uneven development, and different provinces also have areas with similar development, so we will grade all the cities in accordance with their comprehensive development level combined with existing "Chinese city grading standards". In a word, this paper primarily discusses regional discrimination in China's P2P lending market from the perspective of city. The key research problems are: whether investors have discrimination against cities with different development; if it does, what is the difference between the default rates of discriminated cities and other cities? Is this a tasted-based discrimination or statistical discrimination?

DATA ACQUISITION AND MODEL DESIGN

Data Acquisition and Website Description

At present, the cities of mainland China are normally divided into four levels: "all-around developed cities", "mid-developed cities", "less-developed cities", and "least-developed cities". In 338 cities at prefectural level and above, all-around cities refer to the four old first-tier cities: Beijing, Shanghai, Guangzhou and Shenzhen; mid-developed cities include Tianjin and 23 second-tier developed and mid-developed cities such as Hangzhou; less-developed cities consist of second-tier less-developed cities and third-tier cities such as Hefei and Nanchang; the rest are classified as the least-developed cities.

Data for this study is obtained from one of China's P2P lending platforms – Peer to Peer lending, which was established in May 2010. Currently, the loan amount borrowers may apply for is 3000-500000 yuan, with the annual interest rate of 7%-24%, and the loan period that borrowers can choose is 3, 6, 9, 12, 15, 18, 24 months. The repayment mode is repaying principal and interest of the same per month. Figure 1 is about the loan process for this platform. On top of this, borrowers cannot apply for overdue repayment; otherwise they will have to bear default interest and certain management fees, and will be deducted corresponding credit score. The annual report of Peer to Peer shows the rate of bad debt in 2015 is 0.37%, where bad debt is overdue repayment of more than 30 days.

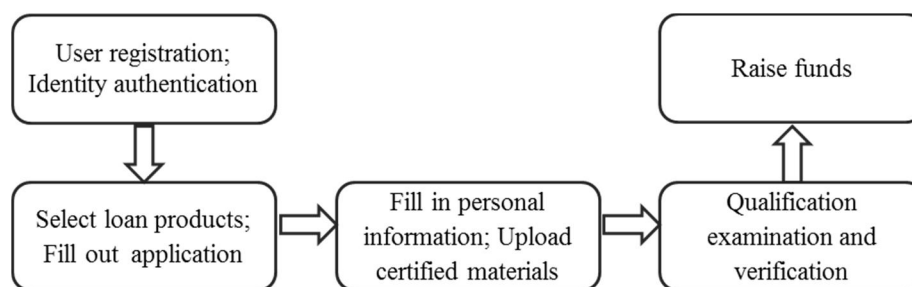


Figure 1: The loan process of Peer to Peer Lending platform

This paper gets 500981 scattered transaction data through crawler, from January 2015 to March 2016. Removing the data whose regional item is missing or meaningless, finally there is 364523 valid data as the study sample. Many existing studies show that gender has little effect on the success of loan [1] [3] [15]. On the other hand, this platform does not require borrowers to fill in their gender. So this article does not take gender into account. As mentioned above, this study aims to explore whether investors have an investment discrimination against different cities, so city attribute is an indispensable and important variable. In data preprocessing stage, we process borrowers' regional information to obtain city name, and then match the level of cities for more than 360 thousand data through database.

Variable Setting

As needed in research, the main variables are set as follows, which can be obtained from the original data directly or indirectly:

Table 1: Variable Description

Variables	Description
success	A virtual variable, its value is 1 when loan is successful, or 0.

overdue	The value of overdue loan is 1, otherwise 0. The repayment of loan late more than 30 days will be marked as bad debt; both refund late 1-30 days and bad debt orders are regarded as overdue.
ln(money)	The log value of loan amount. Before the release of fund-raising, the platform will communicate loan amount and interest rate with borrowers in accordance with their credit rating and line.
rate	The annual interest rate, range is 7%-24%.
period	The term that borrowers can use the loan as promised.
city_degree	The 338 cities are divided into four levels: "all-around developed cities", "mid-developed cities", "less-developed cities", and "least-developed cities", they are marked with 4, 3, 2, 1, respectively.
num_success	The number of times that borrower has succeeded in raising money.
credit	The credit score of borrowers, given by the platform after a comprehensive assessment of various aspects of borrowers.
num_overdue	The number of times that borrower defaults.
age	The age of borrowers.
education	High school and below, junior college, undergraduate, graduate and above qualifications are respectively marked as 1, 2, 3, 4.
marriage	The unmarried, married, divorced or widowed are assigned value of 1, 2 and 3.
income	Monthly income of borrowers.
houceloan	The value is 1 when borrower has a mortgage, otherwise 0.
carloan	The value is 1 when borrower has an automobile loan, otherwise 0.

The independent variables except city grade are divided into three categories, as shown in Table 2.

Table 2: Classification of variables

Order information (D)	Credit information (X)	Population characteristics (T)	Financial information (C)
ln(money)	credit	age	income
rate	num_success	education	houceloan
period	num_overdue	marriage	carloan

Descriptive statistics for all variables are shown in Table 3.

Table 3: Descriptive statistics of variables

Variables	Obs.	Mean	Std.	Min	Max
success	364523	0.33	0.471	0	1
overdue	21078	0.10	0.304	0	1
ln(money)	364523	10.4238	1.15997	7.60	13.12
rate	364523	12.382	1.8862	3.0	24.4
period	364523	20.12	10.480	3	36
city_degree	364523	2.32	1.030	1	4
num_success	364523	0.52	2.754	0	144
credit	364523	69.53	75.045	0	3220
num_overdue	364523	0.20	1.400	0	54
age	364523	32.62	7.590	16	71
education	364195	1.90	0.771	1	4
marriage	364484	1.69	0.583	1	3
income	363492	4.05	1.164	1	7
houceloan	364523	0.23	0.420	0	1
carloan	364523	0.07	0.455	0	1

Modeling

To explore people's discrimination against different grades of cities, we first examine if there is a significant difference among

their success rates. However, descriptive statistics and variance analysis in the following cannot prove the difference is "robust", for various factors do affect the outcome. Other factors should be controlled so as to test the effect of city grade on loan success. To this end, we take "success" as the dependent variable, to build logistic regression model (1):

$$\text{logit}(P | \text{success}=1) = \alpha + \beta_1 \times \text{city_degree} + \beta_2 \times D + \beta_3 \times X + \beta_4 \times T + \beta_5 \times C + \varepsilon \quad (1)$$

In this model, P represents the frequency of loan success, $\text{logit } P = \ln \frac{P}{1-P}$.

Denote D 、 X 、 T 、 C , respectively, as the variables of loan order information, borrower's credit, characteristics and financial information, and denote β_1 、 β_2 、 β_3 、 β_4 、 β_5 as the corresponding coefficient matrix. In addition, α is the constant and ε represents random error. In model (1), when controlling the variables of loan order, borrower's credit and other information, if β_1 is significant, then it can be inferred that city grade has a significant impact on borrower's loan success rate, namely investors indeed have discrimination against different cities.

After that we will further investigate the difference of loan default rates among each grade cities, analyze how the default rates of being discriminated cities differ from others, so as to infer if the discrimination is non-rational tasted-based. In the same way, we construct the logistic regression model (2) with "overdue" as the dependent variable:

$$\text{logit}(P | \text{overdue}=1) = \alpha + \beta_1 \times \text{city_degree} + \beta_2 \times D + \beta_3 \times X + \beta_4 \times T + \beta_5 \times C + \varepsilon \quad (2)$$

In model (2), P represents the frequency of loan overdue.

And $\text{logit } P = \ln \frac{P}{1-P}$, the meaning of other variables are the same as in model (1).

For model (2), only the orders whose status is displayed as "overdue" or "bad debt" are included. When controlling for other factors, if β_1 is significantly negative, indicating the lower of the city grade, the higher the default rate; Conversely, if β_1 is significantly positive, indicating that the default rate of higher grade city is higher; while a non-significant β_1 means city grade has no significant influence on default rate. By further studying the relationship between default rates and success rates of different cities, we can infer whether there is statistical or tasted-based regional discrimination in investors' behavior.

ANALYSIS

Descriptive Statistics and Difference Test

Descriptive statistics of order status for each grade cities are shown in Table IV. Among them, "closed", "repaying", "overdue" and "bad debt" mean having completed borrowing money, which belong to success category. And "overdue" and "bad debt" orders pertain to overdue category, not overdue orders refer to "closed" orders, the repayment of which have been accomplished. So we will exclude the "failed" and "repaying" orders when study overdue ones. From Table IV we can see that the total loan orders in the least-developed cities reach 102397, and its failure, overdue and bad debt orders are significantly more than the other three grades of cities.

Table 4: Descriptive statistics of order status of different cities

City grade	Failed	Success				Total
		Closed	Repaying	Overdue	Bad debt	
least-developed	84798	3554	13191	111	743	102397
less-developed	62090	4819	27189	87	494	94679
mid-developed	59474	7658	48470	57	363	116022
all-around developed	37280	2870	10953	63	259	51425

To intuitively compare the success rate and default rate of different cities, we give the statistical results in Table 4. As can be seen from Table V, the success rate of least-developed cities is the lowest, only 17.2%, significantly lower than others; and that of mid-developed cities is as high as 48.7%. On the other hand, mid-developed cities have the lowest default rate of 5.2%, while that of least-developed cities reaches 19.4%. Overall, for different cities, there is apparently great difference of success rate as well as default rate.

Table 5: Statistics of success rate and default rate of each great city

City grade	Success rate	Default rate
least-developed	17.2%	19.4%
less-developed	34.4%	10.8%
mid-developed	48.7%	5.2%

all-around developed	27.5%	10.1%
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Furthermore, variance analysis is used to compare the success rate of four-grade cities, and the results are shown in Table 5, including mean difference and standard error, and P value is marked out by “*”. The average success rate of each grade city is compared with the other three grades. It can be seen that the mean difference of each grade city with others is significant at the 5% level. So we can believe that discrimination may exist for there is a significant difference among the success rates of different cities.

Table 6: Pairwise comparison test of the success rate of each level city

City (I)	City (J)	Mean difference (I-J)	SE
least-developed	less-developed	-.1722*	.00199
	mid-developed	-.3154*	.00189
	all-around developed	-.1031*	.00239
less-developed	least-developed	.1722*	.00199
	mid-developed	-.1432*	.00193
	all-around developed	.0691*	.00242
mid-developed	least-developed	.3154*	.00189
	less-developed	.1432*	.00193
	all-around developed	.2123*	.00234
all-around developed	least-developed	.1031*	.00239
	less-developed	-.0691*	.00242
	mid-developed	-.2123*	.00234

* indicates $p < 0.05$.

Whether Investors Have Regional Discrimination

Preliminary judgment for the results described above is not enough to prove that investors have discrimination against different cities. The reason is that except city grade, there are many other factors including order itself, borrower's credit and financial information will affect investor's decision. Therefore, we use model (1) to control other factors to accurately analyze the effect of city grade.

In Table 7, we give the regression results of model (1), where model 1 contains only one independent variable, and model 2, 3, 4 are gradually added to order variables, borrower's credit variables and finally all other variables. The chi square tests of the four models are all significant. With the addition of more variables, R^2 gradually increased to 0.935, indicating that the selected variables have strong explanatory power to the dependent variable.

In model 1, the coefficient of city grade is 0.338 and is significant at the 0.05 level, suggesting that city grade has significant influence on dependent variable when other factors are not considered. At this time R^2 is only 0.036, so the explanatory power is low. With the addition of more variables, the coefficient of city grade in model 2, 3 and 4 is on the decrease, and is always significantly positive at the 1% level, suggesting that when controlling order information, borrowers' credit information and other characteristics, city grade still plays an important part. Specifically, borrowers in the higher grade cities are more likely to get the favor of investors, while borrowers of the less developed cities will probably fail to borrow money. This result is consistent with the results of previous descriptive statistics and analysis of variance. Thus it can be seen that investors indeed have discrimination against cities of different grades in P2P lending.

Table 7: Test of whether investors have discrimination against different cities

Variables	Dependent variable: success			
	Model 1	Model 2	Model 3	Model 4
	Coefficients (SE)	Coefficients (SE)	Coefficients (SE)	Coefficients (SE)
Constant	-1.505*** (0.009)	10.758*** (0.082)	2.129*** (0.136)	1.878*** (0.143)
city_degree	0.338*** (0.003)	0.285*** (0.005)	0.083*** (0.011)	0.079*** (0.011)

ln(money)	0.113***	-0.706***	-0.925***
	(0.005)	(0.013)	(0.015)
rate	-1.451***	-0.181***	-0.180***
	(0.006)	(0.006)	(0.006)
period	0.195***	0.033***	0.045***
	(0.001)	(0.001)	(0.001)
num_success		-0.060***	-0.061***
		(0.004)	(0.004)
credit		0.062***	0.060***
		(0.000)	(0.000)
num_overdue		0.518***	0.508***
		(0.005)	(0.005)
income			0.279***
			(0.011)
housetloan			0.238***
			(0.029)
carloan			0.169***
			(0.044)
age			0.027***
			(0.002)
education			0.030**
			(0.015)
marriage			0.141***
			(0.024)
R ²	0.036	0.515	0.933
			0.935

*** p<0.01, ** p<0.05, * p<0.1.

From the comprehensive analysis of model 1-4 we can see that, both loan amount and rate have significant negative effect on loan. This means that the success rate will decline with the increase of loan mount, which is consistent with the results of Puro et al. [17], the possible reason is that the default risk may increase. And when setting higher interest rates, borrowers are not so easy to succeed in financing, because high interest rate is more likely to pose a high risk. Obviously most investors are quite rational in investment and not simply in the pursuit of high returns without considering the potential risk [7]. Besides, both credit score and borrower's monthly income have significant positive impact. It shows that the higher the credit score is, the easier it is to borrow money, which is consistent with the empirical research of Klafft for Prosper, an American P2P lending platform. He finds borrower's credit score has the most significant impact on the success of loan; and the risk level of more than half of the orders on Prosper is HR, while the success ratio is only 5.5% [12]. Monthly income to a certain extent represents borrower's ability to repay. One can easily envisage people with high income may have better repayment ability and lower default risk, so it may be easier for them to obtain financing.

Surprisingly, we find out historical success times has a significant negative effect on loan, while overdue times has a significant positive effect. This is totally opposed to our intuitive conjecture. A possible explanation is that both the two variables can only reflect the conditions of all borrowers from one side, and are far from sufficient to detect the circumstances of every single borrower. For example, borrowers with more success times may have more overdue records, and those with less are likely to have few record of success.

The Examination of the Rationality of Regional Discrimination

Taking "overdue" as dependent variable, we show the regression results of model (2) in Table 8. Model 1 tells us without considering other factors, the coefficient of city grade is significantly negative. In model 2, with order variables being added, city grade still negatively impact dependent variable, while the overall fit of model 1 and 2 is relatively low. With the addition of more variables, the explanatory power of selected variables on overdue increased gradually. Nevertheless, we find the coefficient of city grade is remained negative but no longer significant in model 3 and 4. Altogether, the higher the city grade, the lower the default rate. This is basically consistent with the results shown in Table V. Combined with the results of model (1), we can make a preliminary inference, that is, investors do have discrimination against different regions, and it is a rational statistical discrimination.

When the selected variables are all added (model 4), it can be seen that both loan period and overdue times positive affect overdue significantly. It follows that the longer duration of the loan, the greater the uncertainty that borrowers repay on time.

Also, the credit of borrowers with more historical overdue times is usually low, who are more likely to make overdue repayment again. On the other hand, the coefficients of credit and historical success times are significantly negative, indicating that making overdue repayment seldom happens to borrowers with higher credit score and more success times. It is often a virtuous cycle, making repayment on time is conducive to the accumulation of credit, as well as the next success of the loan.

Table 8: Test of the rationality of regional discrimination

Variables	Dependent variable: overdue			
	Model 1	Model 1	Model 1	Model 1
	Coefficients (SE)	Coefficients (SE)	Coefficients (SE)	Coefficients (SE)
Constant	-1.140*** (0.056)	1.739 (0.345)	-0.329 (0.714)	0.622 (0.711)
city_degree	-0.442*** (0.024)	-0.382*** (0.024)	-0.039 (0.043)	-0.060 (0.044)
ln(money)		-0.413*** (0.032)	0.098 (0.063)	0.007 (0.076)
rate		0.068*** (0.010)	0.034 (0.023)	0.022 (0.023)
period		0.016*** (0.001)	0.098*** (0.006)	0.107*** (0.007)
num_success			-0.378*** (0.030)	-0.382*** (0.031)
credit			-0.051*** (0.001)	-0.050*** (0.001)
num_overdue			0.087*** (0.011)	0.086*** (0.011)
income				0.124*** (0.043)
housetloan				-0.507*** (0.119)
carloan				0.117 (0.166)
age				-0.001 (0.008)
education				-0.247*** (0.059)
marriage				0.027 (0.093)
R ²	0.035	0.068	0.791	0.794

*** p<0.01, ** p<0.05, * p<0.1.

In Figure 2, we describe the relationship between default rates and success rates by a scatter diagram. From the graph we can see that there is a negative correlation between them. Specifically, as default rates rise, success rates will decline accordingly. So it can be inferred that default rate bears a huge responsibility for the difference among success rates of different cities. Combined with the results of model (1) and (2), we have reason to believe that investors' discrimination against different cities is a rational statistical discrimination.

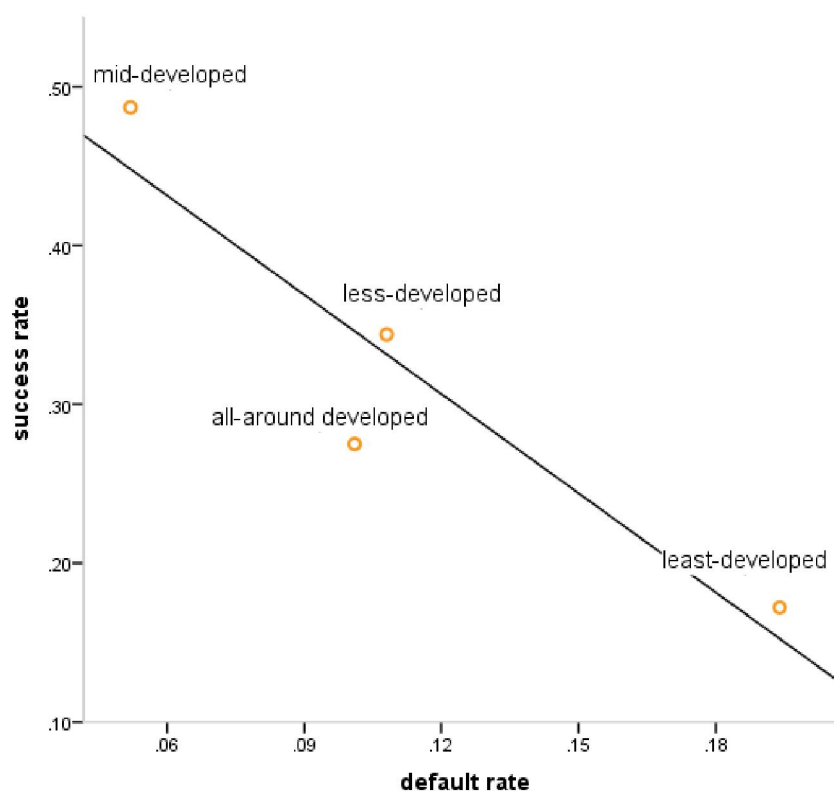


Figure 2: Scatter plots of default rate and success rate of each level city

Robust Test

1. In order to verify the relationship between default rates and success rates of different cities, we build a linear regression model with "rate_success" as the dependent variable and "rate_overdue" as the independent variable. The results are shown in Table 9.

Table 9: Test of the relationship between default rate and success rate

	Dependent variable: rate_success	
	Coefficients	SE
Constant	0.556*	0.073
rate_overdue	-2.082**	0.058
R ²	0.797	

*** p<0.01, ** p<0.05, * p<0.1.

We can see from Table 9, the model's explanatory power is 79.7%, and the coefficient of default rate is -2.082 and significant at the 5% level, suggesting that success rates will decline as default rates rise. Namely, the success rate of cities with higher default rate is lower, once again proving that investors' regional discrimination is a rational statistical discrimination.

2. We divide all the cities into four grades according to the existing standards and the general division. But in fact, with the development of various regions, the classification criterion of cities is constantly changing. According to "China's new urban grading standards", all cities are divided into first tier to sixth tier, where second-tier cities are divided into "second-tier developed cities", "second-tier mid-developed cities" and "second-tier less-developed cities". Based on this classification, we will test the robustness of previous analysis. This time, third to sixth tier cities are respectively assigned value of 4、3、2、1; the value of second-tier developed、mid-developed and less-developed cities are 4.5, 5, 5.5; and first-tier cities take the value of 6.

Table 10 shows the results of robustness test--the regression results of model (1) and (2) after changing the value of city grade (city_degree). We can see that, after fixing other variables, city grade still has a significant positive effect on the success of loan. Once again it is verified that investors do have discrimination against different cities. On the other hand, the regression results for overdue show that the coefficient of city grade is negative but not significant, consistent with the previous analysis. It indicates that the difference in default rate may be the result of a combined effect of various factors. In order to further clarify the regional discrimination is rational or irrational, we examine the correlation between success rate and default rate through a scatter plot and a fitting trend line in Figure 3.

Table 10: Robustness test

Variables	Dependent variable: success		Dependent variable: overdue	
	Coefficients	SE	Coefficients	SE
Constant	1.826***	0.145	-0.623	0.772
city_degree	0.056***	0.008	-0.037	0.032
ln(money)	-0.925***	0.015	0.009	0.077
rate	-0.180***	0.006	0.022	0.023
period	0.044***	0.001	0.107***	0.007
num_success	-0.061***	0.004	-0.383***	0.031
credit	0.060***	0.000	-0.050***	0.001
num_overdue	0.508***	0.005	0.086***	0.011
income	0.279***	0.011	0.123***	0.043
housetloan	0.236***	0.029	-0.504***	0.119
carloan	0.163***	0.044	0.124	0.166
age	0.027***	0.002	0.000	0.008
education	0.033**	0.015	-0.248***	0.059
marriage	0.138***	0.024	0.030	0.093
R ²	0.935		0.794	

***p<0.01, ** p<0.05, * p<0.1.

We can easily see from Figure 3 that there is a significant negative correlation between success rate and default rate, and the R^2 of linear correlation is 0.834. From the overall trend of view, the higher the default rate of the region, the lower its success rate. Also it shows that investors may not simply discriminate against less-developed regions (e.g., fourth to sixth tier cities), but make more rational investment decisions in the face of higher default rates, then involved more in investment activities of cities with lower default rates. By this taken, the discrimination of investors against different regions is a kind of rational statistical discrimination. It means that our results are robust.

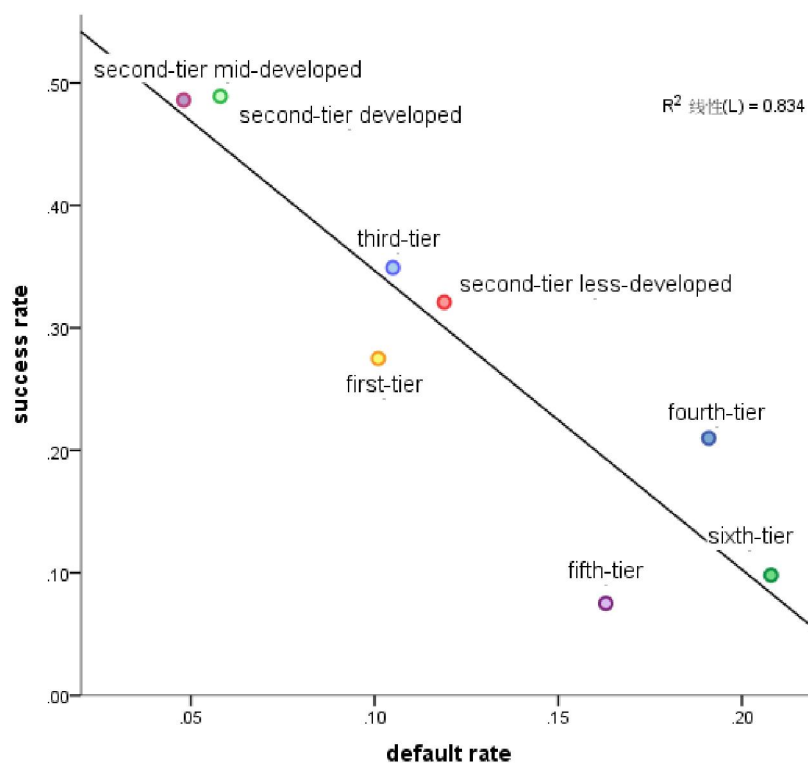


Figure 3: Scatter plots of default rate and success rate of different cities

CONCLUSION AND ENLIGHTENMENT

In sociology, there has been considerable progress in regional discrimination research, while in economics, especially in credit market there is not much study. The extant research examining lending discrimination generally has focused on demographic characteristics including race and gender, while few researchers study the influence of regional factors on investors' decision

making. For the first time, this paper discusses that in the emerging P2P lending market, which is friendlier to both lenders and borrowers, whether the funding behavior of investors is still regional discriminatory, and thus fill up the gap.

It is intended to shed light on regional discrimination in China's P2P lending market from the perspective of city. Through empirical analysis on the micro loan data of individual level from Peer to Peer lending, we find that city grade has a significant positive effect on loan under the control of other factors. This suggests that there is a significant difference among success rates of cities with different development, reflecting the regional discrimination of investors. In other words, the allocation of funding in these cities is brimming with bias, whereas we do not yet know definitely what the causal mechanisms that account for discriminatory behavior are. Further research finds that city grade has a negative but not significant effect on default rate. Combined with the fitting trend of scatter plot, it is clear that there is a significantly negative correlation between success rate and default rate. As default rates rise, success rates will decline accordingly. Thereby, we can finally conclude that, it is default rate rather than regional preference that should account for discrimination, indicating it is a rational statistical discrimination. This conclusion is different from previous research [14].

Investors' discriminating between loan applicants may be part attributable to their stereotypes and prejudices, but we have not yet probed into the causal mechanisms. Future research can further explore discrimination and its causes in credit market from other aspects such as the identity of borrowers, cultural differences and so on. Anyway, this paper enriches the study on P2P lending behavior in finance, especially on regional discrimination, which has certain significance for scholars to know China's P2P lending market and its discrimination.

ACKNOWLEDGEMENTS

This work is supported by the Natural Science Foundation of China (No: 71373192) and the MOE Project of Key Research Institute of Humanities and Social Science (NO: 14JJD870002).

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APPENDIX

In 2016, "The New First Tier Cities Institute", a data news project of First Financial, regrades 338 cities at prefectural level and above of China by means of weighted average calculation of 5 dimensions: the concentration of business resources, the hub of city, people's activeness, life diversity and future plasticity, after investigating the distribution of 160 brands and the user data of 14 Internet companies. In the list, the four old first-tier cities of Beijing, Shanghai, Guangzhou and Shenzhen still maintain their front-line positions, followed by 15 new first-tier cities: Chengdu, Hangzhou, Wuhan, Tianjin, Nanjing, Chongqing, Xi'an, Changsha, Qingdao, Shenyang, Dalian, Xiamen, Suzhou, Ningbo and Wuxi; the second-tier cities include 30 cities such as Hefei and Zhengzhou; besides, there are 70 third-tier cities, 90 fourth-tier cities and 129 fifth-tier cities. However, in the list of city classification of 2014, first-tier cities also include Tianjin except four old first-tier cities; Hangzhou, Nanjing, Jinan, Chongqing, Qingdao, Dalian, Ningbo and Xiamen are classified as second-tier developed cities; second-tier mid-developed cities include 15 cities, such as Chengdu and Wuhan; Hefei and other six cities are categorized as second-tier less developed cities. We divide all the 338 cities into four grades according to the existing standards and the division of the public generally recognized: "all-around developed cities", "mid-developed cities", "less-developed cities", and "least-developed cities". Here, all-around cities refer to the four old first-tier cities of Beijing, Shanghai, Guangzhou and Shenzhen; mid-developed cities include Tianjin and the second-tier developed and mid-developed cities in list of 2014; less-developed cities consist of second-tier less-developed cities and third-tier cities such as Hefei and Nanchang according to the classification of 2014; the rest are classed as least-developed cities.

Information Security Challenges in the New Era of Fintech

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ABSTRACT

After the recent cyber-attacks on financial institutions around the world, we are faced with a whole new set of challenges never seen before. Traditionally, fraud and theft were conducted in person or through traditional telecommunications such as telephone. However, today we are facing highly sophisticated and intelligent hackers who have the ability to illegally access financial institutions' computer systems from remote locations and even across borders. Therefore, this study will focus on reviewing the information security framework by adopting up-to-date standards as the way to counter financial information theft.

Keywords: Cyberattack, Information Security System, Fintech, Hacker

INTRODUCTION

Information security problems come in various forms worldwide, including the cyberattack on Central Bank of Bangladesh by hackers in February 2016, which hackers used APT (Advanced Persistent Threat) malware to hack into the system of Central Bank of Bangladesh and stole the access to SWIFT system, submitting transfer requests to Federal Reserve Bank of New York and successfully transferred the foreign-exchange reserved of 81 million US Dollars owned by Central Bank of Bangladesh. Later, in August this year, the biggest USD to Bitcoin Exchanger Bitfinex was attacked by hackers and more than 65 million USD was taken. This summer, teller machines in Taiwan was under attack of malware and was robbed of over 70 million NTD. Transnational scams conducted in Kenya occur commonly. These frequently happening information security incidents proved that the measures of cyberattacks are changing nonstop, becoming more destructive, and the amounts of heist are far higher than a conventional bank robbery. Many enterprises and businesses depended on the entire service provided by information security company or use the information system that hasn't been updated for years when it comes to information security management in the past. However, the professionalism of hackers, on many occasions, overwhelms the information security level that information security companies can provide. In the meantime, Fintech has been burgeoning globally recently; nevertheless, many responsible persons investing in angel fund recently have made remarks that without information security, there won't be Fintech. When they review new investment cases, whether these startups are having a wholesome information security mechanism becomes the key factor making determining their investments. In particular, many of the startups are internet companies storing massive amount of client information, frequent trades, even ginormous capital. Therefore, information security is the premise of Fintech's success.

RESEARCH QUESTIONS

After multiple new information security problems have happened, this study intends to research the following three issues to find the information security strategies matching requirements by financial institutes in the future.

RQ1: How to improve the software, hardware, internet and management system of financial industries to prevent attacks by hackers?

RQ2: How to perfect in downside improvement and profiting simultaneously? In other words, how to make information security operating smoothly while Fintech can be well-developed?

RQ3: Information security system can take massive time and manpower inputs. How to consolidate the mutual power of the government and financial industry to develop an information security system catering to people's needs?

CONCEPTUAL FRAMEWORK

Figure 1 exhibits the six important components used to analyze the information security system in this study. These components are mutually related and indispensable, coming as such: (1) Design of information security system, (2) Software of Information Security System, (3) Internet Security, (4) Central Surveillance Institute, (5) Control of Information Security, and (6) Cultivation of Information Security Talents.

Design of Information Security System

The design for Fintech

In the past, the design of system stressed on functionality, thus cost lowering and efficiency facilitation are the main considerations. As Fintech starts to develop rapidly, business models are undergoing a metamorphosis, and designs of information security system should meet the requirements of Fintech era. Firstly, for instance, block chain is an operation model featuring decentralization whose greatest advantage is the high security, and all transactions rely on the dependability of codes and block chain's trait of being unable to manipulate, making a huge difference from the transactions in the past with centralized

managements by financial information systems of Central banks in countries. Many bank applications including trade finance, multinational payment and syndication have been provided with newly developed block chain applications, although the business values of such needs time to tell, the applications have replaced many traditional payments. For instance, in apps Alipay and WeChat Pay, we can find the functions of communications by social media, shopping site, withdrawal and deposit and payment in one application. Each function may involve different information security issue, for example, social media needs excellent personal information protection; payment system needs strong detection of financial crime control. Combining information security features needed by different functions into the same platform is a great challenge to information security developers. Therefore, an information security developer in the financial institute should have a profound understanding with new internet financial environment and Fintech to catch up with the information security level their institute needs.

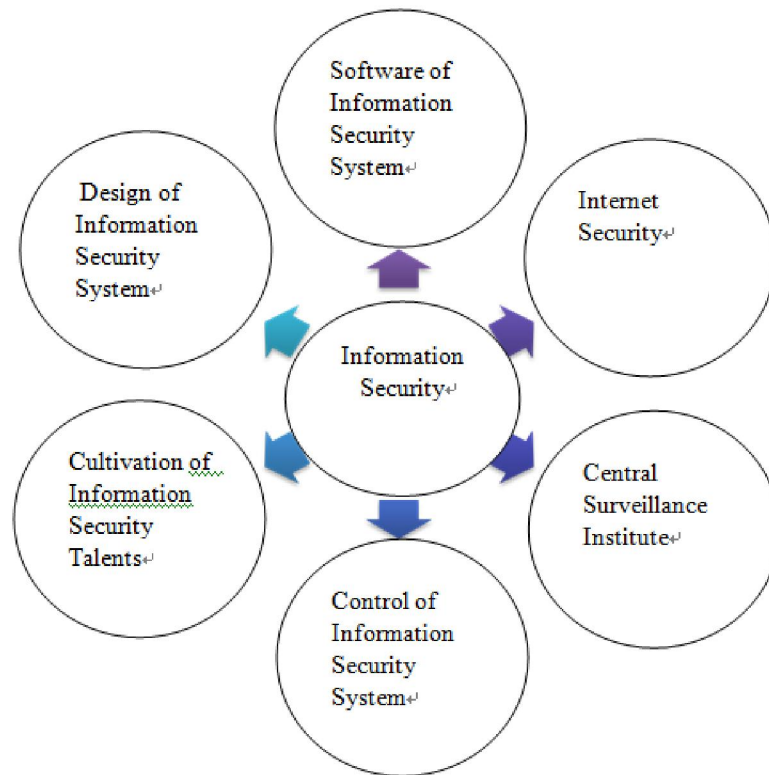


Figure 1: Conceptual Framework

System update

The ATM involved in this ATM attack incident is the 1500 model by Wincore, a model used for a long period. Besides the incapability to respond to intelligent and automatic transaction model in the future, it is also in need for major improvement in information security level. ATMs in the future will be evolved into VTM. More transactions will be completed directly via ATM, and identification and transaction features including verification needing signatures of clients, immediate renewal of passbooks and instant confirmation of purchase of financial products will be the priority for banks to stride into the Fintech Era. As the surge of WeChat and Alibaba strikes in the internet finance, most banks respond to such phenomenon by evaluation the values of branches meanwhile knowing the degree of acceptance by clients on Fintech. Should a branch be conserved after evaluation of its value, the functions for new models can be less wholesome; however, if the area of land is massive, for instance, the market in Mainland China and India, then using intelligent teller machines to offer more universal financial services will be the future trend, and remote security protection will become more important. Every bank is having its international finance development work in progress. New international finance will surely result in massive information security pressure to financial industry. Therefore, upon system updates, a more prospective planning is needed to cover the development of new technologies in the future.

System space

Although cloud storage for information and transaction processing becomes more and more common, however, as the advent of big data era comes, the information increases exponentially, additional to enough space, sufficient power as well as fireproof and quakeproof safety measures should be considered. Take Bitcoin as instance, during the data mining process, a great deal of power consumption can be expected, and each nation rushes to expand its mining capacity to claim their rights to keep accounts on block chains. For example, Mainland China locates their virtual coin mining center at regions with ease of access to solar power to offer the center cheap and sufficient electricity. At the same time, system temperature control and prevention to unnecessary loss caused by system interruption brought about by power interruption and natural disaster should be taken.

Process of system maintenance

As the information confidentiality in the future and security of system are the most important parts of information security, even an ordinary routine system maintenance should be treated with the high-class measures equivalent to semiconductor entering and exiting facilities and company by IT personnel in the company.

System outsourcing

To save costs, many enterprises outsource their information system-related affairs to information company of the external, from setup to maintenance. Nevertheless, since various information security issues have happened, contents of contracts should be under scrutiny once again. Firstly, whether the outsourced company with excessively small amount of capital can indemnify when major information security issues happen should be the important consideration factor a company determines their system outsourcing company, more than just cost and effectiveness consideration. Besides, the outsourced company, in most of the time, complies with access controls but has loose management on information of clients, which faces possible embezzlement or backup. Besides, time needed by the outsourced company to recover system operation should be regularly reviewed. Meanwhile, audit departments should perform irregular checks to outsourced company to ensure the operation quality of system.

Insurance for information security system

Cyber-attacks and risks of theft have become crucial risks for financial institutes. Besides facilitating information security clearances, obtaining insurance can be the extremely important part to prevent possible losses.

Software of Information Security

Instant checks performed anytime

Most attacks by hackers are personal information theft or access to users' accounts for deposit heist. After the ATM attack, Investigation Bureau, Ministry of Justice released the four APT Attack malwares (cnginfo.exe, engdisp.exe, sdelete.exe, cheanup.bat). The financial industry should, besides scanning their systems for the four released malwares, always stay alert with the new malware attack incidents occurring worldwide. The malware involved should also be listed on the program list for scheduled system scan. Current APT attacks remain latent in the company's system for some time and activate when suitable. Such period of time is the prime time for information security personnel to capture the attacking program. The bank industry can perform overall check to tens of thousands of computers via EDR (EDR, Endpoint detection and response).

White list

Programs and applications passing scrutiny and can be remained in the computer must be compared with system programs. The information security team should delete the rest of the programs excluded from the white list. Take ATM as instance, except for programs on the white list such as withdrawal, deposit and transfer, other programs aren't allowed to be stored on the ATM. In addition, the process of white list review should not be limited to ATM. The review should be performed on domestic and overseas systems of the bank and a list should be compiled for control. Plus, automatic scanning process shall be established. Programs not on the white list after scanning should be blocked and reported. Should a new program need to be added to white list, an official review process must be taken.

Validity of software

The operating system used in the teller machine involved in the ATM heist is Windows XP by Microsoft. In addition to the old system, the software developer has also suspended its system maintenance; hence, in the phase of system design, not only the hardware but also the software update and ability to protect the system should be taken into consideration.

Anti-virus software

Malwares usually go through steps of intrusion, diffusion, waiting and execution. Anti-virus software should build up strong firewall before the occurrence of intrusion and diffusion to prevent malware intrusion. And virus scanning software should detect and clean the intruded malwares in phase of waiting and execution. Usually, after the malware has accessed to the company's system, it will stay latent for a certain period of time, observe the operation of the company's internet security mechanism, find out who has been authorized and record the password of whomever has been authorized, which is the best timing for cleaning these malwares. Some companies use virus scanning software whose version is utterly old due to their lack of hacker encounter experience or reason of cost saving. No matter outsourcing to software company or system fortification by internal IT personnel, all needs to be sped up in the process. According to Symantec's internet threat analysis report, in the past 6 years, the number of mutated malware has multiplied by 184 times. Therefore, the information security in traditional concepts contains no capacity to react to new alien threats.

Internet Security

Auto sandbox

For external Email and internet uses, auto sandbox should, other than passive processes of screening and more, take actions to know what abnormal transactions are, such as abnormal magnifying of trading volumes in a short period and uses of internet or

external Email systems. It is found in the ATM attack incident that internet hackers constantly seek for opportunities to intrude into company systems via use of internet and Email. Once the original attached file goes on the black list, hackers will change the attached file into the normal names of attached files hardly recognizable. Thus, as hackers relentlessly change attack patterns, if we merely perform screening based on name of attached files and high-risk terms, we may fall into risks of being unable to follow hacker's techniques. From time to time, hackers will entice company users to open attachments containing malwares on social media platforms; thus, should one open the external attachments, the action shall be authorized and screened. Auto sandbox should screen the so-called "abnormal data", for instance, abnormal transactions inclusive of abnormal cash dispensing in a short period and uses of system at abnormal time by privileged users, and take those as points for intensive monitoring and management.

View of internet framework

The original design of internet framework is supposed to burden the responsibility of transmitting the company's internal information and documents and undertaking transaction. However, as the methods of transaction change, the connecting body, time, country and joints of internet framework should be redefined. For instance, whether the connection time among different systems should be available for 24 hours should be reassessed. Divisions on the internet and segregation are crucial. Segregations are as flooding in a ship's cabin, once segregated properly, cruise of the ship won't be affected; hackers won't be granted full access even after they hacked in. Segregation of host and setup of firewall are especially important. New connections to the host should be assessed with prudence and old connections should never be opened. For the one with greater influence, for instance, the emergency exit in the ATM Heist, the authorization level should be massively heightened and cannot be opened without grants by two or more authorization managers.

Authorization

To companies, different levels of authorized systems and authorization personnel of companies, meaning by whom can what system be used and authorization occasions should be regulated. For example, software companies usually leave a backdoor, and the backdoor cannot be opened except for emergency. Consequently, besides the manager of information security, COO and CRO of the company should be managers owning authorization rights to backdoor so as to open in proximity, to supervise the use of backdoor, and to ensure its closing. Moreover, the authorization occasion cannot be accessed via the Blackberry at home to prevent employees from exploiting the window of management in managers' leaves or typhoon day-off to open the evacuation exit and execute malware. Furthermore, the authorized personnel and password should be changed constantly.

Information security dashboard

For important data of information security, an information security dashboard should be established. The dashboard contains the overall information security status a manager needs for control, for example, risk index and information security early warning, and central monitoring institute needs monitoring marquee for instant display of information security incident. Take ATM as an example, since the machines are distributed in a vast area, the monitoring of abnormal volume and white list programs have strong remote monitoring effects.

Use of remote equipment

It becomes widely common for people to work at home, have flexible hours, attend a meeting via tablet computer and to read encrypted data through cellphone. As the equipment enhances convenience at work, it adds burden to information security tasks. When a company is faced with situation that numbers of employees using mobile devices of laptops, cellphones and tablet computers outside of the company, special regulations shall be made to lower the loophole and risks created by use of mobile device outside of company.

Central Monitoring Institute

Detect abnormal transactions

Abnormal transactions include fraud, false claim, manipulation of account information, financing terrorists, money laundering, client information theft, etc. Each abnormal transaction takes different ways to avoid. For instance, fraud usually involves finding management loopholes from shopping platforms including e-commerce and TV shopping for information theft and setting scams via overseas calls to complete the process. At this moment, to detect the abnormal action like information theft, the information security system should be equipped with extremely advanced identification capacity; what's more, in respect of anti-terrorist-financing and anti-money-laundering which attract banks' attention recently, the system should have the ability to have a clear hold on clients' cash flows and complex transaction type. For example, should a client's cash flow comes from sanctioned nations such as Syria, how the system can detect effectively and the ways to define valid parameters are utterly important. Once an abnormal transaction is found, an UAR (Unusual Activity Report) should be submitted and the Compliance should review the abnormal transaction. Even more, a report to Investigation Bureau, Ministry of Justice should help with detection of abnormal transactions to fully prevent financial crime from occurrence.

Stop abnormal transactions

When the system is hacked or the abnormal transaction is underway, whether the central control institute can immediate detect

and stop the abnormal transaction is important. For example, in the ATM attack, the malware has been hiding in the company's network for a long time, finding the perfect timing to commit crime. They were able to choose the typhoon night and period of card-free service system updates for commit due to observations for a long time. As tens of teller machines dispense bulk amount of cash simultaneously, whether the central control institute's system detects such abnormality and whether the notification is sent to manager's phone immediately are the highlights to be improved in the future. The prime guideline of immediate stops to handle abnormal transactions without affecting normal transactions online or via ATM by clients should be taken when the system abnormality is spotted. Otherwise, should a mega-sized international bank halt all transactions once it encounters system abnormality until the cause is found, rights and interests of clients as well as convenience brought by transnational system use will be massively affected.

Setup of surveillance system

The ATM attack case cannot be solved rapidly without the great help from surveillance system. The surveillance system we refer to here doesn't only contain cameras, it also includes monitoring mechanism surveilling abnormal access, abnormal use and abnormal program.

The information security management issue on software/hardware and internet contained in Research Question 1 can be solved with the above four components.

Control of Information Security

The structure of information security control

As shown in Figure 2, the level of information security control should reach the Board to obtain sufficient resources and attention. In the past, information security couldn't enter the main agenda in the board meeting. In the future, besides the classification of information security as important issue by the board, the risk management committee hosted by independent directors should regularly review the system validity and execution status of information security. The institute in charge of execution should be mutually hosted by COO who manages information system and backstage operations along with CRO, and management items should stress on internet security, credit risk, financial crime prevention and Fintech.

- (1) Internet security: this has been fully discussed in this study.
- (2) Credit risk: After many non-structured information has been transformed into the basic information of big data analysis, information security issues come along. Internet businesses utilize kinds of trading data in its ecology to provide credit line to banks through algorithm, which is totally different from the banks' existing credit method fetched by scoring of clients' financial statements. Nevertheless, as the internet businesses can serve multiple clients with rather little manpower, for example, the online commercial bank by Alibaba can process 200 thousand credit transactions and serve 2 million clients with 400 people, the similar credit technology will be used by banks undoubtedly. Nevertheless, as banks cannot obtain sufficient information for analysis, if the same algorithm is taken for credit, the other type of credit risk caused by information security issue will therefore come to existence. Thus, to prevent this type of risk, when a bank is undergoing the change of credit mode, it is advised to perform in both new and old methods and react with prudence.
- (3) Financial Crime Prevention: Since transactions with alleged intention of money laundering have taken place in large financial institutes in domestic and foreign territories and they were penalized by U.S. government, financial crime prevention have become the emphasis of the other type of information security. When creating information system for fighting financial crimes, the required KYC (Know Your Customer) has a rather high standard. Information inclusive of clients' capital whereabouts, understanding of end beneficiary and past criminal records are the basic conditions for bank to effectively fight financial crimes. In the meantime, for suspicious transactions, the system shall be able to automatically report warnings, and enter the anti-money-laundering and anti-information-terrorism scrutiny before the transaction performs. In the phase of system design and function advancement, setup of relative features for fighting financial crime is a cardinal part of information security.
- (4) Fintech: Information security should be able to keep up with the Fintech trend. In the information security control trend, Fintech is particularly set as emphasized item and needs full cooperation by sales manager in charge of Fintech and horizontal function managers with hopes to keep the pace with the trend, no matter it's information security issue generated by new internet platform, new product, big data analysis technology, transnational payment or trade finance.

Based on the ways to "perfect in downside improvement and profiting simultaneously" raised in research question 2, we can refer to the control structure as shown in Figure 2. With the full cooperation by the managers of four major functions, COO, CRO and CCO can understand latest progress of Fintech development and therefore able to advise effective internet security control mechanism for cooperation and performance.

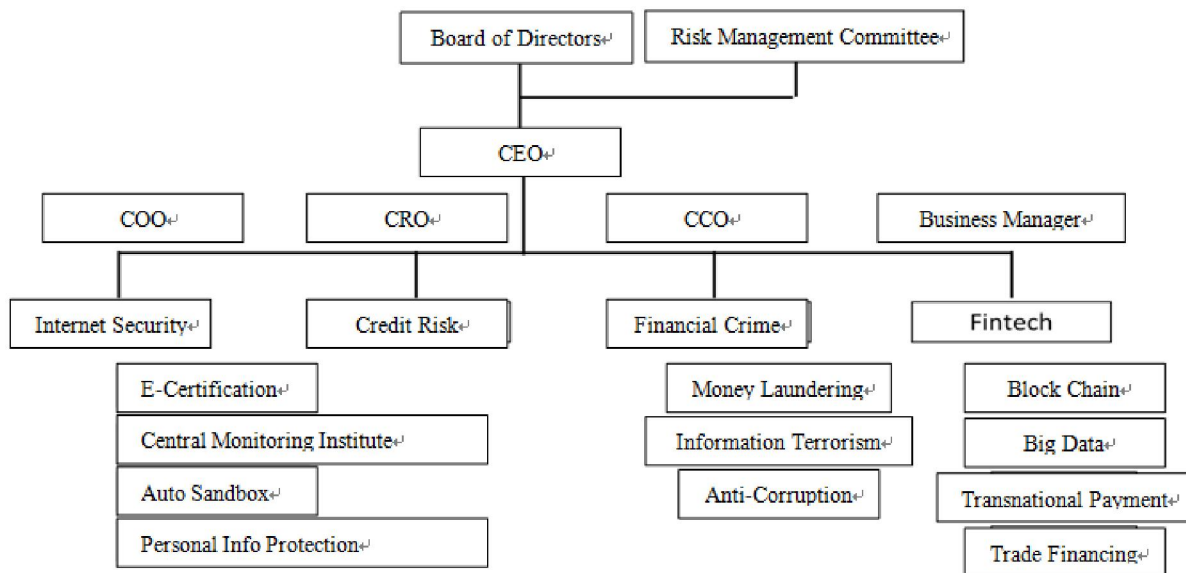


Figure 2: Control Structure of Financial Institutes

Audit

At the aspect of internet security, financial institutes should set three defenses. The first shall be system engineer responsible for instant checks and thorough records focusing on software, hardware and internet abnormality. The second is the defense by CRO, COO and CCO reviewing the check records compiled by the first defense anytime to understand whether there are new abnormalities. What's more, the reports shall be performed in the monthly risk management committee meeting. The last one is audit. The traditional audit shows limited capability to information security due to their non-information learning background. Nevertheless, as the information security incidents emerge nonstop and have become the operation risk of financial business owners, the audit authority should consider the possibility of employing audit employees with information background to ensure the audit quality. Meanwhile, the audit personnel should perform permeation testing to the system and the network for weak spot finding to ensure information security personnel will remind themselves of improving disadvantages.

Handling after attacks

After the occurrence of incidents, a set of full handling standards including evidence keeping and immediate report to authorities as well as internal managers in charge should be established, and drills shall be taken at all times.

Cultivation of Information Security Talents

Information security engineer

In a financial institute, IT personnel mainly take charge of system repairs. Soon, as information security becomes the main risk of financial industry, the specialized information security engineer should take regular views to every part of information security loopholes that may take place. Information security engineer should not burden other jobs and should focus on protecting the company's system and information security. Taiwanese system companies tend to provide free post sale services for business, which will majorly affect repair quality and working willingness of engineers. Businesses should change their mindset of "Free of Charge means Money Saving", after all, once the system is hacked, clients will lose faith to their system providers thus sabotaging the goodwill of system provider, causing losses greater than gains.

Cultivation of information security personnel

Besides the basic knowledge of software and hardware as well as internet, the company shall send their personnel to top-notch information security companies overseas or to banks with great information security measures for visits or on-the-job training. Knowing all types of emerging financial crime and different attack patterns by malware will enable the personnel to provide the best guaranteed information security.

Role of government

With regards to the role of government mentioned in research question 3, besides providing solid training and licenses related to information security to Academy of Banking and Finance Institute, Institute for Information Industry and more, the additional responsibility is to conglomerate the public's strength and resources. "Department of Cyber Security" of Executive Yuan was officially established in August, 2016 under the circumstances that information security issues result from miscellaneous factors and methods are renewed constantly, which a single institute cannot build a holistic information security system with its own strength. Therefore, the study intends to provide the government with advices to step up for compilation, enabling all the publics and financial business owners to live in a safe information environment.

CONCLUSIONS

Fintech changes over time, and new modes for financial crime have been renewed nonstop. The study discusses the six major components of information security, advising items the information technology can be improved. The most important thing shall be the change of managers' mindset. If information security is not well established, great harms to the goodwill of financial industry and clients' rights and interests will be made. To face the menacing internet business owners' competitions and development of Fintech, if relative information security prevention is taken into consideration, both can be handled, leading financial industry to embrace the new internet era with joy.

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Research on The Issue of Payments in The Cross-Border E-Commerce

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ABSTRACT

Cross-border e-commerce is the combination of "Internet+" International Trade, which shorten the distance between products and market in time and space, and promote trade development. While cross-border payment services play an important role in cross-border e-commerce, once the payment services is not successful, it means we are unable to make a deal, so, it pushes the completion of cross-border e-commerce transactions. This paper researches the concept of cross-border e-commerce and cross-border payment, and develops a model to describe current situation of China's cross-border payment business, summarizes the domestic and foreign cross-border e-commerce platform to solve cross-border payments service solutions. Finally, we analyze the opportunities and challenges of Xi'an city facing e-commerce cross-border payment, and proposes solutions.

Keywords: Cross-border e-commerce, Cross-border payment, Third-party payment, Cross-border payment of Xi'an

INTRODUCTION

With the rapid growth of China's import and export transactions, the growing number of rich people, large number of consumers intend to go shopping from abroad overseas, the demands of cross-border online shopping is growing faster and faster. According to the China Electronic Commerce Research Center data, it is reported that China's overseas purchasing transaction size doubled in recent years, the trade size of 2011 reached 18 billion, an increase of 132% over the previous year, and 2012 overseas purchasing transactions were 48.3 billion, and the number exceed 75 billion in 2013. In 2014, there is total 3.75 trillion, and increasing 39%. 2015, Chinese cross-border transactions is about 5.4 trillion, an increase of 26%, it suddenly occurs to us that tremendous demand of China market, we have reason to believe there is great potential to develop for cross-border e-commerce companies. It is expected by 2016 that the total will reach 6.5 trillion, therefore, China have a huge consumer market of cross-border e-commerce. There are also many hands to build the core national policy promoting development, such as the Belt and Road, Free Trade Area (FTA), the international of RMB, Chinese manufacturing 2015, Internet + and the coordinated development of regional economy, these both lead to the birth of cross-border e-commerce. Cross-border e-commerce generally refers to international business transactions between different countries or regions by technical tools, which could shorten the distance between product and market. It is a new pattern of cross-border trade which takes electronic as means, and it will be the main mean of upgrading trade development. China's e-commerce is in a period of great development. We should make full use of resources and provides the opportunities for enterprises to promote China's cross-border e-commerce development. Cross-border e-commerce involves many aspects, which are settlement, billing, logistics, financing, taxation, payments and so on, these factors play an vital role in reaching a cross-border e-commerce deal. With the rapid development of cross-border e-commerce business, the demands of expanding cross-border payment services gradually becomes intense, cross-border payment services is equivalent to the cross-border e-commerce "last kilometer", the last kilometer service becomes the focus of market share, only cross-border payments business do well, are customers more willing to buy. Therefore, the construction of cross-border payment services for cross-border e-commerce has become particularly important.

CROSS-BORDER E-COMMERCE AND CROSS PAYMENT SERVICES

Cross-border e-commerce generally refers to international business transactions between different countries or regions who communicate via e-commerce platform to trade and defray, and bring goods or services from sellers to buyers by logistics systems. It is a new trade patterns which are more often faster or convenience than before. Cross-border e-commerce greatly shorten the distance between product and market in time and space, It will be the main mean of promoting trade a facilitation, upgrade trade development and promote the effective implementation of new tool.

Cross-border Payment services refers to the capital which was traded or invested transfer behavior among two or more than two countries and regions by certain settlement instruments and payment systems. Cross-border payment services mainly consists of three sections, which are cross-border network consumption、cross-border transfer remittance and consumption under the overseas offline. There are a lot of ways of cross-border network consumption including the third-party payment platform、Internet banking online payment、credit card online payment、telegraphic transfer、mobile phone payment and fixed telephone payment. Cross-border transfer remittance mainly involves third-party payment platform, commercial banks and specialized remittance companies. There are some forms of payment, such as credit card, deposit card, Cash in foreign currency and CNY cash, these all belong to consumption under the overseas offline. This paper deals with the problem of cross-border network consumption.

There is a close relationship between cross-border e-commerce and cross-border payment services. Huge space of cross-border e-commerce development and potential profit margins both continuously promote cross-border payment companies to provide high-quality service and upgrade capital management ability in cross-border payments. Cross-border payments services play an integral role in cross-border e-commerce, it is an important condition for occupying consumer market at home and abroad.

Security and timeliness on the cash flow of Cross-border payment companies will bring sense of credibility and dependence to domestic and foreign buyers and sellers, cross-border payment services will tremendously promote cross-border e-commerce to develop from the perspective of technology.

PRESENT SITUATION OF CROSS-BORDER E-COMMERCE PAYMENT SERVICES

Theoretical Model

Michael Porter Diamond Model explains improving industrial competitiveness from the six aspects, there are factor conditions, demand conditions, related and supporting industries, firm strategy (structure and rivalry), government, chances. Factor conditions refer to human resource, physical resources, knowledge resources, capital resources and infrastructure. Demand conditions in the market can help companies create a competitive advantage, which pressure firms to innovate faster and to create more advanced products. Related and supporting industries can produce inputs that are important for innovation and internationalization. Firm strategy, structure and rivalry refer to the goals and management methods of company, which is important for company success. Government can influence each of the above four determinants of competitiveness. Government can influence the supply conditions of key production factors, demand conditions and chances in the home market. Chance events are occurrences that are outside of control of a firm, and it is important to create discontinuities in successful companies and the fail. The thesis is that these factors interact with each other to create competitive advantage for company. We summarize the factor conditions and related and supporting industries into resource because of them all providing the companies needed resource. Since the market, demands conditions, chance also represents the market requirements, we just the market and chance and demand conditions as a complement—Market. So we summarize the four elements to describe the competitiveness. Cross-border e-commerce can be regarded as a process of circulation, which including logistics, capital, business, and information flow the four components. In any transaction, buyers or sellers will involve product delivery, cash flow, information transmission.. Based we mention above, we propose an integrative model to explain the issues of payments in the cross-border e-commerce as shown Figure.1.

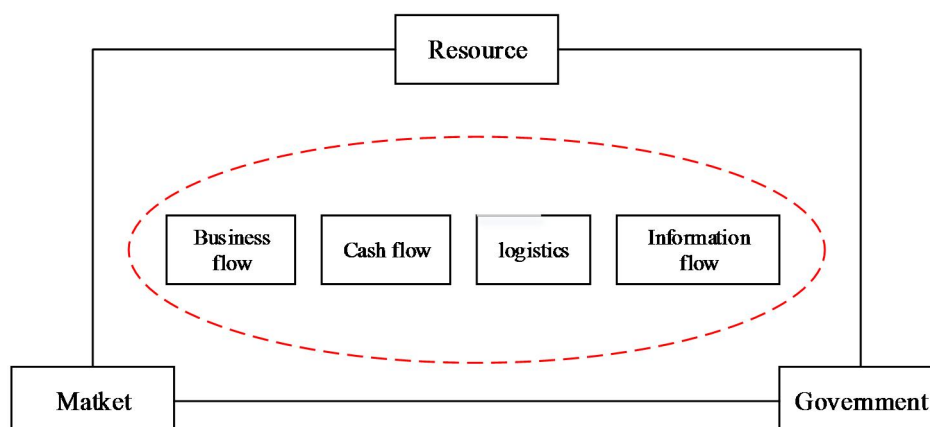


Figure1: Theoretical Model

Resource— Our Country Major Cross-Border E-Commerce Payment Institutions

Our country major cross-border e-commerce payment institutions has two forms, one of is the domestic third-party payment institutions, for example, Alipay, Unionpay, Tenpay and so on, these payment institutions both are approved and released by The State Administration of foreign exchange to transact cross-border payment business. Alipay gradually enter the fields of cross-border payments by good basis for domestic third-party payment. Currently, the cross-border payment service of Alipay has covered 34 countries and regions, and supported the dollar, pound, euro, swiss franc and so on to do foreign currency settlement. Besides, Unionpay can achieve cross-border payments business outside of China about the 125 countries and regions, In China, its distinct advantages of cross-border payments become increasingly apparent.

The second is providing global online payment services institutions outside China, such as PayPal. PayPal as the world's largest online payment company, occupies an important position in the third-party payment fields, and it supports 25 kinds of currency to trade business in 190 countries and regions, especially it is very popular in European and American counties.

Market—the Scale of Business

By 2015, the company accounting for the largest share of China cross-border payment market is Alipay, the total size of cross-border payment is approximately 900 million, which only occupies 5% of total cross-border e-commerce transaction volume. Billions of dollars each year in cross-border third-party payment market is mainly dominated by the United States' company-PayPal and other foreign payment company 95% of cross-border payment market is controlled by PayPal.

Government—the measures

The government has taken numerous measures to promote the development of cross-border e-commerce. Firstly, the government clearly regulates the import and export policy to promote the fair competition and strengthen of import and export tax administration. Secondly, financial supports are provided, the government encourages traditional manufacturing and trade enterprises to apply cross-border e-commerce platform to explore the international market, and gives the necessary financial

support to priority projects meeting the requirements. Thirdly, the government optimizes supervision measures out of customs. The operations processes of goods or services importing and exporting through customs are optimized, and the government has considered the possibility of simplifying the categorization of cross-border e-commerce exports and idealized the cross-border e-commerce statistical system.

The Process of Financing of Cross-Border E-Commerce

Figure 2 shows the process of financing of Cross-border e-commerce. First, Domestic consumers log on foreign Web sites to select which goods or services they want and order (①Log overseas online shopping web sites to select goods). Second, Overseas sellers send the orders of consumer to the payment platform (② commodity information) third, payment platform certify domestic consumers' authentication information (③certify consumers' account).fourth, , The domestic consumers to fill in their personal information and choose the payment pattern(④ write authentication information; Choice of CNY payment; confirm the payment) . fifth, Payment platform transmits the payment message to bank (⑤payment message), And the receive the message of foreign exchange purchasing available from bank (⑥purchase of foreign exchange payment information). Finally, After foreign sellers accept available remittance information from payment platform (⑦remittance information),and send products and related services (⑧ send goods) to domestic consumers. And all the steps involve the input and output of flow of business, cash, information and logistics.

SOLUTIONS TO THE PROBLEM OF PAYMENTS ON THE CROSS-BORDER E-COMMERCE PLATFORM

From the experience of cross-border e-commerce platform we found that there are two ways to solve the problem of the payments. One is the companies to establish their own payment platforms to complete the payments, and the other is dependent on the third party platform to pay.

For example, EBay and Alibaba are dealing with the payment problems through their own payment system. On EBay, you

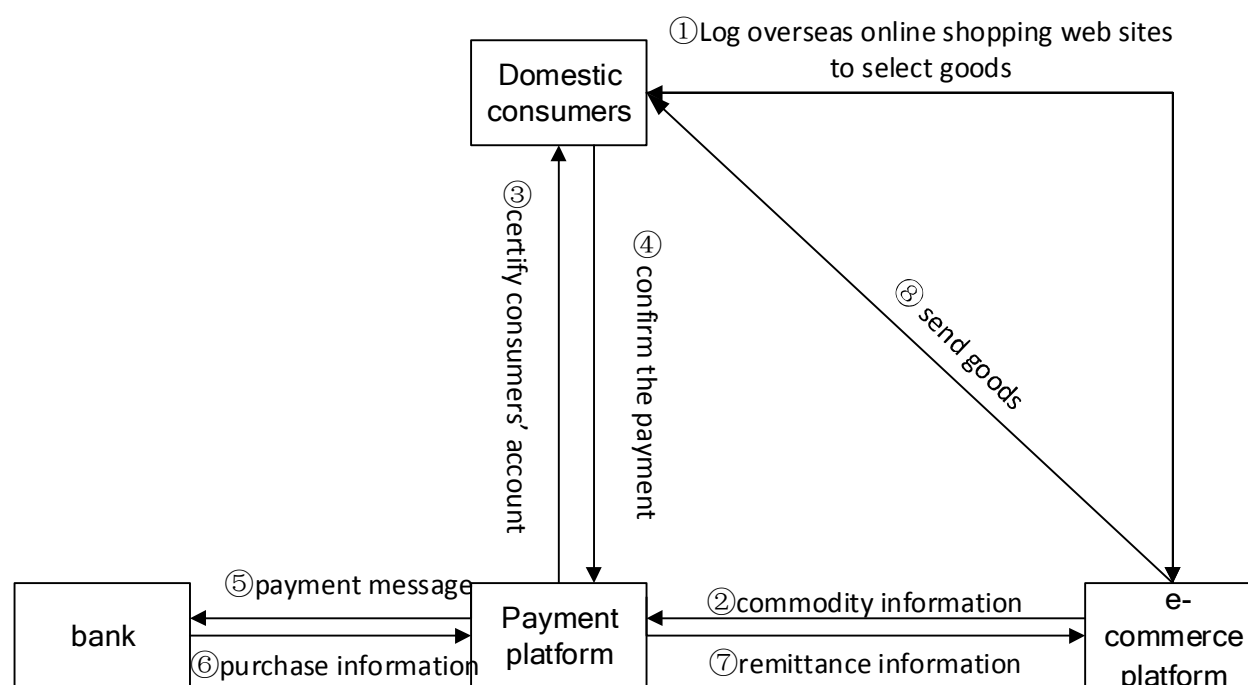


Figure2: The process of financing of Cross-border e-commerce

complete the payments mainly via Paypal. Using Paypal is very simple. First you should register a Paypal account. Then bind a VISA or Master dual currency credit card issued by any of domestic banks, and then you can go shopping at the EBay. Compared to EBay, Alibaba platform has three cross-border online shopping services. They are Taobao global purchase, Tmall International and Etao. In order to solve the network transaction security problems, Alibaba launched Alipay. Alipay uses the “third party secured transaction mode”, in which the buyer pay for purchases to Alipay firstly. Secondly Alipay remind the seller to delivery. And finally, when the buyer receive the goods and confirm the receipt, Alipay will remit the payment to the seller, a network transaction finished.

While most of the other cross-border e-commerce enterprises are paid through the third party payment platform. For example, to Amazon's overseas users, you could complete the payment without any difficulty as long as you have a VISA or Master dual currency credit card. Specifically, you need to create an account in Amazon, enter your bank card number. After shopping the website will send you an e-mail about your information and what you've bought. When you confirm the e-mail the bank will

automatically debit in 24h. Some domestic e-commerce companies such as Lightin The Box and Dunhuang are through Alipay or Paypal platform to complete the cross-border payments.

ANALYSIS OF THE CROSS-BORDER E-COMMERCE PAYMENT SERVICES IN XI'AN

Opportunities for Cross-Border E-Commerce Payment Services in Xi'an

The official reply of the pilot cities

March 19, 2014, the General Administration of Customs approved Xi'an to carry out cross-border e-commerce trade services as a pilot. After more than half a year of preparation, Xi'an cross-border electronic business platform (export) formally launched on October 28, 2014. This platform is designed as a bridge to facilitate the Shaanxi enterprises to go abroad and expand overseas markets. At the end of January this year, the platform cumulatively export more than 18000 times, the total export volume is more than \$600,000. The main export destinations are the United States, Britain, Japan and Italy and the main export products are clothing, shoes, hats, local handicrafts and ornaments. Shaanxi's products are out of the country through the network. The cross-border e-commerce business will not only take the Xi'an manufacturing to the international market, also bring the cheap and good quality products in international market to china, which is conducive to the development of Xi'an economy. At the same time, as the core of cross-border trade, foreign currency payments' volume will also be greatly increased.

The strategy of "The Belt and Road"

"The Belt and Road" strategy accelerating has brought cross-border payments industry significant opportunities for development. According to the Commerce Department data, in 2015, the import and export trade volume is totaled \$846 million which is an increase of 10% between Xi'an and the countries along "The Belt and Road". This strategy not only accelerated the development of cross-border e-commerce in Xi'an. Also led to the rapid development of traveling and studying abroad. Thus further enabled the cross-border payment scale in the transactions is also gradually rising.

"Silk Road Online" strategic opportunities

Construction of "Silk Road Online", which is focused on promoting the trade exchanges based on the internet and the development of cross-border e-commerce has the highest priority, will bring a greater development of cross-border e-commerce platform payment services in Xi'an. Xi'an should seize the policy opportunities, vigorously improve the e-commerce environment within the city. With the internet-based reciprocal trade both to promote the exports of manufactured products from Xi'an to the countries along "The Belt and Road ", but also to promote the countries with abundant resources of energy and agricultural products to input to inland market. Guided by this policy, the cross-border e-commerce payment services in Xi'an will be a substantial rise.

Challenges for Cross-Border E-Commerce Payment Services in Xi'an

Deficiencies in existing development

Compared with Zhengzhou, Chongqing, Hangzhou and other pilot cities, the development of cross-border e-commerce in Xi'an is relatively backward. The main inferiorities are as following: First, the overall size of the e-commerce industry is small. In 2014, Guangzhou, Shenzhen, Hangzhou, any of their e-commerce transactions are more than 1 trillion CNY. And as Xi'an is located in the west of China, Chongqing and Chengdu's are more than 450 billion CNY and 500 billion CNY, respectively, while only 120 billion CNY in Xi'an. Second, the support of the policies is not enough. The policies in various departments have not been effectively integrated, especially the excessive dispersion of financial resources make the support limited. Third, infrastructure, financial system and other ancillary services are not perfect, such as logistics, payment, financing, and so on. Fourth, the development of e-commerce consciousness is not strong. Departments and districts have not realized the importance of developing the e-commerce. Thus it is lagging behind in terms of promotion, brand packaging, personnel training. It has not formed a good atmosphere for the development yet. The above four points cause the development of cross-border e-commerce is relatively slow, so that the cross-border payment services are very backward.

Cross-border payment safety coefficient isn't stable

Cross border payment services are vulnerable to the security and stability of the payment instruments. In the process of cross-border payments, it's prone to appear sort of risks such as payment failure or payment account theft caused by the system failures, lack of information or other human factors. Which has brought the both sides of transaction some payment risks. In addition, the electronic payment also easily leads to the risk of cross-border money laundering crimes.

Suggestions for Cross-Border E-Commerce Payment Services in Xi'an

Actively seeking cooperation with third party payment platform

Xi'an is an important center city of the Silk Road Economic Belt and the beginning of the ancient Silk Road. As we all know, the Silk Road Economic Belt is a platform with the similar functions as the free trade zone, which can produce more close economic relations with Central Asian countries and even European countries. Given there are Xi'an Comprehensive Bonded Zone, Xi'an Hi-Tech Comprehensive Bonded Zone, New West Ham airport bonded logistics area and other logistics distribution center in Xi'an, cross-border trade of this city will become increasingly prosperous. Therefore, the enterprises should actively take advantage of the Xi'an cross-border e-commerce platform to attract third party payment companies those who have the qualification of settlement in cross-border e-commerce and strive for cooperation with them to expand the scale of Xi'an cross-border e-commerce transactions as well as promote the economic development of Xi'an.

Government guidance

Xi'an Municipal Government has set up the following several measures to encourage the development of cross-border e-commerce payments: first, to encourage banks and Payment institutions to provide payment services for cross-border e-commerce enterprises. Second, to encourage banks to provide cross-border e-commerce companies the cross-border CNY settlement services. Third, to push the banks and Payment institutions to accelerate product innovation, improve cross-border payment service experience and payment efficiency, strengthen the construction of credit system. These measures are implemented and led by the Provincial Finance Office and the People's Bank of China Xi'an Branch.

Pay attention to the access management of Payment institutions

People's Bank of China approved the third party payment institutions to carry out payment services. The State Administration of Foreign Exchange approved the enterprises the launching of cross-border payment service network access qualification. Strictness and cohesion of these two departments policy play a decisive role in the payment institutions qualification examination. Therefore, the government should choose the payment enterprise which with legitimate business qualifications and mature technical conditions to participate in cross-border payment services.

THEORETICAL AND PRACTICAL IMPLICATIONS

By addressing the research questions at the beginning of this paper, this study makes several important theoretical contributions. First, this study makes significant contribution to the literature on Michael Porter diamond Model, The phenomena that are analyzed and classified into six broad factors incorporated into the Porter diamond, including factor conditions, demand conditions, related and supporting industries, firm strategy, government, chances, the six factors play a vital role in improving industrial competitiveness. Diamond model also explain the phenomenon of cross-border e-commerce, and this paper mainly describes how governments to help promote the development of cross-border e-commerce of Xi'an.

Second, this study also proposes a specific combination of Michael Porter diamond Model and circulating theory contribute to the payments in the cross-border e-commerce. This paper emphasizes making full use of diamond model at the same time dealing with the transaction in logistics, cash, business, information flow.

In terms of implications for practice, this study is significant in that it provides some comprehensive advice for governments, the government must make full use of opportunities to support payments business of cross-border.

CONCLUSION

With the development of cross-border e-commerce in China, the two-way demand for domestic consumers shopping overseas and overseas consumers purchase domestics is increasing. China's cross-border e-commerce transactions are rapidly growing in size every year, it will increase to 1.3 trillion in 2017. So the scale of cross-border payments business is also gradually expanded. Cross-border payment is mainly based on the third party payment. Third party cross-border payments are adopted by a large number of cross-border e-commerce platform because of its convenient and safe transaction, saving cost and other advantages. It has greatly promoted the development of cross-border e-commerce in china. Each of cross-border e-commerce platforms should actively take the advantages of policy to develop their own business, and promote the development of China's economy at the same time. Also, the government should vigorously provide convenience for China's third party payment platform to be out of the country.

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ACKNOWLEDGEMENT

This research was supported by the Xi'an Science and Technology Project under Grant SF1502 (1).

How Do Alibaba Penetrate into and Benefit from the Internet Finance Sector Successfully? An Ecosystem Perspective

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ABSTRACT

The internet finance (or online financial) industry in China has boomed in recent years. Amongst the players, Internet attackers are quoted as key facilitators, fostering innovation and possessing a uniquely competitive landscape. To explore the methods through which such companies penetrate and benefit from the online financial sector, this study analyzes the evolutionary path of Alibaba's ecosystem during 2013 and 2015, discovering how Alibaba positions and shapes interactions within the ecosystem. Based on our findings, Alibaba first expanded to the investment and financial management sectors with regard to the entry strategy. Second, owing to its lack of experience in the financial landscape, Alibaba applied the evolutionary strategy and placed a higher focus on cooperating with Internet-based companies. Finally, to ensure sustainable and mutually beneficial relationships amongst most ecosystem players, Ant Financial became a keystone player, enabling Alibaba to serve as the physical dominator.

Keywords: Online financial / internet finance industry, Alibaba Group, ecosystem analysis.

CURRENT UNDERSTANDING OF THE ONLINE FINANCIAL INDUSTRY

The Paradigm Shift of the Financial Service Sector in the Internet+ Era

Since the 1990s, the Internet has caused both evolutionary and revolutionary changes in the practices and services of existing industries, leading to paradigm shifts. Moreover, owing to the fundamental changes in both business and living environments caused by information and communication technology (ICT), the Internet+ era has been a major focus of both managers and academics in recent years. The influence of disruptive innovations on the structuring, provisioning, and consumption of services has become a vital concern (World Economic Forum [WEF], 2015).

This viewpoint is particularly evident in the financial services sector, as finance technology (FinTech) has had disruptive impacts on current practices. To help financial firms systematically capture the aforementioned patterns, the WEF initiated a global research project in 2015, which proposed the first consolidated taxonomy of disruptive innovation in financial services (WEF, 2015). According to the WEF, although the design, delivery, and providers of financial services is rapidly changing, the core needs that those services fulfill remain the same. Thus, the six core functions that comprised financial services remain relevant and are highlighted and identified in the WEF framework: payments, market provisioning, investment management, insurance, deposit and lending, and capital raising. Additionally, 11 clusters of innovations exerting pressure on traditional business models are identified: emerging payment rails, cashless initiatives, smarter and faster machines, new market platforms, process externalization, empowered investors, insurance disaggregation, connected insurance, alternative lending, shifting customer preferences, and crowdfunding (WEF, 2015).

WEF further synthesized six high-level insights on the impact of Internet-enabled innovations in financial services; based on the proposed comments, Internet-enabled, disruptive innovations will continuously reshape the long-term structure of the financial service industry, spotlight platform-based data-driven service models, and push incumbent institutions to employ online competition strategies (i.e., competing with new Internet-based entrants vs. leveraging legacy assets to provide similar services online) (WEF, 2015).

The Growth Potential in China's Booming FinTech Sector

China is cited as one of the places with the most development in the internet finance (or online financial) sector in recent years, owing to FinTech start-ups' mushrooming growth. Not surprisingly, at the end of 2015, the market size of China's online financial sector was more than USD 1.8 trillion (or RMB 12 trillion). According to McKinsey, four key factors are driving the rapid growth of China's online financial industry: (1) the open, supportive regulatory environment; (2) a highly developed e-commerce (EC) sector; (3) an enormous latent demand for inclusive finance; and (4) the strong profitability of traditional banks underwriting a strong trial-and-effort culture and facilitating aggressive investments in innovative digital services (Ngai et al., 2016).

McKinsey also identifies three typical types of players in China's online financial industry. The first type is the Internet attackers (or "barbarians from outside"). China has a uniquely competitive landscape that is dominated by a few digital companies that have established comprehensive multilicensed financial ecosystems, which are differentiated by their target customers. Alibaba and Tencent are two typical Internet attackers. Alibaba utilizes its EC business as the foundation of its financial empire (first entering into the payment sectors before expanding into financing and wealth management), with an emphasis on hundreds of millions of individuals and small- and medium-sized enterprises (SMEs). In contrast to Alibaba's techniques, Tencent expanded beyond the powerful social nature of the WeChat platform to build a consumer-oriented financial network that taps into its huge

user base (Ngai et al., 2016).

The second type of player is traditional financial institutions. These players are usually considered industrial followers because of their strict regulations and relatively conservative mindsets; however, they are still accelerating their push into the emerging online financial sector. Ping An Insurance Group, China Construction Bank, and the Industrial and Commercial Bank of China, which are all building their own ecosystems, represent traditional financial institutions (Ngai et al., 2016).

The final type of player is nonfinancial companies, a relatively small group that lacks experience in both the finance and Internet sectors. Retail companies such as Gome and Suning and real estate companies such as the Wanda Group are now marrying extensive offline resources to design new financial products, which threaten to undermine banks' control over key business customers (Ngai et al., 2016).

Nevertheless, Internet attackers appear to evoke and initiate the booming of China's online financial industry, thus creating a payment-dominated industry and shaping a differentiated development pattern to that of other leading nations. The relatives of a business and corresponding business models are, therefore, worthy of further investigation.

The Ecosystem Perspective Provides Insight for Understanding the Evolutionary Path

Business ecosystems are a wonderland for companies in the EC era, sustaining competition and innovation amongst enterprises (Fan and Liu, 2015). Tracing the origin and theoretical concepts of business ecosystems, Moore (1993) is possibly one of the first authors to have highlighted their importance as he argued the new ecology of competition in the early 1990s. Under Moore's concept, the evolutionary circle of a business ecosystem may include four stages: birth, expansion, leadership, and self-renewal. As businesses enter the self-renewal stage, innovation increases to ensure the sustainability of the business ecosystem.

Concerning the structural characteristics of a business ecosystem, Iansiti and Levin (2004) argue that interrelated enterprises occupy different ecological niches. They stated that keystone, physical and value dominators, and niche players are the major types of players and strategies. In particular, keystone firms play a crucial role in business ecosystems, specifically in creating value. keystones aim to improve the overall health of the ecosystem by providing a stable and predictable set of common assets that other firms use to build their own offering. keystones ensure their own survival and prosperity by continually trying to improve the entire ecosystem. In other words, they promote the health of others for strategic rather than altruistic reasons. Consequently, an effective keystone strategy must fulfill two criteria: (1) create value within the ecosystem, and (2) share value with other participants in the ecosystem.

Dominators in a business ecosystem wield their clout through more traditional means. Physical dominators aim to integrate vertically or horizontally to directly own and manage a large portion of a network; they generally control much of an ecosystem and are responsible for creating the value they capture. By contrast, a value dominator has little direct control over its ecosystem and creates little value for the ecosystem, but extracts as much value as it can.

Most players in business ecosystems follow niche strategies and are regarded as niche players. Niche players devote themselves to developing specialized capabilities that differentiate them from other firms in the network, and focus all their energies on enhancing their narrow domains of expertise.

Furthermore, Iansiti and Levin (2004) suggest that the choice of ecosystem strategy is governed primarily by current company type and ambitious company type. If a firm faces rapid and constant change and usually focuses on a narrowly but clearly defined business sector, a niche strategy may be most appropriate; if a firm is at the center of a complex network of asset-sharing relationships, the keystone strategy may be most effective; whereas if a firm relies on a complex network of external assets and operates in a matured industry, the physical dominator strategy may be the optimal choice.

Current Gaps and Research Focus

As mentioned, although current reports and studies have analyzed the potential development of the online financial service sector, as well as illustrated how specific innovative or successful firms are formed and operated, and have provided guidelines for depicting the future profile of the online financial sector, few have considered how leading Internet attackers have successfully established comprehensive multilicensed financial ecosystems or how they build uniquely competitive landscapes. Thus, clues and information are limited for conducting benchmark studies and analyzing evolutionary paths.

Therefore, to help bridge the gap between practice and theory, this study analyzes how the Alibaba group, the most representative player in China's FinTech industry, formed and expanded its financial service ecosystem during 2013–2015; namely, how it interacted with firms joining its financial ecosystem, as well as how it penetrated and benefited from the online financial sector.

RESEARCH METHOD AND DESIGN

Research Method and Case Selection

Because the development of the online financial service sector is still in its early stages, the qualitative research method is considered suitable for capturing the insight and implicit signals of the research subject. Therefore, case-based analysis is our key research method.

Alibaba is selected as our research target. The Alibaba group was formed in 1999 in the initial field (i.e., B2B) and later expanded to the EC areas of B2C and C2C. In the 2010s, the group gradually constructed its business ecosystem in information, logistics, infrastructure, and finance. In particular, Alipay is regarded as the key application fostering Alibaba's business ecosystem and service innovations.

Alibaba is a representative case of China's online financial ecosystem, because of the following reasons: (1) Alibaba began to form its EC ecosystem in 1999 and is cited as the most representative EC giant in China (Fan and Liu, 2015); (2) Alibaba is quoted as the leading and most typical Internet attacker in China's online financial service sector, leveraging its payment services for its business expansion (Ngai et al., 2016); and (3) Alibaba has been applied as the most representative multisided platform in analyses of the Chinese e-business ecosystem and its evolutionary path (Huang et al., 2009; Tan et al., 2015).

Consequently, this study focused on the evolutionary period of the Alibaba and Ant Financial business ecosystem and considered niche firms secondarily. Additionally, a blended analysis strategy is employed to ensure validity; time horizon-based pattern matching analysis is applied when using the case method.

Data Collection

The authors obtain relevant data from the literature as well as online news. The link between two firms within Alibaba's online financial ecosystem in a specific year is recorded and the data is then converted into a table including the cooperative news collected online. The data is then cross checked to ensure that each relation link is valid and current.

Because China officially initiated its online financial service sector in 2013, and the Ant Financial group was formed in 2014, this study focuses on analyzing the evolutionary paths between 2013 and 2015. In other words, only the birth and expansion stages of this ecosystem are analyzed in this study, following Moore (1993).

Analytical Framework

To provide a comparable outcome, WEF's six core functions of financial services are adopted in the analytical framework of this study; all the members of this ecosystem are categorized as one of the six functions (i.e., the corresponding types of firms and financial service category they belong to).

Moreover, Alibaba's networking strategies and subsequent connections to its Internet financial ecosystem are also specified. Therefore, the strength of the relationships (or links) between any two companies in the ecosystem (i.e., project-based cooperation, investments, and mergers and acquisitions) are specifically illustrated.

Finally, to determine how Alibaba and its partners perform in the ecosystem, this study analyzes the possible role of each member by applying Iansiti and Levin's (2004) framework.

ANALYSIS AND PRELIMINARY FINDINGS

Analytical Outcomes

Figures 1, 2 and 3 depict the profile of Alibaba's online financial ecosystem at the end of 2013, 2014 and 2015, respectively. In 2013, Alibaba had limited assets and capabilities in all the financial service sectors (except for payment). To establish its financial ecosystem based on its core competence (i.e., EC, SME users, and payment), Ali mainly invited suppliers, service providers, and capital investors during this period. Thus, as Figure 1 depicts, connections amongst players were relatively simple, whereas the differentiation amongst players remained limited. Based on an in-depth analysis of firm structure, 29 participants joined the ecosystem in 2013. Under this ecosystem, only 6 firms were self-owned and initiated by the Alibaba group, whereas 16 players belonged to Internet-based firms. Regarding the business scope of the ecosystem, Alibaba entered the online financial service sector with its online payment platform, Alipay, in the 2000s and soon expanded its services to include investment management and insurance services, targeting then-current Alibaba customers. Additionally, they trialed deposit and lending services through leveraging what outside (physical and leading) firms could provide. During this stage, the relationships between players in this ecosystem were still weak and simple; both parties were trying to leverage each other to create niche markets.

In 2014, Alibaba replaced Ali Finance with the Ant Financial Group to serve as its financial service and product offering platform, in response to changing regulations in China in the upcoming year. Based on the core of third party payment, Ant Financial Group emphasized serving as the payment gateway for the whole Alibaba ecosystem, and tried to gather the behavioral information and patterns of all participants and customers in the meantime. Moreover, as seen in Figure 2, in addition to helping

Ant Financial Group building its business relationships with firms belonging to Ali Finance's ecosystem, Alibaba continues its expansion of its service scope and variety particularly in domains of investment management service and deposits and lending services. Therefore, not surprisingly, a variety of derived innovative financial services based on AliPay were launched in 2014. Another issue that worth paying attention to is that a greater number trial on building stronger relationships between Alibaba and its partners through M&A could be found in 2014.

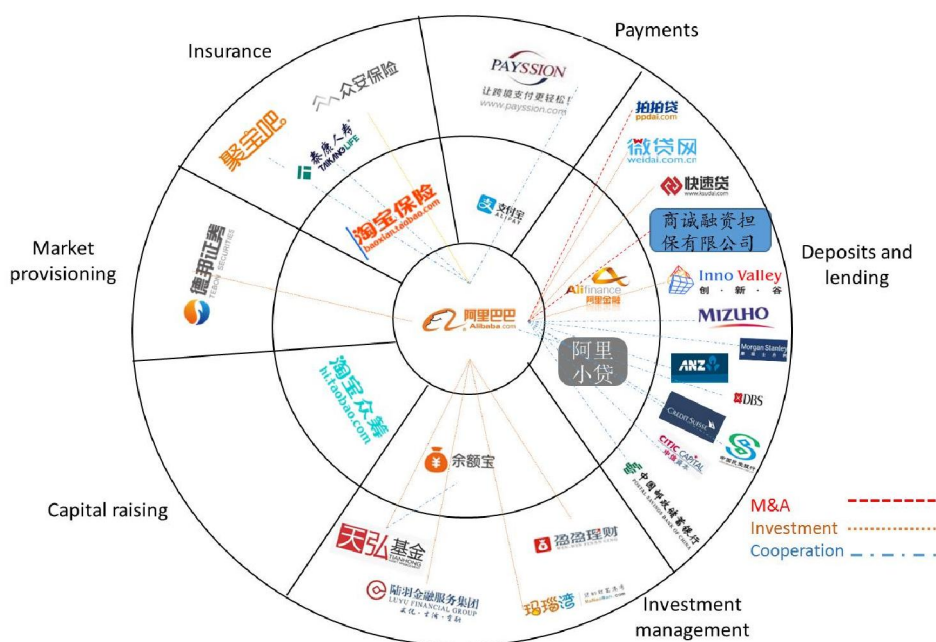


Figure 1: Alibaba's Internet finance ecosystem in the end of 2013

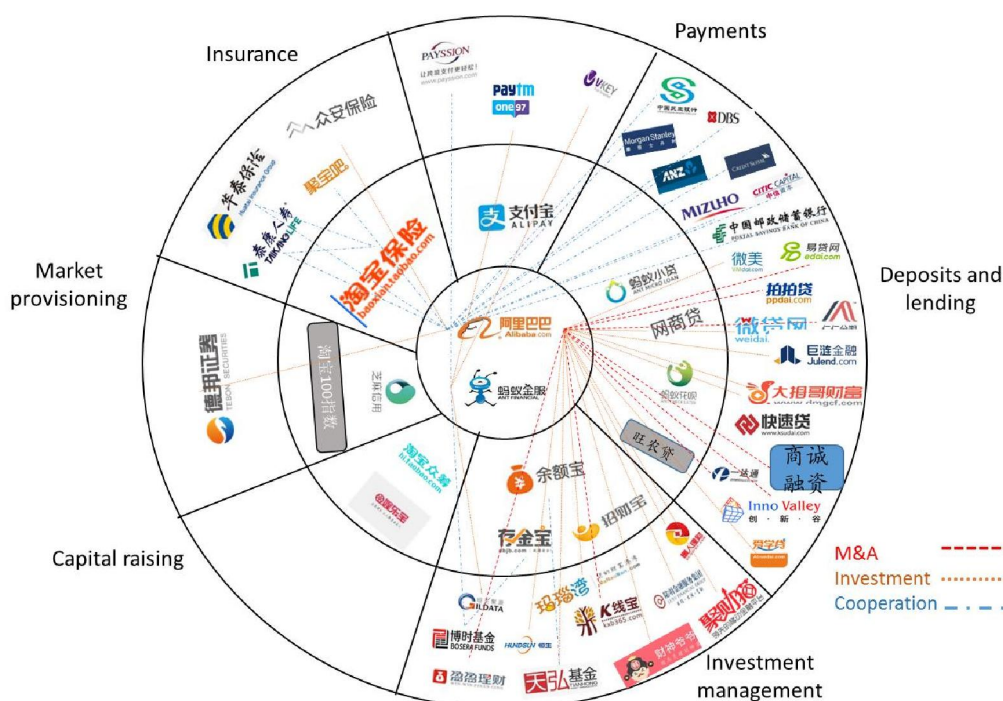


Figure 2: Alibaba's Internet finance ecosystem in the end of 2014

In 2015, thanks to the booming FinTech within Alibaba, Ali and Ant Financial focused on strengthening partnerships with other companies and building possible links amongst internal services. As seen in Figure 3, owing to more strategic cooperation, as well as M&A, Alibaba's financial ecosystem now consisted of 81 participants, and was more robust and complete. Specifically, at the end of 2015, the number of firms had grown by 279% in comparison with 2013. Under this ecosystem, 18 firms were self-owned and initiated by the Alibaba group, and another 17 firms joined because of either Alibaba's or Ant Financial's M&A strategy. Moreover, Internet-based firms are still relatively critical to this ecosystem as 53 of 81 participants are Internet-based firms. Finally, although still in its expansion stage, the Alibaba's online financial ecosystem expanded into the six core function

areas to build a more complete and robust service landscape. Furthermore and more critically, this current expansion of the Alibaba group and Ant Financial is implemented with supplementary perspective. Therefore, the Alibaba group and Ant Financial have built their own platform for ensuring the continuous growth and sustainability of the ecosystem through fulfilling the unmet needs of Alibaba's customers, thus growing the membership of this ecosystem more proactively.

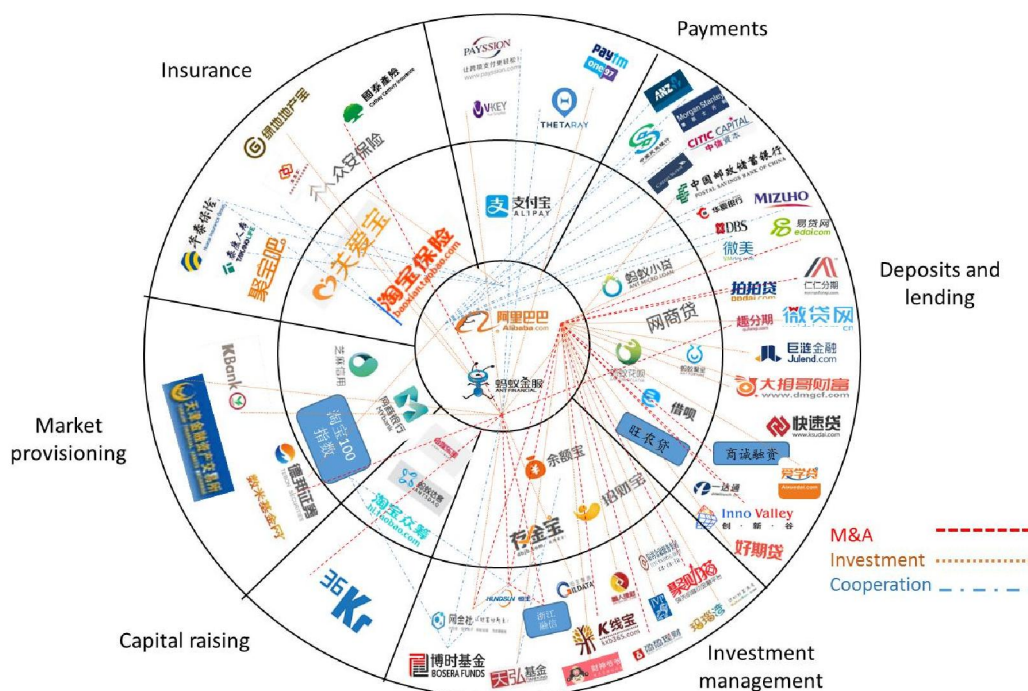


Figure 3: Alibaba's Internet finance ecosystem in the end of 2015

Conclusions and Implications

Key findings and conclusions

The Internet has engendered both evolutionary and revolutionary changes in the services and interactions of business firms for the past several years. Namely, the Internet+ era has been associated with fundamental ICT-driven changes in both business and living environments and constant disruptive innovations, including the online financial industry (WEF, 2015). Because of the mushrooming of FinTech start-ups and the major contribution of Internet attackers (such as Alibaba and Tencent), China, with its unique development pattern and competitive landscape, is considered one of the countries with the highest expansion in this industry in recent years.

However, although numerous studies have illustrated single innovative or successful cases and have provided guidelines for depicting the profile of the future industry, few have considered the strategies by which leading Internet attackers have successfully established comprehensive multi-licensed financial ecosystems successfully or how they have built uniquely competitive landscapes, thus providing limited clues and information for conducting benchmark studies and analyzing their evolutionary paths. Recognizing that Internet attackers in China have been changing the game rules or service landscape, exploring the penetration of the online financial sector by these companies and the associated benefits is crucial. Therefore, to help bridge the possible gap between practice and theory, this paper analyzes the evolutionary path of Alibaba's ecosystem during 2013 and 2015, namely, how Alibaba influences interactions within the ecosystem, by applying WEF's (2015) framework and Iansiti and Levin's (2004) perspective.

The findings of this study are as follows. First, Alibaba started its expansion in the investment and financial management sectors, followed by insurance and crowdfunding. Second, owing to its "barbarian" nature and lack of financial landscape coverage, Alibaba applied the evolutionary strategy when forming its ecosystem; Alibaba placed higher focus on cooperating with Internet-based companies, thus shaping an entirely different strategy than that of traditional financial institutions that were penetrating the FinTech sector. Third, to ensure sustainability and mutuality amongst most ecosystem players, Ant Financial adopted the keystone role, allowing Alibaba to serve as the physical dominator.

Contributions and implications

Based on the above findings, both theoretical contributions and practical implications can be drawn from this study. First of all, with regard to the theoretical aspect, as argued in current reports as well as in this study, Internet+ is deeply believed to be a new force to not only increase the effectiveness of current industrial practices but also reshape the game rules and service scope of industries, thus varying practices and landscapes. Therefore, the possible impacts and evolutions echo den Hertog's (2000)

framework for depicting the nature of service innovation. Moreover, the developmental path and strategy of Alibaba's online financial service ecosystem reflects a customer-oriented, niche-based, evolutionary strategy, mirroring how Alibaba succeeded in its EC landscape, which is consistent with the business ecosystem discussed.

In addition, although current studies on business ecosystem, such as Moore (1993) and Iansiti and Levien (2004), have demonstrated how to depict the roles and goals of firms participating in the system, less is discussed on analytical techniques depicting the dynamics and relationships amongst the business ecosystem. To help bridge this gap, this study tries to capture the dynamic changes by applying analytical techniques from the industrial / value net analysis domain. More specifically, by adding the cross-year comparison viewpoint and specifying the level of strengths of each link, this study is believed work well in visualizing the evolutionary path and its robustness of this ecosystem, thus offering new analytical perspectives for future research on business ecosystem.

With regard to the practical aspect, most of the hypotheses of WEF regarding the development of the online financial service sector are reflected in our analysis. More specifically, thanks to Alipay's contribution and business model, a typical platform-based model and ecosystem is then built; moreover, as Ant Financial and Alibaba adopt a complementary but cooperative position in this ecosystem (i.e., Ant Financial is a keystone business, whereas Alibaba employs the physical dominator strategy), both physical and traditional financial service firms and Internet-based firms are attracted to and proactively join this niche-based ecosystem, to leverage Alibaba for their market expansion. Such strategic approaches differ from how traditional financial institutions operate and innovate. Thus, based on the preceding discussion, this study has three practical implications: (1) online payment (or virtual money or points) service providers may be either platforms or keystones in fostering financial services; (2) the omnichannel (or O2O) strategy may be the key for differentiating the services and propositioning the value of focal players in the ecosystem; and (3) the findings may be applied to expand the landscape of current EC ecosystems or reshape other physically dominant service sectors.

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Internet Finance: A Systematic Literature Review and Bibliometric Analysis

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ABSTRACT

Internet finance has gained growing popularity in internet plus environment. While various problems have emerged, and hindered the sustainable growth of internet finance industry. Thus, a summary of existent research and directions for future study are expected. However, few comprehensive literature reviews has been published. This paper presents a thorough bibliometric and network analysis following a systematic literature review methodology. The analysis begins by identifying 331 published studies in Web of Science. Prolific authors, institutions and nations are identified by rigorous bibliometric tools. Based on citation and co-citation analysis, influential papers from different time periods are identified. Established and emergent research clusters are identified for topological analysis by coupling analysis. Future research opportunities are pointed out.

Keywords: internet finance; P2P lending; peer-to-peer lending; crowdfunding; social lending.

INTRODUCTION

Internet finance is the application internet in finance industry. It heralds an era in which all market participants can borrow and lend directly on the Internet with few information barriers. This emergent academic field has been growing for about 8 years and is well into its future of investigation. To correspond to a global trend, the notion of Internet finance has received more attention in the past few years and obtained emerging clusters of research in this field.

Research on internet finance contains two major parts: crowdfunding and peer-to-peer (P2P) lending. Crowdfunding is a new financing channel for small-sized and medium-sized enterprises and individual entrepreneurs to raise funds for innovation projects online [64]. And it has received a great deal of attention as a promising avenue to fostering entrepreneurship and innovation[8]. Online peer-to-peer (P2P) lending is a new but essential financing method for small and micro enterprises that is conducted on the Internet and excludes the involvement of collateral and financial institutions [13]. While the regulation and fraud problems are severely criticized recently.

A number of literature reviews on internet finance have been completed[10] [41] [1]. While, some of these reviews focus on specific aspect of internet finance such as crowdfunding[41] and P2P lending[1]. Cao, Chang [10] conducted a review on Chinese database. Additional analysis of this literature using strict bibliometric tools can provide further insights not previously fully grasped or evaluated.

Network analysis through bibliometric tools can prove powerful for identifying established and emerging topical areas. Besides, it can assist to identify the clusters of research and researchers showing how the various areas of thought may have emerged based on author and institutional characteristics. Identifying the more influential researchers within the clusters sets the stage for determining additional emergent study fields through capturing of more recent topics covered by these researchers. This paper presents a comprehensive evaluation of the field, focusing on forward Internet finance, starting with a pool of over 380 published studies and filtering this pool to more influential works and investigators. Using rigorous bibliometric tools, a comprehensive network analysis (e.g. citation, co-citation analyses and coupling analyses) is completed and six major clusters of research are identified. These algorithmically identified clusters set the stage for topical classification of the published models and further investigation of the evolution of these clusters over years. From these results, additional insights are also gained on the current research interests and potential directions for future research.

The remainder of the paper begins with an introduction of a structured methodology used to identify and further refine the literature that will be reviewed and evaluated in this study. Influential authors, affiliations and countries are identified by a bibliometric analysis in section 3. Section 4 presents research clusters and lead papers in internet finance through network analyses. A further dynamic investigation is conducted in section 5. Section 6 summarizes the results, presents some limitations of this study, and discusses opportunities for future research.

RESEARCH METHODOLOGY AND INITIAL DATA STATISTICS

Literature reviews aim to evaluate and map the intellectual structure to identify research gaps and highlight the boundaries of knowledge[56]. Structured literature reviews typically start from an iterative cycle of defining appropriate search keywords[51]. Rowley and Slack proposed a structured methodology for scanning resources, designing the mind map to structure the literature review, writing the study and building the bibliography[50]. Following this structured methodology, we combine it with bibliometric analysis and network analysis to carry an iterative cycle of defining search terms, identify influential publications, determine existing topical areas of research and provide insights for future research.

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Defining the Appropriate Search Keywords

A research field usually has many relevant keywords. Traditionally, researchers collect important keywords by iteratively reading various papers. In this study, bibliometric tool is used to facilitate the iterative cycle of defining appropriate keywords and a five steps method is provided. First we use the original keywords that is “internet finance” to download the reference information in web of science. Second bibliometric tool is used to extract all the other keywords in that data set. Third, keywords are sorted by frequency. Fourth, we add all the other relevant keywords in our new search terms. Fifth, we use the new search terms to download new reference information. Sixth, we redo step two to four until that there is no more relevant keywords. The whole process give us a comprehensive search term that is "internet finance" or "P2P lending" or "peer-to-peer lending" or "crowdfunding" or "social lending".

Database and Refinement of Data

We adopt Web of Science (WOS) core collection as the data source in this paper. WOS, covering over 10,000 high impact journals, as well as over 120,000 international conference proceedings, is the world’s leading citation database. Thus, the reference and publication information in WOS is representative of the whole academic field in bibliometric analysis.

Using the search term from last step, we get 380 publications in our database. We further refine the data to articles, proceeding papers and reviews. This refinement give us a final literature set of 331 publications for further analysis.

Initial Data Statistics

Fig. 1 indicates the trend in quantity of articles published. The results demonstrate that a geometric growth in publications is occurring, while the field is still in its early growth and expansion period. The initial statistics from table 1 show that 248 journals or sources have contributed to the publication of 331 papers. It was found that New media & Society has published 10 of these identified articles, ranked first in all journals or sources. But, no journal has dominated that list.

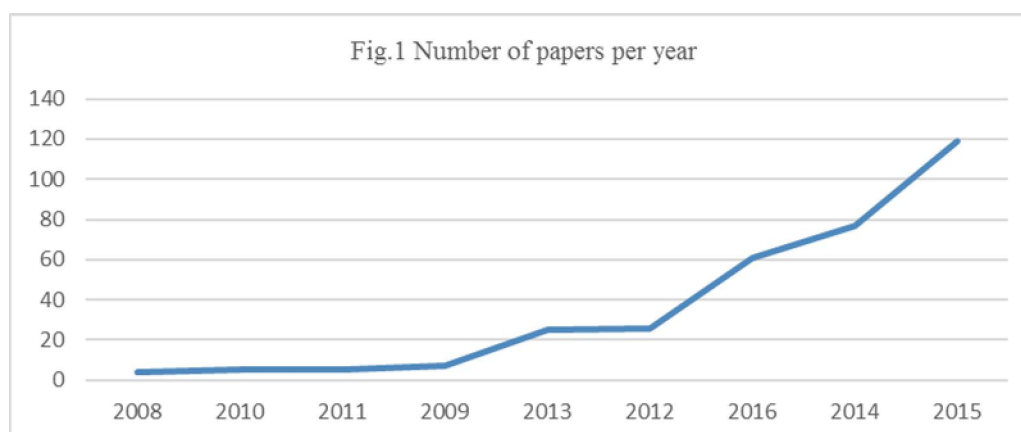


Table 1: Top 10 Journals or sources

No. of papers	Journals or sources
10	NEW MEDIA & SOCIETY
6	CALIFORNIA MANAGEMENT REVIEW
6	PROCEEDINGS OF THE 6TH (2014) INTERNATIONAL CONFERENCE ON FINANCIAL RISK AND CORPORATE FINANCE MANAGEMENT
5	MANAGEMENT SCIENCE
4	ELECTRONIC COMMERCE RESEARCH AND APPLICATIONS
4	2016 49TH HAWAII INTERNATIONAL CONFERENCE ON SYSTEM SCIENCES (HICSS)
4	FORBES
4	HISTORIA Y COMUNICACION SOCIAL
4	PROCEEDINGS OF THE 17TH INTERNATIONAL ACADEMIC MINDTREK CONFERENCE: MAKING SENSE OF CONVERGING MEDIA
4	ENTREPRENEURSHIP THEORY AND PRACTICE

Data Analysis

Given the nature of a citation analysis study, we adopt an inductive approach for the purpose of data analysis[53]. The literature classification portion of this study is completed before the actual data analysis by using a deductive approach. Data analysis is composed of two parts including a “bibliometric analysis” and a “network analysis”.

BIBLIOMETRIC ANALYSIS

Bibliometric, introduced by Alan Pritchard in 1969, is an application of mathematics and statistical methods to media of communication[47]. It has been adopted in various management fields to analyze the scientific publications[63];

Ramos-Rodriguez and Ruiz-Navarro[49]; Pilkington[44]; Chai[11]; Adrian Kovacs[32]. The major assumption of bibliometric analysis on citations is that authors tend to cite those publications which contribute to their current work, thus the frequency of received citations can reflect the relevant importance of an article, a topic or a journal[26]; White and Griffith[62].

In this paper we choose BibExcel to carry the bibliometric analysis because of its compatibility with different computer applications including Excel, Ucinet, Pajek and Gephi[43]. It also has high degree of flexibility with reference data imported from various databases including Web of Science and Scopus. One drawback of Bibexcel is its relevant fixed functions. To make state of art bibliometric analysis, we use also use python to supplement Bibexcel.

Author Influence

BibExcel can be used to analyze the frequency of occurrence of a text in different fields of the bibliographic data. The author field was extracted from the data file and frequency of appearance of all authors was recorded. Table 2 outlines the top ten contributing authors and the quantity of papers they authored or co-authored. And Table3 outlines the top paired authors. As can be seen in this Table2 and Table3, Chen,DY I is leading the list but has not coauthored often. It should be noted that Burtch, G, Wattal, S and Ghose, A have coauthored tightly with each other.

Table 2: The top 10 contributing authors

Author	No. of papers	Author	No. of papers
Chen, DY	6	Dholakia, UM	3
Lin, ZX	4	Lasrado, LA	3
Ghose, A	4	Valanciene, L	3
Zheng, HC	4	Jegeleviciute, S	3
Xu, Y	4	Rossi-Lamastra, C	3

Table 3: Top 4 paired authors

No. of cooperation	Authors	
3	Herzenstein, M	Dholakia, UM
3	Burtch, G	Wattal, S
3	Ghose, A	Wattal, S
3	Burtch, G	Ghose, A

Affiliation Statistics

The affiliations of the authors were extracted from the TXT file and analyzed in Bib Excel. For each affiliation, the country where the organization is located was extracted for this analysis. As the origin of the Internet finance, China dominates the contributing country list followed by USA and Germany.

Table 4: Top 10 contributing countries

Region	No. of papers
China	220
USA	214
Germany	43
France	34
Canada	31
Spain	30
England	27
Italy	26
Finland	20
Israel	17

The top contributing organizations, based on geographical locations and the quantity of published papers are shown in Table 4. The geographical dispersion of these organizations demonstrates that affiliated institutions whose researches focusing on internet finance are mainly located in China and USA. The top three contributing organizations are International Space University, Southwestern University of Finance and Economics and Northwestern University as shown in Table 5.

Table 5: Top 10 affiliations

Institutions	No. of papers
International Space University	25
Southwestern University of Finance and Economics	19
Northwestern University	13
University of Turin	12
Tampere University of Technology	11
Politecnico di Milano	10
Dalian University of Technology	9
University of Toronto	9
Guizhou University of Finance and Economics	8
University of Delaware	8

Comparing this list with the top 10 contributing authors in Table 4, we observe that International Space University, Southwestern University of Finance and Economics, Northwestern University, University of Turin, Tampere University of Technology and Politecnico di Milano are represented respectively by the more prolific authors Chen, Lin, Ghose, Zheng, Xu and Dholakia. Thus, it may take the work of more than two researchers for an organization to be ranked as a top performer.

Keywords Statistics

A similar analysis is conducted to identify the most frequently used words/phrases in the paper title and the list of keywords. The top 20 keywords used in the paper titles are summarized in Table 6. Similarly, Table 7 shows the most popular keywords from the list of keywords. A comparison between the two tables indicates that in most cases there is a consistency in the use of keywords in the title and the list of keywords. For example, the top keywords in both tables include a combination of Crowdfunding, Internet, Finance, P2P and Peer-to-Peer. Obviously, the five most popular words in Table 7 occur because they were the search keywords chosen in this study.

Table 6: Top 20 words in the title

Words	Frequency	Words	Frequency
Crowdfunding	133	model	21
Lending	61	analysis	20
Internet	42	financial	19
Finance	34	New	19
Online	34	Financing	18
Social	31	Platform	17
Research	27	China	17
P2P	27	Development	15
Peer-to-Peer	26	Based	15
Study	24	Evidence	15

Table 7: Top 20 words in the keywords

Keywords	Frequency	Keywords	Frequency
Crowdfunding	104	entrepreneurial finance	7
internet finance	33	Social networks	7
peer-to-peer lending	29	trust	6
Crowdsourcing	21	venture capital	6
P2P lending	13	Social Capital	6
entrepreneurship	12	motivation	6
Microfinance	11	Internet	5
Innovation	9	Financing	5
Social Lending	8	Kickstarter	5
social media	7	entrepreneur	5

NETWORK ANALYSIS AND LITERATURE CLASSIFICATION

Social network analysis (SNA) is the process of investigating social structures through the use of network and graph theories.

Social networks are comprised of interactions for the exchange of resources. It involves nodes and the links or ties. Pieters and Baumgartner point out that “journal citation networks are specific social networks in which actors are journals, the valued resources are knowledge and ideas, and the interactions are citations between journals”. This method has been adopted in various management fields to analyze the scientific publications.

We use Gephi software to perform a network analysis and topical content-based classification of the existing literature of internet finance. Gephi is chosen for this study over the existing network analysis software such as Pajek[19] and VOSviewer[57] due to its easy and broad access to network data, visualization flexibility (editable and user-friendly environment), advanced filtering capabilities, specialized clustering of data, ability to work with different data formats, and several built-in network analysis toolboxes[2].

In order to use Gephi to map and visualize the citations among papers, a graph dataset needs to be generated and published papers are shown as nodes and citations are represented by the arcs/edges between the nodes. The bibliographic data is reformatted with BibExcel to represent a graph dataset, which is in “.NET” format, for Gephi analysis. In this study, the graph dataset is based on coupling analysis.

Citation Analysis

A citation analysis is used to examine the degree of connectivity between pairs of nodes/papers in the created 331-node network. The initial citation analysis in Gephi revealed that 253 papers out of 331 have cited at least one same reference. The top 10 papers based on the number of local citations are shown in Table 8. 'Local citation' refers to the number of times a paper has been cited by other papers within the 331-paper network, and 'global citation' is the overall WOS citations for the paper. The gap between local citation and global citation values in Table 8 indicates that Internet finance has also received attention from researchers in other disciplines (i.e. they have also been cited by papers not appearing in our search results). It can also be seen that the order of papers based upon local citation does not necessarily match the global citation order. For example Pope DG is ranked 6th based on the number of local citations, but has the second highest global citation count. This result is interesting since the citation references for Pope DG seem to be more popular outside the realm of Internet finance.

Table 8: Top 10 local papers by citations

Author, Year, Journal	Local citation	Global citation
Mollick E, 2014, J BUS VENTURING	63	84
Belleflamme P, 2014, J BUS VENTURING	34	40
Zhang JJ, 2012, MANAGE SCI	25	39
Burtch G, 2013, INFORM SYST RES	25	26
Lin MF, 2013, MANAGE SCI	22	32
Pope DG, 2011, J HUM RESOUR	18	40
Herzenstein M, 2011, J INTERACT MARK	14	17
Yum H, 2012, ELECTRON COMMER R A	13	13
Duarte J, 2012, REV FINANC STUD	13	27
Herzenstein M, 2011, J MARKETING RES	13	9

Pagerank Analysis

Different methods have been used in the past to measure the significance of a paper. The most common method is to count the number of citations which was presented in table 8. Ding et al. argue that in addition to popularity of a paper measured by the number of citations, prestige is another important indicator which is the number of times a paper is cited by highly cited papers. A highly-cited paper may not necessarily be a prestigious paper, although in some cases there might be a strong positive correlation between the two measures. PageRank is used as a measure for both popularity and prestige. See more details about Pagerank in Fahimnia, Sarkis [24]

Table 10 shows the top papers using a PageRank measure. For this study's 331-node network, PageRank values vary between zero and 0.08808489. It can be seen that a higher number of local and global citations cannot guarantee the 'prestige' of a paper. Comparing the top ten papers based on citation and PageRank (Table 9 versus Table 10), we see that two of the highly-cited papers are not among the top ten high-PageRank papers. These include Yum H and Duarte J. In return, Chan C (and Munt A appear in the top 10 papers with highest PageRank, but they are not high-cited papers. Given that PageRank is greatly influenced by the citations from other high-cited papers, the later-published papers have obviously had a limited chance to be cited by other high-cited papers (simply because they have not been around long enough to establish citation). As the field matures and stabilizes in terms of output, PageRank will likely give a better picture of overall prestige of publications.

Table 9: Top 10 papers by Pagerank

Author, Year, Journal	Pagerank	Local citation	Global citation
Mollick E, 2014, J BUS VENTURING	0.08808489	63	84
Zhang JJ, 2012, MANAGE SCI	0.04843116	25	39
Pope DG, 2011, J HUM RESOUR	0.04571602	18	40
Herzenstein M, 2011, J INTERACT MARK	0.04506318	14	17
Burtch G, 2013, INFORM SYST RES	0.03090148	25	26
Belleflamme P, 2014, J BUS VENTURING	0.02606964	34	40
Herzenstein M, 2011, J MARKETING RES	0.02386747	13	9
Chan C, 2016, RES SOCIAL WORK PRAC	0.01775401	1	0
Munt A, 2014, J SCREENWRITING	0.01775401	1	1
Lin MF, 2013, MANAGE SCI	0.01646502	22	32

Coupling Analysis

There are two bibliometric techniques that build on the analysis of authors' referencing behavior—co-citation analysis and bibliographic coupling. Accordingly, these techniques rely on the fundamental assumption that, to the extent that the cited references of a focal publication provide a background for this publication, they denote at least some degree of relatedness between the focal publication and the publication(s) to which it refers. Based on this assumption, citation-based indicators have been widely applied in the field of bibliometrics as a means of mapping the flow of science and the development of fields and communities[31] [60] [58]. The basic assumption underlying both bibliographic coupling and co-citation analysis is that the greater the degree of overlap in the referencing patterns of a pair of focal publications, the greater the relatedness between both publications.

We choose coupling technique to calculate the relatedness matrix for further network analysis for two reasons. First, it is more suitable to identify clusters or themes within internet finance research. While co-citation is better at identifying the knowledge base of focal research field[32]. Second, reference information is available for all publications but not all focal publications are cited especially in local citing environment on which co-citation relies. Table 10 is a sample of coupling based relatedness matrix. From the sample matrix, we can tell that article 1 and article 3 cite three same publications and the references of article 1 and 2 share no common. A python script and Bibexcel are used to make the relatedness matrix of 311 publications. Importation of the matrix to Gephi shows that 253 out of 311 publications share certain degree of references.

Table 10: Sample relatedness matrix

	Article 1	Article 2	Article 3
Article 1		0	3
Article 2	0		8
Article 3	3	8	

Literature Classification: Data Clustering

The nodes of a network can be divided into 'clusters' or 'modules' where the connection (density of edges) is greater between the nodes of the same cluster compared to those of different clusters[17] [35] [48]. In a coupling network, a cluster can be seen as a group of publications that base on more similar knowledge base than that in other clusters or research areas. Data clustering (also termed modularity) has been used in the past as a classification tool for grouping of a set of given publications[48]. It allows for the topological analysis of a co-citation network, identifying topics, interrelations, and collaboration patterns. Data clustering has received increasing attention from scholars and research organizations turning it into a critical research field in social network analysis[4].

The default clustering tool in Gephi is based on the Louvain algorithm, an iterative optimization model that aims to determine the optimal number of partitions that maximize the modularity index. It outperform other community detection methods in terms of computation time and its accuracy is also verified. The modularity index of a partition is a scalar value between -1 and $+1$ that measures the density of links inside communities versus the links between communities. See more detail about the mathematic function of Louvain algorithm in Gephi in [4].

Clustering result

Applying this algorithm to the 311-node coupling network in Gephi resulted in the creation of six major clusters. The modularity index in Fig. 4 is equal to 0.41 indicating strong relationship between the nodes within each cluster and yet a relatively strong relationship between the nodes of different clusters. To determine the research focus for each cluster, we need to identify the "lead papers" (top 10 papers) of each cluster. This is a common practice of other bibliometric analysis papers[24]. A PageRank measure was used for this purpose. In a co-citation network, the PageRank algorithm takes into account how many times a paper is co-cited with other papers (the 'popularity' measure) and how many times it is co-cited

with highly co-cited papers (the ‘prestige’ measure). Most of the papers in this study with high PageRank also possess a high citation count. To find out the area of research focus of each cluster, we analyzed and evaluated the contents of all lead papers of each cluster.

Although the clustering algorithm is accurate to a relative high degree, the clustering result is not perfect because of the unordinary refereeing behavior of some authors and the drawback of bibliometric analysis itself. To have a better clustering result, we conduct a deductive method based on the research focus from last step to modify clusters. Specifically, we manually check the title and abstracts of every other papers in each cluster to see whether it conforms to the research focus. If a paper is clustered by error, it will be changed to a cluster that most suits the nature of this paper.

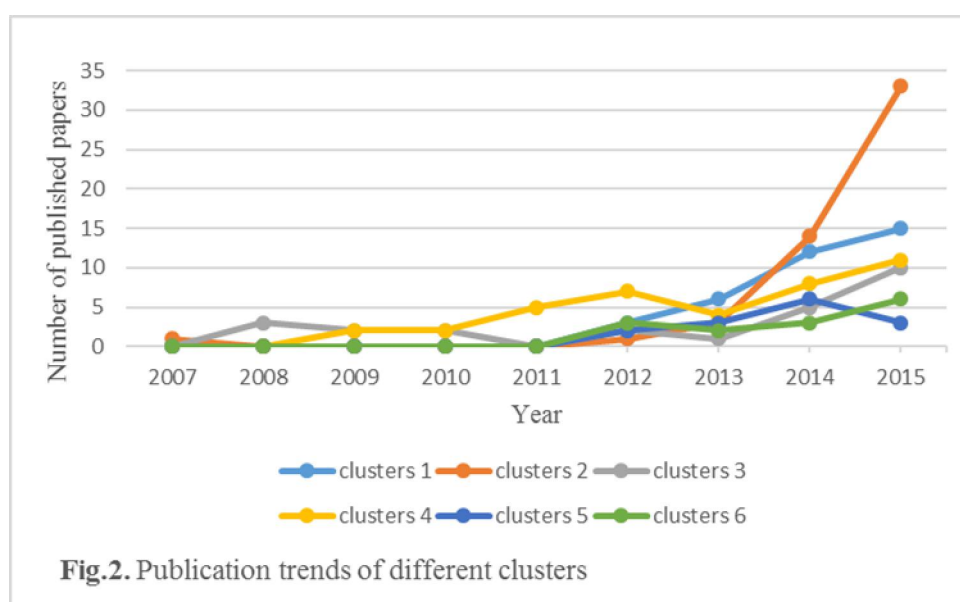
Table 11: Major clusters and their areas of focus

Cluster	No. of paper	Area of research focus
1	42	Application of crowdfunding in different industries and countries
2	87	Mechanisms of crowdfunders and fundraisers’ behaviors Broad-based empirical studies
3	29	Credit and risk problems in P2P lending Solve practical problems
4	45	Mechanism of lenders and borrowers’ behaviors in P2P lending
5	14	Regulation and policy issues in internet finance
6	16	Crowdfunding in media industry

The topical literature classification summarized in Table 11 shows that the research field of internet finance mainly focuses on crowdfunding (cluster 1, 2 and 6) and Peer-to-peer lending (cluster 3 and 4). Regulation and law is also a major concern of this field. However, compared to its importance, research on regulation of internet finance is still limited. Specifically, cluster one explores the possible application of crowdfunding. For example crowdfunding in scientific research[61] [29] [9], health industry [42] [20] [37] and different countries [33] [23]. Cluster two mainly focuses on mechanism of crowdfunders and fundraisers’ behaviors. Most of the research in this cluster are empirical studies. And the use of data in Proser.com is popular in this cluster. Sub research fields include geography effect[40] [39], social influence [7], behaviors in different types of crowdfunding [16] and so on. Cluster three mainly focuses on solving practical problems in P2P lending such as bidding in auction [22] [15] and credit assessing [38] [65]. Cluster four is about the mechanism of lenders and borrowers’ behaviors. Two major sub research fields are herding effect [66] [34] [12] and factors in lending decision such as demography effect [45], appearance [21] and social influence [36]. Cluster five is mainly around the Jumpstart Our Business Startups (JOBS) Act signed by Obama in 2012. Other regulations and supervision advice are also suggested for crowdfunding and P2P lending. It is noteworthy that although Chinese researcher dominate the author list, there is only one paper by Chinese researcher in this cluster. Compared with the numerous runaway events in China’s P2P industry, academic research on regulations is surprisingly lacking at least in English database. Cluster six is about the application of crowdfunding in media industry.

DYNAMIC ANALYSIS

To understand the evolution of internet finance research field over time, we also complete a dynamic citation analysis for the papers of all clusters. First, the growth of clusters over time for each cluster will be shown. Second, the lead papers of each clusters during three time periods will be summarized to reflect the research trend. Third, the citing pattern will be provided to help researchers to grasp the knowledge foundation of their focused research field.



As shown in figure 2, research on P2P lending (cluster 3 and 4) started earlier than that on crowd funding (cluster 1 and 2). After 2013, the growth of papers about crowdfunding has surpassed that about P2P lending. Research on mechanism of participants' behavior is more popular in internet finance. Overall, all clusters have shown a growing trend except the regulation and policy research (cluster 5).

Emergent Research Field

After a careful check of every lead papers in table 13 we find that in cluster one, research on the application of crowdfunding in scientific research [61] [9] covers both the two time periods, suggesting that researchers' interest on applying crowdfunding to raise funds lasts. New research focus include crowdfunding in corporate finance [55] and possible application of epidemic model in crowdfunding [30]. In cluster two, research focus seems to change from studying the behaviors of crowdfunders to that of entrepreneurs [40] and the underlying successful factors from the side of fundraisers [3].

In the initial stage of P2P lending, much efforts were given to research on how to build trust [14] and on the mechanism of the bidding in P2P auction [27]. Then, research on how to facilitate philanthropic donation in P2P emerged. Currently, assessing credit risk, bidding strategy and donation in P2P are three major sub research focus within cluster three. In cluster four, most attention were paid to study influence of information system [59], reputation of fundraisers [18] and type of disclosed information on crowd funders' trust [46]. During 2011 and 2013, study on the herding effect in P2P lending emerged [28] [66]. Most recently, the influence of quality of disclosed information and social network effect on lenders' trust are most studied.

In cluster five, most papers studied potential impact of the JOBS act which legalizes equity crowdfunding from 2011 to 2013. In latest time period, effect of regulations on crowdfunding in solar energy industry [6] and in gender/sexual reassignment surgeries are studied [25]. In cluster six, early papers are mainly about the use of crowdfunding on new media products. Now, much attentions are paid to leverage fans in crowdfunding new digital products [5] [52].

Evolutionary Citing Pattern

The progress of knowledge inflows to each clusters can be inferred from those most cited papers over time. As shown in table 13, citing patterns of cluster 1 to 5 have been substantially changing. It indicates that internet finance field lacks leading authors and this research field is more propelled by business practice than by theory. Influential papers for crowdfunding share little similarity with that for P2P lending, suggesting an opportunity to leverage the findings from the other field to their own research field. Researchers who want to have a grasp of the knowledge foundation of the focused research cluster can use those top references as a convenient start.

CONCLUSION AND DIRECTIONS FOR FUTURE RESEARCH

This paper uses thorough bibliometric and network analysis to present a comprehensive and structured review on internet finance. 311 articles, proceeding papers and reviews are selected as the publication set through the use of an iteratively defined search term in Web of Science core collection. Adopting different objective measures, our study identified prolific authors, affiliations and countries, classified 6 major research clusters and illustrated the knowledge foundations as well as lead papers for each cluster over time. Researchers can use the findings to find potential coauthors, have a panorama of internet finance, track the research trends and grasp the knowledge foundation on which they can build their own research.

The following key conclusions can be drawn from this study on internet finance: (1) Two major forms of internet finance are crowdfunding and P2P lending (also called social lending). The growing of research on crowdfunding surpassed that of P2P

lending since 2013, which is partially because of the JOBS Act signed in 2012 by president Obama. (2) China and USA are two dominant contributing countries in this field. (3) Papers are sparsely distributed in various journals. No leading journals has appeared yet. (4) Internet finance research can be classified into six different categories from which we recognize that cluster one is about application of crowdfunding in different industries and countries; Cluster two focuses on mechanisms of crowd funders and fundraisers' behaviors; Cluster three pay more attention on solving practical problems in P2P lending, such as assessing credit risk and bidding strategy; Cluster four is about mechanism of lenders and borrowers' behaviors in P2P lending; Cluster five focus on policy and regulation; Cluster six cares about use crowdfunding in media industry.

Based on the analysis, we propose a key future research direction for internet finance. First, much efforts have been made to study the behaviors of lenders and crowd funders. However, a relative small number of research are about the behaviors of borrowers and fundraisers. Future research can pay more attention on the detection of potential credit default and runaway of P2P platform. Second, since herding effect is significant in P2P lending, a similar effect can be tested in crowdfunding platforms. Third, emergent interdisciplinary research fields, such as crowdfunding in corporate finance [54] and marketing [22] could be further explored. Fourth, although China is the dominant country in this field, research on regulations and policy of internet finance is few in English database. Inter-country study on regulations of internet finance can fill this gap. Fifth, the effect of appearance of entrepreneurs and the endorsement of celebrity for both fundraisers and platforms can be empirically tested.

There are also several limitations to this study. First, the data source is Web of Science. Although WOS is the biggest citation based academic database available, there are many journals and books excluded by the dataset. Second, bibliometric study relies on the assumption that researchers tend to cite more publications which contribute to their current paper. While it is not always true. Researchers also cite papers which they want to deny or criticize. Third, although coupling analysis maximize the use of reference information in network analysis, a co-citation based Pagerank analysis suffers from insufficient local citation data for latest publications.

ACKNOWLEDGEMENT

This work is supported by grant 71672128 of the Program of National Nature Science Foundation of China.

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APPENDIX

Table 12 Lead papers in different time periods

	2008-2010	2011-2013	2014-2016
Cluster 1		Wheat RE, 2013, TRENDS ECOL EVOL Perlstein EO, 2013, SPRINGERPLUS Lasrado LA, 2013, PROCEEDINGS OF THE 17TH IAMC: MAKING SENSE OF CONVERGING MEDIA	Kandhway K, 2014, COMMUN NONLINEAR SCI Stroková Z, 2014, MANAGING AND MODELLING OF FINANCIAL RISKS Bymes JEK, 2014, PLOS ONE
Cluster 2		Burch G, 2013, INFORM SYST RES Gerber EM, 2013, ACM T COMPUT-HUM INT Schwartz AA, 2013, NOTRE DAME LAW REV	Mollick E, 2014, J BUS VENTURING Belleflamme P, 2014, J BUS VENTURING Jian L, 2014, J COMPUT-MEDIA T COMM
Cluster 3	Greiner ME, 2010, INT J ELECTRON COMM Chen N, 2009, 10TH ACM COEC Serrellis E, 2010, LN INST COM P SCI SO	Balhaves M, 2012, MEDIA INT AUST Ly P, 2012, VOLUNTAS Chen XH, 2013, ADV MATH PHYS	Chen N, 2014, GAME ECON BEHAV Enektier R, 2015, APPL ECON Corazzini L, 2015, J PUBLIC ECON
Cluster 4	Potzsch S, 2010, LECT NOTES COMPUT SC Collier B, 2010, 2010 ACM COGSCW Wang H, 2009, LECT NOTES BUS INF	Zhang JJ, 2012, MANAGE SCI Pope DG, 2011, J HUM RESOUR Herzenstein M, 2011, J INTERACT MARK Sigar K, 2012, ADMIN LAW REV	Chen DY, 2014, INFORM TECHNOL MANAG Allison TH, 2015, ENTREP THEORY PRACT Liu D, 2015, MIS QUART
Cluster 5		Stemler AR, 2013, BUS HORIZONS Bradford CS, 2012, SECUR REGUL LA W J	Murray J, 2015, JASSA Booth S, 2014, UCLA LAW REV Valanciene L, 2014, PROCD SOC BEHV
Cluster 6		Sorensen IE, 2012, MEDIA CULT SOC Martinez Gallardo FD, 2013, HIST COMMUN SOC Baranova D, 2013, PROCEEDINGS OF THE 17TH IAMC: MAKING SENSE OF CONVERGING MEDIA	Chan C, 2016, RES SOCIAL WORK PRAC Davies R, 2015, INFORM COMMUN SOC Bennett L, 2015, NEW MEDIA SOC

Table 13 Top cited references

	2008-2010	2011-2013	2014-2016
Cluster one:		<p>Surowiecki J, 2004, WISDOM CROWDS WHY MA</p> <p>Lambert T, 2010, EMPIRICAL ANAL CROWD</p> <p>Ordanini A, 2011, J SERV MANAGE</p> <p>Mollick E, 2012, DYNAMICS CROWDFUNDIN</p> <p>Poetz MK, 2012, J PROD INNOVAT MANAG</p>	<p>Ordanini A, 2011, J SERV MANAGE</p> <p>De K Buyere, 2012, FRAMEWORK EUROPEAN C</p> <p>Cameron P, 2013, GENOME BIOL</p> <p>EISENHARDT KM, 1989, ACAD MANAGE REV</p> <p>Mollick ER, 2013, JOURNAL OF BUSINESS</p>
Cluster two:		<p>Hazen Thomas Lee, 2012, N C L REV</p> <p>Hanley Dean F, 2012, INSIGHTS</p> <p>Cohn Stuart R, 2007, N Y U J L BUS</p> <p>Hoffman Sheldon Ryan, 2011, TENN L REV</p> <p>Loewenstein Mark J, 1999, DEL J CORP L</p>	<p>Mollick E, 2014, J BUS VENTURING</p> <p>Bellemme P, 2014, J BUS VENTURING</p> <p>Burtch G, 2013, INFORM SYST RES</p> <p>Ordanini A, 2011, J SERV MANAGE</p> <p>Zhang JJ, 2012, MANAGE SCI</p>
Cluster three:	<p>Ghatak M, 1999, J DEV ECON</p> <p>Petty R, 1986, ADV EXPT SOCIAL PSYC</p> <p>PETTY RE, 1981, J PERS SOC PSYCHOL</p> <p>PETTY RE, 1984, J PERS SOC PSYCHOL</p> <p>Pavlou PA, 2006, MIS QUART</p>	<p>Ghatak M, 1999, J DEV ECON</p> <p>Morgan J, 2009, MARKETING PROFS 0511</p> <p>Murphy C, 2012, GUARDIAN</p> <p>Nancy G, 2006, WP0639 IMF I</p> <p>Morduch J, 1999, J ECON LIT</p>	<p>Berger SC, 2009, BUR BUSINESS RES</p> <p>Duarte J, 2012, REV FINANC STUD</p> <p>Lee E, 2012, ELECTRON COMMERC R A</p> <p>Herzenstein M, 2011, J INTERACT MARK</p> <p>Lin MF, 2013, MANAGE SCI</p>
Cluster four:	<p>AKERLOF GA, 1970, Q J ECON</p> <p>Mishra DP, 1998, J MARKETING RES</p> <p>Moulton L, 2007, SOCIOL FORUM</p> <p>MEYER T, 2006, FINANCIAL SERVICES 2</p> <p>MAYER RC, 1995, ACAD MANAGE REV</p>	<p>Freedman S, 2008, DO SOCIAL NETWORKS S</p> <p>Pope DG, 2011, J HUM RESOUR</p> <p>Ravina E, 2008, LOVE LOANS EFFECT BE</p> <p>Iyer R, 2009, SCREENING NEW CREDIT</p> <p>BANERJEE AV, 1992, Q J ECON</p>	<p>Duarte J, 2012, REV FINANC STUD</p> <p>Herzenstein M, 2011, J MARKETING RES</p> <p>[Anonymous], 2012, RES TECHNOL MANAGE</p> <p>Valanciene L, 2013, EC MANAGEMENT</p> <p>Sigar K, 2012, ADMIN LAW REV</p> <p>MASSON GAETAN, 2012, EUR PHOTOVOLTAIC IND</p> <p>Joint Committee of the Parliamentary Commission on Banking Standards, 2013, CHANG BANK GOOD</p>
Cluster five:		<p>Fisch Jill E, 1998, J SMALL EMERGING BUS</p> <p>Campbell Jr Ruthford B, 2006, DEL J CORP L</p> <p>Sjostrom Jr William K, 2001, FLA L REV</p> <p>Johnson Jennifer J, 2010, DEL J CORP L</p> <p>[Anonymous], 1982, BUS LAW</p>	
Cluster six:		<p>Jenkins H, 2006, CONVERGENCE CULTURE</p> <p>Mises L von, 1998, HUMAN ACTION TREATIS</p> <p>Milfi T, 2012, COMMUNICATION</p> <p>More Thomas, 2003, UTOPIA</p> <p>Neill JO, 1972, SOCIOLOGY SKIN TRADE</p>	<p>Jenkins H, 2013, SPREADABLE MEDIA CRE</p> <p>Jenkins H, 2006, CONVERGENCE CULTURE</p> <p>Terranova Tiziana, 2000, SOCIAL TEXT</p> <p>Mittell J, 2013, JUST TV</p> <p>Pebler Luke, 2013, REVENGE OF THE FANS</p>

An Empirical Study of The Effect on Traffic of Large Online Promotion Activities

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ABSTRACT

This study selects multiple indicators of Web Analytics to measure the volume and quality of traffic, and collects the time series data of a certain brand's sales on JD.com from October 27, 2014 to June 30, 2015, using the Structural Time Series Model to analyze the effect of attracting traffic of five large-scale online promotion activities during this period. The results for the case study show that: large-scale online promotion activities have a significant positive effect on total page traffic, but the difference is showed on the quality effect of the page traffic; different activities affect the volume of unpaid traffic differently, while effects on traffic quality are not significant. This analysis may benefit e-commerce sites to develop a better strategy to carry out similar promotion activities.

Keywords: Online promotion, website traffic, web analytics, structural time series model, JD.com.

INTRODUCTION

Nowadays, promotion activity is one of the crucial methods to attract consumers' attention during the online shopping. Numerous Chinese e-commerce websites such as Tmall.com, Taobao.com and JD.com, developed "Double 11", "618" and other online promotion activities to achieve better sales and greater influence. Price promotion occupies a large share of the marketing budget, and it has also been proved to be the most effective approach to obtain consumers and increase sales [11] [19] [31]. For instance, "Double 11" of Tmall.com in 2015 involved 232 countries and regions, and the transaction amount reached 14.3 billion dollars, refreshing the world record on turnover of single e-commerce platform in single day again [2].

Comparing with the brick-and-mortar stores, it is obviously easier for e-commerce websites to collect large amounts of detailed data on visitor traffic and activities on websites by today's online technology [16]. Web analytics is the measurement, collection, analysis and reporting of web data for purposes of understanding and optimizing web usage [5]. Using Web Analytics can acquire and record key indicators of website, such as page views, unique visitors, referrers, bounce rate and so on. These indicators can effectively reflect the volume and quality of traffic [41]. The main purpose of our paper is carrying out quantitative research on website traffic by these metrics to measure the effect of large online promotion activities.

Online advertising has become the first choice of e-commerce website owing to its diverse styles, low cost, direct access using hyperlink, and easily available data, compared with traditional advertising [13]. E-commerce sites make use of online advertising to increase the exposure of activities and the accessibility of activities' pages during the campaign period, which can bring more traffic. Generally, traffic forms include two types: paid and unpaid traffic. Paid traffic refers to the traffic which activities' page was directly arrived through the network advertising. The traffic from other channels are all defined as unpaid traffic. Promotion activities ordinarily have direct impacts on the paid traffic.

As China's largest ecommerce platform by revenue, JD.com accounts for 58.3% of the market share of Chinese self-run B2C platform transaction size at 2015's second quarter [24]. At different times of the year, JD.com launches large-scale promotion activities. Crest is a brand of personal care belonging to P&G, which is the FMGC industry giant. Fast moving consumer goods have the characteristics of short consumption cycle, high purchase frequency and low brand loyalty, therefore it needs to carry out vast promotion activities [15]. The research object of this paper is the Crest brand page at JD.com, including 136 kinds of goods of the Crest.

In our research, the case of study is Crest, a self-run brand by JD.com. We monitor its pages and then analyze the time series data sample about some key performance indicators of traffic using the Structural Time Series Model. The analysis aims at two aspects: first, the effect on total traffic by large promotion activities; second, the indirect effect on unpaid traffic by large promotion activities. Through this study, we evaluate the effectiveness of online promotion activities, and then explore and summarize its effect further, which can provide the instruction for the similar large-scale promotion activities in the future.

Our research has threefold contributions: first, in the field of online marketing, pervious research attention has focused on consumer behavior [42], promotion form [7] [34] and so on, while this paper analyze effect of attracting traffic from the perspective of promotion activities, which can enlighten enterprises' marketing more directly; second, former researches retrieved data mainly by the questionnaire survey method and the experimental method, while the data using in this paper come from the real web's operation environment, which is more authentic; third, the analysis results show that the Structure Time Series Model can estimate the effect on attracting traffic by promotion activities, providing an effective method for the next related research.

RESEARCH DESIGN

Traffic Metrics

Website traffic data are usually collected by professional web analytics tools, such as Google Analytics and Baidu Statistics. Google Analytics is a free web service with powerful capabilities about websites' traffic. It has been extensively used in various research fields, e.g. tourism websites [38], library websites [3] [14] [40], food composition websites [35] and medical websites [6] [27]. Baidu Statistics has been used in the field of education website research [28].

Several scholars have proposed different metrics about analysis of website traffic in their research based on Google Analytics. Hasan et al. [23] selected 13 metrics to evaluate the usability of e-commerce websites from six aspects, e.g. navigation, internal search and architecture. Plaza [36] proposed a performance measurement of websites and four traffic indicators related. Plaza et al. [38] optimized the metrics in Plaza [36] and used them to assess a tourism website. Considering the situation of our research object, the volume and the quality of traffic are characterised here by metrics referred to Hasan et al. [23] and Plaza et al. [38], which consist of five key performance indicators (KPIs):

Metrics measuring the volume of traffic

page views: the total number of page visits in a specified period.

unique visitors: the total number of visitors reaching the pages in a specified period. Each visitor is identified and distinguished by unique cookies generated in their browsers.

Metrics measuring the quality of traffic

time of the visit: the average duration of page views measured in seconds.

bounce rate: the percentage of visits in which the visitor closes the page or browser directly instead of interacting with the page.

Order conversion rate: the percentage of visits that result in an order.

Generally, high quality traffic represents longer time of the visit, lower bounce rate and higher order conversion rate. Abbreviated name of these KPIs are shown in Table I.

Table I. Abbreviation of KPIs

Abbreviation	PV	UV	ToV	BR	OCR
KPI	page views	unique visitors	time of the visit	bounce rate	order conversion rate

Structural Time Series Model

Moral et al. [32] pointed out the elements which are common in economic time series, such as trend, seasonality and holiday effects. These factors should be considered simultaneously in our model, though the model focuses on the effectiveness of large online promotion activities. In order to capture and reflect the influences of these unobservable components, we apply a framework of univariate time series known as Structural Time Series Model (STSM) [20].

STSM generally indicates economic indicators using factors of trend, seasonality, cycle and irregularity, based on structure characteristics of time series [12] [20] [21]. This model has at least two advantages over other time series models, such as Autoregressive Integrated Moving Average Model (ARIMA). First, the model breaks through the limitations that traditional Box-Jenkins method is only able to be applied to stationary time series, prompting more extensive research and application of non-stationary time series. Second, the components of time series can be direct interpreted in the model [8] [22]. Since the components decomposed from time series of economic indicators are unobservable in STSM, traditional regression analysis methods cannot solve the model. State space form is used here to represent STSM in statistic treatment. Apart from utilizing state vectors to represent unobservable components, state space model also provides methods for optimal estimation, smoothing and forecasting using the recursive algorithm named Kalman Filter. Meanwhile, the model can deal with explanatory variables, structural breaks, interventions, outliers, and missing observations.

The basic framework of STSM is very flexible, so that complex patterns in the data can be captured using a relatively parsimonious model. STSM can also naturally combine the estimation of a series of components and the effects of explanatory variables. The general structure of our estimated model is built as follows:

$$(1)$$

where μ , γ , δ and ϵ are components of trend, cycle, seasonality and irregularity, respectively; C represents the effectiveness of large online promotion activities; H is the component of holiday effects (such as Christmas, Chinese New Year and other holidays).

DATA COLLECTION AND MODEL MODIFICATION

Descriptive Statistics

Like Google Analytics, JSHOP's traffic statistics module of JD.com can collect data from specified pages at different time granularity, such as monthly data, weekly data and daily data. The data are composed of aggregated data of pages and particular traffic source data: aggregated data of pages include collective data of each metric in unit time, and the data of metrics in unit time from different source URLs are collected in particular traffic source data. According to the source URLs, traffic is divided into two categories: traffic from Internet advertising, which is called paid traffic (or sponsored traffic), and traffic from other channels named unpaid traffic (or organic traffic), and mainly are direct visits by entering URL at browsers or clicking the link in Favorites. Considering the continuity for monitoring web pages and uncertainty of promotion activity duration, we collect daily traffic data. The data for analysis runs from 27 October 2014 to 30 June 2015, which makes a total of 247 daily observations about pages of Crest on JD.com. In this period, Crest participated in 5 large online promotion activities, which are detailedly showed in Table II.

Table II. Details of large promotion activities

	Activity 1	Activity 2	Activity 3	Activity 4	Activity 5
Name	Double 11	Double 12	New Year's shopping festival	Butterfly festival	618
Start time	2014.11.1	2014.12.8	2015.1.19	2015.3.1	2015.6.1
End time	2014.11.12	2014.12.14	2015.2.23	2015.3.13	2015.6.19
Duration	12	7	36	13	19
Merchandise categories involved	all categories	all categories	all categories	mainly personal care products	all categories

Table III shows the mean values of the five key performance indicators (KPIs) for two subsamples, depending on whether or not the day was involved in the period of large promotion activities. The figures reflect that all 5 KPIs have better performance during the period of campaigns: more page views per day means more visits on pages in campaign period; bounce rate decreased from 78.77% to 68.77%, which illustrates that larger rate of visits have interactions with the pages during the activities' time; and order conversion rate, the metric which is more important to e-commerce websites, grew nearly by one time.

Table III. Mean values per source

	PV	UV	ToV (s)	BR (%)	OCR (%)
Campaign period (87 observations)					
Total traffic	49269	31666	127.984	68.766	0.825
Organic	26164	15514	137.706	72.054	0.038
Paid	23105	16152	120.574	53.266	3.031
Out of campaign (160 observations)					
Total traffic	13953	10977	111.881	78.766	0.363
Organic	6763	5242	112.678	84.298	0.026
Paid	7190	5735	111.442	63.520	1.167

Figure 1 shows the evolution over time the indicator of page views for total traffic and unpaid traffic. The figure intuitively shows that the promotion activities increase the volume of traffic, but behavior differ from one activity to another. Finally, it should be pointed out that we lost data between 1 and 9 April 2015 because of system failure, as can be seen in the figure.

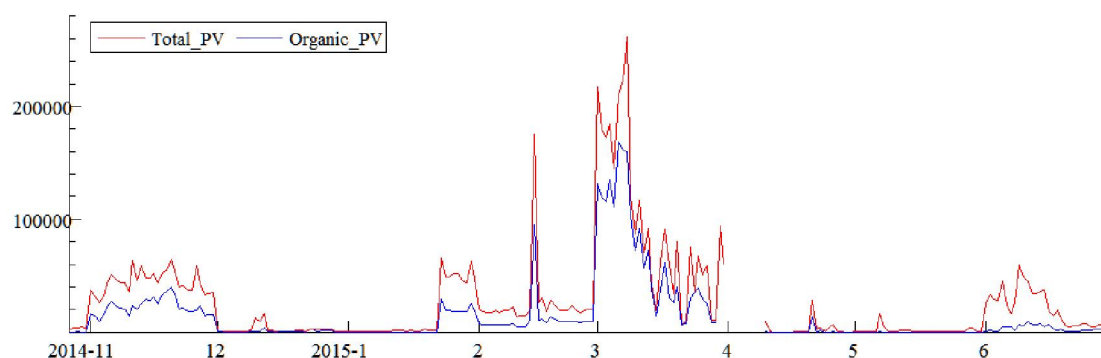


Figure 1. Page views

Model Modification

With the purpose of providing a user-friendly environment for analyzing, modelling, and forecasting of STSM, Koopman et al. [33] developed STAMP (Structural Time Series Analyser, Modeller and Predictor) package. This modelling approach has proved useful in many contexts, including the field of tourism economy [17] [18] [32] and energy economy [1] [25]. The version we applied here is STAMP 8.2.

The factor of cycle will be ignored in our model since the time span of sample is less than a year. Therefore, the model should include: the factor of large promotion activities, trend, seasonality, holiday effects and irregularity. The specification of the different elements of model is explained below.

First, the five large campaigns staged during the sample period are included in the model by means of five dummy variables C1, C2, C3, C4 and C5. Each of these variables is set to 1 for the observations related to the corresponding campaign and 0 otherwise.

Trend component usually explains the track of long-term development. In our research, it relies on a stochastic formulation that allows the level, μ , and the slope, γ , of the trend to vary slowly over time with the changes observed in the data:

$$(2)$$

where ϵ_t and η_t are mutually independent Gaussian white noise disturbances with zero mean and variances σ_ϵ^2 and σ_η^2 , respectively. The changes related to long-term and medium-term factors that influence the website's evolution, such as popularity, economic situation, etc., are captured by this local linear trend. It is a local approximation to a linear trend; it will collapse to the deterministic global linear trend when $\sigma_\eta^2 = 0$, in fact.

We express the seasonal fluctuations using daily dummy variables alone since the time of our sample doesn't involve all 12 months. Daily dummies from Tuesday to Sunday are defined as D2, D3, ..., D7 = 1 for corresponding observations and 0 otherwise.

Holiday effects considered traditional Chinese festivals, traditional Western festivals and other holidays. The following dummy variables were therefore constructed: =1 for Chinese New Year and Dragon Boat Festival and 0 otherwise; =1 for Christmas and Valentine's Day, two western festivals which are very popular in China nowadays, and 0 otherwise; =1 for New Year's Day, Women's Day, Labor Day and Children's Day and 0 otherwise.

More volatility has been showed by daily data than weekly data and monthly data. Meanwhile, daily data present data irregularities such as outliers. In addition, there are no data collected from 1 to 9 April 2015, when the statistical system suffered some breakdowns, so some observations can be considered as missing. We use the automatic identification and estimation procedures implemented in STAMP package to handle the outliers and missing data.

After the modifications of components above, the STSM for the website traffic metrics is the following, assuming that the functional form is linear or log-linear:

$$(3)$$

where \ln is the logarithm in three of the indicators considered (PV, UV and ToV) and raw data for the other two (BR and OCR), follows model (2) and ϵ_t , the irregular component that captures all the short-term shocks in the series, is a white noise with zero mean value and variance σ_ϵ^2 which is not correlated with μ and γ . The regression coefficients $\beta_0, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7, \beta_8, \beta_9, \beta_{10}, \beta_{11}, \beta_{12}, \beta_{13}, \beta_{14}, \beta_{15}, \beta_{16}, \beta_{17}, \beta_{18}, \beta_{19}, \beta_{20}, \beta_{21}, \beta_{22}, \beta_{23}, \beta_{24}, \beta_{25}, \beta_{26}, \beta_{27}, \beta_{28}, \beta_{29}, \beta_{30}, \beta_{31}, \beta_{32}, \beta_{33}, \beta_{34}, \beta_{35}, \beta_{36}, \beta_{37}, \beta_{38}, \beta_{39}, \beta_{40}, \beta_{41}, \beta_{42}, \beta_{43}, \beta_{44}, \beta_{45}, \beta_{46}, \beta_{47}, \beta_{48}, \beta_{49}, \beta_{50}, \beta_{51}, \beta_{52}, \beta_{53}, \beta_{54}, \beta_{55}, \beta_{56}, \beta_{57}, \beta_{58}, \beta_{59}, \beta_{60}, \beta_{61}, \beta_{62}, \beta_{63}, \beta_{64}, \beta_{65}, \beta_{66}, \beta_{67}, \beta_{68}, \beta_{69}, \beta_{70}, \beta_{71}, \beta_{72}, \beta_{73}, \beta_{74}, \beta_{75}, \beta_{76}, \beta_{77}, \beta_{78}, \beta_{79}, \beta_{80}, \beta_{81}, \beta_{82}, \beta_{83}, \beta_{84}, \beta_{85}, \beta_{86}, \beta_{87}, \beta_{88}, \beta_{89}, \beta_{90}, \beta_{91}, \beta_{92}, \beta_{93}, \beta_{94}, \beta_{95}, \beta_{96}, \beta_{97}, \beta_{98}, \beta_{99}$, the variances of the unobserved components σ_μ^2 and σ_γ^2 , and of the irregular term σ_ϵ^2 are unknown parameters to be estimated. Model (3) can be interpreted as a generalization of the classical general linear regression model. This model will collapse to a standard regression model with a linear deterministic time trend when $\sigma_\mu^2 = \sigma_\gamma^2 = 0$.

β_i , the coefficients control the influence of each promotion activity on the metrics, are the focal points in our research. Generally, a positive effect of campaign implies that the coefficient β_i is negative for the bounce rate and positive for the other four indicators. The behavior of the indicator y_t is not affected by campaign i if the value $\beta_i = 0$. The coefficients $\beta_{10}, \beta_{11}, \beta_{12}, \beta_{13}, \beta_{14}, \beta_{15}, \beta_{16}, \beta_{17}, \beta_{18}, \beta_{19}, \beta_{20}, \beta_{21}, \beta_{22}, \beta_{23}, \beta_{24}, \beta_{25}, \beta_{26}, \beta_{27}, \beta_{28}, \beta_{29}, \beta_{30}, \beta_{31}, \beta_{32}, \beta_{33}, \beta_{34}, \beta_{35}, \beta_{36}, \beta_{37}, \beta_{38}, \beta_{39}, \beta_{40}, \beta_{41}, \beta_{42}, \beta_{43}, \beta_{44}, \beta_{45}, \beta_{46}, \beta_{47}, \beta_{48}, \beta_{49}, \beta_{50}, \beta_{51}, \beta_{52}, \beta_{53}, \beta_{54}, \beta_{55}, \beta_{56}, \beta_{57}, \beta_{58}, \beta_{59}, \beta_{60}, \beta_{61}, \beta_{62}, \beta_{63}, \beta_{64}, \beta_{65}, \beta_{66}, \beta_{67}, \beta_{68}, \beta_{69}, \beta_{70}, \beta_{71}, \beta_{72}, \beta_{73}, \beta_{74}, \beta_{75}, \beta_{76}, \beta_{77}, \beta_{78}, \beta_{79}, \beta_{80}, \beta_{81}, \beta_{82}, \beta_{83}, \beta_{84}, \beta_{85}, \beta_{86}, \beta_{87}, \beta_{88}, \beta_{89}, \beta_{90}, \beta_{91}, \beta_{92}, \beta_{93}, \beta_{94}, \beta_{95}, \beta_{96}, \beta_{97}, \beta_{98}, \beta_{99}$ indicate the effects of different kinds of holidays to those KPIs.

RESULT ANALYSIS

In this chapter, the effectiveness of each large online promotion activity is analyzed in two aspects below, and there are some discussion and implication after the analysis.

The Effectiveness of Campaigns on Total Page Traffic

Model (3) is estimated for all five indicators of total page traffic and the results are showed in Table IV. β_0 is not present in the table for its static 0 value. The values of test statistics reflect that all situations have passed diagnostic tests.

PV and UV are the metrics directly representing the volume of traffic. The first two rows of Table IV show the estimation and test results when the endogenous variables are $\ln(\text{PV})$ and $\ln(\text{UV})$ respectively. The impact of the five activities on traffic volume is seen to be positive and statistically significant, while the effect size differs from one activity to another apparently: Activity 5 (“618”) performed best and Activity 2 (“Double 12”) performed worst at the aspect of attracting traffic, demonstrated by the coefficients of C_i .

Other factors also have some impacts on traffic volume that can be found in Table IV. For instance, PV and UV increase significantly on Thursday and Friday. As far as holiday effects are concerned, traffic mounts up obviously during Christmas and Valentine’s Day, the two well-known Western festivals in China. However, Chinese traditional festivals and other holidays selected have no strong, significant impact on these metrics.

The estimates of the variances of the stochastic components are constant 0, showing that the slope of trend component is constant over time, so the trend of the model follows a random walk plus drift process. The irregular component is the biggest source of variability.

Table IV. Estimation results for KPIs of total page traffic

	$\ln(\text{PV})$	$\ln(\text{UV})$	$\ln(\text{ToV})$	BR	OCR
	1.5076**	1.5660**	0.0327	0.4058***	-0.0450**
	(0.6078)	(0.6044)	(0.1654)	(0.0884)	(0.0189)
	1.0267*	1.0530*	0.2285	0.1055	-0.0166
	(0.5985)	(0.5952)	(0.1909)	(0.0870)	(0.0162)
	1.2404**	1.2286**	-0.1615	0.0230	0.0012
	(0.6069)	(0.6035)	(0.1661)	(0.0885)	(0.0189)
	1.4627**	1.1360*	0.2711*	-0.1813**	0.0105*
	(0.6066)	(0.6032)	(0.1617)	(0.0884)	(0.0164)
	2.2374***	2.1223***	-0.0194	-0.1819**	0.0337**
	(0.6253)	(0.6215)	(0.1655)	(0.0917)	(0.0170)
	0.2162	0.2426*	-0.0482	0.0313	0.0020
	(0.1404)	(0.1400)	(0.0743)	(0.0200)	(0.0037)
	0.2606	0.2925*	-0.0270	0.0222	0.0048
	(0.1723)	(0.1713)	(0.0747)	(0.0260)	(0.0048)
	0.3509*	0.3905**	-0.0042	0.0053	0.0047
	(0.1877)	(0.1864)	(0.0761)	(0.0286)	(0.0053)
	0.4820**	0.5284***	0.0076	0.0282	0.0027
	(0.1873)	(0.1860)	(0.0762)	(0.0286)	(0.0053)
	0.1207	0.1366	-0.1218*	0.1019***	0.0043
	(0.1724)	(0.1713)	(0.0750)	(0.0261)	(0.0049)
	0.0619	0.0816	0.0299	0.1049***	0.0001
	(0.1418)	(0.1415)	(0.0744)	(0.0208)	(0.0039)
	0.8820**	0.8658**	-0.3671**	-0.0514	-0.0038
	(0.4400)	(0.4386)	(0.1774)	(0.0620)	(0.0116)
	0.0738	0.0854	-0.0663	0.0151	0.0042
	(0.4271)	(0.4248)	(0.1383)	(0.0620)	(0.0115)
	0.3960	0.3435	-0.2780**	-0.0558	0.0066
	(0.3207)	(0.3196)	(0.1299)	(0.0455)	(0.0085)
	0.5658	0.5498	0.0074	0.0151	0.0005
	0.0853	0.0907	0.0863	0.0002	7.08E-6
Diagnostics					
r(1)	0.0528	0.0565	0.0549	-0.0388	0.0568
Q(15)	16.000	16.175	12.491	15.980	13.338
H(72)	1.0237	0.9904	1.4855	1.0104	0.6200
	0.4422	0.4370	0.7122	0.6755	0.6280

Notes: Numbers reported in parentheses are standard errors; *, ** and *** respectively denote significant at the 10%, 5% and 1% level; $r(1)$ is the first-order autocorrelation coefficient of the one-step-ahead prediction errors; $Q(15)$ is the Box-Ljung statistic distributed as chi-square(15); $H(72)$ is a test for heteroscedasticity, distributed as $F(72,72)$ based on a two-tailed test [10]; \hat{R}^2 is a modified coefficient of determination where the actual observations have been replaced by their first differences.

The estimates and test results are showed in the last three rows of Table IV when \hat{R}^2 are $\ln(\text{ToV})$, BR and OCR respectively. According to the results, evident differences can be identified among these three indicators representing the effect of large promotion activities on traffic quality: For BR and OCR, Activity 4(“Butterfly Festival”) and Activity 5(“618”) bring better quality traffic with lower BR and higher OCR, but the situation of Activity 1(“Double 11”) is opposite; For ToV, there is no significant effect by the indicator.

Considering the estimation results of all metrics, we evaluate all five activities as follows: Activity 4(“Butterfly Festival”) and Activity 5(“618”) are the best two online promotion activities on the effect of attracting traffic since the two activities significantly promote the volume and quality of total page traffic. Activity 1(“Double 11”) also attract considerable volume of traffic. However, the lack of retention and conversion has negative impact on traffic quality, making the effect of activity discount. Activity 2(“Double 12”) and Activity 3(“New Year’s Shopping Festival”) significantly increase traffic volume, but has no strong effect on traffic quality.

The Effectiveness of Campaigns on Unpaid Traffic

As revealed in Table III, plentiful paid traffic has been brought to the pages in the period of the campaigns by the means of online advertising. Meanwhile, the metrics’ daily average values of unpaid traffic are promoted. Some researches has focused on the relationship between paid and organic search traffic: Yang and Ghose [43] found positive interdependence between these two kinds of traffic after analyzing six months’ weekly data of a large retail store’s website; and Rutz et al. [39] analyzed daily traffic data during May to September 2006 from a commercial website in the field of automotive industry and realized that paid search traffic has significant effect on unpaid traffic.

In this section, model (3) is used to evaluate performance of the five campaigns affecting volume and quality of unpaid traffic. Table V shows estimation and test results of each coefficient in model (3) for the five KPIs. Trend component here also follows a random walk plus drift process owing to the constant slope over time. The model passes diagnostic test explicitly relying on the test result.

Table V. Estimation results for KPIs of unpaid traffic

	ln(PV)	ln(UV)	ln(ToV)	BR	OCR
	2.7860***	2.8812***	0.2007	0.3526***	-0.0222*
	(0.6716)	(0.6685)	(0.2987)	(0.0916)	(0.0125)
	0.8410	0.8609	0.0642	-0.0060	0.0106
	(0.6617)	(0.6587)	(0.3272)	(0.0903)	(0.0118)
	0.7606	0.8015	0.2079	-0.0746	0.0295**
	(0.6893)	(0.6686)	(0.3044)	(0.0919)	(0.0124)
	1.7393**	1.4892**	0.2819	-0.1442	0.0016
	(0.6697)	(0.6667)	(0.2957)	(0.0912)	(0.0118)
	2.0975***	2.1403***	0.6651**	-0.1501*	0.0008
	(0.6880)	(0.6850)	(0.2914)	(0.0933)	(0.0120)
	0.2267	0.2606	0.0177	0.0170	0.0028
	(0.1652)	(0.1648)	(0.1338)	(0.0246)	(0.0041)
	0.2025	0.2186	0.1569	0.0094	0.0036
	(0.1921)	(0.1924)	(0.1375)	(0.0274)	(0.0042)
	0.3319	0.3699*	0.0639	0.0189	0.0099**
	(0.2067)	(0.2070)	(0.1411)	(0.0290)	(0.0044)
	0.5260**	0.5447***	0.1468	0.0357	0.0010
	(0.2049)	(0.2052)	(0.1365)	(0.0293)	(0.0043)
	0.4588**	0.4527**	-0.1842	0.1156***	0.0037
	(0.1922)	(0.1926)	(0.1368)	(0.0275)	(0.0042)
	0.3571**	0.3533**	-0.0876	0.0869***	-0.0028
	(0.1649)	(0.1660)	(0.1354)	(0.0248)	(0.0041)
	1.4154***	1.2527**	0.2100	0.0248	-0.0041
	(0.5291)	(0.5402)	(0.3254)	(0.0748)	(0.0109)
	-0.0994	-0.1125	-0.2568	0.0704	-0.0040
	(0.4743)	(0.4721)	(0.2507)	(0.0655)	(0.0090)
	0.1371	0.1392	-0.1995	-0.0593	0.0031
	(0.3631)	(0.3612)	(0.3901)	(0.0517)	(0.0077)
	0.5728	0.5706	0.0229	0.0082	7.39E-5
	0.1915	0.1872	0.2903	0.0060	0.0002
Diagnostics					
r(1)	-0.0117	0.0006	0.0111	0.0110	-0.0320
Q(15)	8.8100	8.4678	16.172	17.167	17.169
H(72)	1.1780	1.1844	1.2316	1.2863	0.5852
	0.4808	0.5089	0.6939	0.5431	0.7311

Notes: Numbers reported in parentheses are standard errors; *, ** and *** respectively denote significant at the 10%, 5% and 1% level; r(1) is the first-order autocorrelation coefficient of the one-step-ahead prediction errors; Q(15) is the Box-Ljung statistic distributed as chi-square(15); H(72) is a test for heteroscedasticity, distributed as F(72,72) based on a two-tailed

test[10]; is a modified coefficient of determination where the actual observations have been replaced by their first differences.

It can be concluded that different campaigns have discrepant effects on unpaid traffic. For the two metrics reflecting traffic volume (PV and UV), "Double 11", "Butterfly Festival" and "618" have significant positive effect on unpaid traffic, but other two campaigns do not show the effect significantly. As for the three indicators reflecting quality of traffic (ToV, BR and OCR), data in Table V reveal that a majority of coefficient estimations don't arrive significance level. Only a few coefficients are significant, showing that "618" promoted unpaid traffic quality while "Double 11" did the opposite. Meanwhile, OCR increased in the period of "New Year's Shopping Festival". In addition, unpaid traffic had significant growth at weekends and Western holidays.

Discussion and Implications

Based on the analysis above, similar large promotion activities can be improved from the following four aspects when designing and carrying out them in the future:

First, the time duration of large promotion activities should be reasonably arranged. Blattberg and Neslin [4] found that most promotion activities are short-term and these campaigns stimulate consumers to buy some certain commodities and services in abundance with a relatively short time. Li et al. [29] studied on promotion activities of a large supermarket in China and found that the longer the price promotion time last, the worse the promotion effect will be. So far, the large online promotions mostly focus on some specific dates, such as "Double 11" (means November 11) and "618" (means June 18), yet e-commerce websites tend to begin these activities earlier before the dates in order to enhance population and influence. Analysis results in Table IV show that Activity 2 ("Double 12") and Activity 3 ("New Year's Shopping Festival") performed poor on the effect of traffic volume. This may be caused by its time duration last too short or too long. While Activity 1 ("Double 11"), Activity 4 ("butterfly festival") and Activity 5 ("618") whose time duration is about 15 days have achieved good performance, therefore, it can be concluded that the duration of a large online promotion activities within a certain time range can bring a better traffic effect.

Second, businesses should put more marketing resources on their own initiative large-scale promotion activities rather than spending much effort in the competition against opponents. "Double 11" and "Double 12" didn't work well: the overall quality of traffic decreases although the volume of the traffic increases significantly during "Double 11"; and "Double 12" activity of JD.com are ineffective for attracting traffic. Both of the campaigns are initiated by Alibaba, JD's most powerful competitor. The JD's initiative promotion activity "618", by contrast, brings better effect of traffic regardless of quantity and quality. "Butterfly Festival", another initiative campaign by JD, performs excellently on attracting traffic as well. What's more, the initiative promotion can make a close connection between campaigns and businesses, promoting influence and popularity of both.

Third, aiming at different categories of goods, businesses are able to design large promotion activities more specific. The commodities of "Butterfly Festival" mainly involve personal care and beauty. Although the popularity and influence of the campaign are not as great as "Double 11" and "618", the effect of attracting traffic for Crest is favorable, just behind "618". Chances are that the restricted categories of goods make consumers visit web pages more pertinent, and more likely conduct further operations.

Fourth, e-commerce websites should pay more attention to unpaid traffic brought by promotion activities, and send targeted messages to the consumers involved before the next promotion. The analysis result of 4.2 indicates that large online promotion activities do have effect on unpaid traffic. The reason may be that, on the one hand, consumers visit the pages autonomously during the promotion based on their past shopping experience, since some activities already have enough awareness and influence. On the other hand, businesses usually run marketing and broadcast campaigns taking advantage of various channels. These measures expand the coverage of activity information. Consumers probably obtain information and related links through these channels and then autonomously access activity pages. This part of the traffic shows strong purpose and autonomy to some extent, which means that they may have stronger purchase intention. Businesses should focus on this group of consumers [30].

In addition, we notice that Western festivals have significant positive effect on traffic volume, while other types of festivals present little effect. It indicates that Chinese online consumers may have greater willingness to go shopping at e-commerce websites in western festivals. Therefore, businesses should concentrate on western festivals, especially those popular in China, such as Christmas and Valentine's day, in the design of promotion activities related to festivals.

CONCLUSION

Our study found that large promotion activities: (1) have significant positive impact on total page traffic; (2) show the difference in the impact of total page traffic's quality, "618" has the best effect, while "Double 11" has the worst; (3) have positive effect on unpaid traffic, although "Double 12" and "New Year's Shopping Festival" are not significant; (4) nearly have no significant effect on the quality of non-paid traffic expect the negative effect of "Double 11" and the positive effect of "618".

However, the case study only involves single brand on JD.com. Further studies can research on different e-commerce sites, different types of goods or different brands within the same goods, and consider more direct indicators related to e-commerce websites, which will more directly reflect ROI of promotion activities.

ACKNOWLEDGEMENTS

This paper is supported by the National Natural Science Foundation of China (No 71373192) and the MOE Project of Key Research Institute of Humanities and Social Science in Chinese Universities (NO: 14JJD870002).

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System Dynamics Based Simulation Study On Storage and Distribution Integration of Electronic Commerce Enterprise

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ABSTRACT

With the strong advocacy of national policies and the rapid development of electronic commerce, offline logistics operation has become the key to efficient and fast e-commerce. This paper will use the system dynamic method to build an integrated warehousing and distribution system of e-commerce, applying the computer simulation to analyze the change of each parameter after the target inventory and delay time have changed. Suggestions will be put forward at last: building of an info-sharing mechanism, reducing the delay time via active coordination, predicting the target inventory of distribution center on time. Through these to reduce the average cost and the possibility of short supply at distribution center, and thus guarantee the delivery quality and speed, optimize buyers' shopping experience, form a virtuous circle and enhance the overall competence of the supply chain.

Keywords: e-commerce; integrated warehousing and distribution; system dynamics; simulation

INTRODUCTION

According to the latest data from iResearch, the 2015 annual China e-commerce trade reaches 16.4 trillion RMB, increasing 22.7% on the same period last year. This includes 3.8 trillion online shopping, which increases 36.2% on the same period last year, and becomes a pivotal part of e-commerce development.

And according to The 2016 (first half year) China E-commerce User Experience and Complaint Monitoring Report, published by China e-commerce study center, the numerous complaints received by China E-commerce Complaint and Mine-rights Public Service Platform and big data monitoring show: the national online shopping buyers' complaints relating to e-commerce sellers received by the platform in the first half of 2016 increases 4.16% on the same period last year. High fund occupation in E-commerce logistics, high cost workers, unreasonable packing, delayed supply, and poor service quality become obstacles on the way to well developed e-commerce. "Logistics distribution being able to achieve the end distribution of online trading commodities will complete the entire e-commerce activities" [1].

As iResearch reports, though C2C market share was surpassed by that of B2C in 2015, it is still large and complete, and has the potential to enlarge in the future.

As analyzed above, this paper studies the integration of storage and distribution of e-commerce business enterprises, and builds system dynamics model, with simulation of Vensim. This study will help e-commerce enterprises provide their agents and sellers with on-time and high quality distribution service, increase their sales, improve customer satisfaction, foster a good image of products and company, and promote a healthy development.

SYSTEM DYNAMICS OVERVIEW

System Dynamics[2], founded by Professor Jay W. Forrester at MIT in 1956, studies the complex information feedback system. Its methods are being employed in various fields like social studies, economics, enterprise management and ecology [3].

LITERATURE REVIEW

Forrester built the simulation model of supply chain involving factory, warehouse, distributor, and retailer with the application of system dynamics [4]. John D. Sterman used system dynamics to build a Delay-Inventory Management model [5]. XIANG Zhuo-yuan proposed a basic framework of building a system dynamic model from a three dimensional distribution to get the an effective scale of distribution center [6]. LU Jun-qiang built a system dynamics model combining distribution center and market inventory, and did simulation analysis from the aspects of allowing shortage or not, reaching the target of cost reduction and service quality promotion [7]. According to the theory of system dynamics, LI Xu built a model of market distribution center inventory [8]. Through simulation analysis, he put as inventory unit cost increases, inventory level should be pared down to optimize the annual revenue of supply chain. CHEN Wen-jia, together with other scholars, used system dynamics to build a distribution center for three-store-distribution, combining actual simulation, and gave suggestions on optimizing distribution center operations [9]. LIU Sheng-liang and others employed system dynamics for simulation analysis on retailing distribution and inventory, optimizing the retailing distribution logistics and inventory, enhancing the overall system competence as well [10]. ZHONG Shen took advantage of system dynamics and simulation model for catering business distribution and gave further suggestions [11]. Through modeling and simulating relief materials reserve strategies, MAN Jiang-hong gave advices on planning relief material reserve [12]. CHEN Jun applied system dynamics on distribution efficiency of military logistics bases [13]. YUD Bao-qin based system dynamics theory on online purchasing, constructed a measuring mechanism of online purchasing-distribution, and analyzed the cause-and-

effect of logistics quality [14]. LUO Jian-feng used system dynamics to construct a control model of distribution center inventory, and pointed significance of introducing system dynamics to logistic system analysis [15]. DONG Yuan-ming constructed a dynamic simulation model for FMCG(fast moving consumer goods) distribution center based on system dynamics, and simulated with the aid of Vensim, to quantifiably and perceptually present whether to newly construct a distribution center on the basis of current distribution center number [16].

With the boom of e-commerce in recent years, scholars are applying system dynamics in e-commerce warehouse and distribution. Literature 17-23 study and illustrate different aspects of e-commerce logistics and distribution based on system dynamics.

MODELING E-COMMERCE DISTRIBUTION CENTER STORAGE SYSTEM

As shown in the chart below, through signing authorized sales contract with e-commerce enterprises and paying certain amount of margin, agent sellers forward the confirmed order through system interface to self-built storage and distribution center of e-commerce enterprise. After receiving order info, storage and distribution center will begin the sorting and packaging at first time, and inform logistics enterprises to pick up and deliver on that day (orders from evening to early morning can be delayed to the next day), transferring the delivery info via platform to agent sellers, who then feedback to buyers (or feedback automatically).

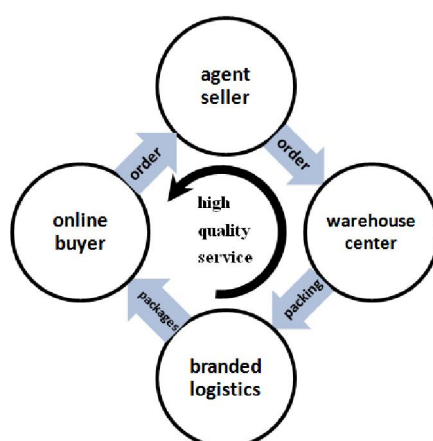


Chart 1: E-commerce Storage and Distribution system Dynamics Flow Chart

Order info flow: online buyer→agent seller→warehouse center→branded logistics

High quality service flow: buyer←branded logistics→warehouse center(big customer)→agent seller→buyer

Fund flow: online buyer→agent seller→terminal(quota)settlement→e-commerce enterprise(warehouse center)

Advantage analysis

Sellers can leave out warehouse related cost, which includes fields, workers, equipments, consumables, etc. In addition, warehouse and distribution center can sign a long-term cooperation agreement to become the big customer and enjoy preferential treatment, overcoming seller's difficulties concerning package, delivery. On-time delivery and uniform package helps promote product and e-commerce enterprise image, enhance, enhance buyers' experience, building a positive circle for agent sellers and enterprises. Agent sellers only need to pay off all the additional fees of packages and logistics at regular periods, or when reaching a certain amount of settlement.

System Boundary Analysis

To build the system dynamics model of distribution center is first to determine the system boundary. For the purpose of system modeling, this paper studies the system of warehouse and distribution center concerning: the target inventory, order rate, en route cargo quantity, time needed for cargo arrival, distribution rate, single order cost, daily holding cost of each product, total cost, daily average cost, and daily order quantity of each agent seller.

The system study boundary above does not take into account some minor or unquantifiable factors, like market economy form, price index, enterprise scale, maximum inventory of distribution center, sales promotion on holidays, or policies and regulations. In addition, assumed conditions by modeling are as follows:

(1) assuming suppliers can provide any number of cargos to distribution center.

- (2) assuming suppliers can provide cargos with 100% qualified rate, leaving out returned subsystem.
- (3) assuming logistics delayed when suppliers distribute cargos to distribute center.
- (4) assuming no delay occurred when cargos were distributed to agent sellers, and branded logistics have the capability to pick up all the packages in the same day.
- (5) assuming the management platform of distribution center can check the inventory in real time, making order warnings in time based on model needs.

System Dynamics Flow Analysis

System dynamic flow chart is the organic combination of basic variables and the symbol. System dynamics is introduced with factors such as level variables, rate variables, auxiliary variables, constants, and is constructed into a more thorough system chart—flow chart, a more complete, specifically describing the system composition, and the overview of interaction mechanism between system behavior and system elements, and can clearly show the quantitative relations[2] between various factors.

In this paper, we study the construction of an e-commerce system dynamics model of warehouse distribution center. As mentioned above, the modeling tool VENSIM is used to construct the system dynamic flow chart of e-commerce warehouse distribution center, as shown in chart 2.

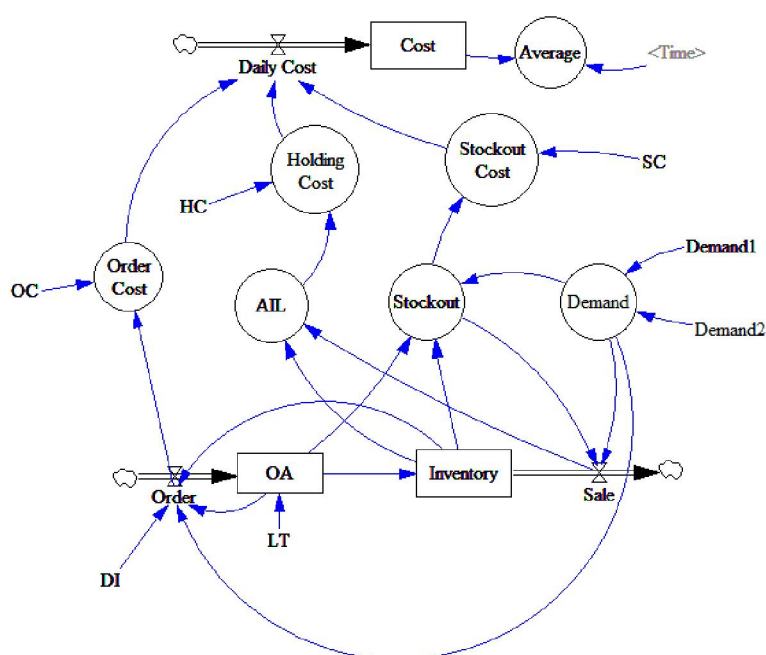


Chart 2: system dynamics of E-commerce distribution center flow chart

System Dynamics Formulae

After building the model, a formula system on system dynamics is needed to be set up to further determine the relation between variables. A few core formulae are as follows:

$$(1) \text{ OrderCost} = \text{OC} * \text{IF THEN ELSE}(\text{INTEGER}(\text{Order}/1000) \geq 1, 0, 1)$$

One supplier makes a statement that as long as the order is over 1000 pieces (at least enough for suppliers paying a car running a trip), the relevant expenses shall be the responsibility of the supplier.

$$(2) \text{ Demand1} = \text{INTEGER}(\text{RANDOM UNIFORM}(1, 1000, 388))$$

Since the sellers actual sales are influenced by many factors, sales generally have maximums and minimums, random numbers are used here for better representatives.

$$(3) \text{ OA} = \text{DELAY FIXED}(\text{Order}, \text{LT}, 0)$$

Due to the inevitable delay in the delivery from suppliers, delay function is thus is used.

Table 1: partial variable description

VARIABLE	VARIABLE DECLARATION	UNIT
OC	Cost per order	yuan
HC	The daily holding cost of each piece of goods	yuan / piece / day
SC	The daily shortage cost of each out of stock	yuan / piece / day
DI	The target inventory	piece
LT	The required number of days from order to arrival, delay time	day
Cost	Total cost	yuan
Average	Average daily cost	yuan / day
Stockout	Out of stock quantity	piece

SIMULATION AND SIMULATIONRESULT ANALYSIS

Before simulation, correctness of the model should be checked. Perform VENSIMCheck Model and function of UnitsCheck, Model checking before simulation. The simulation interval length $L = 1095$ days (3 years), step length $DT = 1$ day. The initial value takes target inventory value, cargos en route takes 0, single ordering less than 1000 pieces cost 3000 yuan.

Simulation Determines Target Inventory of Distribution Center

After considering various costs, the daily holding cost is 1 yuan / piece / day, 150 yuan/piece/ day when being out of stock . The goal is to determine the target inventory, under which minimizing the possibility and number of being out of stock. After many times simulation, target inventory is set for 2900 pieces , the average cost and the shortage of inventory under this target is shown in chart 3 and chart 4.

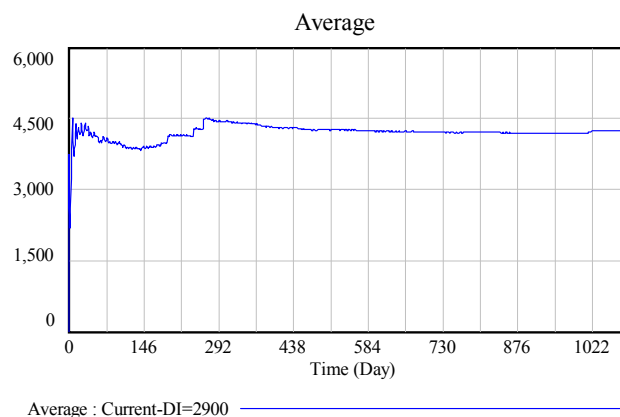


Chart3: average cost simulation result under $HC=1$ and $DI=2900$

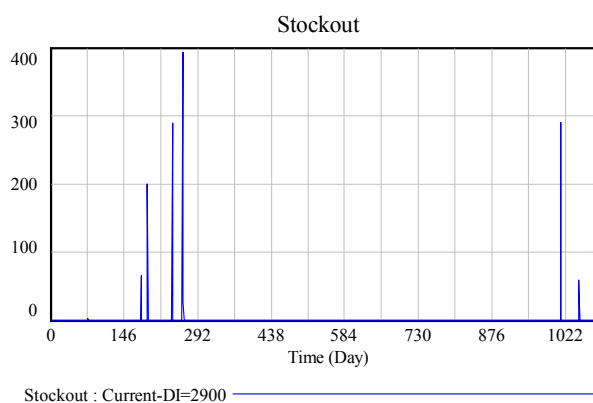


Chart 4: simulation result under $HC=1$ and $DI=2900$ in shortage

Considering the features of short duration and inconvenient storage of a warehouse distribution center, target inventory is determined under the inventory cost is 10 yuan/piece/day, determine the.

After many times simulation, target inventory is set for 2300 pieces , and the average cost and the shortage of this target inventory is shown in chart 5 and chart 6.

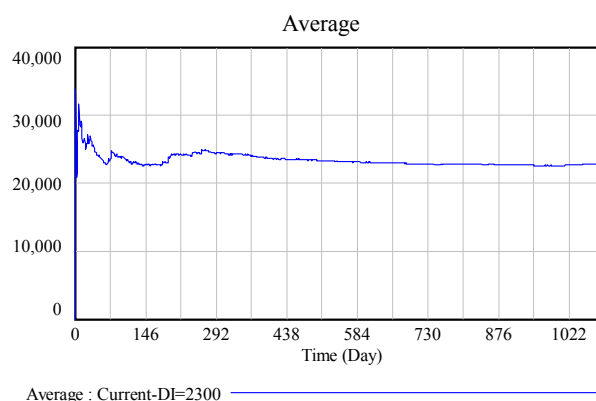


Chart 5: average cost simulation result under HC=10 and DI=2300

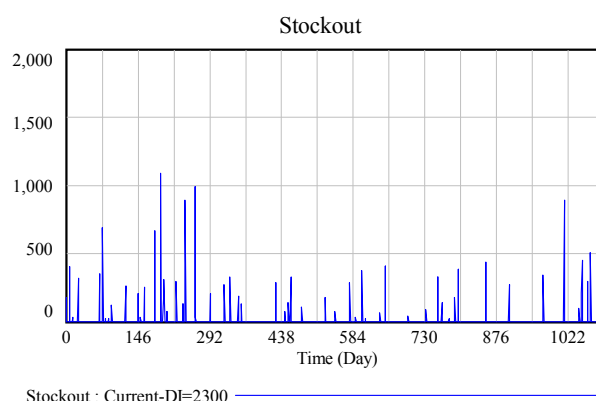


Chart 6: simulation result under HC=10 and DI=2300 in shortage

Analysis: from the simulation results above, daily inventory cost of each product affects the target inventory of warehouse distribution center. In fact, under the same condition, higher shortage cost will also affect the target inventory value. In the actual operation of warehouse distribution center and e-commerce enterprises, target inventory should be adjusted according to commodity kinds, low and peak seasons.

Effects of Simulation Supplier Delivery Delay on System

Only change the constant value of delay delivery from supplier to the warehouse distribution center, but keep the target inventory DI = 2900 conditions without change. With several simulations, the change of the average cost of warehouse distribution center is shown in chart 7, and shortage situation under different delay time are shown in chart 8, chart 9, chart 10 and chart 11.

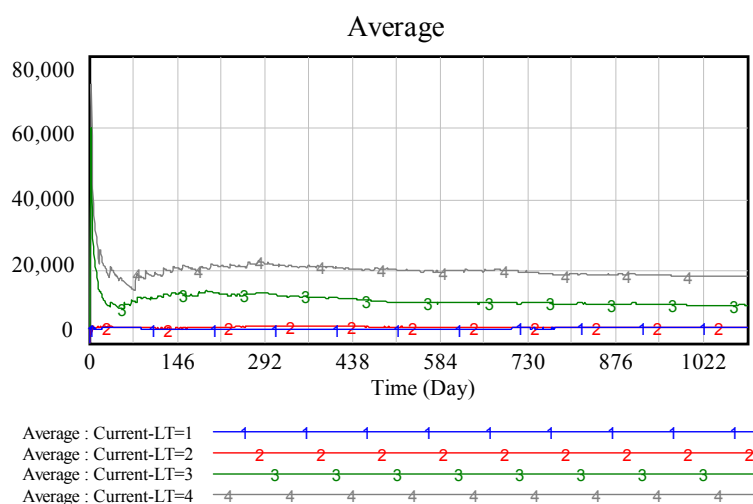


Chart 7: daily average cost simulation result under different delay time

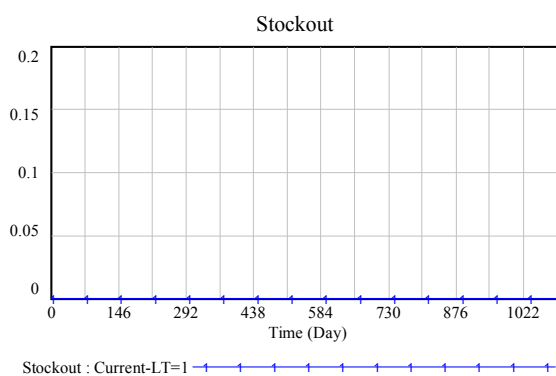


Chart 8: shortage when delay time LT=1

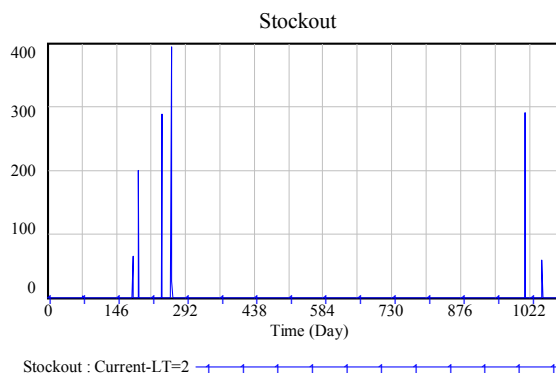


Chart 9: shortage when delay time LT=2

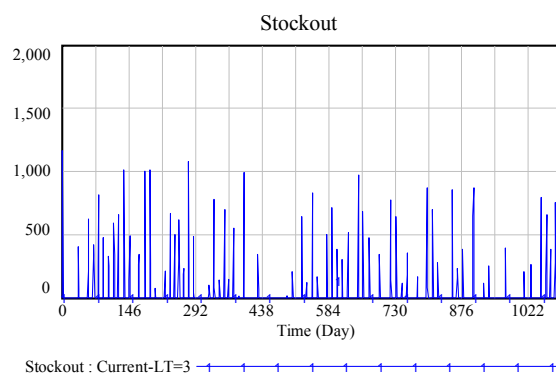


Chart 10: shortage when delay time LT=3

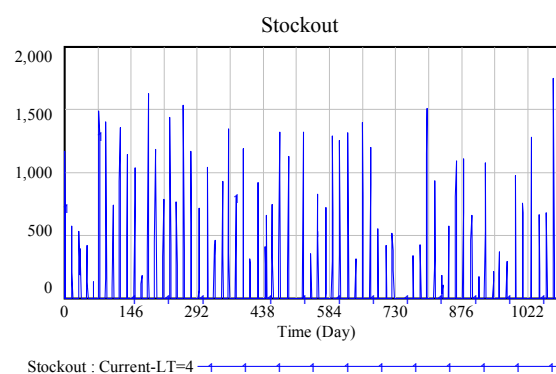


Chart 10: shortage when delay time LT=4

Analysis: chart 7 shows that delay time affects the average cost, in LT = 3 and LT = 4 cases, the average cost increases in times, bringing great pressure to e-commerce enterprises on cost. The chart 10 and chart 11 show that shortage is also frequent, bringing great cost pressure to e-commerce enterprises when shortage cost is high, at the same time bringing inconvenience to agentsellers who are cautious of delivery speed, and also bringing bad shopping experience to buyers.

Known from the analysis above, in actual production and operation, e-commerce enterprises should actively communicate with suppliers, try to shorten the delay time from the aspects of delivery time and transportation selection. Agent sellers, warehouse

distribution centers and suppliers should also use the information platform to set up the information communication mechanism, process orders on time, and work hard to shorten the delay time and achieving win-win cooperation.

CONCLUSION AND SUGGESTIONS

Based on the system dynamics, this paper studies the dynamic behavior of the e-commerce storage and distribution integration system quantitatively. With the analysis of the simulation results, suggestions on operation of distribution center are as follows:

- (1) Actively build a communication mechanism between sellers, warehouse distribution center, suppliers, achieving information sharing in a reasonable scope to reduce the average cost of warehouse distribution center and the occasion of warehouse distribution center being out of stock, optimize buyers' shopping experience, form a benign circle and improve the overall competence of the supply chain.
- (2) Active coordination. E-commerce enterprises should actively coordinate with suppliers, try to shorten the delay time from several aspects, reduce the cost, and reduce the occasion of being out of stock.
- (3) Reasonable and timely forecast. Warehouse distribution center should reasonably choose the forecast method of target inventory, timely adjust the target inventory, and improve the accuracy of demand forecast. Distribution center should reserve certain goods before receiving orders, and timely adjust inventory under exceptional situations to avoid being out of stock or backlog of goods. Due to the complexity of the warehouse distribution system, this paper only focuses on the change of the modeling parameters after different goods inventory and delay time have changed, leaving out the external social factors (such as price index) and the changing variables' effect of distribution center inventory adjusting time on the result of simulation, which would be furthered in next research.

ACKNOWLEDGEMENT

This paper was supported both by Fujian provincial education and scientific research project for young and middle-aged teachers (No.:JAT160602) and the scientific research project of Fuzhou College of Foreign Studies and Trade (No.:FWX15014).

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Research on Coordinating Cloud Service Supply Chain Considering Service Disruption

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ABSTRACT

The risk of the implementation of cloud service and the worry about the failure of projects or strategies caused by service disruption is an important reason of low adoption rates of the cloud service. Service disruption not only directly affects the cloud service free trial results, but also leads to compensation to the consumers. The coordination problem between a CFP (cloud function provider) and a CIP (cloud integration provider) in a cloud supply chain is investigated, in which service demand is determined by the application free trial. Coordination Contracts are discussed in two kinds of situations, linked respectively to the information symmetry and information asymmetry. The results show that the cost and risk-sharing coordination contracts we proposed can realize optimal supply chain performance, and Pareto improvement of supply chain members' profits. Reducing the service disruption probability and improving the level of service reliability are the key to the free trial. Besides, the compensation cost allocation enhances the scalability of cost allocation. Through numerical exploration analysis, effectiveness of the model is demonstrated and some managerial insights are obtained.

Keywords: Service Disruption, Cloud Service Supply Chain, Free Trial, Coordination.

INTRODUCTION

With the development of the theory and the technology of cloud computing, the cloud service mode shows the tendency of the enterprise strategic alliance. In 2014, HP and Cisco, as the world's top cloud service integration providers, announced that they would establish Helion and Intercloud cloud computing service supply chain networks respectively. Both of the networks covered cloud service function providers, such as cloud computing provider, telecom operators and data centers. Domestic Internet giant Alibaba also announced the launch of Ali Cloud Cooperation Plan in August 2014. He planned to recruit more than 10000 cloud service partners to build the cloud ecological system adapting to the processing technology in the DT era and provide one-stop cloud service for more customers.

As more enterprise strategic alliances established, the demand for cooperation among members of the supply chain grows accordingly. Recently IT service market design and coordination have been a theme of many studies. Dorsch (2014)^[5] pointed out that the coordination of this kind supply chain paid more attention to service, effort and ability coordinating. Scholars^{[2][3]} have proposed some collaborative method of normal service condition (Demirkan and Cheng, 2008 and 2010), such as revenue sharing contract, cost sharing contract, laying sufficient theoretical model for the research on cloud service supply chain coordination. Demirkan and Cheng studied an application services supply chain consisting of one application service provider (ASP) and one application infrastructure provider (AIP). They found that it is better to let the player closer to the market coordinate the supply chain. This research provided a good reference for the subsequent research about the relationship of new IT service model from the perspective of service supply chain. On this basis, Demirkan et al. (2010)^[3] introduced the queuing model constraints and studied the coordination strategies about time cost and service ability in SaaS service supply chain.

There exist lots of research addressing issues related to the ASP field. Lin (2009)^[10] analyzed the establishment and coordination of outsourcing relationship between ASP and customers. He discussed opportunism, interdependence, trust and relationship coordination, etc. Based on the intangibility and unverifiability of contributed resources resulting in double moral hazard, Dan et al.^[11] analyzed the effect of different membership in the supply chain on the risk sharing (Dan et al., 2010). In order to solve the problems involving ASP providers' capability construction and motivation, Ren and Zhang(2012)^[12] built a multi-task principal-agent model. Based on three kinds of capability constructing models, the incentive contracts for the ASP providers that provide critical business application service and execute the two tasks involving the system operation service and the business consultant service are analyzed. Li et al. (2011)^[7] studied the coordination problem between a network service provider (NSP) and an application service provider (ASP) from the perspective of application service supply chain based on the ASP model. In this paper, they proposed a method that introduced the risk sharing of ASP's over and under-capacity into the revenue sharing contract to coordinate the application service supply chain.

With the development of theory and technology of cloud computing, the service platform dominated by new carriers of value such as cloud computing, Internet of things and big data became one new business development model. At the same time, cloud service supply chain has gradually been a hot research on the emerging supply relationship (Jula et al., 2014^[6]; Dha, 2012^[4]; Song et al., 2010^[12]). The Software as a Service (SaaS), as the marketing front of cloud service delivery, got extensive concern of scholars and industry. In domestic research field, most coordination research on SaaS service supply chain focused on the coordination among SaaS function providers, SaaS service providers and SaaS service agents. For instance, the team leading by Yan analyzed incentive and risk control problems of SaaS service supply chain, which includes both the upstream enterprise

(namely SaaS function provider) and the downstream enterprise (namely SaaS service distributors) (Yan et al., 2012, 2014 and 2015^{[13][14][15]}). Li et al. (2013)^[8] investigated the coordination problem between an AIP and an ASP in a SaaS supply chain, in which the service demand is determined by the application free trial. Additionally, they discussed the opportunism in ability cooperation under asymmetrical information.

However, few scholars analyzed incentive, allocation and compensation problems of interruptible service. While one important reason leading to the low cloud adoption rate is customers' worry about implement risk and project failure causing by service disruption. Most studies don't explicitly take into account the effect of service disruption and failure on the supply chain coordination, and don't pay attention to the change of the risk and benefits in ASP or SaaS model of the cloud platform. The important role of behavior efforts for supply chain coordination under the features of super-large scale and non-inventory of the cloud service have also been ignored.

Our model is similar in vein to the one studied in Liang and Ye (2015)^[9]. However, Liang's model does not explicitly consider the effects of exogenous risk of service failure. Instead, Liang first specifies coordination of cloud service supply chain based on the cost distributions of efforts cost and compensation costs. We depart from the Liang's model by explicitly taking into account the service interruption causing the low adoption rate of cloud service and by allowing the demand determined by the application free trial. The major contributions of this paper include that service disruption affect free trial result, which in turn affect the market demand. When facing with asymmetrical information problems, we discuss the opportunism behavior in cooperation and coordination. Further managerial insights are also derived from extensive numerical exploration where the results indicate that the decentralized "cost and risk sharing" mechanism achieves the same supply chain performance as a centralized system. Several insights not reported in prior literature are discussed in Section 5.

The paper is organized as follows. In Section 2, we present the problem description and model assumption. In Section 3 and 4, we model decision-makers and their behavior and the coordination contracts among decision makers under symmetrical and asymmetrical information respectively. In Section 5, we conduct numerical simulation and analysis. In the concluding Section 6, we summarize our results and suggest directions for future research.

PROBLEM DESCRIPTION AND MODEL ASSUMPTION

Before using cloud computing, a lot of customers have some doubts, especially worry about the stability, security of cloud service. So most of them choose to try before they buy. And most CIP (Cloud Integration Provider) are also glad to provide free trial for customers, such as Amazon, he announced to provide one-year free cloud service for AWS new users in 2011. This event promotes the standard of "free" business model, thus customers can try the suppliers' service first and then decide to buy or not. CCW Research points that "try before they buy" is a big advantage of SaaS to the traditional software. In this model, customers could enjoy free trial before formal purchase for a period of time, thereby reducing the risk and cost of supplier's selection process. Therefore, in this paper, we consider the actual market demand is to rely on the free trial implementation, which is different from the product supply chain assuming the demand is dependent on price or random. As the core enterprise on the supply chain, on one hand, CIP needs to incent CFP's (Cloud Function Provider's) joint by cooperation, win-win and information environment construction to build internal cooperation platform and business model. On the other hand, CIP needs to provide compensation to improve customers' satisfaction, encourage more demand to become partners and expand the market share.

With the development of the theory and the technology of cloud computing, the cloud service mode shows the tendency of the enterprise strategic alliance. In 2014, HP and Cisco, as the world's top cloud service integration providers, announced that they would establish Helion and Intercloud cloud computing service supply chain networks respectively. Both of the networks covered cloud service function providers, such as cloud computing provider, telecom operators and data centers. Domestic Internet giant Alibaba also announced the launch of Ali Cloud Cooperation Plan in August 2014. He planned to recruit more than 10000 cloud service partners to build the cloud ecological system adapting to the processing technology in the DT era and provide one-stop cloud service for more customers. We develop a stylized model to study the cloud service supply chain. Fig. 1 shows the cloud service supply chain model.

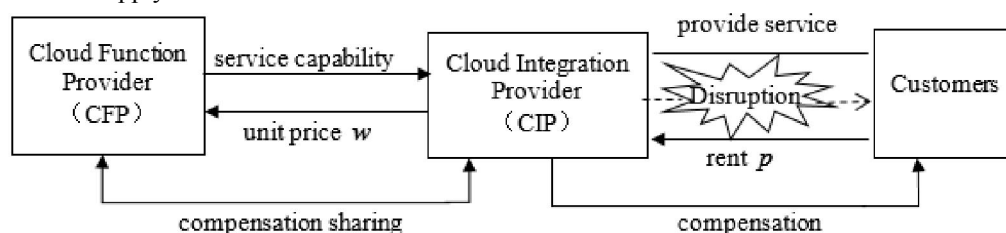


Figure 1: The cloud service supply chain model

In order to make the study more representative and easily quantify the decision process of CFP and CIP, we make the following assumptions.

Assumption 1. There is only one CFP, one CIP and many potential customers in the market. The CFP provides service capability for the CIP, on this basis, the CIP provides value-added service for customers (The specific supply chain model is shown in Fig. 1). Potential customers decide whether to rent the cloud service after free trial. The actual market demand depends on the effect of free trial, which is also the bright spot of this article.

Assumption 2. The adoption probability of cloud service of potential customers is $\varphi=1-r^\delta$ ($0 \leq r \leq 1$). Here we mainly consider two factors affecting customer adoption intention. One is the interruption risk probability, which is unchangeable and uncontrollable by the CIP in a short term due to various factors of the nature (such as extreme weather), human factors and cost budget. The other one is the effort level during free trial period, which is quantitative investment and the decision variable of the CIP.

Figure 2 shows the relationship between the cloud service adoption rate and the CIP's effort level. As is shown in Fig.2, along with the increase of the CIP's effort level, the adoption rate of cloud service rises while marginal effects of the effort decreases. For the same effort level, the smaller the service disruption probability is, the higher the adoption rate is. service disruption. Otherwise, the lower the adoption rate is and the easier the CIP loses customers.

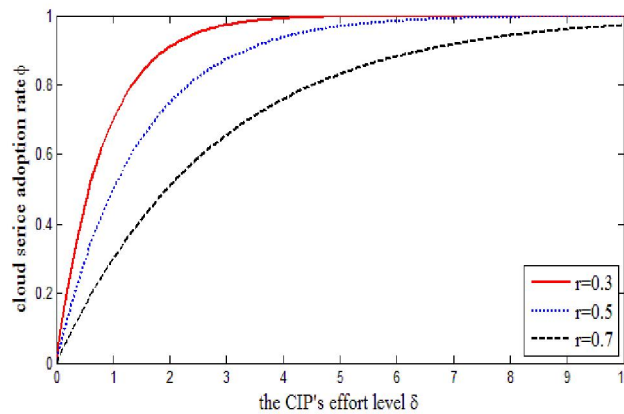


Figure 2: The relationship between the CIP's effort level and cloud service adoption rate

Assumption 3. In one contract period, the cost of unit service ability of the CFP is c , and the according price is w . After the free trial, if the potential customers adopt the service, then they will sign a service contract with the CIP and the service fee will be p .

During the free trial period of cooperation of the CFP and the CIP, the cost of the CFP is $c_0 N$, where c_0 is the unit service ability of the CFP, N is the number of all customers. The effort cost of the CIP is $c(\delta) = b\delta$ (referred Li's research, 2013^[8]), where b is cost factor. It is worth noting that we assume the effort cost of the CIP is the linear function instead of quadratic function. Adoption rate has already been set nonlinear and reflects marginal utility diminishing. So linear function could depict the effect of marginal effort diminishing in reality.

Assumption 4. The expected number of customers in contract period is $N(1-r^\delta)$. Because of the uncertainty of the market, the number of customer is uniformly distributed over $[\mu-a, \mu+a]$, where $\mu=N(1-r^\delta)$. We use $f(x)$ to denote the probability density function and $F(x)$ to denote the cumulative distribution function.

Assumption 5. Faced with customer dissatisfaction with service interruption, the CIP attract customers through the compensation strategy in order to improve the customer satisfaction and increase market share. The amount of compensation is $r(\Delta-\delta)$, which is related to the risk probability r and insufficient efforts $(\Delta-\delta)$. Here we use Δ to denote the maximum of the effort level, however it is difficult to achieve this maximum value because the CIP can't pay all effort to meet customer requirements for the sake of cost control and idle resources. The unit compensation price is β times of the market price p , where β is compensation coefficient. When $\beta=1$, the unit compensation price is $\beta p = 1 \cdot p = p$, that is free. This compensation strategy is based on market price, which is common in reality and measured easily and conveniently. The variables used throughout this model are summarized in Table 1.

Table 1: Variables used throughout the model

Notation	Definition
N	the number of potential customers
p	price of cloud service
w	price of per unit of capacity paid by CFP to CIP
r	service disruption probability
δ	the effort level of CIP
φ	Customer adoption rate after the trial, and $\varphi=1-r^\delta$
c_0	Service cost coefficient of CFP
$c(\delta)$	the effort cost of CIP, and $c(\delta)=b\delta$, where b is cost coefficient, $b > 0$
Δ	the maximum of effort level
β	compensation multiple relative to the p
α, α'	Allocation proportion of effort cost and compensation cost, allocation proportion of effort cost
γ	risk sharing proportion
$\Pi_{CFP}^s, \Pi_{CFP,\alpha}^s$	the expected return of CFP in symmetrical information situation, the expected return of CFP under the cost sharing contract in symmetrical information situation
$\Pi_{CIP}^s, \Pi_{CIP,\alpha}^s$	the expected return of CIP in symmetrical information situation, the expected return of CIP under the cost sharing contract in symmetrical information situation
$\Pi_{CFP}^a, \Pi_{CFP,\alpha,\gamma}^a$	the expected return of CFP in asymmetrical information situation, the expected return of CFP under the cost and risk sharing contract in asymmetrical information situation
$\Pi_{CIP}^a, \Pi_{CIP,\alpha,\gamma}^a$	the expected return of CIP in information asymmetry situation, the expected return of CIP under the cost and risk sharing contract in asymmetrical information situation
Π_{SC}^s, Π_{SC}^a	the expected return of cloud service supply chain in symmetrical information situation and asymmetrical information situation respectively

CLOUD SERVICE SUPPLY CHAIN COORDINATION UNDER SYMMETRICAL INFORMATION

In asymmetrical information situation, the service reliability of CIP (service disruption probability, denoted by r) is the knowledge shared by both sides of the cooperation, that is to say, the CFP knows the service disruption probability of the CIP. In this case, the actual needs of customers are influenced by service disruption probability and the CIP's effort level. For the CIP, the major costs include effort cost and compensation cost. For the CFP, there is only the service capacity cost to be considered. The expected revenue function of CFP, CIP and the whole cloud service supply chain are

$$\Pi_{CFP}^s = (w - c)N(1 - r^\delta) - c_0N \quad (1)$$

$$\Pi_{CIP}^s = (p - w)N(1 - r^\delta) - b\delta - r(\Delta - \delta)\beta p \quad (2)$$

$$\Pi_{SC}^s = (p - c)N(1 - r^\delta) - c_0N - b\delta - r(\Delta - \delta)\beta p \quad (3)$$

Centralized Decision-making

In the centralized supply chain, the CFP and the CIP form a joint venture to achieve the goal of optimizing the supply chain as a whole. The whole supply chain's expected profit is the sum of the expected profit functions of the CFP and the CIP described in Eq. (3). The first order and the second order of Eq. (3) leads to

$$\frac{\partial \Pi_{SC}^s}{\partial \delta} = -(p - c)Nr^\delta \ln r - b + r\beta p \quad (4)$$

$$\frac{\partial^2 \Pi_{sc}^s}{\partial \delta^2} = -(p-c)Nr^\delta (\ln r)^2 < 0 \quad (5)$$

Because the second order of Eq. (3) is less than zero, the objective function in Eq. (3) is strictly concave, thereby ensuring the existence of a unique optimal solution. To find the optimal effort level, first order conditions require $\frac{\partial \Pi_{sc}^s}{\partial \delta} = 0$. After some algebra, first order conditions lead to

$$\delta_{sc}^{s*} = \log_r \frac{b-r\beta p}{(c-p)N \ln r} \quad (6)$$

In order to make the results conform to reality, $b > r\beta p$ need to meet. This constraint shows that the effort cost coefficient is greater than the compensation cost coefficient.

In centralized decision-making, the whole supply chain's expected profit is

$$\Pi_{sc}^s = (p-c)N(1-r^{\delta_{sc}^{s*}}) - c_0N - b\delta_{sc}^{s*} - r(\Delta - \delta_{sc}^{s*})\beta p \quad (7)$$

Decentralized Decision-making

In reality, the CFP and the CIP are independent of the benefit. Most of time, they will just consider their own interests, regardless of the other party and the whole supply chain. In this scenario, the CIP make the independent decision to maximize his own profit in a dominant position. The first order and the second order of Eq. (2) leads to

$$\frac{\partial \Pi_{CIP}^s}{\partial \delta} = -(p-w)Nr^\delta \ln r - b + r\beta p \quad (8)$$

$$\frac{\partial^2 \Pi_{CIP}^s}{\partial \delta^2} = -(p-w)Nr^\delta (\ln r)^2 < 0 \quad (9)$$

Because the second order of Eq. (2) is less than zero, the objective function in Eq. (2) is strictly concave, thereby ensuring the existence of a unique optimal solution. To find the optimal supply chain profit, first order conditions require $\frac{\partial \Pi_{CIP}^s}{\partial \delta} = 0$. After some algebra, first order conditions lead to

$$\delta_{CIP}^{s*} = \log_r \frac{b-r\beta p}{(w-p)N \ln r} \quad (10)$$

In order to make the results conform to reality, $b > r\beta p$ need to meet. This constraint shows that the effort cost coefficient is greater than the compensation cost coefficient.

In decentralized decision-making, the whole supply chain's expected profit is

$$\Pi_{sc}^{s'} = (p-c)N(1-r^{\delta_{CIP}^{s*}}) - c_0N - b\delta_{CIP}^{s*} - r(\Delta - \delta_{CIP}^{s*})\beta p \quad (11)$$

Proposition 1. In decentralized supply chain, the optimal effort level of the CIP's independent decision making is lower than that in centralized decision-making, that is to say, $\delta_{CIP}^{s*} < \delta_{sc}^{s*}$, and $\Pi_{sc}^{s'} < \Pi_{sc}^s$, the cloud service supply chain cannot achieve coordination.

Proof. See the Appendix.

Proposition 1 implies that there is double marginalized effect under the decentralized decision, which is similar to products supply chain. Because the CIP make more effort in integration supply chain, centralized decision increases the profits of the whole supply chain. However, it's shown that the CIP does not make enough effort to maximized the supply chain's total profit because the CIP ignores the impact of his action on the CFP's profit. Hence, coordination requires that the CIP be given an incentive to increase his effort.

Cost Sharing Coordination Mechanism

The above analysis shows that under the certain service disruption probability, when the CIP increases his effort level, the number of customers winning through the free trial grows. Because the CIP bears all effort and compensation costs, conversely, the CFP only benefit without sharing any cost, which causing the distortion of the CIP's independent decision. As an effective coordination approach of supply chain, contracts have been widely used. This study intends to adopt cost sharing contract, in which the effort costs and compensation costs are shared by both the CFP and the CIP. Assume the cost ratio hold by CIP is α , while the cost ratio hold by CFP is $1 - \alpha$. The expected revenue function of CFP, CIP are

$$\Pi_{CFP,\alpha}^s = (w - c)N(1 - r^\delta) - c_0N - (1 - \alpha)[b\delta + r(\Delta - \delta)\beta p] \quad (12)$$

$$\Pi_{CIP,\alpha}^s = (p - w)N(1 - r^\delta) - \alpha[b\delta + r(\Delta - \delta)\beta p] \quad (13)$$

Because the second order of Eq. (13) is less than zero, the objective function in Eq. (13) is strictly concave, thereby ensuring the existence of a unique optimal solution. To find the optimal effort level, first order conditions require $\frac{\partial \Pi_{CIP,\alpha}^s}{\partial \delta} = 0$. After some algebra, first order conditions lead to

$$\delta_{CIP,\alpha}^{s*} = \log_r \frac{\alpha(b - r\beta p)}{(w - p)N \ln r} \quad (14)$$

To achieve coordination, $\delta_{CIP,\alpha}^{s*} = \delta_{SC}^{s*}$ only when

$$\alpha = \frac{p - w}{p - c} \quad (15)$$

Proposition 2. To enable cloud service supply chain to achieve the coordination, the cost sharing ratio is $\alpha : (1 - \alpha) = (p - w) : (w - c)$. The proportion of cost-sharing is equal to the proportion allocating the marginal profit of supply chain, which reflecting consistency of costs and benefits in supply chain coordination.

Proof. $\frac{\alpha}{1 - \alpha} = \frac{p - w}{p - c} \cdot \frac{p - c}{w - c} = \frac{p - w}{w - c}$

Proposition 2 implies that when the unit service capacity price is fixed and the cloud service supply chain achieves coordination, the CFP and the CIP's allocation proportions are unique and fixed. If the unit service capacity price is variable, we can get proposition 3.

Proposition 3. Under the cost sharing contract, if w is variable and meets the condition $w^* = \alpha c + (1 - \alpha)p$, cost sharing contract can achieve supply chain coordination, and at this time the effect of free trial is optimal. In addition, the relationship between the profits (including the CFP's and the CIP's) and α are linear respectively. We can change the ratio of sharing the maximum profit of the supply chain by adjusting α .

Proof. See the Appendix.

Proposition 3 illustrates that in cost sharing contract, if w is variable, the scope of the contract will be expanded. When the cloud service supply chain reaches coordination, they can freely choose cost-sharing ratio and share maximum profits of the supply chain in any proportion.

Lemma 1. If only sharing the effort cost, not sharing compensation cost in the coordination of the supply chain, the coordination parameter is $\alpha' = \frac{p-w}{p-c} + \frac{(w-c)r\beta p}{(p-c)b}$, and the allocation of compensation enhances the intuitiveness and scalability of the cost allocation.

Proof. See the Appendix.

Easy to know $\alpha' > \alpha$ from Lemma1. It implies that if not sharing the compensation cost, more effort cost needs to be shared to achieve the supply chain coordination. However, the effort cost is difficult to measure compared to the compensation cost, which is based on the price with better scalability and intuitiveness. So the implementation of the policy of compensation cost sharing increases visualization and impartiality of the sharing mechanism, and more easily accepted by supply chain members.

CLOUD SERVICE SUPPLY CHAIN COORDINATION UNDER ASYMMETRICAL INFORMATION

In the case of asymmetrical information, the service reliability capacity (service disruption probability) is a private information of the CIP. Because the CFP cannot detect the service reliability ability of the CIP, the CIP with poor service reliability (higher risk of service) also hopes to cooperate with the CFP under the opportunism motivation. If the CFP cooperate with the CIP with low reliability, the free trial may not be able to attract sufficient numbers of potential customers, and even cannot offset costs during the free trial period, which is a cooperation of relatively high risk.

In order to avoid the risk of opportunism, the CFP needs to take corresponding measures to distinguish the service reliability ability of the CIP through some information before cooperation. The above analysis shows that the higher the service reliability of the CIP (the lower the service disruption probability), the higher the customer adoption rate, and the more ultimate customers through free trial, which leading to more service ability. Thus, the amount of the required service ability is a kind of signal which reflects the service level and the size of the effort of the CIP. Therefore, this paper proposes a service capacity reservation strategy, that is to say the CFP could reveal hidden service reliability information by the amount of reservation service ability during the cooperation period before free trial. Through this order quantity, the CFP can judge the service reliability of the CIP and weigh his own input costs to determine whether to achieve his expected return and whether to cooperate with the CIP.

Game process is as follows, first, the CIP orders service ability during contract from the CFP according to his own circumstance. Secondly, the CFP determines his profitability and decides whether to cooperate with the CIP to provide free trial according to the order quantity. If they cooperate, the CIP will win clients by effort and realize the market demand, If they do not cooperate, the market demand faced by the CIP is random distribution on the interval $[0, N]$, the order of the service ability of the CIP is similar to a typical newsboy model.

Under the capacity reservation strategy, the expected revenue function of the CFP is

$$\Pi_{CFP}^a = (w - c)q - c_0N \quad (16)$$

For the CIP, the capacity reservation strategy requires to order before the contract. Therefore, he will face the excessive or deficient order risk. We use $M(q, \delta)$ to denote the expected number of customers when the CIP's order quantity is q and effort level during free trail is δ . Then

$$\begin{aligned} M(q, \delta) &= E[\min(q, x)] = \int_{N(1-r^\delta)-a}^{N(1-r^\delta)+a} \min(q, x) f(x) dx \\ &= \int_{N(1-r^\delta)-a}^q x f(x) dx + \int_q^{N(1-r^\delta)+a} q f(x) dx \\ &= \frac{q^2 - [N(1-r^\delta) - a]^2 + 2q[N(1-r^\delta) + a - q]}{4a} \end{aligned} \quad (17)$$

The CIP's expected revenue function is

$$\Pi_{CIP}^a = (p - w)M(q, \delta) - b\delta - r(\Delta - \delta)\beta p - (w - g)[q - M(q, \delta)] - k[\mu - M(q, \delta)] \quad (18)$$

Where g is unit residual value of excess capacity, and k is unit opportunity cost lost by insufficient service ability.

The expected revenue function of the whole cloud service supply chain is

$$\begin{aligned} \Pi_{SC}^a &= \Pi_{CFP}^a + \Pi_{CIP}^a \\ &= (w - c)q - c_0N + (p - w)M(q, \delta) - b\delta - r(\Delta - \delta)\beta p \\ &\quad - (w - g)[q - M(q, \delta)] - k[\mu - M(q, \delta)] \\ &= (p - c)M(q, \delta) - (c - g)[q - M(q, \delta)] - k[\mu - M(q, \delta)] - c_0N - b\delta - r(\Delta - \delta)\beta p \end{aligned} \quad (19)$$

Centralized Decision-making

There are little literatures proposed the approach responding to cloud service security risk under the insurance perspective, the cloud insurance in this paper covers the business interruption caused by sudden accidents of cloud service, and it's similar to the traditional business interruption insurance.

Similar to the analysis under symmetrical information, we discuss centralized supply chain system, in which the CFP and the CIP is a community of interests. However, under asymmetrical information, the CIP do not only decide effort level δ , but also decide order quantity q of service ability. To find the optimal decision of the whole supply chain system, first order conditions

require $\frac{\partial \Pi_{SC}^a}{\partial \delta} = 0$ and $\frac{\partial \Pi_{SC}^a}{\partial q} = 0$. After some algebra, first order conditions lead to

$$\delta_{SC}^{a*} = \log_r \frac{b - r\beta p}{(c - p)N \ln r} \quad (20)$$

$$q_{SC}^{a*} = N - \frac{b - r\beta p}{(c - p) \ln r} + \frac{a(p + g + k - 2c)}{p - g + k} \quad (21)$$

And

$$\frac{\partial^2 \Pi_{SC}^a}{\partial \delta^2} = Nr^\delta (\ln r)^2 \left[c - p - \frac{(p - g + k)Nr^\delta}{2a} \right] < 0 \quad (22)$$

$$\frac{\partial^2 \Pi_{SC}^a}{\partial q^2} = -\frac{p - g + k}{2a} < 0 \quad (23)$$

$$\frac{\partial^2 \Pi_{SC}^a}{\partial \delta \partial q} = \frac{\partial^2 \Pi_{SC}^a}{\partial q \partial \delta} = -\frac{(p - g + k)Nr^\delta \ln r}{2a} \quad (24)$$

So Hessian Matrix is:

$$H = \frac{\partial^2 \Pi_{SC}^a}{\partial \delta^2} \frac{\partial^2 \Pi_{SC}^a}{\partial q^2} - \frac{\partial^2 \Pi_{SC}^a}{\partial \delta \partial q} \frac{\partial^2 \Pi_{SC}^a}{\partial q \partial \delta} = \frac{(Nr^\delta \ln r)^2 (p - c)(p - g + k)}{2a} > 0 \quad (25)$$

So the expected profit function of supply chain system is joint concave, that is to say the solution above is the only combination

to get the maximum profit of the supply chain.

Decentralized Decision-making

In reality, the CFP and the CIP are separate interests in cloud service supply chain. They often only consider their own interests and make independent decision regardless of the other party. In this case, the CIP in the dominant position make independent decision according to his own profit maximization principle, so to get the optimal effort level and service capacity of the CIP, first order conditions require

$$\begin{aligned}\frac{\partial \Pi_{CIP}^a}{\partial \delta} &= (p - w + w - g + k) \frac{\partial M(q, \delta)}{\partial \delta} - k \frac{\partial \mu}{\partial e} - b + r\beta p \\ &= (p - g + k) \frac{Nr^\delta \ln r [N(1 - r^\delta) - a - q]}{2a} + kNr^\delta \ln r - b + r\beta p = 0\end{aligned}\quad (26)$$

$$\begin{aligned}\frac{\partial \Pi_{CIP}^a}{\partial q} &= (p - w + w - g + k) \frac{\partial M(q, \delta)}{\partial q} - (w - g) \\ &= (p - g + k) \frac{N(1 - r^\delta) + a - q}{2a} - w + g = 0\end{aligned}\quad (27)$$

After some algebra, first order conditions lead to

$$\delta_{CIP}^{a*} = \log_r \frac{b - r\beta p}{(w - p)N \ln r} \quad (28)$$

$$q_{CIP}^{a*} = N - \frac{b - r\beta p}{(w - p) \ln r} + \frac{a(p + g + k - 2w)}{p - g + k} \quad (29)$$

Contrast Eq.(20) and Eq.(21) with Eq. (28) and Eq. (29), we assert Proposition 4.

Proposition 4. In decentralized supply chain, $\delta_{CIP}^{a*} < \delta_{SC}^{a*}$ and $q_{CIP}^{a*} < q_{SC}^{a*}$, that is to say, both the optimal effort level and the optimal service ability ordering quantity of the CIP in independent decision are lower than those in cloud service supply chain system. Thus the cloud service supply chain cannot be coordinated.

Proof. See the Appendix.

Cost and Risk Sharing Coordination Mechanism

In the case of symmetrical information, the cost sharing contract is testified to be a proper solution. If we still use the cost sharing contract under asymmetrical information, set the contract parameter equal to α . Then the cost ratio borne by the CIP is α , and the cost ratio borne by the CFP is $1 - \alpha$. The expected revenue function of CFP, CIP and the whole cloud service supply chain are

$$\Pi_{CFP, \alpha}^a = (w - c)q - c_0N - (1 - \alpha)[b\delta + r(\Delta - \delta)\beta p] \quad (30)$$

$$\Pi_{CIP, \alpha}^a = (p - w)M(q, \delta) - \alpha[b\delta + r(\Delta - \delta)\beta p] - \{(w - g)[q - M(q, \delta)] + k[\mu - M(q, \delta)]\} \quad (31)$$

$$\begin{aligned}\Pi_{SC, \alpha}^a &= \Pi_{CFP, \alpha}^a + \Pi_{CIP, \alpha}^a \\ &= (p - c)M(q, \delta) - (c - g)[q - M(q, \delta)] - k[\mu - M(q, \delta)] - c_0N - b\delta - r(\Delta - \delta)\beta p\end{aligned}\quad (32)$$

Under the cost sharing contract, to get the optimal decision of the CIP, first order conditions require

$$\frac{\partial \Pi_{CIP, \alpha}^a}{\partial \delta} = (p - g + k) \frac{Nr^\delta \ln r [N(1 - r^\delta) - a - q]}{2a} + kNr^\delta \ln r - \alpha(b - r\beta p) = 0 \quad (33)$$

$$\frac{\partial \Pi_{CIP, \alpha}^a}{\partial q} = (p - g + k) \frac{N(1 - r^\delta) + a - q}{2a} - (w - g) = 0 \quad (34)$$

After some algebra, first order conditions lead to

$$\delta_{CIP, \alpha}^{a*} = \log_r \frac{\alpha(b - r\beta p)}{(w - p)N \ln r} \quad (35)$$

$$q_{CIP, \alpha}^{a*} = N - \frac{\alpha(b - r\beta p)}{(w - p) \ln r} + \frac{a(p + g + k - 2w)}{p - g + k} \quad (36)$$

The results should be equal to the optimal results under centralized decision-making, which requires $\delta_{CIP, \alpha}^{a*} = \delta_{SC}^{a*}$ and $q_{CIP, \alpha}^{a*} = q_{SC}^{a*}$. But because of $c < w$, we can't get $q_{CIP, \alpha}^{a*} = q_{SC}^{a*}$, so the cost sharing contract cannot achieve cloud service supply chain coordination under asymmetrical information.

The past researches show that when the risk is borne by one party alone in the supply chain, the double marginalized effect will lead to low performance of the whole supply chain. Studies of Dan (2010) and Lin (2010) have shown that risk-sharing can solve this problem and achieve supply chain coordination. So we intend to adopt the combination of cost and risk sharing contract in this paper. Contract parameters are $\{\alpha, \gamma\}$, where the CIP's cost ratio and risk ratio are α and γ respectively, and the CFP's cost ratio and risk ratio are $1 - \alpha$ and $1 - \gamma$ respectively. Under the cost and risk sharing contract, the expected revenue function of CFP, CIP and the whole cloud service supply chain are

$$\begin{aligned} \Pi_{CFP, \alpha, \gamma}^a &= (w - c)q - c_0N - (1 - \alpha)[b\delta + r(\Delta - \delta)\beta p] \\ &\quad - (1 - \gamma)\{(w - g)[q - M(q, \delta)] + k[\mu - M(q, \delta)]\} \end{aligned} \quad (37)$$

$$\begin{aligned} \Pi_{CIP, \alpha, \gamma}^a &= (p - w)M(q, \delta) - \alpha[b\delta + r(\Delta - \delta)\beta p] \\ &\quad - \gamma\{(w - g)[q - M(q, \delta)] + k[\mu - M(q, \delta)]\} \end{aligned} \quad (38)$$

$$\begin{aligned} \Pi_{SC, \alpha, \gamma}^a &= \Pi_{CFP, \alpha, \gamma}^a + \Pi_{CIP, \alpha, \gamma}^a \\ &= (p - c)M(q, \delta) - (c - g)[q - M(q, \delta)] - k[\mu - M(q, \delta)] - c_0N - b\delta - r(\Delta - \delta)\beta p \end{aligned} \quad (39)$$

Under the cost and risk sharing contract, to get the optimal decision of the CIP, first order conditions require

$$\frac{\partial \Pi_{CIP, \alpha, \gamma}^a}{\partial \delta} = [p - w + \gamma(w - g + k)] \frac{\partial M(q, \delta)}{\partial \delta} - \gamma k \frac{\partial \mu}{\partial \delta} - \alpha(b - r\beta p) = 0 \quad (40)$$

$$\frac{\partial \Pi_{CIP, \alpha, \gamma}^a}{\partial q} = [p - w + \gamma(w - g + k)] \frac{\partial M(q, \delta)}{\partial q} - \gamma(w - g) = 0 \quad (41)$$

After some algebra, first order conditions lead to

$$\delta_{CIP, \alpha, \gamma}^{a*} = \log_r \frac{\alpha(b - r\beta p)}{(w - p)N \ln r} \quad (42)$$

$$q_{CIP,\alpha,\gamma}^a = N - \frac{\alpha(b-r\beta p)}{(w-p)\ln r} + \frac{a(p-w-\gamma(w-g-k))}{p-w+\gamma(w-g+k)} \quad (43)$$

The results should be equal to the optimal results under centralized decision-making, which requires $\delta_{CIP,\alpha,\gamma}^a = \delta_{SC}^a$ and $q_{CIP,\alpha,\gamma}^a = q_{SC}^a$. So we can obtain the cost and risk sharing contract parameters are

$$\alpha = \frac{p-w}{p-c} \quad (44)$$

$$\gamma = \frac{(p-w)(c-g)}{(w-g)(p-c+k)+k(g-c)} \quad (45)$$

Proposition 5. In the cost and risk sharing contract, the coordination parameters only determined by coefficient parameters and has nothing with the CIP's effort level, service capacity reservation decision, service reliability and market uncertainty. The cost sharing ratio α is equal to the proportion under the symmetrical information, while risk sharing ratio γ has positive

correlation with the cost sharing ratio α , and $\gamma = \frac{\alpha(c-g)(p-c)}{(\alpha c + (1-\alpha)p - g)(p-c+k) + k(g-c)}$

Proof. See the Appendix.

Proposition 5 implies that the coordination parameters only determined by objective parameters of the market, and has nothing with subjective decision. It shows that this coordination contract has stronger adaptability and not easily influenced by subjective factors. When unit service capacity price w is fixed and cloud service supply achieves coordination, the cost sharing ratio is unique and fixed. If w is variable, we can get proposition 6.

Proposition 6. Under the cost and risk sharing contract, if w is variable and meets the condition $w^* = \alpha c + (1-\alpha)p$, the

risk sharing parameter will meet the condition $\gamma = \frac{\alpha(c-g)(p-c)}{(\alpha c + (1-\alpha)p - g)(p-c+k) + k(g-c)}$. The cost and risk

sharing contract can achieve supply chain coordination, and at this time the effect of free trial is optimal. In addition, we can change the ratio of sharing the maximum profit of the supply chain by adjusting α, γ .

Proof. See the Appendix.

Proposition 6 illustrates that in cost and risk sharing contract, if w is decision variable, the scope of the contract will be expanded. When the cloud service supply chain reaches coordination, they can freely choose sharing ratio and share maximum profits of the supply chain in any proportion. The contract has good flexibility.

NUMERICAL SIMULATION AND ANALYSIS

In this section, we make some numerical examples to demonstrate our findings. We compare information both symmetrical and asymmetrical circumstances, in terms of the expected revenue of CFP, CIP and the whole cloud service supply chain. Then, we discuss the effects of some key parameters in the model.

The Performance Comparison of Cloud Service Supply Chain Under Symmetrical Information

We set $N=100$, $r=0.5$, $c=12$, $w=15$, $c_0=0.5$, $p=20$, $b=100$, $\beta=0.5$, $\Delta=10$. Parameter setting meets assumed condition, and results are presented in Table 2.

Table 2: The performance of cloud service supply chain under symmetrical information

	δ^*	μ	α	w	Π_{CFP}	Π_{CIP}	Π_{SC}
Centralized Decision-making	2.54	82.9	—	—	—	—	321.1

Decentralized Decision-making	1.87	72.6	—	15.0	167.8	135.6	303.3
Cost Sharing (w is fixed)	2.54	82.9	0.63	15.0	89.2	231.9	321.1
Cost Sharing (w is variable)	2.54	82.9	0.4	16.8	172.7	148.4	321.1

Table 2 compares the expected revenue of CFP, CIP and the whole cloud service supply chain under symmetrical information. The results show that first, both the optimal effort level and the whole supply chain profit in decentralized decision are lower than those in centralized decision. The cloud service supply chain cannot achieve coordination. Secondly, in cost sharing contract, if w is fixed, both the CIP's profit (from 135.6 to 231.9) and the expected profit of the whole supply chain (from 303.3 to 321.1) will increase, which is equal to the profit in centralized decision. So cloud service supply chain can achieve coordination, but compared to decentralized decision, the CFP's profit decreases (from 167.8 to 89.2), which cannot achieve pareto optimality. Thirdly, if w is variable and meets the condition $w^* = \alpha c + (1 - \alpha)p$, we can change the ratio of sharing the maximum profit of the supply chain by adjusting α . In this case, when $\alpha=0.4$ and $w^* = 16.8$, the expected profit of CFP, CIP and the whole cloud service supply chain are improved. And the cloud service supply chain coordination and pareto optimality can be achieved.

The Performance Comparison of Cloud Service Supply Chain Under Asymmetrical Information

Similarly, we set $N=100$, $r=0.5$, $c=12$, $w=15$, $c_0=0.5$, $p=20$, $b=100$, and $g=10$, $k=2$. Parameter setting meets assumed condition, and results are presented in Table 3.

Table 3: The performance of cloud service supply chain under asymmetrical information

	δ^*	q^*	α	γ	w	Π_{CFP}	Π_{CIP}	Π_{SC}
Centralized Decision-making	2.54	89.5	—	—	—	—	—	304.5
Decentralized Decision-making	1.87	74.3	—	—	15.0	172.8	106.4	279.2
Cost Sharing (w is fixed)	2.54	84.5	0.63	—	15.0	94.2	202.8	297.0
Cost and Risk Sharing (w is fixed)	2.54	89.5	0.63	0.22	15	81.6	222.9	304.5
Cost and Risk Sharing (w is variable)	2.54	89.5	0.33	0.1	17.4	186.7	117.8	304.5

Table 3 compares the expected revenue of CFP, CIP and the whole cloud service supply chain under asymmetrical information. The results show that first, similarly with symmetrical information, both the optimal effort level, service capacity ordering quantity and the whole supply chain profit in decentralized decision are lower than those in centralized decision. The cloud service supply chain cannot achieve coordination. Secondly, the cost sharing contract cannot achieve cloud service supply chain coordination under asymmetrical information. Thirdly, in cost and risk sharing contract, if w is fixed, both the CIP's profit (from 106.4 to 222.9) and the expected profit of the whole supply chain (from 279.2 to 304.5) will increase, which is equal to the profit in centralized decision. So cloud service supply chain can achieve coordination, but compared to decentralized decision, the CFP's profit decreases (from 172.8 to 81.6), which cannot achieve pareto optimality. Finally, if w is variable and meets the condition $w^* = \alpha c + (1 - \alpha)p$, we can change the ratio of sharing the maximum profit of the supply chain by adjusting α . In this case, when $\alpha=0.33$, $\gamma=0.1$ and $w^* = 17.4$, the expected profit of CFP, CIP and the whole cloud service supply chain are improved. And the cloud service supply chain coordination and pareto optimality can be achieved.

In addition, some results can be found in the comparison of table 3 and table 2. First, the supply chain system performance under symmetrical information is higher than those under asymmetrical information ($321.1 > 304.5$), which is due to the low efficiency of asymmetrical information. Secondly, if there is no contract, the CIP's profit under asymmetrical information decreases (from 135.6 to 106.4), while the expected profit of CFP rises (increased from 167.8 to 172.8). It is mainly due to the capacity reservation strategy used by the CFP to prevent opportunistic risk of the CIP. It can avoid opportunism behavior of CIP with high interruption risk, but the disadvantage is that it will bring losses for CIP with low interruption risk.

The impact of Service Reliability Parameter (Service Disruption Probability) on the Profit

Service interruption probability is an important exogenous variable in free trial. It affects the adoption rate of customers, thus affects the actual demand of the market. Here we discuss the role of interruption probability r .

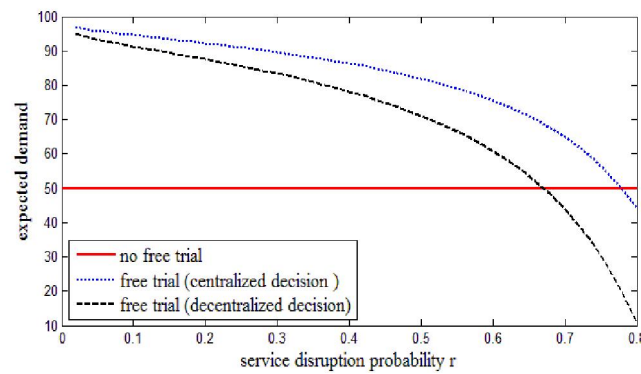


Figure 3: The relationship between the expected demand and service disruption probability

Figure 3 shows the relationship between the expected demand and service disruption probability. As is shown in Fig.3, free trial stimulates the demand of cloud service, and the effect of the free trial is closely related to service disruption probability (service reliability level) of the CIP. Along with the increase of service disruption probability, the expected demand will be less than no free trial. Thus, service reliability level is one of the key elements for free trial. CIP must constantly improve his technological capabilities, reduce service disruption probability, then play a better effect of free trial.

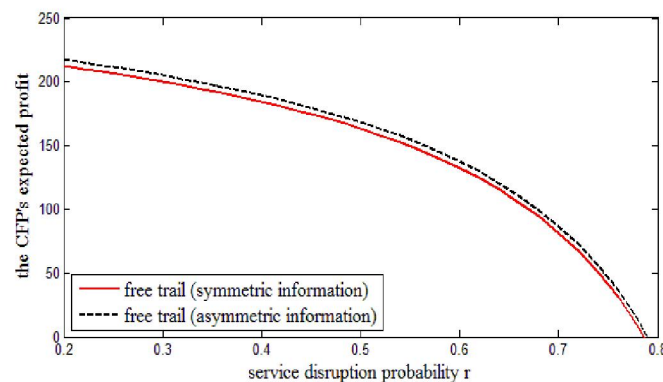


Figure 4: The relationship between the CFP's expected profit and service disruption probability

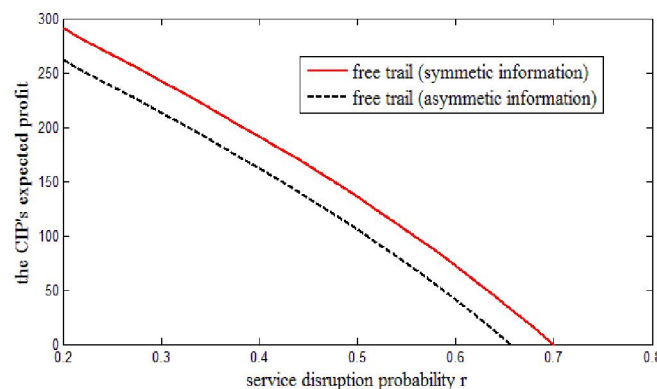


Figure 5: The relationship between the CIP's expected profit and service disruption probability

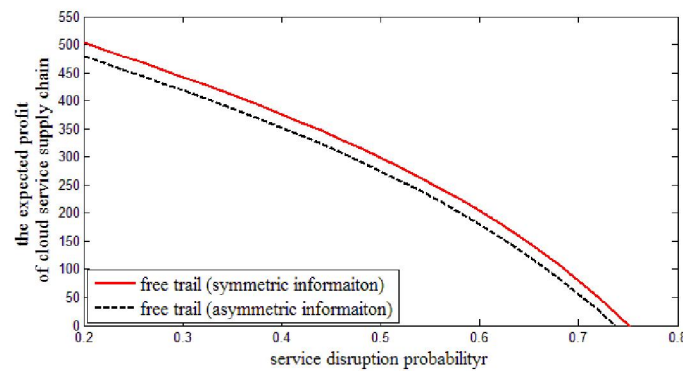


Figure 6: The relationship between the expected profit of cloud service supply chain and service disruption probability

Fig. 4, 5 and 6 give the expected profit of CFP, CIP and the whole cloud service supply chain comparisons, and all of parameter input values are the same. We can draw the following conclusions. Firstly, the effect of the free trail is closely related to service disruption probability (service reliability level) of the CIP. The smaller the service disruption probability, the higher the expected profit. Thus, service reliability level is one of the key elements for free trail. CIP must constantly improve his technological capabilities and reduce service disruption probability.

Secondly, asymmetrical information will lower the performance of cloud service supply chain. Although service capacity reservation strategy can guarantee CFP's profit do not be damaged by asymmetrical information (as shown in Fig.4). But the profit of both CIP and the whole supply chain will decrease (as shown in Fig. 5 and 6). The service capacity reservation strategy can avoid opportunism behavior of CIP with high interruption risk, but the disadvantage is that it will bring losses for CIP with low interruption risk.

Finally, the sensitivity of expected profit of CFP, CIP and the whole cloud service supply chain to interruption probability is different. For CFP, when service interruption probability is low, his profit changes in a small range. When service interruption probability becomes higher, the profit will significantly descend. So CFP should cooperate with CFP with high service reliability to ensure stable benefit. For CIP, his expected profit almost shows a linear correlation of service interruption probability. Thus CIP must continually reduce interruption probability and improve his service reliability level to improve earnings. The changes of the profit of cloud service supply chain is somewhere between CFP and CIP.

The impact of Compensation Ratio on the Decision Variables and the Target

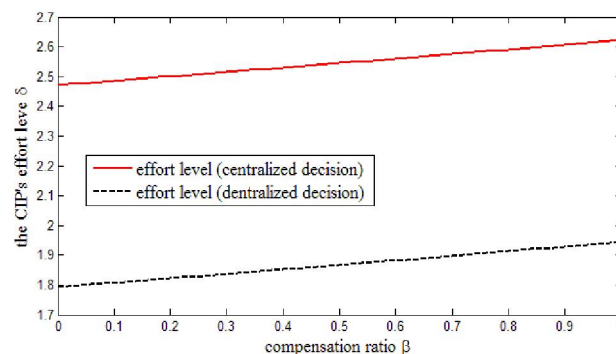


Figure 7: The relationship between the CIP's effort level and compensation ratio

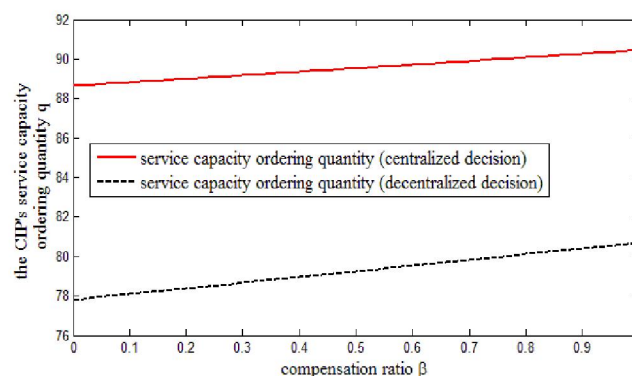


Figure 8: The relationship between the CIP's service capacity ordering quantity and compensation ratio

Fig. 7 and 8 shows the relationship between the CIP's two decision variables (effort level and service capacity ordering quantity) and compensation ratio respectively. As compensation ratio grows, both of the effort level and service capacity ordering quantity increases. This is because the compensation value related to inadequate effort. On one hand, the CIP can reduce the amount of compensation through improving his effort level. On the other hand, he can also improve customer satisfaction and increase sales.

Fig. 9 and 10 shows the relationship between the expected profit and compensation ratio in decentralized decision and cost and risk sharing contract respectively.

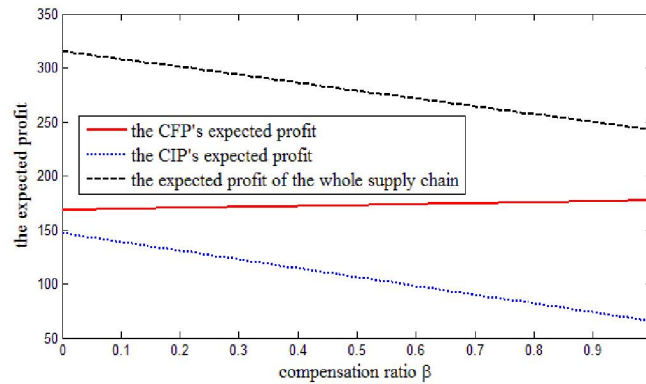


Figure 9: The relationship between the expected profit and compensation ratio in decentralized decision

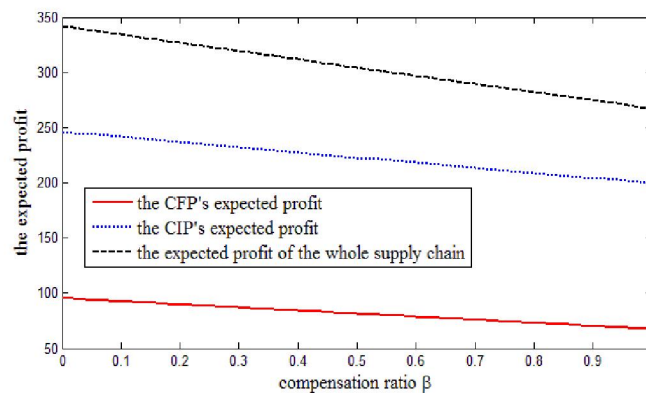


Figure 10: The relationship between the expected profit and compensation ratio in cost and risk sharing contract

Comparing Fig. 9 and 10, both the CIP's profit and cloud services supply chain profit increase with compensation ratio growing. Differently, the CFP's profit increases in decentralized decision making but decreases in cost and risk sharing contract. This is because in decentralized decision making, all compensation costs are borne by CIP alone. With the increase of compensation ratio, expected sales will increase, while CFP benefits without bearing any cost. In cost and risk sharing contract, CFP needs to share effort and compensation costs with CIP, so its profits changed trend is the same as CIP and the whole supply chain. In practice, CIP should carefully set compensation ratio referring to the industry standard.

The impact of Cost-sharing Ratio on the Profits

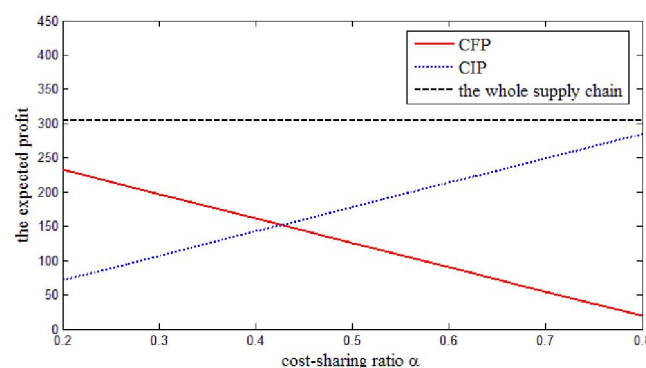


Figure 11: The relationship between the expected profit and cost-sharing ratio

Fig.11 shows the relationship between the expected profit and cost-sharing ratio. The cost sharing ratio α can adjust percentage of sharing profits of cloud service supply chain when achieving coordination. As is shown in Fig. 11, with the increase of cost sharing ratio, CFP's expected profit will decrease while CIP's expected profit rises. In reality, the two sides can determine the corresponding α according to their own game ability, thus striving for respective profit share proportion for their own interests.

CONCLUSION

As more and more enterprise strategy alliances established, cooperation demand between members of cloud service supply chain upstream and downstream is increasing. One of the reasons causing low adoption rate is the worry about implement risk of cloud services, as well as service disruption. Therefore, considering service failure compensation strategy, this paper builds a new three-level supply chain including CFP, CIP and customers. Coordination Contracts are discussed in two kinds of situations, linked respectively to the information symmetry and information asymmetry. The results show that the cost and risk sharing contract we proposed can realize optimal supply chain performance. Our findings have managerial implications. We discuss them and offer some recommendations, beginning with:

Recommendation 1.

Reducing service disruption probability and improving service reliability level are the key to a free trial, which plays a decisive role no the effect of free trial and overall supply chain performance. As the focus of enterprise customers, service reliability must get enough attention in order to improve the adoption rates and the performance of the whole supply.

Recommendation 2.

In cost sharing mechanism, compensation cost allocation enhances the scalability of cost allocation because it is based on the price. So introducing compensation cost sharing can increase visualization and impartiality of the sharing mechanism in supply chain coordination, and is also more acceptable by the chain members.

Recommendation 3.

The supply chain members between upstream and downstream should strengthen information exchange and communication to avoid the distortion caused by information asymmetry. To avoid losing profit, CIP with high service reliability should actively prove their ability in communication with the upstream CFP through conveying useful signal to CFP. In addition, how to eliminate or reduce the negative effects causing by the information asymmetry to cloud services supply chain is worth further study.

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APPENDIX

Appendix A.

This work is supported by China Postdoctoral Science Foundation Funded Project “Risk Transfer and Sharing of Cloud Service Supply Chain Based on Uncontrollable Service Interruption” and National Natural Science foundations of China “Research on the Incentive and Risk Control of IT Service Supply Chain Based on the SaaS” (Grant No.71172072).

Appendix B. Mathematical results and proofs

B.1. Proof of proposition 1

Because of $w > c$, yields, $p - w < p - c$,

$$0 < -(p-w)N \ln r < -(p-c)N \ln r, \log_r \frac{b-r\beta p}{-(p-w)N \ln r} < \log_r \frac{b-r\beta p}{-(p-c)N \ln r}, \text{ that is to say } \delta_{CIP}^{s*} < \delta_{SC}^{s*}.$$

So $r^{\delta_{SC}^{s*}} - r^{\delta_{CIP}^{s*}} < 0$, $(p-c)N(r^{\delta_{SC}^{s*}} - r^{\delta_{CIP}^{s*}}) < 0$. Consequently, $(b-r\beta p)(\delta_{CIP}^{s*} - \delta_{SC}^{s*}) < 0$,

$$\Pi_{SC}^{s*} - \Pi_{SC}^s = (p-c)N(r^{\delta_{SC}^{s*}} - r^{\delta_{CIP}^{s*}}) - (b-r\beta p)(\delta_{CIP}^{s*} - \delta_{SC}^{s*}) < 0.$$

B.2. Proof of proposition 3

Substituting $w^* = \alpha c + (1-\alpha)p$ into $\delta_{CIP,\alpha}^{s*} = \log_r \frac{\alpha(b-r\beta p)}{(w-p)N \ln r}$, we can get $\delta_{CIP,\alpha}^{s*} = \delta_{SC}^{s*}$, which meets the

conditions of the coordination of the supply chain. After $w^* = \alpha c + (1-\alpha)p$ is sent to the expected profit function of the CFP and the CIP respectively, we can get $\Pi_{CFP,\alpha}^s = (1-\alpha)\Pi_{SC}^s - \alpha c_0 N$ and $\Pi_{CIP}^s = \alpha \Pi_{SC}^s + \alpha c_0 N$. So the relationship between the profits (including the CFP's and the CIP's) and α are linear respectively.

B.3. Proof of Lemma 1

If only considering to share effort cost, the profit of the CIP is $\Pi_{CIP,\alpha'}^s = (p-w)N(1-r^\delta) - \alpha'b\delta - r(\Delta-\delta)\beta p$, and the

first order is $\frac{\partial \Pi_{CIP,\alpha'}^s}{\partial \delta} = -(p-w)Nr^\delta \ln r - \alpha'b + r\beta p$. Because of $\frac{\partial^2 \Pi_{CIP,\alpha'}^s}{\partial \delta^2} = -(p-w)Nr^\delta (\ln r)^2 < 0$, the first

order conditions require $\frac{\partial \Pi_{CIP,\alpha'}^s}{\partial \delta} = 0$. So we can get $\delta_{CIP,\alpha'}^{s*} = \log_r \frac{\alpha'b - r\beta p}{(w-p)N \ln r}$. To achieve coordination,

$$\delta_{CIP,\alpha'}^{s*} = \delta_{SC}^{s*} \text{ only when } \alpha' = \frac{p-w}{p-c} + \frac{(w-c)r\beta p}{(p-c)b}.$$

B.4. Proof of proposition 4

Because of $w > c$, yields $0 > w-p > c-p$, $\log_r \frac{b-r\beta p}{(w-p)N \ln r} < \log_r \frac{b-r\beta p}{(c-p)N \ln r}$, that is to say $\delta_{CIP}^{a*} < \delta_{SC}^{a*}$.

Because $\frac{b-r\beta p}{(w-p) \ln r} > \frac{b-r\beta p}{(c-p) \ln r}$ and $\frac{a(p+g+k-2w)}{p-g+k} < \frac{a(p+g+k-2c)}{p-g+k}$, it is easily to know

$$N - \frac{b-r\beta p}{(w-p) \ln r} + \frac{a(p+g+k-2w)}{p-g+k} < N - \frac{b-r\beta p}{(c-p) \ln r} + \frac{a(p+g+k-2c)}{p-g+k}. \text{ Consequently } q_{CIP}^{a*} < q_{SC}^{a*}.$$

B.5. Proof of proposition 5

Because of $\alpha = \frac{p-w}{p-c}$, $\gamma = \frac{(p-w)(c-g)}{(w-g)(p-c+k)+k(g-c)}$, yields $p-w = \alpha(p-c)$, $w = p - \alpha(p-c)$, it is

easily to know $\gamma = \frac{\alpha(p-c)(c-g)}{(\alpha c + (1-\alpha)p - g)(p-c+k) + k(g-c)}$ by substituting w into expressions.

B.6. Proof of proposition 6

Substituting $w^* = \alpha c + (1-\alpha)p$ and $\gamma = \frac{\alpha(p-c)(c-g)}{(\alpha c + (1-\alpha)p - g)(p-c+k) + k(g-c)}$ into Eq.(42) and Eq.(43), it is

easily to know $\delta_{CIP, \alpha, \gamma}^a = \log_r \frac{\alpha(b-r\beta p)}{(w-p)N \ln r} = \log_r \frac{b-r\beta p}{(c-p)N \ln r} = \delta_{SC}^s$,

and $q_{CIP, \alpha, \gamma}^a = N - \frac{\alpha(b-r\beta p)}{(w-p) \ln r} + \frac{a(p-w-\gamma(w-g-k))}{p-w+\gamma(w-g+k)} = N - \frac{b-r\beta p}{(c-p) \ln r} + \frac{a(p+g+k-2c)}{p-g+k} = q_{SC}^a$. The

conditions to achieve the supply chain coordination are meet.

The Long-Term Impact Of RFID Adoption

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ABSTRACT

Most research problems on Radio frequency identification (RFID) focus on effects of RFID implementation on firms, factors affecting RFID adoption, and impact evaluation of RFID implementation. And literature about RFID adoption concentrates on short-term effects or impact evaluation. However, short-term analysis will not identify the impact of RFID adoption adequately. We use monthly data of 86 companies which adopted RFID projects around the world at some point from January 1997 to December 2011 and perform four years calendar portfolio analysis (CPA) and Tobin's Q comparison analysis to gain comprehensive insights into the mechanism of RFID on firm performance. Further, we investigate five contextual factors that moderate the impact of RFID adoption including adoption time, country, industry, and financial health condition of adoption firms. We find that RFID may not demonstrate its value instantly, but it has indeed enhanced firms' future growth potential in the long run.

Keywords: RFID adoption, event study, calendar portfolio analysis, Tobin's Q.

INTRODUCTION

As of 2006, it has witnessed a mushroom development of the Radio Frequency Identification (RFID), which is expected to take over the barcode technology at a great rate. However, some existing challenges, such as the huge cost, the integration problem and performance uncertainties, make investors hesitate to undertake this innovative technology project. As a result, there is a need for rigorous empirical assessment of the effects of RFID investments on firm performance. At the same time, investigation of this nature is crucial as it provides researchers and practitioners with concrete evidence on whether RFID investments should be considered as a strategy for the creation of firm competitive advantage. Nevertheless, the literature has not yet adequately addressed that issue. Both conceptual and empirical research that assesses the effect of RFID adoption on firm performance remains underdeveloped. Therefore, it is of critical importance to understand not only whether RFID can create value but also how, when and why it could impact firm performance.

The RFID system is viewed as a type of IT-based supply chain management systems (SCMS) because it can provide unprecedented visibility to the supply chain^[37]. This visibility has the potential to improve supply chain efficiency and firms operational performance through enhancing inventory efficiency, increasing inventory accuracy, optimizing logistics, and coordinating the flow of materials^{[10][73]}. The use of RFID technology is an extension of IT technology, which can also expand IT technology to the physical world. RFID systems are key components of Internet of things (IoT) at the present stage, which is the network of connected physical objects, and stresses the item traceability and addressability, not mere objects identification^[4]. Due to network connectivity or the function of RFID technology, connected objects can collect and exchange data. Therefore, the application of RFID can realize real-time monitoring of almost every link in the supply chain ranging from purchasing, production, sales and after-sale service, which is believed to be able to reduce cost, increase revenue, or increase customer satisfaction because of efficiency improvement^{[72][75]}. During the application process, RFID systems can gather data for subsequent analysis to advocate for or against management decisions. Tajima^[60] argued that appropriate use of RFID could create and sustain a competitive advantage. In fact, with the application of RFID, Vital Entertainment Group, which provides video production services and equipment rental and sales to customers throughout the United States, improved efficiency, increased inventory accuracy by more than 50 percent and decreased labor costs^[8]. Following the RFID solution's installation at all three distribution centers (DC) of Patrizia Pepe, an Italian fashion brand of Tessilform S.p.A., the DCs could process approximately 330 products hourly compared to 140 products previously^[64]. Hellström^[25] analyzed two firms' data and found that RFID investment resulted in nearly 0% loss of roll containers in IKEA, and, a 20% annual loss was avoided in Arla Foods.

However, there is no consistent empirical evidence on the trade-off between RFID benefits and costs among those a few empirical studies. Jeong and Lu^[28] had used the event study method to estimate the short-term impact of RFID on market value of firms, and found a positive impact. But another similar research conducted by Bose et al.^[9] observed opposite results in short time. Both theoretical and methodological explanations could be used to account for the contradictory results. From the theoretical viewpoint, RFID has the potential to improve firm performance and customer value, but as the RFID technology matures, the entry barriers is lowered, the market competition is intensified and the market efficiency that enables a firm to maintain monopoly power is eliminated. From the methodological viewpoint, the samples used, measurements used, or the failure to control the other event effects are the primary reasons for the inconsistent results. Furthermore, RFID implementation takes years of effort, experimentation, and commitment, research on the short-term impact may not fully reflect possible financial influence of RFID adoption. And IT, like RFID, contributes to performance dimensions such as strategic flexibility and intangible value. RFID's value cannot be fully realized in a short time and short-term analysis will not identify these benefits of RFID^[6]. Thus, a long-term observation is needed to investigate RFID's impact.

A critique in the management literature to event studies using long-term windows is that other events will naturally occur as the window expands into the future and will confound the effects of the event under study^[44]. In response to those issues, calendar portfolio analysis is used in this study to discover RFID's long term impact on firms' market value. This method is market-based and risk-adjusted for general market movement, inflation, firms' market risk and so on. Single indicator alone has its prerequisite and its insufficiency, in this paper we use different metrics. It is argued that efficiency performance measures (such as Tobin's Q, Return on Equity, productivity) are different from effectiveness performance measures (such as market value-added and IT-enabled strategic options)^[39]. Rate-of-return measures, such as Return of Assets (ROA), Return on Equity (ROE), and Return on Sales (ROS), are base on historical accounting measures. These ratios based upon accounting measures typically only reflect the past information of the firm, not forward looking and they are not risk-adjusted. Additionally, accounting measures of firm performance are sensitive to the time lags necessary for realizing the potential of capital investment. This could be particularly problematic in the situation of RFID investment, due to the RFID implementation complexity and uncertainty. While Tobin's Q is a forward-looking performance measure, which not only reflects the value of physical assets but the value of its intangible assets^{[40][51][54]}. Therefore, we adopt the CPA and Tobin's Q comparison analysis to gain comprehensive insights into the mechanism of RFID on firm performance.

Our paper contributes to the research in the following ways. Firstly, by adopting metrics including the market based performance measure (AR) and efficiency performance measure (Tobin's Q), we examine the impact of RFID adoption on company's performance from different perspectives. Our results indicate that RFID investments do create value to firms but this benefit is more invisible and stands for shareholder value, which is quite different from bondholder value indicators such as AR. Thus we provide a reasonable explanation to the inconsistent results reported in literature. Secondly, since the adoption of RFID requires significant amount of time and effort, therefore short-term observation in the length of a few months may not be sufficient. We measure the influence of RFID adoption over a period from the first year to the fourth year after adoption and therefore our results are more reliable compared to short-term analysis. Moreover, from the long-term analysis, we provide empirical evidence to the question of how long can a company benefit from RFID adoption.

The remainder of this paper is structured as follows: First, we briefly summarize previous literature on RFID implementation effects, factors affecting RFID adoption and impact evaluation of RFID implementation. Then, we present our hypothesis in detail. And we describe our data and methodology involved in the next. Finally, we discuss our results and make the conclusion.

LITERATURE REVIEW

Effects of RFID Implementation on Firms

The resource-based view (RBV) argues that firms possess resources, which are defined as assets or capabilities used to detect or respond to market opportunities, fluctuation or threats^{[14][52][67]}. As to information system (IS) resources, they rarely make a direct contribution to sustained competitive advantage (SCA); they are necessary for SCA, but not sufficient^[15]. From the RBV perspective, firms develop IS capability from the deployment of IS resources to production operations and business processes over an extended period of time, which makes the capability embed in the firm and idiosyncratic to the firm. Thus it is difficult for firms that have much in common to imitate due to path dependencies^{[12][14][17][21]}. When integrated with business process, can RFID bring benefits for adopting firms^[25]. Visich et al.,^[66] generalized three-stage impact of RFID on supply chain. This three-stage impact is corresponding to preliminary, intermediate, and mature stages of RFID implementation.

At the preliminary stage, RFID project is not yet started, and firms is prepared for RFID implementation. Firms may conduct a pilot project to experience potential benefits of RFID implementation and to see whether or not there is a match between business process and the application of RFID. This stage reflects the customization of RFID^[25]. Once firms decide to implement the technology, they must invest corresponding manpower, material and financial resources. At the intermediate stage, RFID is implemented at a certain entity in the firm and the impact of RFID is associated with automational effects on operational processes for value creation^[13]. This stage reveals that RFID can be considered as a part of the "universal infrastructure^[30]" or firm resources (ideally, all facilities in the firm are RFID-enabled^[3]). At the mature stage, RFID technology is embedded in the organization's operational and managerial work and is used to its fullest potentials^[12], i.e. informational effects on managerial processes, and help the adoption firms obtain sustained competitive advantage. A report by the McKinsey Global Institute^[43] presented that data were also firm resources. With application of RFID technology, firms can obtain a large amount of RFID data with abundant explicit or implicit information that are real-time and time-dependent^[1], which is not possible with the use of bar codes—the predecessor technology of RFID technology^[60]. If the derived data are appropriately analyzed for business purpose with certain data analysis technology, the application becomes more customer-oriented and it may generate economic gains for the firm further^[107], which can guarantee the firms sensitivity towards market response and external relationships^[67].

Factors Affecting RFID Adoption

Despite the advantages of RFID implementation, the reality of RFID adoption is far behind early anticipation that RFID will be widely applied^[74]. Therefore, it is necessary to make a comprehensive analysis of the various factors that affect RFID adoption decision. Based on technology-organization-environment (TOE) framework^{[48][62][70]}, the factors influencing RFID adoption can

be grouped into technological (T), organizational (O) and environmental (E) context^{[7][12][32][34][36][65][70][77]}. Furthermore, TOE factors not only have impacts on RFID adoption, but also affect value creation of RFID^{[10][68]}. Once the factors that significantly influence the adoption of RFID have been validated, in next phase it would be of great value to explore the value difference across adopters and non-adopters—namely the value or impact evaluation of RFID implementation.

Impact Evaluation of RFID Implementation

Different performance measures represent RFID implementation influence on different perspectives of the firm. In general, there are nonfinancial measures and financial measures. Possible nonfinancial measures are inventory days^[41], inventory accuracy^[18], throughput^[27], and productivity^[58]. These measures are limited to manufacture firms. Because non-manufacture firms are also in our sample, these measures cannot be applied in our study. As to financial measures, there are accounting based measures and market based measures.

Accounting Based Measures

Accounting based measures, e.g., profit margins^[10] and sales growth^[41], do reflect some association between a firm deployment of its RFID resources and RFID value. Among all accounting based measures, ROA and return on sales (ROS) are the most widely used accounting based measures for IT value^{[19][26]}. However, ROA is a lag indicator that reports the outcome of past actions and is backward-looking^[55]. Due to the fact that IT adoption usually doesn't generate direct and tangible benefit, using ROA may produce conflict results^[69]. Furthermore, RFID implementation require large costs, such as hardware costs, software costs, system integration costs, installation services costs, personnel costs and business process reengineering costs^[53]. The cost of RFID may still larger than the technology itself^[76]. Hence, ROA or other accounting based measures may not completely evaluate the impact of RFID adoption on firm performance. Moreover, almost all studies that evaluate the impact of IT implementation on firms focus on performance measures measured over a period of time, not measured at a point in time. The conclusions made by these studies are severely affected by their sample period, and these ex post studies suffer from benchmark choice problems and interpretation problems at the same time. These problems are severe for studies that use accounting measures of performance^[35].

Market Based Measures

Market based measures such as stock response, i.e. AR, are believed to have advantages such as reflecting stockholders value directly and also investors' evaluation of the impact of managerial decisions. Due to its failure to control for clustering time problem and the differences in the involved firm's environment, it is unsuitable to examine long term impact. For long term impact, cumulative abnormal returns (CAR) or calendar portfolio analysis is mostly used. In continuous time, the CAR represents the abnormal return on a portfolio that is rebalanced every period to give equal weight in each security^[57]. Considering the diversity of our samples, CAR will not be an option in our study. To measure long-term abnormal return appropriately, we use calendar-time portfolio analysis (CPA), which is method from the finance literature. The main advantage of the calendar-time portfolio analysis method is that it automatically accounts for cross-sectional correlation of returns^[46].

To avoid the drawbacks of ex post metrics, such as ROA, we focus on a performance measure evaluated at a point in time-Tobin's Q^[6]. The Tobin's Q is commonly known to be a good market based measure of firm value which is forward-looking, risk-adjusted, and less susceptible to changes in accounting practices^[47]. The advantage of Tobin's Q is that it incorporates the capitalized value of benefits from RFID implementation, and can measure the contribution of the firm's intangible assets derived from RFID to market value. Tobin's Q can measure market power from both existing assets and future growth potential of the firm. It is more consistent with the forward-looking nature of the capital markets. In this regard, using Tobin's Q to measure firm performance allows us to capture both observable and unobservable aspects of the relationship between stakeholder welfare. It does a better reflection of RFID's true contribution to firm value.

Then, in order to get comprehensive insights about the RFID adoption impact on adopting firms, we adopt the CPA and Tobin's Q methods to calculate AR and Tobin's Q at the same time.

HYPOTHESIS

The success of IT projects is contingent on whether firms can accrue enough resources and capabilities to create the business value. During the implementation process, IT investments interact with other organizational resources and the external environment to help the firm to respond more proactively and in a timely manner to the external and inherent changes.

For technologies bring significant changes to the operation of firms like RFID, it could be quite time consuming since more resources need to be allocated. Some even caution that the benefits of RFID investments will never materialize because of the consumption of the huge resources. Empirical evidence shows that the major effects from the implementation of RFID are automational effects on operational processes followed by informational effects on managerial processes [66]. Furthermore, the implementation of complicated systematic project like RFID will increase firm expense and asset item, and decrease cash flow in the financial statements. As a result, a firm that implements RFID project may appear financially unattractive to investors. Referring to Tobin's Q, it is quite different from other indicators and stands for the shareholder value. Motivated by their

diverging interests, shareholders favor riskier investments and focus more on future expected returns. Indirect benefits such as customer satisfaction improvement, shortened customer response times may not be truly reflected in stock market evaluation but could be reflected in shareholder value indicator like Tobin's Q. Hence, we may hypothesize the following:

H1a: Firms adopting RFID investments generally will experience significant and negative abnormal market return over a long term.

H1b: The adoption of RFID will have positive influence on Tobin's Q of Firms over a long term.

The timing of adoption reflects the IT strategy of firms. However, no consensus has ever been made regarding the relationship between entry order and profitability. On one hand, first mover advantage view-holders claim that early adopters can obtain a lot of potential benefits such as technological leadership, favorable market position, better access to scarce resources, and strengths in the learning curve, which can make early adopters obtain superior performance and a competitive advantage at the same time^[50]. On the other hand, others argue that entry order is not the sole determinant of competitive edge but must be contingent on certain markets and the actions of the first mover and the later entrants^[38]. The year 2006 is selected as the boundary year because RFID Journal.com claims that "as we enter 2006, RFID can be said to have crossed the chasm". Firms are divided into two groups: RFID adoption before 2006 and RFID adoption after 2006. If first mover advantage exists, we expect to see that companies adopt RFID before 2006 will suffer less negative influence on their abnormal market return, and have greater growth and development potential than later adopters. Early adopters may benefit more compared with later adopters. Hence, we hypothesize the following:

H2a: Firms adopt RFID after 2006 will have higher and negative market abnormal return than those adopt RFID before 2006 over a long term.

H2b: RFID adoption will have more positive influence on Tobin's Q for firms adopt RFID before 2006 than those adopt RFID after 2006.

Research has asserted that country plays an important role in determining IT investment's impact. But the conclusion from existing literature is controversial. Dewan and Kraemer^[20] together with Pohjola^[49] had found a strong relationship between IT and productivity in developed countries, but not in developing countries. However, Meng and Lee^[45] discovered that the abnormal return IT investment announcements brought in China was significantly positive. The reasons for mixed results reported in literature are multiple. For one thing, the national environment like cultural, economic, legal and business markets is crucial for firms to develop sustained competitive advantages^[71]. For another, though non-US countries may face numerous problems such as standards, costs, business environments and untested markets, the huge market size together with a rapid increase in logistic demand could also bring them fresh opportunities. In US, RFID becomes a competitive necessity to avoid the competitive decline rather than the competitive edge. In non-US countries, the adoption of RFID is much less popular and therefore adopters may capture the competitive advantage more easily. Hence, we conjecture that non-US listed companies have more opportunities to achieve longstanding competitive advantage than firms in US, however US companies may benefit from lower cost for implementation therefore will have better performance in terms of abnormal market return.

H3a: Non-US listed RFID adopters will have higher and significant negative abnormal market returns compared with US listed adopters over a long term.

H3b: RFID adoption will have higher and positive influence on Tobin's Q for Non-US firms than US firms.

Type of industry is believed to be an essential moderator of IT investment. Different industries have different technological resources, capital resources and complementary assets as well as different level of IT capability. We follow Bose et al.^[9] and classify our samples into manufacturing and nonmanufacturing samples. On one hand, the manufacturing industry relies heavily on RFID owing to the external supplier and customer's pressure. Greater effort is needed for manufacturing firms than non-manufacturing firms to integrate RFID technology with their customers and to improve the visibility of material flow^[23]. While Non-manufactures don't focus on manufacturing parts thus they don't have to invest much into RFID. Non-manufacture RFID adopters can greatly enhance the efficiency of firms and improve the quality of operation or services, which makes them stand out in their industry. On the other hand, manufacturing firms usually don't have IT infrastructure foundation and high IT management capability as good as those of nonmanufacturing firms have. More effort is needed to address the resource problem and the transformation cost could be really high. This higher cost would even compress their lower profit margin compared with non-manufacturers. Hence, we may anticipate that manufacturing firms will suffer more compared with nonmanufacturing firms.

H4a: Manufactures who adopted RFID will have lower and significant negative abnormal market return compared with non-manufacture adopters.

H4b: RFID adoption will have higher and positive influence on Tobin's Q for non-manufacturers than manufacturers.

The financial resources dimension refers to the monetary resources, which are available to cover the costs associated with the purchase, implementation, and maintenance of technological innovations. Additionally the extra resources can be used to acquire the necessary managerial and technical talent to facilitate the implementation of an innovation^[11]. A greater abundance of financial resources should provide an organization with more opportunities and resources to evaluate RFID using means such as experiment to decide the appropriateness of RFID^[32]. To be short, financial health of firms is an indicator whether firms have enough IT related budget to cover associated IT costs of recruiting specialized personnel and building any needed infrastructure which may turn into drivers for future growth. This is especially the case in the long term, because more cash is needed to ensure the transformation process of RFID. However, allocating more money in building IT infrastructure may imply that less money can be invested in the core business of firms especially for financially unhealthy firms. Based on the above studies, we hypothesize that the market will react more negatively toward financially unhealthy firms over a long term. Thus, we propose the following hypothesis:

H5a: Financially healthy RFID adopters will have significant and higher negative abnormal return compared with financially unhealthy RFID adopters.

H5b: RFID adoption will have higher and positive influence on Tobin's Q for financially healthy RFID adopters than financially unhealthy RFID adopters.

DATA AND METHODOLOGY

Data Collection

Our data are derived from several secondary sources, including Standard & Poor's COMPUSTAT database, Lexis-Nexis, Bvd-Orisis database, and Dr. Kenneth French's website (<http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/index.html>). RFID announcements are collected from Lexis-Nexis database. We refer to Dr. French's website to calculate the stock market based performance measure used in our analysis. In addition, we rely on COMPUSTAT for calculating abnormal return, Tobin's Q, and the controls used in our analysis. Altogether our datasets comprises approximately 119 RFID announcements by 86 firms over the period from January 1th, 1997 to December 31th, 2011. The firms in the final sample meet the following criteria. We collect data using a systematic screening mechanism is conducted following Bose et al. [9]. We gather performance data for five successive years upon and after the adoption of the RFID technology (i.e., t to $t + 3$, where t is the year of introduction).

Next, we use two different metrics to capture firm financial performance, namely, abnormal return (AR) and Tobin's Q. We outline our measurement approach for capturing these measures as follows.

Calendar Portfolio Analysis

The calendar portfolio analysis is conducted in two steps: the first step involves computing an average return for the cross-section of investors or firms, and the second step then measures the risk-adjusted performance by estimating a multifactor (e.g., the Fama-French three factor) time-series regression model. The CPA procedure is illustrated in next.

The first step is computed as follows. Firstly, we calculate the monthly stock fluctuation:

$$MAR_{it} = (R_{it} - R_{i(t-1)}) / R_{it} \quad (1)$$

Where, R_{it} is the closing price for i th firm in month t . The stock price is retrieved from Google finance and Yahoo finance. Then, in each calendar month t , calculate a mean abnormal return R_{pt} across firms in the portfolio:

$$R_{pt} = 1 / (\sum_i D_{it}) * (\sum_i MAR_{it} * D_{it}) \quad (2)$$

R_{pt} is the portfolio return for month t , MAR_{it} is the monthly abnormal return for i th firm in the portfolio, N is the number of stocks in month t , D_{it} is a dummy variable, when stock i exists in month t , then 1 else 0.

Next, we adopt the Fama-French three-factor time-series regression model. For each portfolio in month t , we form an equally weighted portfolio for each subset consisting of all announcements. Under the assumption that individual abnormal returns are normally distributed with mean zero, we pool them together and get a pooled R_{pt} . The observing time windows we have chosen are 12 months, 24 months, and 36 months. Next, we undertake FFM method to observe the long term excess abnormal returns. In line with Sorescu et al. [55], we measure the returns on these portfolios using a three-factor Fama French model^[22]. This implies regressing monthly stock returns on market, size, and book-to-market factors. In model form, this gives us:

$$R_{pt} - R_{ft} = \alpha_p + \beta_p (R_{mt} - R_{ft}) + \gamma_p SMB_{pt} + \delta_p HML_{pt} + \varepsilon_{pt} \quad (3)$$

Where R_{pt} is the rate of return of portfolio announcement on month t , R_{ft} is the rate of return on a U.S. Treasury bond f during the same period; R_{mt} is the rate of return of market index m on month t , SMB_{pt} was the correction for the difference in the rate of return between small and big firms in a value-weighted portfolio of stocks; and HML_{pt} is for the difference between the high and low book-to-market ratio stocks in a value-weighted portfolio of stocks. α_p is the model intercept. And β_p , γ_p and δ_p are parameter loadings of the three factors.

Several scholars have employed the FFM model to study the impact of branding ^[42], new product announcements ^[55] and marketing alliances ^[59] on market value. Since the samples in our paper are both US listed and non-US listed, hence, we adopt the merged model proposed by Bose et al. ^[9] in which an international HML is added to the FFM-three factor model, thus the model could explain the returns generated from global value and global growth portfolios. The monthly $IHML$ data are downloaded from Prof. French's website. The merged Fama French model (FFM) is shown below .

$$R_{pt} - R_{ft} = \alpha_p + \beta_p (R_{mt} - R_{ft}) + D_p (\gamma_p SMB_{pt} + \delta_p HML_{pt}) + (1 - D_p) \epsilon_i IHML_{pt} + \varepsilon_{pt} \quad (4)$$

Where, $IHML_{pt}$ is the international book-to-market ratio correction factor for month t , D_p is a dummy variable that takes the value 1 when the announcement is listed in a US stock exchange and 0 otherwise. The estimate of y-intercept α_p provides a test of the null hypothesis that the mean monthly abnormal return on the calendar-time portfolio is zero. β_p is the slope that measures the sensitivity of R_{mt} , and ϵ_i is the corresponding slope. And ε_{pt} is the error term. The error term in this regression may be heteroskedastic, thus we use the weighted least squares estimation, where the weighting factor is based on square root of the number of securities in the portfolio in each calendar month. We used this model to establish expectations of the stock returns of firm i in year t . The monthly R_{ft} , SMB_{pt} , HML_{pt} , and $IHML_{pt}$ are downloaded from Prof. French's website. To examine the moderating effects, we define the market-to-book value correction factor ($IHML$) and firm size correction factor (SMB) as control variables and each moderating factor is put into the equation each time.

Tobin's Q Comparison Analysis

Tobin's Q is defined as the ratio of market value to the replacement cost of the firm. In principle, the numerator in Tobin's Q can be decomposed into the sum of the firm's capitalized income streams. Previous research has invented a number of ways to calculate Tobin's Q. Some suggest that the market value of the firm can be composed into the value of physical assets and the value of its intangible assets ^{[40][51][63]}. King and Lenox ^[33] argued that calculation of Tobin's Q was measured by dividing the sum of the firm's market capitalization, the book value of its long-term debt, and its net current liabilities by the book value of its total assets. We take the method of Chung and Pruitt ^[16], Bharadwaj et al. ^[7], Lindenberg and Ross's ^[40] using financial and accounting information available from the Compustat database. If the liquidating value is not available, we adopted another substitute method ^[24].

Next, a matched-pair test is conducted to examine whether the RFID adopting firms outperformed non RFID adopters. We match sample and control pairs based on specific matching criteria to minimize the confounding effects caused by some special factors in a particular industry or by the overall state of the economy at a specific time period. Matching on these variables rules out other alternative explanations for any difference found in financial performance between the two groups. Typically, the matching procedure is based on the industry (in terms of four industry Standard Industrial Classification code) and firm size (in terms of total assets) to control the industry and size effect. Following Stratopoulos and Dehning's ^[56], in our research, we adopt a similar method. The matched control group acts as a benchmark to measure differential performance. The control group is consisted of a list of non-RFID adopters. They are matched on Standard Industrial Classification (SIC) code and total assets to control for industry effect and size effect.

Aggregation of the differences between the RFID adopting group and the matched control group constitutes the test metrics. These differences are computed as follows:

$$(Tobin's\ Q\ Differential)_i = Tobin's\ Q_{RFID\ adopters} - Tobin's\ Q_{matched\ control} \quad (5)$$

Where $i = t + 1$, $t + 2$, and $t + 3$. If the Tobin's Q differential is positive and significant, it means that the RFID implementation does contribute to the future total firm value.

Control variable

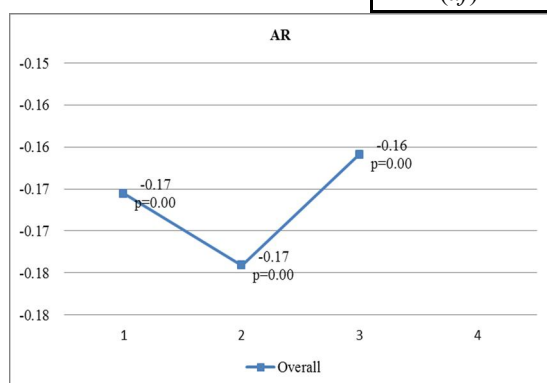
In addition to examining the overall effect of RFID adoption, the sample was divided into subsamples according to the value of contingent factors: timing, country, industry, and financial health. For timing, we divide the companies into two groups: announcements issued before 2006 and after 2006. The dummy variable M takes 1 when it is an announcement made after 2006. For country, we divide our sample as US firms and non-US firms. For industry, we divide our samples as manufacturing firms and non-manufacturing firms. For financial health, EM score is positively correlated with the firms' financial health ^[2]. According to ^[9], EM score higher than 8.63 is defined as healthy financial firms and lower than 8.63 unhealthy financial firms.

RESULTS

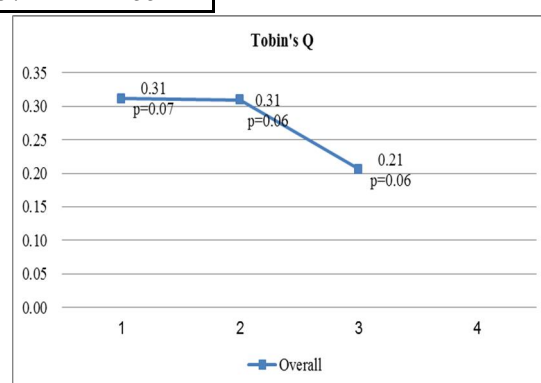
The overall results for the whole sample using two different performance indicators are presented in Table 1. As to the abnormal return, we can clearly observe a consistent significant negative relationship from $t + 1$ to $t + 3$. In contrast, RFID adoption has significant positive influence on Tobin's Q from $t + 1$ to $t + 3$. An decline in the absolute value of Tobin's Q is also observed.

Table 1: Overall effect of RFID adoption

	$t + 1$	$t + 2$	$t + 3$
AR	-0.17	-0.17	-0.16
P-value	(0.00)	(0.00)	(0.00)
(df)	496	778	1012
Tobin's Q	0.31	0.31	0.21
P-value	(0.07)	(0.06)	(0.06)
(df)	56	57	55



(a)



(b)

Figure 1: Overall influence of RFID adoption

The results are quite mixed in relation to the adoption time. As show in Table 2, in general RFID adoption has negative influence on abnormal market return. However the effects on pre-2006 adopters are stronger than post-2006 adopters. It could also be observed that the effect size on pre-2006 adopters decreases from $t + 1$ to $t + 3$ while the effect size of post-2006 adopters increases over that period. The influence of RFID adoption on Tobin's Q is different for pre- and post-2006 adopter. It seems that early adopters Tobin's Q receive positive influence from adoption of RFID while later adopters received non-significant influences. However, the effect size of influence on Tobin's Q decreases from $t + 1$ to $t + 3$.

Table 2: Impact of adoption timing

	$t + 1$		$t + 2$		$t + 3$	
Timing	Pre	Post	Pre	Post	Pre	Post
AR	-0.21	-0.09	-0.21	-0.09	-0.19	-0.11
P-value	(0.00)	(0.05)	(0.00)	(0.01)	(0.00)	(0.00)
(df)	216	262	348	445	451	593
Tobin's Q	1.08	-0.04	0.98	-0.02	0.63	0.01
P-value	(0.05)	0.75	(0.05)	0.72	(0.05)	0.54
(df)	17	38	18	38	17	37

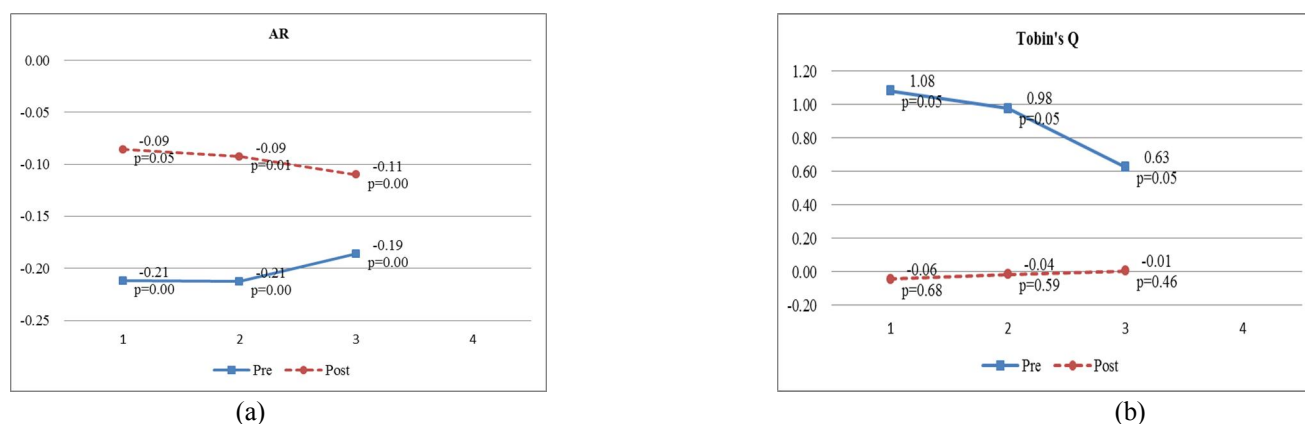


Figure 2: Impact of adoption timing

As is shown in table 3, our results revealed that in US companies suffer a higher and significant negative abnormal market return than Non-US companies over the period during $t + 1$ to $t + 3$. The effect size increased from $t + 1$ to $t + 3$ for US companies but decreased for Non-US companies. For Tobin's Q, it seems that for the first two years, the influence of adoption is not significant for US companies except for the first year. In contrast, for Non-US companies, although the influence is not significant at the beginning, the effect sizes gradually increases while the p-value gradually decreases.

Table 3: Impact of the country of firms

	$t + 1$		$t + 2$		$t + 3$	
Country	US	Non-US	US	Non-US	US	Non-US
AR	-0.27	-0.09	-0.34	-0.09	-0.38	-0.08
P-value	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
(df)	135	359	165	611	189	821
Tobin's Q	0.55	0.04	0.51	0.10	0.28	0.12
	(0.08)	0.37	(0.09)	0.21	0.12	0.11
(df)	29	26	29	27	28	26

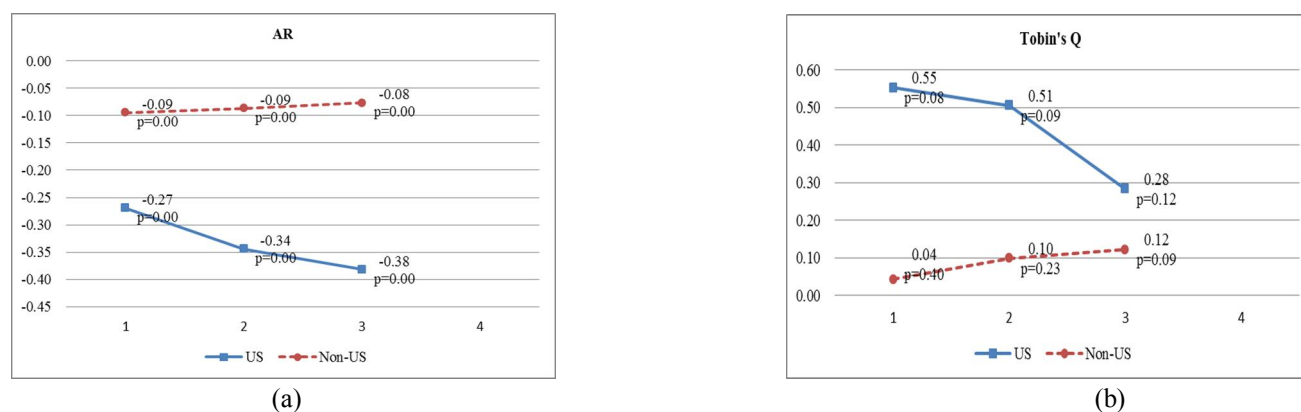


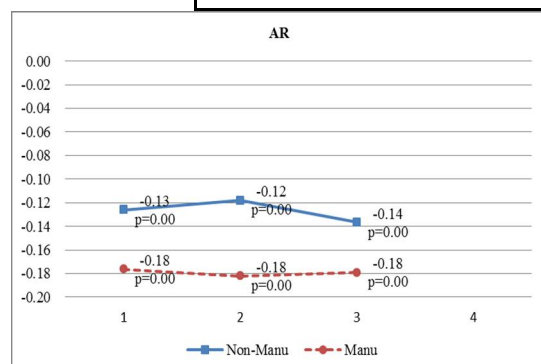
Figure 3: Impact of the country of firms

From Table 4, it is observed both non-manufacturers and manufacturers suffer significant negative influence on their abnormal market return from RFID adoption. The effect size is larger for manufacturers than that for non-manufacturers. For Tobin's Q, RFID adoption seems to have positive influence for both non-manufacturers and manufacturers. The size of effect on non-manufacturers is larger than that on manufacturers in general. However the influence is not significant for manufacturers. In contrast, the influence of RFID adoption begins to appear for non-manufacturers since $t + 2$.

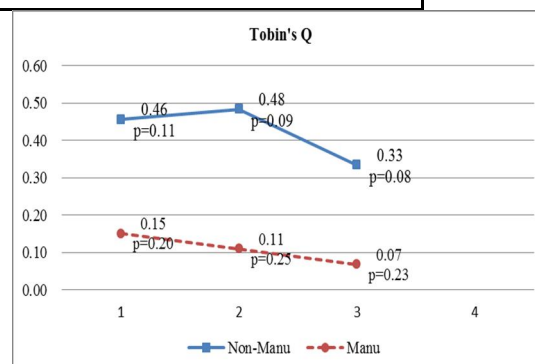
Table 4: Impact of the industry of firms

	$t + 1$		$t + 2$		$t + 3$	
Industry	Non-Manu	Manu	Non-Manu	Manu	Non-Manu	Manu

AR	-0.13	-0.18	-0.12	-0.18	-0.14	-0.18
P-value	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
(df)	330	237	512	405	685	509
Tobin's Q	0.46	0.15	0.48	0.11	0.33	0.07
P-value	0.11	0.20	(0.09)	0.23	(0.08)	0.25
(df)	29	26	30	26	28	26



(a)



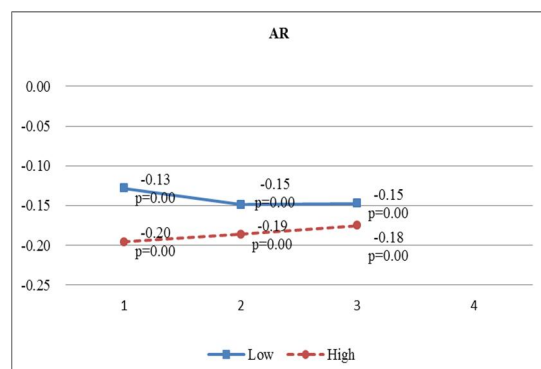
(b)

Figure 4: Impact of industry of firms

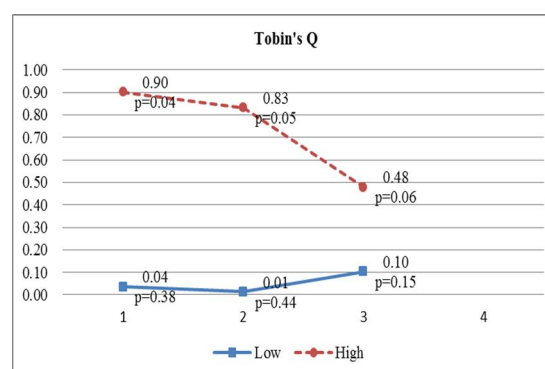
As is revealed in Table 5, abnormal market return is more negative to firms with good financial health (high EM scores) compared with financial unhealthy firms (low EM scores) during the period from $t + 1$ to $t + 3$. On the other hand, RFID adoption has significant and positive influence on Tobin's Q for firms with high EM scores but the effect size decreases from $t + 1$ to $t + 3$. But for low EM score companies, there is no significant influence on Tobin's Q.

Table 5: Impact of financial health of firms

	$t + 1$		$t + 2$		$t + 3$	
EM	Low	High	Low	High	Low	High
AR	-0.13	-0.20	-0.15	-0.19	-0.15	-0.18
P-value	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
(df)	332	213	569	334	759	382
Tobin's Q	0.04	0.90	0.01	0.83	0.10	0.48
P-value	0.38	(0.04)	0.44	(0.05)	0.15	(0.06)
(df)	25	22	26	22	25	21



(a)



(b)

Figure 5: Impact of financial health

DISCUSSION

Generally, it is revealed that RFID adoption has a significant negative impact on firms in terms of abnormal return. However, whether there is an influence on Tobin's Q depends on factors such as the timing of adoption, country, industry, and level of

financial health. The reasons behind our results could be multiple.

Firstly, RFID investment does not translate into performance improvement directly. Prior research has showed that the average payback period of RFID adoption is 4-5 years^[25]. Therefore the spending or cost of RFID implementation will appear in firms' financial report over a long period and the amount is usually huge. By extending into a long-term observation period, it is helpful for us to understand the impact of RFID more accurately compared with short term studies because the implementation of RFID is a long term project. We discover an interesting pattern regarding to the length of influence of RFID on firms' growth potential, the evidence of which is from our analysis with contingent factors. Subgroup analysis showed that the influence of RFID on Tobin's Q sometimes appear only after $t + 3$ and the influence may decrease from $t + 1$ to $t + 3$. This finding is consistent with Kim and Sohn^[31] whose research discovered that the average payback period is 4-5 years.

Secondly, the influence of RFID adoption may not be observed correctly because of the choice of performance measurement and contingent factors. By considering contingent factors, our results provide evidence on how RFID adoption strategy may influence firms' financial performance. The results considering the country effect suggest that in mature market such as US, RFID is a type of competitive necessity which is essential for survive but may not bring competitive advantage. Our results on adoption timing suggest that first mover advantage is still important for RFID implementation. The results on industry again suggest that IT investment does not lead to financial gain directly. Therefore, managerial speaking, our results provides the following suggestions to practitioners. First, it is necessary to examine the overall adoption rate of RFID in market. If the adoption rate is low, RFID adoption may make you lead otherwise RFID's effect is just keep you survive. Second, for managers of manufacturers, extra caution is needed if they want to adopt RFID because those firms may face additional risk due to heavy operational cost and challenges in integrating IT and business. Third, for short term stock market investors, they should avoid investing in firms who adopted RFID during the last three years while for long term value investors, those firms were worth of investment especially for those whose Tobin's Q received a positive influence from the adoption.

This study has its own limitation. First, the sample size could be larger is the data are complete. Second, instead of dividing the firms into US firms and non-US firms, it would be more interesting to fix effect of individual countries given that enough samples could be collected for each country. Finally, it would be more interesting if longer period is studied. If that is possible, we may discover whether manufacturers can finally gain benefit from RFID adoption, which indicates the time profit from usage of RFID exceeds the cost for RFID implementation.

CONCLUSION

Previous studies on the effects of RFID adoption have relied largely on anecdotal evidence, non-financial metrics or accounting based measures that ignore intangible value. In this paper, we present an empirical study of the impact of RFID adoption on firm value across a broad sample of 86 firms over the period from 1997 to 2011. Using different measures: abnormal market return and Tobin's Q, we observe the influence of RFID adoption on those measures during the period of $t + 1$ to $t + 3$ (where t is the year of adoption). Our study offers a comprehensive insight of RFID adoption from its market reaction, accounting operational performance and its future revenue-generation potential. In general, significant negative abnormal return for RFID adoption firms and significant positive influence on Tobin's Q are observed. Subsample analysis with contingent factors discover results consistent with those of the whole sample.

Our research has several contributions. First, our results suggest within the window of three years of adoption, RFID will bring beneficial influence to future growth potential but not ROA and market value. Second, the influence may last for two years but no more. Our results also discover the effect of adoption timing which may suggest first move advantage for RFID adoption. In addition, country, industry, and financial health of firms all may assert influence on the impact of RFID adoption, suggesting that RFID adoption is a complex project and managers should take all these factors into consideration.

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The Impact of Different Power Structures on The Cross-Border e-Retail Supply Chain With An O2O Dual- Channel

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ABSTRACT

In this paper, considering a cross-border e-retail supply chain composed by a foreign supplier and a cross-border e-retailer, we study the impact of different power structures on the supply chain members' pricing and profits by establishing foreign supplier Stackelberg (FSS), cross-border e-retailer Stackelberg (CES) and vertical Nash (VN) game model on the basis of discussing O2O dual-channel retail mode and pricing decision. The results show that: i) the cross-border e-retailer prefer to choose the centralized pricing mode and will gain more profit than that in the decentralized pricing mode under the condition of O2O dual-channel retailing. ii) The impact of Stackelberg game on dual channel pricing of the cross-border e-retailer is identical, but the impact of three games on foreign supplier's pricing is significant, (i.e., the wholesale price of the foreign supplier becomes smaller with the game dominance decreased gradually). iii) The impact of three games on cross-border electronic supply chain members' profits is significant (i.e., members' profits become smaller with the game dominance decreased gradually). In addition, the impact of Stackelberg game on supply chain total profits is identical. However, the supply chain total profits under Vertical Nash game are more than Stackelberg game.

Keywords: Dual-channel retailing, Stackelberg/Nash game, cross-border e-commerce, supply chain management.

INTRODUCTION

In recent years, along with the rapid implementation of a succession of policies, cross-border electronic commerce in China has got swift and violent development [1-2]. According to the China E-business Research Center (2016), only Hangzhou city, the size of its cross-border e-commerce transactions is \$3.464 billion in 2015, export \$2.273 billion and \$1.191 billion of imports [3]. However, the impacts of lacking of physical product experience, waiting for a long time to pay and delivery and experiencing a complex refunding or changing on the customer's shopping experience are so serious. Under this background, the cross-border O2O dual-channel retail mode consist of physical offline retail channels and online channels becomes more and more popular, and then the decision issue is how to develop a pricing strategy in an O2O mixed dual-channel to maximize the cross-border e-retailer's benefits in the online and offline channels [4]. In addition, the different power structures between e-commerce giants, small, medium-sized e-retailers and foreign suppliers in the cross-border electronic supply chain result in the different bargaining power between them and foreign suppliers, which affect their pricing strategies and profits level.

Therefore, from the perspective of cross-border electronic supply chain, studying the impact of different power structures on dual-channel pricing of cross-border e-retailers and supply chain members' profits is an interesting issue. As a consequence, we assume that there are three supply chain power structures which are foreign supplier Stackelberg (FSS) (power structure 1), cross-border e-retailer Stackelberg (CES) (power structure 2) and Vertical Nash (VN) game model (power structure 3) in a cross-border electronic supply chain composed of a foreign supplier and a cross-border e-retailer with O2O dual channel. We firstly build demand models by comparing the consumer surplus and discuss the pricing decision problem. Then on this basis, we analyze the impact of different power structures of supply chain on the supply chain members' pricing and profits by comparing the sales prices and profits under three supply chain power structures. The results show that i) Cross-border e-retailer should implement the centralized pricing strategy comparing with the decentralized pricing decisions under the condition of O2O dual-channel retailing. ii) The impact of Stackelberg game on dual channel pricing of the cross-border e-retailer is identical, but the impact of three games on foreign supplier's pricing is significant (i.e., the wholesale price of the foreign supplier becomes smaller with the game dominance decreased gradually). iii) The impact of three games on cross-border electronic supply chain members' profits is significant (i.e., members' profits become smaller with the game dominance decreased gradually). In addition, the impact of Stackelberg game on supply chain total profits is identical. However, the supply chain total profits under Vertical Nash game are more than Stackelberg game.

The remainder of this article is organized as follows. In Section 2, we make a brief review of relevant literature. In Section 3, we provide a model description and problem statement. In Section 4, we analyze the two pricing modes, centralized pricing and decentralized pricing. In section 5, we discuss the pricing strategies in FSS model, CES model, and VN model respectively. In Section 6, the impact of different power structures on pricing decisions and cross-border electronic supply chain profits in an O2O dual-channel is discussed. Finally, conclusions and managerial insights are presented in Section 7.

LITERATURE REVIEW

The literature related to this paper mainly includes the following two aspects: on the one hand, it is related research about O2O channel mode selection, on the other hand, it is the study of how supply chain member's relative power effect on the member pricing and profit.

O2O Dual-channel Selection

Among many studies of O2O dual-channel selection, the researchers initially studied the operation mode of the O2O and its impact on traditional business model [5-7] based on O2O initial definition Online - Offline (Online to Offline) which is to bring online consumers into the traditional bricks-and-mortar stores. However, the O2O dual-channel in this study refers to the cross-border e-retailer sells product through online and offline sales channels. In this respect, the early investigators from the perspective of manufacturers studied the issue of whether manufacturers should self-built online direct sales channel based on the original retail channels [8-14], their researches show that self-built new online direct sales channels for manufacturers are advantageous, in which Kumar et al [15] study the causes and mechanism that the original manufacturers add online direct sales channel based on traditional retail from the perspective of strategy. However, Yoo and Lee [16] pointed out that the introduction of direct sales channels does not always lead to lower retail prices and increase consumer welfare, and even in certain market conditions may lead to the deterioration of independent retailers' income.

The above researches only considered the price factors, through comparing the profits before and after building the online direct sales channel, and determined whether to introduce online direct marketing channels or not. Hill et al [17-21] made the delivery time decoupled from the service level, and assimilated the delivery time of online direct marketing channels into the model development to study the dual channel decision problem of manufacturer by comparing consumer surplus between two channels and building demand functions. In addition, Chen et al [22] studied dual channel strategy selection problem of manufacturers based on different levels of service between channels, pointed out the optimal channel decisions depending on operating costs of direct sales channels, inconvenience of buying from the entity shops and goods' characteristics and other factors.

Analysis shows that the above studies mostly from the perspective of manufacturer study the issue of dual channels decision and rarely analyze the issue from the perspective of retailers considering the impact of power structure of supply chain on member's decisions.

The Impact of Power Structure of Supply Chain on the Members' Pricing and Profits

Gaski et al [23-25] examined the impact of the power structure of the supply chain on the pricing and revenue of the members. In recent years, with the rapid development of network technology and logistics delivery, some manufacturers began to use online direct channel and traditional retail channel to sell goods. In this business environment, exploring the impact of different power structures of supply chain on members' pricing and profits has become the focus concerned by operations management and marketing scholars. Cai et al. [26-29] used supplier Stackelberg, retailer Stackelberg and vertical Nash game to model three different supply chain power structures and analyzed the impact of different power structures of supply chain on members' pricing and profits. These studies are based on background that manufacturers add online direct marketing channels and form dual-channel supply chain structure. However, Chen et al. [30] studied the impact of different power structures on members' pricing and profits from the perspective of retailer who owned online channel and offline channel. On the basis of comparative analysis of [30], Huang et al. [31] analyzed the effects of different power structures on members' pricing and benefits of two types of dual-channel supply chain, in which manufacturer owned the dual-channel or retailer owned the dual-channel. In addition, Lin et al [32] used manufacturer Stackelberg and retailer Stackelberg to establish pricing model of closed-loop supply chain with two channels, research and compare the impact of different power structure of closed-loop supply chain on members' pricing and revenue.

In summary, most existing literature study the operation and management of dual channels, and the impact of different power structures on members' pricing and profits from the perspective of manufacturer who establishes online direct channel. Few literatures study the impact of different power structures on members' pricing and profits from the perspective of retailer, especially cross-border e-retailer who owns on-line and off-line channels. Only Chen et al. [30] studied the similar problem, but the two deterministic linear demand functions of channels are given in that paper, which cannot reflect the essence of the customer channel choice. In this paper, from the perspective of the consumer surplus, we build dual channels demand function and benefit function to research dual channel pricing strategy problem of cross-border e-retailer with offline and online channels, meanwhile, analyze the impact of different power structures on members' pricing and benefits by comparing the price and profits.

PROBLEM DESCRIPTION AND ASSUMPTIONS

A foreign supplier and a cross-border e-retailer in our study form a two-echelon cross-border e-retail supply chain. The foreign supplier supplies product for the cross-border e-retailer and the cross-border e-retailer sells the product to the consumers through O2O channels that include both offline channel and online channel. We use c and w to denote foreign supplier's unit product cost and unit wholesale price, where $w > c$. We use p_1 and c_1 to denote offline unit retail price and offline unit sale cost. Similarly, p_2 is the online retail price and c_2 is the online unit sale cost. $p_i > w + c_i$ ($i = 1, 2$). Without loss of generality, we assume that $c_1 > c_2$.

The online channel only could use text, graphics, or symbols in a paper or web page catalog to describe the product for consumers virtually. Consumers can not touch, taste, smell the products before purchase them, and make evaluation mistakes. Even if the product may be returned after a mistaken purchase, the refund is typically only partial, therefore reducing the expectation of consumption value [33]. When consumers purchase from online channel, typically they need to wait several days for delivery and will be charged a shipping and handling fee [34]. Therefore, we use μ represent the customer acceptance of the online channel. According to Chiang et al. [9], when consumers purchase from online channel, they will have a less consumption value (alternatively called “willingness to pay”) for the identical product purchased through offline channel. An empirical study by Liang and Huang [35] shows that overall, consumers prefer offline channel more than the online channels. Another recent survey by Kacen et al [36] Provides further evidence (Please see Table1) that the customer acceptance of online purchases is less than one for many product categories. Hence, the model in this paper is developed for those products with $0 < \mu < 1$.

Table 1: Customers' Acceptance Index μ for Online Channel

Category	Book	Shoes	Toothpaste	DVD player	Flowers	Food items
Acceptance	0.904	0.769	0.886	0.787	0.792	0.784

Note: the above values come from the study of Kacen et al. [36].

Following the model development in [9, 37-38], we assume that consumers have heterogeneous consumption value v . Thus, we assume that v is uniformly distributed within the consumer population from 0 to 1, with a density of 1. Therefore, the consumer surplus through the offline channel would be $v - p_1$. Due to $0 < \mu < 1$, the consumption value of consumers when the product is purchased through an online channel would be less than v . Therefore, the consumption value of the product when it is obtained from the online channel is μv , and then the resulting consumer surplus is $\mu v - p_2$. According to the theory of consumer's surplus, when $v - p_1 \geq 0$, all consumers will consider buying through the offline channel. The marginal consumer whose consumption value v_1 equals p_1 is indifferent to buying from through the offline channel. Similarly, when $\mu v - p_2 \geq 0$, all consumers will consider buying through the online channel. The marginal consumer whose consumption value v_2 equals p_2/μ is indifferent to buying from through the online channel. Under the O2O dual-channel retail environment, consumers are strategic, i.e., their purchase decisions are based on consumer surplus maximization. They would prefer the channel where they derive more surpluses. Thus consumers will compare the consumer surplus derived through the offline channel with the consumer surplus derived through the online channel (i.e., $v - p_1$ versus $\mu v - p_2$). If $v - p_1 > \mu v - p_2$, consumer would like to buy from the offline channel because consumer can derive more surpluses from the offline channel. If $\mu v - p_2 > v - p_1$, consumer would like to buy from the online channel because consumer can derive more surpluses from the online channel. If $\mu v - p_2 = v - p_1$ (i.e., $v_{12} = \frac{p_1 - p_2}{1 - \mu}$), the consumer would be indifferent to buying from either the offline channel or the online channel because consumer derives equal surplus from either channel. By comparing different consumption values (i.e., v_1 , v_2 and v_{12}), we can show that when $v_1 > v_2$ (i.e., $p_1 > \frac{p_2}{\mu}$), then $v_{12} > v_1 > v_2$, all consumers with consumption value in the interval $[v_2, v_{12}]$ prefer to buy from the online channel, and all those in the interval $[v_{12}, 1]$ prefer to buy from the offline channel. Consumers whose consumption values are found in $[0, v_2]$ will not buy the product from either channel. When $v_2 > v_1$ (i.e., $\frac{p_2}{\mu} > p_1$), then $v_2 > v_1 > v_{12}$, all consumers would buy from the offline channel. Hence, we only consider the case where $p_1 > \frac{p_2}{\mu}$ and dual channels co-exist. Through above analysis, O2O dual-channel demand functions can be written as

$$d_1 = 1 - \frac{p_1 - p_2}{1 - \mu} \quad (1)$$

$$d_2 = \frac{p_1 - p_2}{1 - \mu} - \frac{p_2}{\mu} \quad (2)$$

Where d_1 and d_2 denote the demands of the offline and online channels, respectively.

In addition, we assume that all the demand and cost information is the common knowledge for both cross-border e-retailer and the foreign supplier. The cross-border e-retailer and the foreign supplier are rational and self-interested and aim to maximize their own profit. Figure 1 displays the model.

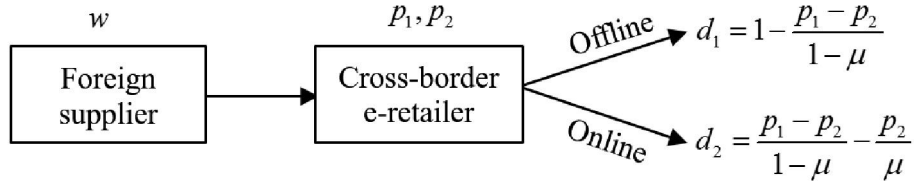


Figure 1: The model illustration of O2O dual-channel retail of cross-border e-retailer.

DUAL-CHANNEL PRICING STRATEGY CHOICE OF CROSS-BORDER E-RETAILER

The cross-border e-retailer has two pricing strategies: centralized pricing strategy and decentralized pricing strategy. Centralized pricing strategy refers that the cross-border e-retailer takes the centralized pricing strategies for both offline and online channels. While decentralized pricing strategy refers that the cross-border e-retailer takes the pricing strategies separately for offline and online channels.

Centralized Pricing Strategy

As to the centralized pricing strategy, the objective of cross-border e-retailer is to maximize the total profit of offline and online channels. In this case, the cross-border e-retailer's profit from two channels can be denoted as follows:

$$\pi_r = (p_1 - w - c_1)d_1 + (p_2 - w - c_2)d_2 \quad (3)$$

After substituting Eqs. (1) and (2) into Eq. (3), we have

$$\pi_r = (p_1 - w - c_1)\left(1 - \frac{p_1 - p_2}{1 - \mu}\right) + (p_2 - w - c_2)\left(\frac{p_1 - p_2}{1 - \mu} - \frac{p_2}{\mu}\right) \quad (4)$$

From Eq. (4) we can see: online channel price p_1 both has positive and negative influence on cross-border e-retailer's profit; offline channel price p_2 both has positive and negative influence on cross-border e-retailer's profit too; so the optimal online and offline prices are exist under certain conditions. As to the cross-border e-retailer's optimal price for offline channel (p_1^*) and online channel (p_2^*) in the centralized pricing strategy, we can obtain the following lemma.

Lemma1: the cross-border e-retailer's optimal prices for offline channel and online channel in the centralized pricing mode are:

$$p_1^* = \frac{1 + w + c_1}{2}$$

$$p_2^* = \frac{\mu + w + c_2}{2}$$

Proof. According to the principle of profit maximization, taking the first order derivatives and second order derivatives of Eq. (4) with respect to p_1 and p_2 , we find that

$$\begin{aligned} \frac{\partial \pi_r}{\partial p_1} &= 1 - \frac{2p_1}{1 - \mu} + \frac{2p_2}{1 - \mu} + \frac{c_1 - c_2}{1 - \mu} \\ \frac{\partial \pi_r}{\partial p_2} &= \frac{2p_1}{1 - \mu} - \frac{2p_2}{\mu(1 - \mu)} + \frac{(1 - \mu)w + c_2 - \mu c_1}{\mu(1 - \mu)} \\ \frac{\partial^2 \pi_r}{\partial p_1^2} &= -\frac{2}{1 - \mu} \\ \frac{\partial^2 \pi_r}{\partial p_1 \partial p_2} &= \frac{2}{1 - \mu} \\ \frac{\partial^2 \pi_r}{\partial p_2^2} &= -\frac{2}{\mu(1 - \mu)} \\ \frac{\partial^2 \pi_r}{\partial p_2 \partial p_1} &= \frac{2}{1 - \mu} \end{aligned}$$

The hessian matrix of π_r is as follows according to the profit function of the cross-border e-retailer:

$$\begin{bmatrix} -\frac{2}{1 - \mu} & \frac{2}{1 - \mu} \\ \frac{2}{1 - \mu} & -\frac{2}{\mu(1 - \mu)} \end{bmatrix}$$

Accordingly, the order principal minor determinants of the matrix are:

$$H_1 = -\frac{2}{1-\mu}, \quad H_2 = \frac{4}{\mu(1-\mu)}$$

Since $0 < \mu < 1$, as a result, $H_1 = -\frac{2}{1-\mu} < 0$, $H_2 = \frac{4}{\mu(1-\mu)} > 0$, therefore, the hessian matrix of π_r is a negative definite for all p_1 and p_2 . The cross-border e-retailers' profit function with respect to p_1 and p_2 is a convex function in the centralized pricing mode, and the maximum value is unique. Let the first order derivations of Eq. (4) with respect to p_1 and p_2 equal to zero, we can get:

$$p_1 = \frac{2p_2 - \mu + c_1 - c_2 + 1}{2}$$

$$p_2 = \frac{2\mu p_1 + (1-\mu)w + c_2 - \mu c_1}{2}$$

Combining the two formulas above, we obtain the optimal retail p_1^* and p_2^* . This completes the proof. Accordingly, we can obtain the profit of cross-border e-retailer in the centralized pricing mode.

$$\begin{aligned} \pi_r(p_1^*, p_2^*) &= \frac{(1-w-c_1)(1-\mu-c_1+c_2)}{4(1-\mu)} + \frac{(\mu-w-c_2)[\mu c_1 - c_2 - (1-\mu)w]}{4\mu(1-\mu)} \\ &= \frac{\mu(1-\mu)[1-2c_1-2w] + w(1-\mu)(2c_2-w) + \mu c_1^2 + c_2^2 - 2\mu c_1 c_2}{4\mu(1-\mu)} \end{aligned}$$

The Decentralized Pricing Strategy

The decentralized pricing strategy refers that the two channels are operated by different departments of the cross-border e-retailer, such as offline channel department and online channel department, and each department decides their channel retail price to maximize the profit. We define this scenario to be decentralized pricing strategy.

As to the decentralized pricing strategy, the offline channel's profit can be expressed as:

$$\pi_{r1} = (p_1 - w - c_1)d_1 \quad (4)$$

After substituting Eq. (1) into above Eq. (π_{r1}), we obtain the offline channel's profit of cross-border e-retailer as

$$\pi_{r1} = (p_1 - w - c_1)(1 - \frac{p_1 - p_2}{1-\mu}) \quad (5)$$

As to the decentralized pricing strategy, the online channel's profit can be expressed as:

$$\pi_{r2} = (p_2 - w - c_2)d_2$$

After substituting Eq. (2) into Eq. (π_{r2}) above, we obtain the online channel's profit of cross-border e-retailer as

$$\pi_{r2} = (p_2 - w - c_2)(\frac{p_1 - p_2}{1-\mu} - \frac{p_2}{\mu}) \quad (6)$$

After maximizing the profits of online and offline separately, we can obtain the following lemma2:

Lemma2: the cross-border e-retailer's optimal prices for offline channel and online channel in the decentralized pricing strategy are:

$$p_1^{d*} = \frac{2(1-\mu) + 3w + 2c_1 + c_2}{4-\mu}$$

$$p_2^{d*} = \frac{\mu(1-\mu) + (\mu+2)w + \mu c_1 + 2c_2}{4-\mu}$$

Proof. According to the principle of profit maximization, taking the first order derivatives and second order derivatives of Eq. (5) with respect to p_1 and taking the first order derivatives and second order derivatives of Eq. (6) with respect to p_2 , we find that

$$\begin{aligned} \frac{\partial \pi_{r1}}{\partial p_1} &= 1 - \frac{2p_1}{1-\mu} + \frac{p_2}{1-\mu} + \frac{w+c_1}{1-\mu} \\ \frac{\partial^2 \pi_{r1}}{\partial p_1^2} &= -\frac{2}{1-\mu} \\ \frac{\partial \pi_{r2}}{\partial p_2} &= \frac{p_1}{1-\mu} - \frac{2p_2}{\mu(1-\mu)} + \frac{w+c_2}{\mu(1-\mu)} \end{aligned}$$

$$\frac{\partial^2 \pi_{r2}}{\partial p_2^2} = -\frac{2}{\mu(1-\mu)}$$

It can be seen that the second order derivative of π_{r1} with respect to p_1 is less than zero, therefore, π_{r1} is a convex function with respect to p_1 ; Similarly, π_{r2} is a convex function with respect to p_2 . Let the first order derivations of Eqs. (5) and (6) with respect to p_1 and p_2 equal to zero, we can get:

$$p_1 = \frac{1-\mu+p_2+w+c_1}{2}$$

$$p_2 = \frac{\mu p_1 + w + c_2}{2}$$

Combining the two formulas above, we obtain the optimal retail p_1^{d*} and p_2^{d*} . This completes the proof. Therefore, we can get the profit of cross-border e-retailers in the decentralized pricing mode.

$$\pi_r(p_1^{d*}, p_2^{d*}) = \frac{[(2-w)(1-\mu) - (2-\mu)c_1 + c_2]^2}{(1-\mu)(4-\mu)^2} + \frac{[(1-\mu)(\mu-2w) + \mu(c_1+c_2) - 2c_2]^2}{\mu(1-\mu)(4-\mu)^2}$$

According to the selection of cross-border e-retailer's pricing strategy, making a comparison of the maximum profits, the following proposition can be obtained.

Proposition 1:

$$\pi_r(p_1^{i*}, p_2^{i*}) > \pi_r(p_1^{d*}, p_2^{d*})$$

The proof of proposition 1 can be found in literature [30]. Not surprisingly, according to Proposition 1, we know that the cross-border e-retailer's profit which is obtained from the centralized pricing strategy is higher than that obtained from the decentralized pricing strategy. Therefore, the cross-border e-retailer prefers to take the centralized pricing strategy. Hereinafter, we assume that the cross-border e-retailer adopts the centralized pricing strategy.

THE PRICING AND PROFIT OF MEMBERS OF CROSS-BORDER E-COMMERCE SUPPLY CHAIN UNDER DIFFERENT POWER STRUCTURES

Foreign Supplier Stackelberg (FSS) Model

The main difference between various power structures is that the players make their decisions in sequence in the Stackelberg games whereas they make their decisions simultaneously in the Nash game [30]. In an FSS market, the sequence of events is as follows. Firstly, the cross-border e-retailer's reaction function is derived, and the cross-border e-retailer's offline and online retail price can be obtained which is denoted by the foreign supplier's wholesale price the foreign supplier announces the wholesale price to the cross-border e-retailer. Then, the manufacturer takes the cross-border e-retailer's reaction function into consideration to determine its wholesale price. Third, the foreign supplier selects her optimal wholesale price using the response function of the cross-border e-retailer so as to maximize her profit. Finally, when the consumer demand is realized, the foreign supplier and the cross-border e-retailer gain their revenues.

The foreign supplier's profit $\pi_s(w)$ in an FSS market can be denoted as:

$$\pi_s(w) = (w-c)d_1 + (w-c)d_2 \quad (7)$$

After substituting Eqs. (1) and (2) into Eq. (7) above, we obtain the foreign supplier's profit

$$\begin{aligned} \pi_s(w) &= (w-c)\left(1 - \frac{p_1 - p_2}{1-\mu}\right) + (w-c)\left(\frac{p_1 - p_2}{1-\mu} - \frac{p_2}{\mu}\right) \\ &= (w-c)\left(1 - \frac{p_2}{\mu}\right) \end{aligned} \quad (8)$$

In the section 4.1 of this paper, we get $p_2^{i*} = \frac{\mu+w+c_2}{2}$. Now we substitute $p_2^{i*} = \frac{\mu+w+c_2}{2}$ into π_s and take the first order derivative of π_s with respect to w . Then, we make the first order derivative equal to 0 and obtain the proposition as below:

Proposition 2: In an FSS market, the wholesale price of the foreign supplier and the offline and online prices of cross-border e-retailer are as below:

$$w_s^* = \frac{\mu+c-c_2}{2}$$

$$p_1^{s*} = \frac{2+\mu+c+2c_1-c_2}{4}$$

$$p_2^{s*} = \frac{3\mu+c+c_2}{4}$$

From proposition 2 and Eq. (4), we get the cross-border e-retailer's maximum profit in an FSS market as

$$\pi_r(p_1^{s*}, p_2^{s*}) = \frac{(2 - \mu - c - 2c_1 + c_2)(1 - \mu - c_1 + c_2)}{8(1 - \mu)} + \frac{(\mu - c - c_2)[\mu^2 - \mu + 2\mu c_1 - \mu c_2 - (1 - \mu)c - c_2]}{16\mu(1 - \mu)} \quad (9)$$

From proposition 2 and Eq. (8), we get the foreign supplier's maximum profit in an FSS market as

$$\pi_s(w_s^*) = \frac{(\mu - c - c_2)^2}{8\mu} \quad (10)$$

From (9) and Eq. (10), we get the supply chain's profit in an FSS market, denoted $\pi(w_s^*, p_1^{s*}, p_2^{s*})$, as

$$\pi(w_s^*, p_1^{s*}, p_2^{s*}) = \pi_r(p_1^{s*}, p_2^{s*}) + \pi_s(w_s^*) \quad (11)$$

Cross-border E-retailer Stackelberg (CES) Model

In a CES market, the cross-border e-retailer and the foreign supplier make their decisions in sequence and the order of events is as follows. Firstly, the cross-border e-retailer announces her offline retail price and online retail price. Then, foreign supplier decides her wholesale price given the retailer's offline retail price and online retail price. Third, the cross-border e-retailer chooses her optimal offline retail price and online retail price using the response function of the supplier so as to maximize her profit. Finally, when the consumer demand is realized, the foreign supplier and the cross-border e-retailer gain their revenues.

We assume that the marginal profit of offline channel (denoted m_1) is $m_1 = p_1 - w$, the marginal profit of online channel (denoted m_2) is $m_2 = p_2 - w$. Then, the foreign supplier's profit, denoted $\pi_s(w)$, is

$$\pi_s(w) = (w - c) \left[1 - \frac{(m_2 + w)}{\mu} \right] \quad (12)$$

Taking the first order derivative of $\pi_s(w)$ with respect to w and making the first order derivative equal to zero, we find that

$$w = \frac{\mu + c - m_2}{2}$$

After substituting $m_2 = p_2 - w$ into the formula above, we get $w = \mu + c - p_2$. After substituting $w = \mu + c - p_2$ into Eq. (4), taking the first order derivatives of Eq. (4) with respect to p_1, p_2 separately and making the first order derivatives equal to 0. We get the proposition as below.

Proposition 3: In a CES market, the wholesale price of the foreign supplier and the offline and online prices of cross-border e-retailer are as below:

$$\begin{aligned} w_r^* &= \frac{\mu + 3c - c_2}{4} \\ p_1^{r*} &= \frac{2 + \mu + c + 2c_1 - c_2}{4} \\ p_2^{r*} &= \frac{3\mu + c + c_2}{4} \end{aligned}$$

From proposition 3 and Eq. (4), we get the cross-border e-retailer's maximum profit in a CES market as

$$\pi_r(p_1^{r*}, p_2^{r*}) = \frac{(1 - c - c_1)(1 - \mu - c_1 + c_2)}{4(1 - \mu)} + \frac{(\mu - c - c_2)[\mu^2 - \mu + 2\mu c_1 - \mu c_2 - (1 - \mu)c - c_2]}{8\mu(1 - \mu)} \quad (13)$$

From proposition 3 and Eq. (12), we get the foreign supplier's maximum profit in a CES market as

$$\pi_s(w_r^*) = \frac{(\mu - c - c_2)^2}{16\mu} \quad (14)$$

From (13) and Eq. (14), we get the supply chain's profit in a CES market, denoted $\pi(w_r^*, p_1^{r*}, p_2^{r*})$, as

$$\pi(w_r^*, p_1^{r*}, p_2^{r*}) = \pi_r(p_1^{r*}, p_2^{r*}) + \pi_s(w_r^*) \quad (15)$$

Vertical Nash (VN) Model

In a VN market, the cross-border e-retailer and the foreign supplier make their decisions simultaneously and the order of events is as follows. The cross-border e-retailer decides her offline retail price and online retail price to maximize her profit given the supplier's wholesale price, and the foreign supplier decides her wholesale price to maximize her profit given the cross-border e-retailer's offline retail price and online retail price. Finally, when the consumer demand is realized, the cross-border e-retailer and the foreign supplier gain their revenues.

We assume that the marginal profit of offline channel (denoted m_1) is $m_1 = p_1 - w$, the marginal profit of online channel (denoted m_2) is $m_2 = p_2 - w$. Then, the foreign supplier's profit, denoted $\pi_s(w)$, is

$$\pi_s(w) = (w - c) \left[1 - \frac{(m_2 + w)}{\mu} \right] \quad (16)$$

Taking the first order derivative of $\pi_s(w)$ with respect to w and making the first order derivative equal to zero, we have

$$w = \frac{\mu + c - m_2}{2}$$

After substituting $m_2 = p_2 - w$ into the formula above, we get $w = \mu + c - p_2$. In the section 4.1 of this paper, the offline and online prices of the cross-border e-retailer in the centralized pricing mode are as below:

$$p_1^i = \frac{1 + w + c_1}{2}$$

$$p_2^i = \frac{\mu + w + c_2}{2}$$

After substituting $w = \mu + c - p_2$ into p_1^i , p_2^i above, we get the following proposition:

Proposition 4: In a VN market, the wholesale price of the foreign supplier and the offline and online prices of cross-border e-retailer are as below:

$$w_v^* = \frac{\mu + 2c - c_2}{3}$$

$$p_1^{v*} = \frac{3 + \mu + 2c + 3c_1 - c_2}{6}$$

$$p_2^{v*} = \frac{2\mu + c + c_2}{3}$$

From proposition 4 and Eq. (4), we get the cross-border e-retailer's maximum profit in a VN market as

$$\pi_r(p_1^{v*}, p_2^{v*}) = \frac{(3 - \mu - 2c - 3c_1 + c_2)(1 - \mu - c_1 + c_2)}{12(1 - \mu)} + \frac{(\mu - c - c_2)[\mu^2 - \mu + 3\mu c_1 - \mu c_2 - (1 - \mu)2c - 2c_2]}{18\mu(1 - \mu)} \quad (17)$$

From proposition 4 and Eq. (16), we get the foreign supplier's maximum profit in a VN market as

$$\pi_s(w_v^*) = \frac{(\mu - c - c_2)^2}{9\mu} \quad (18)$$

From (17) and Eq. (18), we get the supply chain's profit in a VN market, denoted $\pi(w_v^*, p_1^{v*}, p_2^{v*})$, as

$$\pi(w_v^*, p_1^{v*}, p_2^{v*}) = \pi_r(p_1^{v*}, p_2^{v*}) + \pi_s(w_v^*) \quad (19)$$

COMPARATIVE ANALYSIS

In this section, we discuss the impact of different power structures on the cross-border e-retail supply chain's decisions and performances. As to the impact of different power structures in the cross-border e-retail supply chain's optimal price, we can obtain the following proposition:

Proposition 5: $p_1^{s*} = p_1^{r*} > p_1^{v*}$, $p_2^{s*} = p_2^{r*} > p_2^{v*}$ and $w_s^* > w_v^* > w_r^*$

Proof. From propositions 2 and 3, we can obtain $p_1^{s*} = p_1^{r*}$ and $p_2^{s*} = p_2^{r*}$ directly. Since $w > c$, from propositions 2, 3 and 4, we get $\mu - c - c_2 > 0$. From propositions 3 and 4, we obtain $p_1^{r*} - p_1^{v*} = \frac{\mu - c - c_2}{12} > 0$ and $p_2^{r*} - p_2^{v*} = \frac{\mu - c - c_2}{12} > 0$, therefore,

$p_1^{r*} > p_1^{v*}$ and $p_2^{r*} > p_2^{v*}$. Hence, $p_1^{s*} = p_1^{r*} > p_1^{v*}$ and $p_2^{s*} = p_2^{r*} > p_2^{v*}$. From propositions 2 and 4, we get $w_s^* - w_v^* = \frac{\mu - c - c_2}{6} > 0$,

that is $w_s^* > w_v^*$. From propositions 3 and 4, we get $w_v^* - w_r^* = \frac{\mu - c - c_2}{12} > 0$, that is $w_v^* > w_r^*$. Therefore, $w_s^* > w_v^* > w_r^*$. This completes the proof.

According to proposition 5, we know that the cross-border e-retailer's optimal offline retail price and online retail price in an FSS market are equal to those in an CES market, that is, FSS or CES market structure has no effect on the cross-border e-retailer's retail prices. It means that the cross-border e-retailer with O2O mixed dual-channel has more flexibility in different

market structures. In addition, the cross-border e-retailer's optimal offline retail price and online retail price in an FSS and CES market are higher than those in a VN market. This means that consumers are generally better off in a VN power structure. This can be explained by the fact that when the foreign supplier and the cross-border e-retailer have a more balanced market power in a VN market, there is a more intense competition which drives the prices down. In addition, we also know that the foreign supplier's optimal wholesale price is more sensitive to the power structure as the foreign supplier's optimal wholesale price in an FSS market is the highest, the foreign supplier's optimal wholesale price in a CES market is the lowest, and the foreign supplier's optimal wholesale price in a VN market is in the middle. This means that the foreign supplier will set higher wholesale price when she has more market power, and set lower wholesale price when she has less market power.

Next, we discuss the impact of power structure on the cross-border e-retail supply chain's maximum profit; we can obtain the following proposition:

Proposition6: $\pi_r(p_1^{r*}, p_2^{r*}) > \pi_r(p_1^{v*}, p_2^{v*}) > \pi_r(p_1^{s*}, p_2^{s*})$, $\pi_s(w_s^*) > \pi_s(w_v^*) > \pi_s(w_r^*)$ And $\pi(w_v^*, p_1^{v*}, p_2^{v*}) > \pi(w_r^*, p_1^{r*}, p_2^{r*}) = \pi(w_s^*, p_1^{s*}, p_2^{s*})$

Proof. From (13) and (17), we get $\pi_r(p_1^{r*}, p_2^{r*}) - \pi_r(p_1^{v*}, p_2^{v*}) = \frac{(\mu - c - c_2)^2}{72\mu} > 0$, that is $\pi_r(p_1^{r*}, p_2^{r*}) > \pi_r(p_1^{v*}, p_2^{v*})$. From (17)

and (9), we get $\pi_r(p_1^{v*}, p_2^{v*}) - \pi_r(p_1^{s*}, p_2^{s*}) = \frac{7(\mu - c - c_2)^2}{144\mu} > 0$, that is $\pi_r(p_1^{v*}, p_2^{v*}) > \pi_r(p_1^{s*}, p_2^{s*})$.

Hence, $\pi_r(p_1^{r*}, p_2^{r*}) > \pi_r(p_1^{v*}, p_2^{v*}) > \pi_r(p_1^{s*}, p_2^{s*})$. From (10), (14) and (18), we can directly get $\pi_s(w_s^*) > \pi_s(w_v^*) > \pi_s(w_r^*)$. From (11) and (15), we get $\pi(w_r^*, p_1^{r*}, p_2^{r*}) - \pi(w_s^*, p_1^{s*}, p_2^{s*}) = 0$, that is $\pi(w_r^*, p_1^{r*}, p_2^{r*}) = \pi(w_s^*, p_1^{s*}, p_2^{s*})$. From (19) and (15), we

get $\pi(w_v^*, p_1^{v*}, p_2^{v*}) - \pi(w_s^*, p_1^{s*}, p_2^{s*}) = \frac{5(\mu - c - c_2)^2}{144\mu}$, that is $\pi(w_v^*, p_1^{v*}, p_2^{v*}) > \pi(w_s^*, p_1^{s*}, p_2^{s*})$.

Hence, $\pi(w_v^*, p_1^{v*}, p_2^{v*}) > \pi(w_r^*, p_1^{r*}, p_2^{r*}) = \pi(w_s^*, p_1^{s*}, p_2^{s*})$. This completes the proof.

According to proposition 6, we know that the cross-border e-retailer's profit in a CES market is the highest; the retailer's profit in an FSS market is the lowest; and the cross-border e-retailer's profit in a VN market is the middle. In contrast, the foreign supplier's profit in a CES market is the lowest; the foreign supplier's profit in an FSS market is the highest; and the foreign supplier's profit in a VN market is in the middle. This means that both the foreign supplier and the cross-border e-retailer will gain more profit when they are the more dominant player in the supply chain. From the view of the whole supply chain, the optimal overall profit in a CES market is equal to that in an FSS market, but lower than that in a VN market. This means that, as a whole, the supply chain is more competitive and generates more profits if the cross-border e-retailer and the foreign supplier have equivalent market power. In this case, the competition turns into an opportunity, which improves the supply chain profitability.

CONCLUSIONS AND MANAGERIAL INSIGHTS

Conclusions

In this paper, we consider a cross-border e-retail supply chain composed by a foreign supplier and a cross-border e-retailer. The cross-border e-retailer orders products from the foreign supplier and sells to the end consumers through offline and online dual channels. We use the game theory to model the cross-border e-retail supply chain with O2O mixed dual channels and obtain many interesting results. The analysis results show that: i) the cross-border e-retailer prefers to choose the centralized pricing mode and will gain more profit than that in the decentralized pricing mode; ii) the supply chain power structure has noticeable effect on the cross-border e-retail supply chain's pricing decisions and performance. In a VN market, the market competition is more intense and the cross-border e-retailer will set lower retail prices than those in an FSS or a CES market. The foreign supplier will set higher wholesale price when she has more market power. In contrast, she will set a lower wholesale price when she has less market power. Both the foreign supplier and the cross-border e-retailer will gain more profit when they have more market power, but the entire supply chain will gain greater profit when the foreign supplier and the cross-border e-retailer have a more balanced power distribution.

Managerial Insights

The managerial insights of this paper are as follows: i) from the perspective of pricing, offline store and online channel of cross-board e-retailers should implement centralized price mode instead of pricing by two independent operating departments separately; ii) under the condition of monopoly, no matter cross-border e-retailers stay at advantages or disadvantages in a Stackelberg game, they can adopt identical online and offline prices, but they should make compromise in VN market to prevent foreign suppliers seeking other cross-border for cooperation; iii) from the perspective of profit, if the cross-border e-retailers stay at a more advantageous position in the competition with foreign suppliers, they will obtain more profits. Therefore, cross-border e-retailers should strive to obtain and maintain their competitive advantages. In addition, it is a challenging and meaningful research direction to integrate the service level into the demand model development.

ACKNOWLEDGEMENTS

This research is supported by National Natural Science Foundation of China (Nos.71471025, 71171029).

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A Hybrid Quantum Algorithm Based on Magtd to Solve The Problem of The Last Mile in Electronic Commerce

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ABSTRACT

For the purpose of solving the problem of the last mile in electronic commerce, this paper establishes the mathematical model to minimize the travel cost and stability value, an improved double chains quantum genetic algorithm was proposed. Firstly, it proposes the method of double chains structure coding including vehicle chain and customer chain. Secondly, it proposes non-dominated sorting based on the crowding distance selection strategy. Thirdly, the most satisfying solute is obtained by the MAGTD (multi-attribute grey target decision model). Finally, the novel method is applied to a dynamic simulation, and the result of comparing with other classical algorithms verifies its effectiveness.

Keywords: double chains quantum, last mile, distribution model, multi-attribute grey target decision

INTRODUCTION

E-commerce and logistics distribution has many features, such as the large number of the orders, the small scale of the orders, uncertain individual specifications, the high dispersity of the consumers, etc. Although “the last mile” is a little part of the whole supply chain, it is the most significant part because people can contact the customers directly. American researcher Mohammad (2013) put forward the idea of adjusting the delivery time of the business district and setting up the picking points in the customer's pick-up address, which is to ease traffic pressure when the “the last mile” distribution of e-commerce logistics imposes great pressure on the urban traffic[1]. Antonio (2012) combined with the characteristics of B2C e-commerce logistics distribution. The solution which has the minimal impact on the the urban environment is found by comparing three common delivery solutions to the “the last mile”[2]. Feliu, J. G (2012) analyzed the applicability of the “the last-mile” distribution model in China based on data from Taobao, and found that the convenience of traditional distribution was the major factor to impact of e-commerce customers to select voluntary pickup[3]. Ehmke J (2014) et al. summarized the features of the online retailer's logistics distribution network, analyzed the way of logistics distribution sites [4]. Bushuev□M (2012) proposed a model of community distributed network delivery which has a specialty of all-weather service, small service radius, short distance, redeliver convenient and so on[5]. Based on the development of community service, Liu R(2013) analyzed the difference and applicability of various kinds of new models that end-to-end logistics, on the basis of the supply chain relationship of e-commerce, he proposed the decision path to choose suitable cooperation mode for each node enterprise in the supply chain of e-commerce [6]. Edwards J. B. (2010) raise the option of electronic commerce terminal distribution model should follow the three principles by the analysis of Amazon in the end of the distribution model [7].

Therefore, it is the key problem to be solved that the comprehensive distribution logistic of “the last mile” should be built. In this paper, three different distribution models are analyzed, and the improved double chains quantum genetic algorithm based on MAGTD is proposed to make the decision of distribution efficiency and cost.

DISTRIBUTION EFFICIENCY MODEL OF DIFFERENT MODELS

Description of problem

The efficiency of the different distribution models varies greatly in the last mile problem, and the efficiency of different distribution models is very important to calculate the total cost of distribution. The distribution efficiency can be represented by the average distribution time as t_i , i is used to distinguish the types of models [8]. The greater the t_i is, the lower the distribution efficiency.

No matter what kind of distribution model, the total distribution time of t_i^a are composed of the following three parts: the travel time of t_i^r , the waiting time (stop or start) of t_i^w and the service time of t_i^s , as is shown in Eq.1. In the model of “door to door” (model D), t_i^s includes the time for the courier to walk to the customer, to wait for customer to check the package and sign, to scan the bar code and update the distribution information. In the model of “self-service box” (model S), t_i^s includes the time for the courier to walk to the self-service boxes, to scan the bar code and update the distribution information, and to pack into the appropriate lockers. In the model of “customer self extracting station” (model C), t_i^s includes the time to load packages and to scan the bar code on the package.

$$t_i^a = t_i^r + t_i^w + t_i^s \quad (1)$$

The calculation method is same for t_i^w and t_i^s in the three distribution models. The solving process of t_i^r is relatively more complicated than the other two variables.

Model of distribution

The model D can be abstracted as the vehicle routing problem with time windows (VRPTW), the model S can be abstracted as the classical vehicle routing problem (VRP) and the model C can be abstracted as the VRP on the basis of clustering [9]. According to the three different models, the corresponding efficiency models are established respectively.

The constant symbolic meanings in the model are expressed as follows:

m : the number of customer points;

λ : the average service time for one customer;

δ : the average waiting time;

Q_v : rated load for the vehicle;

v : the average speed;

T : rated working time;

$[a_j, b_j]$: time windows;

The variable symbolic meanings in the model are expressed as follows:

d_{ij} : the distance between point i and point j ;

R : the total number of route;

q : the demand for the entire area;

s_j : the start service time on the point j ;

x_{ijr} : the edge of (i, j) is included in the route of r or not;

y_{jr} : the point of j is included in the route of r or not;

q_j : the demand on the point j ;

The model of model D is as follows:

Objective function:

$$\min t^r = \sum_{r=1}^R \sum_{i=0}^{m+1} \sum_{j=0}^{m+1} x_{ijr} (d_{ij} / v) \quad (2)$$

Constraint condition:

$$\sum_{j=1}^m q_j = q; \quad (3)$$

$$\sum_{r=1}^R y_{jr} = 1, \quad j = 1, 2, 3, \dots, m \quad (4)$$

$$\sum_{j=0}^m x_{ijr} = y_{ir}, \quad i = 1, 2, 3, \dots, m+1; r = 1, 2, \dots, R \quad (5)$$

$$\sum_{i=1}^{m+1} x_{ijr} = y_{jr}, \quad j = 0, 1, 2, 3, \dots, m; r = 1, 2, \dots, R \quad (6)$$

$$\sum_{i=1}^{m+1} x_{i0r} = 1, \quad r = 1, 2, 3 \dots R \quad (7)$$

$$\sum_{j=0}^m x_{(m+1)jr} = 1, \quad r = 1, 2, 3 \dots R \quad (8)$$

$$\sum_{j=1}^m y_{jr} q_j \leq Q_v, \quad r = 1, 2, 3 \dots R \quad (9)$$

$$s_j + \lambda q_j + \delta + d_{ij} / v - M(1 - \sum_{r=1}^R x_{ijr}) \leq s_i \quad j=0, 1, 2, \dots, m; i=1, 2, \dots, m+1 \quad (10)$$

$$a_j \leq s_j \leq b_j \leq T \quad j=0, 1, 2, \dots, m+1 \quad (11)$$

Eq. 3 indicates that the sum of the demand for each distribution point is exactly equal to the total demand in the region; Eq.4 – Eq.6 ensure that each distribution point is served only once; Eq.7- Eq.8 show that each vehicle is starting from the distribution center and finally return to the distribution center; Eq.9 shows that the amount of cargo carried per vehicle must not exceed the vehicle's deadweight; Eq.10 - Eq.11 ensure that the vehicle delivery time can meet the special requirements of a small number of customers.

In this paper, real-coding is used to solve the above problem [10]. Taking the way of sequence encoding, each delivery point is assigned a sequence number, in which 0 represents the distribution center. Each chromosome contains $m+R+1$ gene. 100 individuals are generated randomly as the initial solutions, and they are tested to eliminate undesirable ones and generate new ones until all the 100 individuals meet the requirements [11]. The parental is selected to reproduce by the wheel method according to the fitness function Eq.12.

$$\min z = \sum_{r=1}^R \sum_{i=0}^{m+1} \sum_{j=0}^{m+1} x_{ijr} (d_{ij} / v) + M \sum_{r=1}^R \max(\sum_{j=1}^m y_{jr} q_j - Q_v, 0) \quad (12)$$

Eq.12 integrates the vehicle weight constraints into the objective function. M is an infinite number acting as a penalty factor when the vehicle load exceeds the dead weight.

The calculation method for t_i^r in the model C is different from the other two models. The model C has almost no capacity limitations, so first to make one clustering analysis for delivery point based on Euclidean distance. In order to simplify the calculation, it is assumed that the self service station is located at the center of each service area. Therefore, K-means clustering algorithm is used in this paper.

Objective function:

$$\sum_{j=1}^m \min_{i \in \{1, 2, \dots, k\}} \|o_j - P_i\|^2 \quad (13)$$

Constraint condition:

$$\overline{O}_j = \frac{1}{|L_j|} \sum_{o \in L_j} o \quad (14)$$

$$E = \sum_{j=1}^k \sum_{o \in L_j} |o - \overline{o}_j|^2 \quad (15)$$

o_j is the position of the customer point; P_i is the average value of L_j (cluster); E is the sum of average errors. Eq.14 is the average value of update cluster; Eq.15 is the calculation criterion of the proposed algorithm. After clustering, the route will be scheduled acting the cluster center as the delivery point to optimize the distribution.

IMPROVED QUANTUM ALGORITHM

An improved double chains quantum genetic algorithm (IDQGA) was proposed to overcome the shortcomings of complex encoding and decoding with common quantum algorithm.

Improvement of quantum rotation angle

The improved quantum rotation angle is divided into two parts which are deflection and direction of rotation. The data of each qubit is as follows: $f(x_i)$ says the fitness of quantum individual x_i , w_{ij} represents the angle of probability amplitude, K_1, K_2, \dots, K_n represent the first n elite individual with the highest fitness in the current state, w_{0j}^n represents the j^{th} qubit angle of the n^{th}

elite individual [12]. The paper proposed an improved method for the rotation angle of qubit combining the chaos theory. The specific steps are as follows:

Step 1: Initialize the parameters. Make $j=1$ and generate the initial value by the Logistic equation;

Step 2: Calculate the direction of the rotation angle. K_1 represents the optimal elite individual and meets $f(x_i) \leq f(K_1)$, the direction of the rotation is shown in Eq.16:

$$X_j = \text{sgn}(\alpha_{ij}\beta_{ij}(k_{1j} - 0.5)) \quad (16)$$

$\text{sgn}()$ is the symbol function, $\alpha_{ij}\beta_{ij}$ represent the probability amplitude of the j^{th} qubit, K_{1j} represents the value of the j^{th} qubit in K_1 ;

Step 3: Calculate the deflection of the rotation angle guided by the elite quantum;

Step 4: Calculate the chaos perturbation of the qubit, i.e.

$$\begin{aligned} \lambda_i &= \mu\lambda_{i-1}(1 - \lambda_{i-1}), \\ \lambda_0 &\in [0, 1], \mu \geq 4. \end{aligned} \quad (17)$$

Step 5: Calculate the rotation angle of the qubit, and the positive or negative value is decided by the direction of rotation, i.e.

$$\theta_{ij} = x_j \Delta \theta_{ij} (1 + x_j \lambda_j) \quad (18)$$

Step 6: Judge whether the calculation for the qubit is completed, if the calculation is not completed, it will make $j=j+1$ and turn to Step 2.

Double chains quantum algorithm

A new compensation factor γ ($\gamma \geq 1$) on the basis of probability amplitude coding was proposed in this paper. p_i is assumed as a quantum chromosome, and the coding scheme of the i^{th} chromosome is as follow:

$$p_i = \begin{bmatrix} \alpha_{i1} & \alpha_{i2} & \dots & \alpha_{im} \\ \beta_{i1} & \beta_{i2} & \dots & \beta_{im} \end{bmatrix} = \begin{bmatrix} \cos(\gamma t_{i1}) & \cos(\gamma t_{i2}) & \dots & \cos(\gamma t_{im}) \\ \sin(\gamma t_{i1}) & \sin(\gamma t_{i2}) & \dots & \sin(\gamma t_{im}) \end{bmatrix} \quad (19)$$

In which, the normalization condition should be met for α and β , that is to say, $|\alpha|^2 + |\beta|^2 = 1$, and $t_{ij} = 2\pi \times \text{rad}$, rad is the random number in $(0, 1)$; $i=1, 2, \dots, n$; $j=1, 2, \dots, m$; n is the size of the population, m is the number of the qubit. γ changes the periodic from 2π into multi-periodic to improve the convergence efficiency of the algorithm [13]. Each chromosome consists of two parallel gene chains, and one is the vehicle selecting chain of $p_{i\cos}$, the other is procedure customer points chain of $p_{i\sin}$. Each gene chain represents an optimized solution, which is shown as follow:

$$\begin{aligned} p_{i\cos} &= (\cos(t_{i1}), \cos(t_{i2}), \dots, \cos(t_{im})) \\ p_{i\sin} &= (\sin(t_{i1}), \sin(t_{i2}), \dots, \sin(t_{im})) \end{aligned}$$

$p_{i\cos}$ is called cosine solution and $p_{i\sin}$ is called sine solution respectively.

The scheduling decision based on MAGTD

This paper uses the model of multi-attribute grey target decision (MAGTD) to get the most satisfactory scheme, which is multi criteria decision making method based on grey system theory [14]. The algorithm is as follows:

(1) Construct effect of sample matrix with m evaluation index and k scheduling scheme according to the Pareto optimal solution obtained by IDQGA, the weight vector of each index can be expressed as: $\omega = (\omega_1, \omega_2, \dots, \omega_m)$;

(2) Transform the effect of sample matrix of G by using the linear transformation operator in $[-1, 1]$ and obtain the decision matrix of $D = (d_{ij})_{m \times k}$;

(3) Get the optimal vector in which is the bull's eye;

(4) Calculate the distance of the bull's eye ξ_i ($i = 1, 2, \dots, k$), according to the Eq. 20:

$$\xi_i = |d_i - d| = \sqrt{\omega_1(d_{i1} - d_1^0)^2 + \omega_2(d_{i2} - d_2^0)^2 + \dots + \omega_m(d_{im} - d_m^0)^2} \quad (20)$$

(5) The optimal scheme is got from ξ_i in ascending order.

ANALYSIS AND VERIFICATION

It is almost impossible to collect the distribution time of different distribution model at the same time. On one hand, it is difficult to apply three models in same environment as the practice, on the other hand, it involves some business secrets of the logistics service providers [15] [16]. The crossover probability and mutation probability in the genetic algorithm (GA) are set

to be 0.8 and 0.2 respectively, and the termination algorithm is updated to the 200 generation.

According to the basic population density, it is reasonable to set 30 delivery points randomly representing the corresponding 30 districts in the square area of 25 square kilometers [17]. The orders of each district are less than 40 to ensure it is enough to set one public self-service box. In the model *C*, it is first to cluster the 30 delivery points and the range of the case is set to be 25 square kilometers, in which 5 self extracting stations are set. It can be seen from Fig.3 that the delivery points with the same shape are in the same cluster [18] [19]. The green point of the center represents the distribution center and the fork at the center of each cluster represents the self extracting station.

In order to verify the efficiency of distribution under standard conditions of different distribution model, in this paper, the correlation value of distribution efficiency is calculated basing on the improved quantum genetic algorithm. The parameter values for the distribution activities of the three models in the standard case are shown in TAB.1.

Table 1: Time spent of different models with normal orders

	Model <i>D</i>	Model <i>S</i>	Model <i>C</i>
Driving distance (km)	40.62	23.4	10.9
Number of order	756	756	756
Stop or start time(min)	40	40	8
Number of vehicle	7	3	1
t^r (min)	82.6	23.7	10.4
t^w (min)	60	60	20
t^s (min)	3635	728	146.7
Total time (min)	3817.6	851.7	185.1
Average time/order (min)	5.05	1.13	0.24

It can be seen from Table 1 that the model *C* is the most efficient, and the model *S* follows, the model *D* is the least efficient.

The absolute value of t^s is the smallest in the model *C* but the maximum in the model *D*.

In order to further study the impact of the number of order on the efficiency of different models, the number of order in the example will be doubled to calculate the different distribution efficiency. The result is shown in Tab.2.

Table 2: Time spent of different models with double orders

	Model <i>D</i>	Model <i>S</i>	Model <i>C</i>
Driving distance (km)	62.4	30.8	12.9
Number of order	1512	1512	1512
Stop or start time(min)	40	40	8
Number of vehicle	13	3	1
t^r (min)	126.2	30.6	11.2
t^w (min)	60	60	20
t^s (min)	7368	1465	241.4
Total time (min)	7594.2	1595.6	280.6
Average time/order (min)	5.02	1.06	0.19

It can be seen from Tab.2 that the average delivery time in the three model changes synchronized with the number of order.

t^s will be distributed to more orders with the increase in orders, but if only the number of order changes, t^r and t^w will change little. If the number of orders were 756 (normal) and 1512(double), the time ratio of unit order are 1: 0.22: 0.048 and 1: 0.21: 0.038 respectively in the three models, as is shown in Fig.1 and Fig.2.

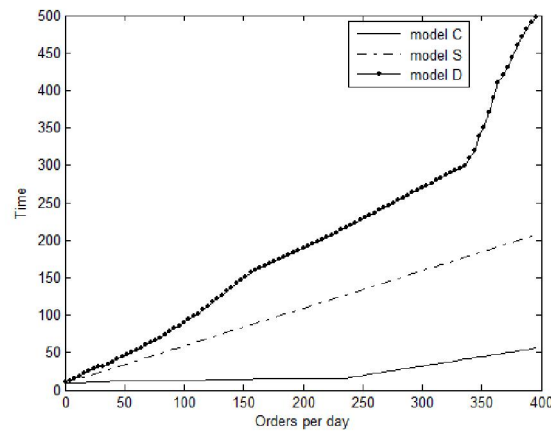


Figure 1: Service time in different models with 756 orders (min)

It can be seen from Fig.1 that the efficiency of the model *C* is enhanced with the increase of the number of order, and the main reason lies in the speed of the model *C* which can effectively reduce t^s and there is no limit to the amount of orders in this model.

In the actual distribution process, it is not enough to only consider the efficiency factor. The proposed research has not considered the influence of the subjective preference of decision makers on the final scheduling results, which may make the following research have more practical value. Therefore, it is necessary to minimize the cost of the vehicle, the cost of the cabinet and the cost of commission cost for the third cooperative shops on the basis of the optimization efficiency. The optimal solution will be obtained by multi-attribute grey target decision

The strategy of MAGTD is used to obtain the most satisfactory solution from the Pareto set. Three groups of the Pareto solutions are shown TAB.3 which are based on efficiency, cost and satisfactory at the same time.

Table 3: Three Pareto solutions got by IDQGA

Serial number	Efficiency	Cost	Satisfactory
1	48	2130	38
2	49	2116	40
3	52	2149	37

The following sample matrix of the optimal scheduling scheme is established from the results of TAB.3:

$$G = \begin{bmatrix} 48 & 2130 & 38 \\ 49 & 2116 & 40 \\ 52 & 2149 & 37 \end{bmatrix}$$

The weight vector of each target can be expressed using Delphi method [13] as $\omega = (0.4538, 0.3561, 0.1901)$, and the decision making matrix *D* is shown as follow:

$$D = \begin{bmatrix} 1 & -1 & 0.4999 \\ 0 & 0.5000 & -1 \\ -1 & 0.5000 & 0.4999 \end{bmatrix}$$

Then the optimal effect of vector (bull's eye) is shown as: $d = (1, 0.5000, 0.4999)$.

The distance of bull's eye in each scheduling scheme can be solved according to equation (20) as $\xi_1=0.7188$; $\xi_2=1.3473$; $\xi_3=0.9564$

The order of the optimal schedule according to the above ascending sort is as follow: scheme 1 f scheme 3 f scheme 2

The scheme 1 is the optimal one and its corresponding solution is of (48, 2130, 38).

CONCLUSION

- (1) The efficiency of model *C* is more sensitive to number of order. In general, the distribution efficiency of the model *C* is the highest, the model *S* follows, and the model *D* is the lowest.
- (2) Because of the low cost of vehicle, the model *D* has significant advantage when the order is less.
- (3) The cost of the model *C* involves the commissioning of third-party cooperative shops and that of the model *S* involves the cost of the self-collection cabinet, therefore, when the number of order is more, the decision to select the model *C* or model *S* depends on the specific commission cost and the cost of the cabinet.
- (4) The introduction of MAGTD guarantees the selection of the most satisfactory distribution model of the last mile in actual process.

ACKNOWLEDGEMENTS

This work is partially supported by the Major Project of the National Natural Foundation of China (No.71531002), Liaoning Provincial Natural Science Foundation of China (No.201602131), the National Natural Science Foundation, China (No.71471025) and the Dr scientific research fund of Liaoning Province (No.201601244).

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Point-of-Interest Recommendation Algorithm Based on User Similarity in Location-Based Social Networks

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ABSTRACT

Location-based social network is rising recent years with the development of mobile internet, and point-of-interest (POI) recommendation is a hot topic of this field. Because the factors that affect the behavior of users are very complex, most of the research focuses on the context of the recommendation. But overall context data acquisition in practice is often difficult to obtain. In this paper, we have considered the most common collaborative recommendation algorithm based on user similarity, and discussed several methods of user similarity definition. Comparing the effect of different methods in the actual dataset, experimental results show among the factors including that social relation, check-in and geographical location the check-in is extremely important, so this work is of certain guiding significance to the actual applications.

Keywords: Collaborative Recommendation, Location-Based Social Networks, Geographical Point-of-Interest.

PREFACE

The rapid development of internet and e-commerce makes information and knowledge unprecedented spread, causes profound The location-based services and the mobile networks are two kinds of technologies that supplement each other. And with the development of mobile networks, the content of location-based services has been enriched. In recent years, location-aware technology has become more and more closely related to the traditional social networks, which has formed the concept of Location-Based Social Networks, putting forward a new task for scientific research. Personalized location recommendation is a key component of location based services (LBS) [1], which is commonly found in the footprint-sharing of such social networks. When users log into footprint-sharing websites through the mobile devices, GPS and other location technologies (one piece of check-in data typically includes user ID, location ID, time of arrival and the latitude and longitude of the location) make it possible for users to do check-in at the current position, make comments and even share experiences, leaving their own "footprints" on the map [2]. These data enable us to understand users' daily behaviors and hobbies. For example, those who often go to the same type of restaurants may be fond of delicious food and share similar tastes; those who regularly go to the gym probably often do physical exercise and like sports. The check-ins on the same system done by a host of users can form a lot of "points of interest". The location recommendation based on these historical data is commonly used in commercial location recommendation of some scenic spots, shops and even the commodities, which is of extensive commercial value. Location recommendation is also known as the "point of interest"(POI) recommendation. The dataset of this kind of algorithm includes the check-in data, content sharing, users' characteristics, social relations and location features, among which check-in data are essential.

According to Max Schmachtenberg et al. [5], in term of "point of interest" recommendation, the "POI information itself and its nearby geographical information" should be fully made use of to launch a location recommendation system based on map information and weather information. Literature [6] points out that the locate function of mobile devices is used to determine the users' location, combined with users' preferences, to recommend points of interest for users by using hybrid recommendation strategy. Literature [7] proposes a method that the location recommendation can be achieved when the topics of mobile networks have been modeled at a semantic level so as to establish the interaction of three major entities: user, post and location. Jie Bao et al. [8] propose that the data of venues should be divided into longitude and latitude values and category description, and the latter one is category hierarchy (for example, "food" category includes Chinese restaurant and Italian restaurant and etc). The check-in data are categorized by city as well as WCH (Weighted Category Hierarchy) sub-tree is established to calculate a user's personal preferences for different layer of a WCH. During the process of recommendation, it provides a user with a list of venues after the calculation based on user similarity, considering the user's preferences, current location, and social opinions from the selected local experts who are nearby.

The literature above has one thing in common that the environmental data are made fully use of. However, it's not an easy job to obtain comprehensive environmental data, considering some users will not share all the information due to the factor of their own privacy. Our work focuses on the data containing some simple user information (records of the friendships between users or not) and check-in data (including user, time and venue such basic information), to do the point of interest recommendation based on these data. There are two factors that have explained why the relationship between friends has been taken into consideration in this paper. Firstly, this kind of data is essential in social networks and easy to get as well. Secondly, as friends in real life or networks tend to share common hobbies, such as drinking coffee, shopping and so on in pairs and groups, this related information can improve the recommendation effect [9]. The check-in data implies users' preferences on location. And moreover,

users usually do check-in at nearby points of interest, which will also help us to study users' location preferences. Nevertheless, we note that the venues a single user visits are limited and the user - location matrix is often sparse [10], so the collaborative filtering technology is often applied in such kind of studies [11]. This paper is no exception.

The existing collaborative filtering technology has made an effective use of user preference information [12], social networks information [13] and the influence of geographical location between points of interest [14]. These methods have been inherited in this paper, where we discuss several calculation methods of user similarity in accordance with the features of data and analyze the recommended effects of these different methods, combined with the impact of geographical location. The specific contributions of this paper can be found from the following aspects.

(1) As far as we know, most POI recommendation algorithms and their application make full use of contextual information but it is hard to obtain, which limits the practical application of these algorithms. On the basis of the limited basic data, we fully mine the data that imply user relationship, and analyze the effect of recommendation.

(2) We have summed up six methods of user similarity in this paper after conducting a linear fusion combined with social networks analysis and algorithms of user similarity in the field of information recommendation. To our knowledge, this is the first study on such problems in similar literature.

(3) Particular literature has attached great importance to the positive effect of geographical location factors on the recommendation but it has not taken into account the geographical location between the users. Therefore, we have put forward a method to speculate a user's address and found that most addresses of a user's friends' are close to the user's address in terms of the relationship between friends. But does this mean that the use of some friends' information is more effective to recommendation? The correlative analysis is also carried out in this paper.

BASIC DEFINITIONS

The user set is represented with $U = \{u_1, u_2, \dots, u_m\}$ while POI set is represented with $L = \{l_1, l_2, \dots, l_n\}$. The social relationship matrix is denoted as S , where $S_{ij} = 1$ represents the friendship between users u_i and u_j . Otherwise, $S_{ij} = 0$. The check-in frequency matrix is denoted as C , where $C_{ij} \geq 0$ represents the check-ins that a user does at the point of interest. Then check-in matrix is notated as C' , if and only if $C_{ij} \neq 0$, then $C'_{ij} = 1$; otherwise $C'_{ij} = 0$.

The collaborative filtering technology can be categorized into the methods respectively based on users and projects. The feature of the former method lies in the recommendation based on user similarity while the latter one lies in the project similarity. In the light of the features of data studied in this paper, we have adopted the technology based on users.

The key of collaborative filtering technology based on users is to calculate the similarity of users. If we want to do the calculation, we have to describe the characteristics of the users at first as different description methods may lead to different results of user

similarity. To calculate the similarity of users u_i and u_k , we make use of the data from social relationship matrix S and

check-in frequency matrix C as well as the following six elementary technical methods, respectively denoted as w_{ik}^1 [15], w_{ik}^2 , w_{ik}^3 [14], w_{ik}^4 , w_{ik}^5 and w_{ik}^6 [15].

$$w_{ik}^1 = \frac{\sum_{p=1}^n C'_{ip} \times C'_{kp}}{\sqrt{\sum_{p=1}^n C'_{ip}} \times \sqrt{\sum_{p=1}^n C'_{kp}}} \quad (1)$$

$$w_{ik}^2 = \frac{\sum_{p=1}^n C_{ip} \times C_{kp}}{\sqrt{\sum_{p=1}^n C_{ip}} \times \sqrt{\sum_{p=1}^n C_{kp}}} \quad (2)$$

$$w_{ik}^3 = \frac{\sum_{u_l \in St(u_i) \cap St(u_k)} \frac{1}{K(u_l)}}{\sqrt{\sum_{u_m \in St(u_i)} \frac{1}{K(u_m)}} \sqrt{\sum_{u_n \in St(u_k)} \frac{1}{K(u_n)}}} \quad (3)$$

$$w_{ik}^4 = \eta \times w_{ik}^1 + (1 - \eta) \times w_{ik}^3 \quad (4)$$

$$w_{ik}^5 = \eta \times w_{ik}^2 + (1 - \eta) \times w_{ik}^3 \quad (5)$$

$$w_{ik}^6 = \eta \times \frac{|F_k \text{ I } F_i|}{|F_k \text{ Y } F_i|} + (1 - \eta) \times \frac{|L_k \text{ I } L_i|}{|L_k \text{ Y } L_i|} \quad (6)$$

We use F_k and L_k to represent user u_k 's set of friends and set of check-in POIs. The neighbor of u_i is denoted as $N(u_i)$,

namely $N(u_i) = \{u_j \mid S_{ij} > 0\}$, $S(u_i) = \{u_i\} \cup N(u_i)$, and $K(u_i) = \sum_{j=1}^n S_{ij}$ is used to represent the number of user u_i 's friends. Equation 1-2 are used to calculate the cosine of vector to show the similarity between two users by using the vector of users' check-in venues as the data describing users' features. Literature [14] makes a propose that Equation (3) is a good method to measure user similarity that can be used for finding social community, only taking the advantage of a user's social relations to describe its features and work out the user similarity; Two factors of user's social networks and check-ins are combined to do the calculation in Equation 4-6.

Moreover, we can predict the check-in times of user u_i at the POI l_j by calculating the check-in times of the user who is similar to user u_i at the place P_j , which is shown in Equation (7).

$$CheckIn_{ij}^u = \frac{\sum_{k=1}^m w_{ik} \times C_{kj}}{\sum_{k=1}^m w_{ik}} \quad (7)$$

The w_{ik} in Equation (7) is used to represent the similarity between users u_i and u_k , and the algorithms are shown in Equation(1)~(6).

EXPERIMENT ANALYSIS

Data Collection

The higher vocational course e-commerce is still in the primary stage, just stays in the mechanical network and digital level, not We collected the data from the frequently-used dataset of Gowalla which contains check-in data from September 2009 to October 2010, including 196591 users, 1279228 POIs, 950327 friendships and 6442890 check-ins. After taking the maximum inscribed rectangle among Paris, Chicago and San Francisco, we can obtain the center coordinate of venues on the basis of the coordinates of venues each user has visited. Then according to the distance, we choose 80% of the venues that are closest to the center coordinate, and then work out the new center coordinate on the basis of these venues. Finally, we set this coordinate as user's location by which we make a judgment whether the user is located in city's largest inscribed rectangle. The data of the three cities obtained in this way is shown in Table1.

Table 1 Test Data

City	Total number of users	Total number of friends	Total number of check-ins
Paris	313	1384	1409
Chicago	1116	7902	6147
San Francisco	3007	48822	7970

Evaluation Metrics

Students are in a passive position under the traditional higher vocational education, there is no chance for them to choose teacher. We use three metrics: precision P , recall R and F-score(F) to make evaluation, which are also commonly used as metrics in the relevant literature. For certain user, we define its standard check-in list as L_{Ture} and its experiment check-in list as L_{test} , so

$$P = \frac{|L_{ture} \text{ I } L_{test}|}{|L_{test}|} \quad (8)$$

$$R = \frac{|L_{ture} \text{ I } L_{test}|}{|L_{ture}|} \quad (9)$$

$$F = \frac{2 \times P \times R}{P + R} \quad (10)$$

The precision (P) reflects the proportion of the number of the correct node pairs in the partition results while the recall (R) reflects the proportion of the node pairs that are correctly classified in the real community. The precision (P) and recall (R) both reflect one aspect of the algorithms but there is no proportional relationship between the two. In other words, a high precision (P) does not necessarily indicate a high recall (R). F-score (F) is more reasonable in comparison. The metric of F-score (F) will be high only if the precision (P) and recall (R) are both high. Obviously, the three metrics are the bigger, the better. The results are counted on the basis of city, each user of the same city. According to the Equation (7), we make the recommendation and calculate these three metrics, taking the average value of the whole city users.

As our algorithms predict the number of check-ins, the POIs in L_{test} are ranged from large to small according to the predicted number of check-ins. Similarly, we can arrange the POIs in L_{true} in descending order according to the check-in frequency so that we can explore the problems of the venues recommended by N in terms of the precision $P - N$, the recall $R - N$ and the comprehensive evaluation $F - N$. In the experiment, we take the values of 2, 4, 6. In order to investigate the effect of different factors on the recommendation, the values in the Equation (4) ~ (6) are from 0 to 1, and the step length is 0.1. Because there are six algorithms of w_{ik} in Equation (7), we denote them respectively as A_1 , A_2 , A_3 , A_4 , A_5 and A_6 in order to make it easy to expound the upcoming content. The summary is as shown in Table 2.

Table 2 Six Specific Recommendations

Algorithm	A1	A2	A3	A4	A5	A6
Description	Calculate the user similarity according to Equation (1)	Calculate the user similarity according to Equation (2)	Calculate the user similarity according to Equation (3)	Calculate the user similarity according to Equation (4), the values of η are from 0 to 1, the step length is 0.1;	Calculate the user similarity according to Equation (5), the values of η are from 0 to 1, the step length is 0.1;	Calculate the user similarity according to Equation (6), the values of η are from 0 to 1, the step length is 0.1;

Results Analysis

First of all, we will compare these algorithms of user similarity. From Figure 1, we find A1 and A2 are better algorithms of user similarity for precision (P), recall (R) and F-score (F) no matter how the referrals have changed. Compared with other algorithms, the evaluation metrics derived from these two algorithms are better than others. The same conclusion also comes from Figure 3. Although the evaluation metrics derived from algorithm A1 in Figure 2 are relatively inferior, algorithm A2 is still a good method. Both algorithms A1 and A2 make the calculation of similarity on the basis of visited venues but algorithm A2 contains the data of check-in frequency while algorithm A1 not. From this point of view, algorithm A2 is more comprehensive. Different from algorithms A1 and A2, other algorithms all include social factors. The experiment shows that the calculation of user similarity which is applied in the POI recommendation based on user similarity generally does not have to take the social factors into consideration. Perhaps the reason is that people's interest in geographical location is more likely to be influenced by their own interests, habits, living conditions and other factors. The impact of social relations is not so important in comparison. For example, people who don't like to go to the gym may have a lot of friends who love sports, so their friends' behavior of often going to the gym can't change their habit of seldom going to the gym. If it's applied in the field of geographical location recommendation, it will be influenced by a host of factors, such as relationship between friends, check-ins, distances and so on.

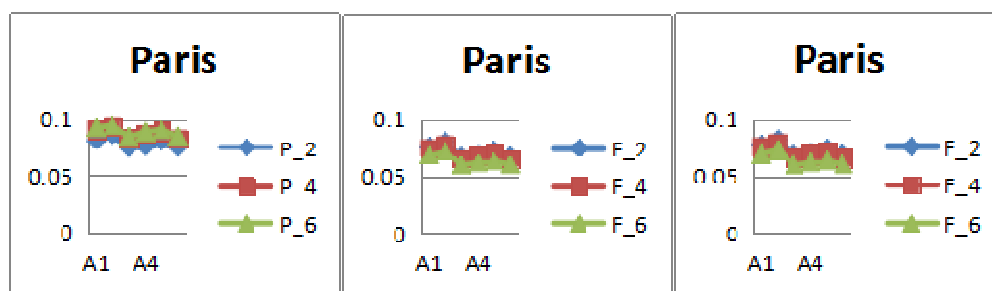


Figure 1 Recommendation Effect of Paris

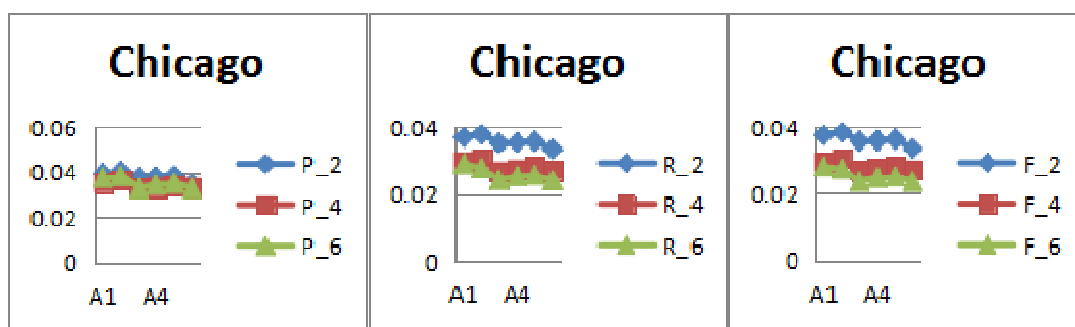


Figure 2 Recommendation Effect of Chicago

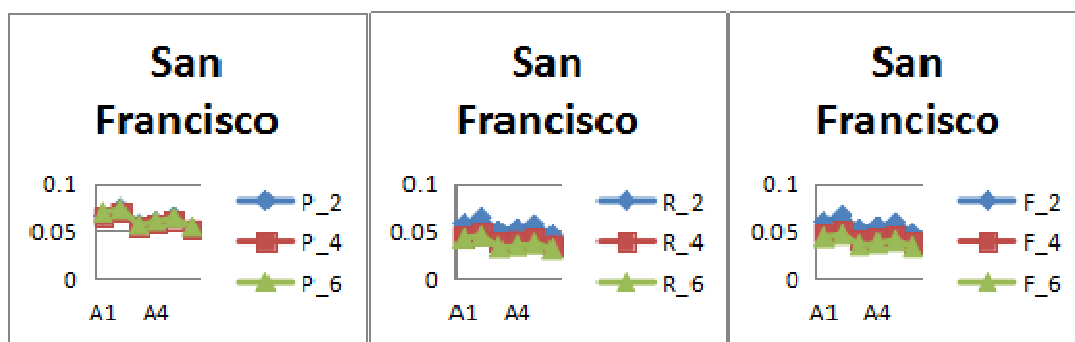


Figure 3 Recommendation Effect of San Francisco

Furthermore, the number of recommendations has an impact on the metrics. With regard to the precision (P), it is presented as $P_2 \leq P_4 \leq P_6$ in Figure 2~ Figure 4. From the data of Paris in Figure 1, we have found that the effect of recommendation for four venues is better than that of two or six. With regard to the recall (R), the effect of P_4 is the best, taken together. As shown in Figure 2 and Figure 3, however, the more venues are recommended, the worse effect it has. There are a number of reasons why this may be the case. First, the problem becomes complex with the increase of users, friendships and check-in venues. Second, there is a limit to A1~A6, the six algorithms of user similarity. Finally, the data itself cannot contain the information on POIs effectively.

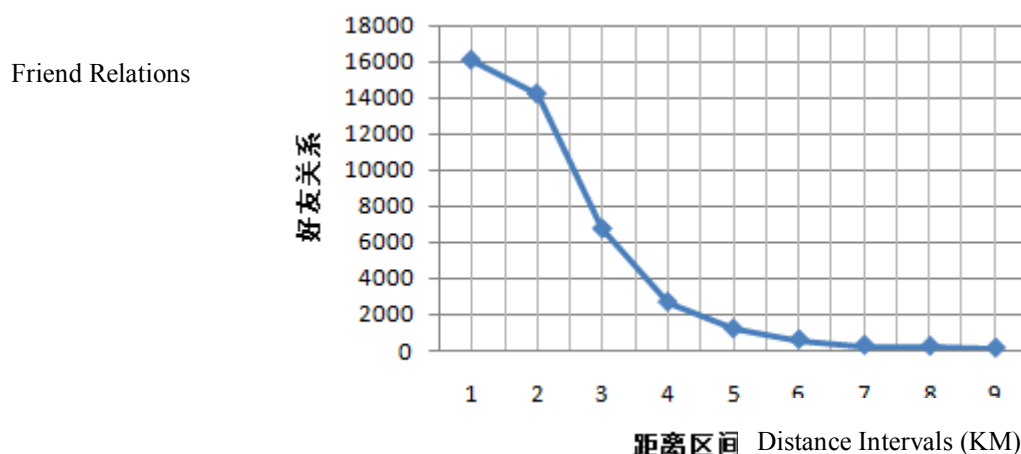


Figure 4 Distance Distribution of Friend Relations in San Francisco Area

According to the study of the large-scale datasets of LBSN (www.foursquare.com and www.whrrl.com), Ye Me et al [15] have observed that users tend to visit POIs that are close to each other and the geographical similarity (geographical proximities) has significant influence on a user's check-in activities, which leads to the conclusion that the check-in probability of nearby POI pairs visited by the same person follows the power-law distribution. Literature [16] also has made the conclusion that taking the geographical similarity into comprehensive consideration will improve the effect of recommendation when comparing the influence of collaborative recommendations based on check-in frequency, social relationship, location similarity and the fusion of the three above. In view of the phenomenon analyzed by relevant literature that users often visit nearby POIs, we have made a further analysis of the interaction between user-user distance and check-in activity. In real life, friends influence each other by behaviors which will be strengthened then. Many documents have also confirmed that the friendship has a positive impact on check-in activity. Therefore, the social relationship should not be ignored in the check-in recommendations. From Equation (6-8), we have observed that the distance between users is ignored when considering the measure of user similarity. Since a user

often visits the POIs which are close to each other, we can assume that the user's address is in the middle of these POIs as well. We have made an analysis on the check-in data of San Francisco from the datasets of Gowalla and chosen some relevant users. Then we work out the arithmetic means of the latitudes and longitudes of the 80% of the check-in venues in short distance and take the mean values as the users' addresses. Afterwards, we find out the distances between friends' addresses in this area which are divided into 0-1, 1-2, 2-3..., 8-9km of the 9 intervals denoted as the horizontal coordinate while the corresponding number of user relations as a vertical coordinate. The results are as shown in Figure 4 below. It is worth noting that the friend relations within 9km account for 99.68% of all in this area.

From Figure 4, we can see that the distance distribution of friend relations accords with the typical power-law distribution (long-tailed distributions). In other words, friends are geographically close to each other in the location-based social networks. In Figure 4, 71.66% of the distances between friends are limited to the range of 2kms. The same conclusion comes from our study of Paris and Chicago. Due to the relatively small data in these two areas, the results are not presented in Figure 4. However, there is still a problem for us to think about: the effect of friends' recommendation according to the recommendation algorithm based on user similarity. Thus, we modify the Equation (7) as shown in the Equation (11).

$$CheckIn_{ij}^{unew} = \frac{\sum_{u_k \in partF_i} w_{ik} \times C_{kj}}{\sum_{u_k \in partF_i} w_{ik}} \quad (11)$$

As shown above, $partF_i \subseteq F_i$ represents some friends of the user u_i 's and the subsets of F_i are taken randomly to form $partF_i$. If $partF_i = F_i$, the Equation (7) is in agreement with the Equation (11), which is considered that the Equation (7)

is a special case of the Equation (11). During the calculation process of the Equation (11), the value of $\frac{|partF_i|}{|F_i|}$ is respectively taken as 1/3, 2/3 and 1. The experiment results are as shown in Figure 5~Figure7.

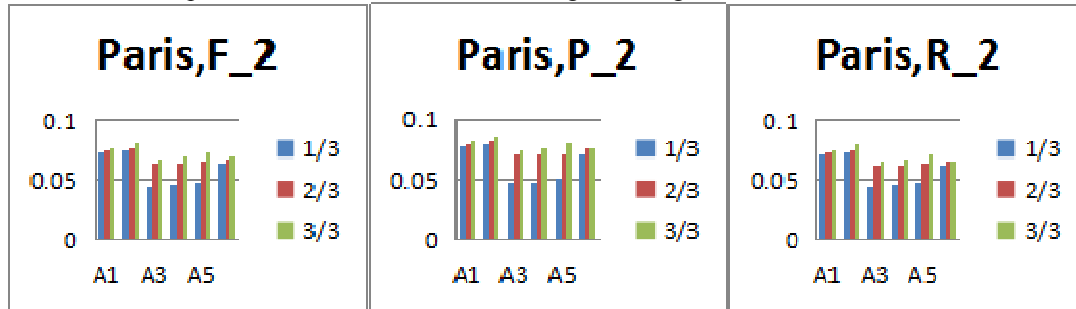


Figure 5 The corresponding metric changes with the different values of $\frac{|partF_i|}{|F_i|}$ in the dataset of Paris

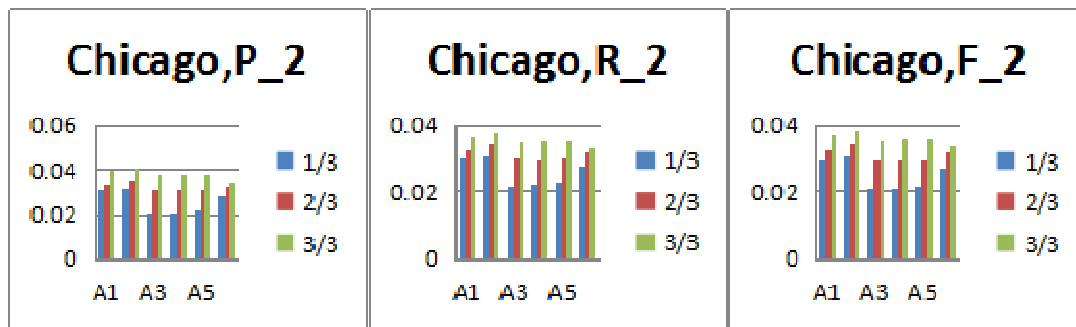


Figure 6 The corresponding metric changes with the different values of $\frac{|partF_i|}{|F_i|}$ in the dataset of Chicago

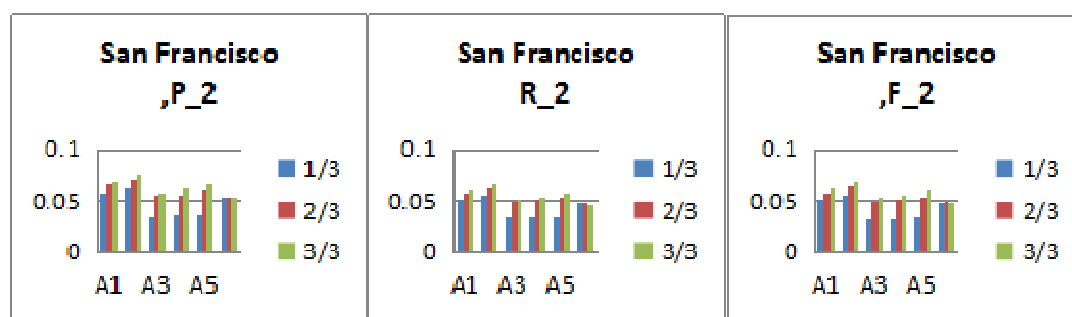


Figure 7 The corresponding metric changes with the different values of $\frac{partF_i}{|F_i|}$ in the dataset of San Francisco

As shown in Figure 5~Figure 7, the three datasets are not in strict ascending order but generally speaking, the larger the number of friends is, the better the three metrics become. It reflects from the side that the nearby friends cannot guarantee a better recommendation effect although the user often visits nearby places. In social networks, we are often able to detect the community structure, such as so-called “A good neighbor is better than a brother far off”. The people who are geographically close to each other tend to form a community. However, this social relationship has limited effect on venue recommendation, which also explains why the Equation (3) as the algorithm based on community searching is very effective while it becomes less effective when being used for venue recommendation in Figure 1~ Figure 3.

CONCLUSION

It is a key step to define the similarity between users for collaborative recommendation technology. The experimental results of this paper has proved that the act of mining the information contained in the check-in data is essential to the effect of recommendation in the location-based social networks. However, the effect of recommendation is related to the quantity and quality of the specific data. Therefore, the direction for future study is to do the work of data statistic and analysis and then study its influence on the commonly used algorithms of user similarity to deduce a theory law that has certain guiding function to the practical application. This paper is focusing on the algorithms of user similarity from different perspectives in location-based networks and the application of venue recommendation based on user similarity. Thus, we can study the problems of recommendation based on user similarity from other perspectives of application, such as the commodity recommendation of e-commerce, the course recommendation of online education and so on.

ACKNOWLEDGMENT

This paper was supported by the National Natural Science Foundation of China (Grant No. 61373147), by the Science and Technology Project of Educational Commission of Fujian Province, China (Grant No. JA14243), by the Project of International Cooperation and Exchanges on Science and Technology of Xiamen University of Technology (Grant No. E201301300).

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Empirical Research on Business Model Innovation Alignment with Social Relationship Affect Firm Performance

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ABSTRACT

The effects of business model innovations alignment with social relationship affect firm performance bear important implication for firms. However, previous literature offers little insight on this question. We know little about how to align business model innovations with social relationship to promote firm performance. Addressing on these gaps, this study builds theoretical model based on business ecosystem theory and social capital theory to investigate how does business model innovation alignment with social relationship affect firm performance. This study further empirical examines theoretical model with data from 174 Chinese firms. The empirical results support our theoretical model. We find that both incremental business model innovation and radical business model innovation have positive effects on firm performance. More importantly, this study finds that two types of social relationships have different moderating effects on business model innovation and firm performance. This study contributes to extant literature by identifying the specific effects of alignment of business model innovation and social relationship, and enriching the empirical evidence. Our findings indicate that firms should align business model innovation with social relationship to promote firm performance.

Keywords: ICEB, Business model innovation; Firm performance; Social relationship.

INSTRUCTIONS

Over the past two decades, with popularity of information and communication technology, the Internet and e-commerce have progressively spread into all industries, providing a new available way of organizing business activity (DaSilva and Trkman, 2014). The notion of the business model has received increasing attention in the literature and in practice to think about "What is the new logic of value creation and value capture?" The increasing consensus that business model innovation is key to firm performance (e.g., Ireland et al., 2001; IBM Global Business Services, 2006; Chesbrough, 2007; Zott and Amit, 2007, 2008; Johnson et al., 2008). Firms may compete through business models (Casadesus-Masanell and Ricart, 2007). Changing the logic of firms and replacing the conventional way of doing transaction things to novel business models become the fashion of entrepreneurs (Magretta, 2002). For example, within the Internet industry, many firms which have innovated diversity of new business models, such as social networks, electronic business platforms, online games and mobile Internet applications, that achieve great business success.

The process of innovating a business model might differ for different organizations in different competitive landscapes. Business model innovation may be conceptualized as a transaction activity system which depicting the rationale of how a firm create, deliver, and capture value in relationship with a network of exchange partners (Afuah and Tucci, 2001; Osterwalder et al., 2005; Zott et al., 2011). Just identifying business logic behind the business model is insufficient to assure competitive advantage (Teece, 2010). Kim and Min (2015) find that firms run similar business model innovation reveal wide performance variation. There are more firms failed to achieve growth by means of new business models behind the successful firms. The reason often is the business model failed to match environment each other. Business model innovation often requires resource re-configuration of spanning the traditional boundaries of the firm. It should be clarify that how does the business model innovation fit with social relationship outside firms jointly impact on firm performance.

However, how does business model innovation (e.g. radical business model innovation and incremental business model innovation) align with social relationship outside firms to jointly impact firm performance? Particularly different business models may define different value propositions for firms and the ways to capture value. In spite of the increasing salient of this question, researchers have mainly rely on conceptual or cases studies to argue that (Kim and Min, 2015), a firm should innovate fit business model to adapt with social relationship. Since confined to a single or few companies, these studies are difficult to abstract to the general theory. In order to better examine the business model innovation impact on firm performance, it still need large sample empirical analysis. Essentially, business model innovation focuses on the whole business logic for value creation (Wei et al. 2014). Until now, extant literature offers few specific answers to the question on how different types of business model innovations fit with social relationship outside firms to jointly impact firm performance.

Addressing this gap, based on business model literature and social capital theory, this research investigates the effects of radical business model innovation and incremental business model innovation on firm performance and also the moderating effects of intraindustry social relationship and extraindustry social relationship. Our results indicate that a alignment outside relationship is needed to leverage radical business model innovation or incremental business model innovation for firm performance.

This research contributes to both business model innovation literature and social capital literature. First, this study extends the business model innovation perspective of firm performance. This research finds that two type of business model innovation

should align with social relationship outside firm to improve firm performance. Second, this research also extends social capital literature. We clearly distinguish contingency conditions required between different types of business model innovation, social relationship should attach more attention to the type of business model innovation. Empirically, this research used a sample of 174 firms examine the theoretical models and empirical assumptions, also provides more general empirical evidence on the interactive effects between business model innovation and social relationship.

THEORY AND HYPOTHESES

Model Construction

Schumpeterian innovation theory proposed firms can achieve endogenous growth by means of five type of innovation: products, processes, materials, marketing and organization, that firms create value through a unique combination of resources (Schumpeter, 1934). However, resources per se do not bring any value to firms and its' customer. Although product innovation is important, Teece (1986) finds product innovation unable to guarantee the success in business by itself. Firms need to jump out of the boundary of the enterprise looking for complementary conditions to profit (Teece, 1986). Teece (2010) constructs a value capture framework to explain why some innovation leaderships eventually do not benefit from innovation, that product innovation should jointly create value together with the way of value chain organized, value capture system and complementary assets orientation. Firms improve performance when firm aligns complementary assets with new business model (Kim and Min, 2015). Spanning-boundary competition incubated by Internet has lead more practitioners and scholars began to rethink the nature of value creation process. The success of firms depend on business ecosystem (Moore, 1996) in which the core firms interdependently perform activities and cooperate with competitors, customers, complementors, and other stakeholders through collaborative or competitive networks (Adner and Kapoor, 2010; Zott and Amit, 2010). Under highly interconnected market environment, social division restructuring driven by complex resource structure, which reshapes the existing business model of various industrial. More and more scholars realize that the traditional value chain has been unable to portray the entire contents of value creation (Zott et al., 2011; Zott and Amit, 2013). A core firm needs to adopt a system spanning-boundary perspective and manage relationships at different levels to generate the idea of value creation and value capture (Wei et al. 2014).

The essence of business model is how to do business in novel ways (Magretta, 2002). Based on analyzing the characteristics of value creation in Internet circumstance, Amit and Zott (2001) formally proposed the concept of the business model, scholars recognize that the business model is a 'system level concept, centered on activities and focusing on value' (Zott et al., 2011), and they consider the business model itself becomes a source of value creation. Zott and Amit (2007) proposed business model is a combination of transaction content, structure, and governance elements. Business model innovation refers to the search for new logics of the firm, new ways to create and capture value for its stakeholders, and focuses primarily on finding new ways to generate revenues and to define value propositions for customers, suppliers, and partners (Amit and Zott 2001; Magretta 2002; Zott and Amit 2007, 2008; Casadesus-Masanell and Ricart 2010). Amit and Zott (2001) differentiate business model innovation with four type of interlinked business model value themes: novelty, lock-in, complementarities, and efficiency. However, that research is limited to e-commerce background. Zott and Amit (2007) expand the research context out of e-commerce to the start-ups, that scholars study the effects of business model innovation on firm performance, and also moderating effects of the environment through empirical work. Firms can adopt two types of business model innovation based on sources which is original or imitative (e.g., Zott and Amit, 2007; Cavalcante et al., 2011; Kim and Min, 2015). In addition, diversity perspective of business model innovations typology are continuously identified and developed to articulate firms' existing or desired business model, such perspective as the radicality of innovation, the reach of innovation and the complexity of innovation (Taran et al., 2015). Based on previous literature, this study will differentiate business model innovation to radical business model innovation and incremental business models innovation according to the novelty of innovation. Incremental business model innovation is to improve the existing business model through imitation, that firms articulate existing business model by reducing information asymmetry, decreasing the complexity of transactions, and reducing transaction errors and other differences. Radical business model innovation proposes new value proposition and design a new business model, for example, making connection with new trading entity, adopting new ways to carry out transactions with existing partners, designing new trading mechanism, pricing models and profit models.

Whenever a firm employs a particular business model, just developing a business model is insufficient to assure competitive advantage if business model configuration is not properly adapted to the competitive environment (Teece, 2010). Business model represents a specific combination of boundary-spanning resources which through transactions exchange with stakeholders and generate value for the company and its customers (Zott et al., 2011; Zott and Amit, 2013; DaSilva and Trkman, 2014). Firms carry out business model innovation to improve performance, which is great challenge for boundary-spanning resources available. A novel business model innovation need to consume abundant resources. Especially, resources are important constraints for entrepreneurial companies, because its infancy often lack resources invested. Social capital theory suggests that firms may exploit resources embedded in external relationship in addition to internal resources. Nahapiet and Ghshal (1998) conceptualize social capital consist of relationship, cognitive and structure. Under the transition context, relationship networks is important channel by which Chinese firms get access to knowledge, technology, information and other resources. Peng and Luo (2000) find that the managerial ties can prompt firm access to resources outside its boundary through empirical study. Because of incumbent firms embedded in a intraindustry network, it is difficult to obtain enough knowledge

from extraindustry and break the established business logic, so that incumbent firms often failed competition with new entry of small businesses (Christensen, 1997). Geletkanycz and Hambrick (1997) differentiate effect of intraindustry and extraindustry information on strategic choices, and find that the more top management team obtain knowledge and information by means of intraindustry relationship, the more established strategic choice is reinforced. In contrast, knowledge and information obtained through extraindustry relations, which help firm to choose different strategy from other peer firms. Stam and Elrfing (2008) find that the knowledge and resources come from intraindustry and extraindustry relationship which have different effects on the development of entrepreneurial opportunities. Boso et al. (2013) also find that intraindustry and extraindustry relationship have different effects on entrepreneurial process. Based on these studies, this research differentiate the relationship from intraindustry relationship and extraindustry relationship. The former refers to the relationship between company and partner, customers, distributors, suppliers. The latter refers to the relationship between company and universities, research institutes, government departments, media and customers from other industry.

Based on the above theoretical analysis, we construct a theoretical model (Figure 1) to propose that although business model innovation may be key drivers for firm performance, its effect may depend on whether alignment of social relationship really exists. Specifically, radical business model innovation and incremental business innovation affect firm performance. However, their effects may be moderated by extra- and intra-industry social relationship.

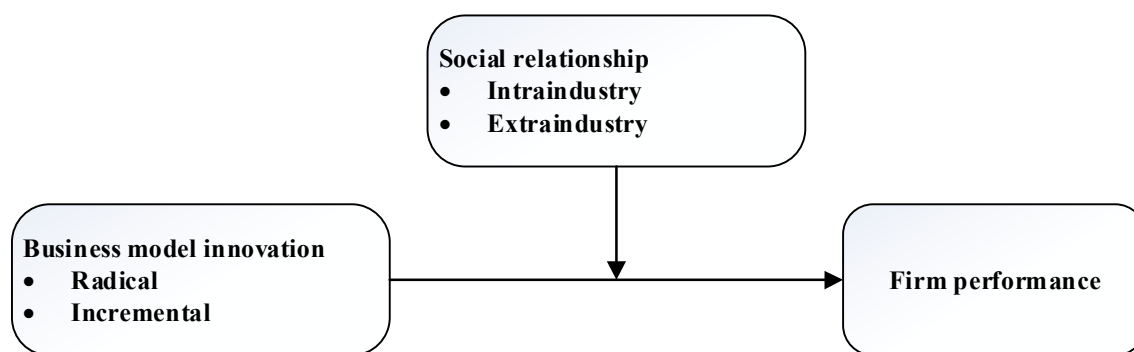


Figure 1: Theoretical model

Business Model Innovation and Firm Performance

Extant literatures offer that there is an important direct relationship between the design of transactions and firm performance (e.g., Milgrom and Roberts, 1992; Poppo and Zenger, 1998). Incremental business model innovation aims to reduce transaction cost, decrease transaction errors, and increase transaction efficiency through information sharing and operational process improvement based on established transaction structure (Zott and Amit, 2007). This reduction can derive from the attenuation of uncertainty, complexity, or information asymmetry (Williamson, 1975), as well as reduction of coordination costs and transaction risk (Clemons and Row 1992).

Furthermore, since the inherent advantages of the Internet and e-business which have a dramatic reduction of transaction cost, the sophisticated technology have progressively spread into all industries as a suitable way of organizing business activity (DaSilva and Trkman, 2014). Even if traditional brick-and-mortar companies can run incremental business innovation, which further explore new products, and improve established product-centered business models, so that firm may improve Schumpeter Rents which can help firm win more market opportunities (Zott and Amit, 2013). For example, bio-pharmaceutical companies more like to explore new drugs and new therapies by increasing R&D investment, meantime the company apply information technology on limited improvement of established business model under the Internet environment. The stability of the business model provide a stable environment for market expansion, which can help firms reduce marketing risk.

However, note that these strategies are often difficult to work within a dynamic and heterogeneity of environment. Within ever-changing customer needs and transaction entities of environment, transaction process has become a major source of organizational inertia, which is original contributing to the success of enterprises (Christensen, 1997). For Chinese companies, it is increasingly more difficult, that firms enhance competitive advantage by dedicated to the incremental improvement of the established business model. The more firms dedicated to the incremental business model innovation, the more firms will emphasize consistency and standardization against transaction processes, which lead the company's business behavior to be firmly solidified in the current activity system. Such stable structure cause that it is difficult for firm to adapt to the dynamic changing environment, thus precludes the firm improving the firm performance. Therefore, the study hypothesize:

Hypothesis 1: Incremental business model innovation has a positive effect on firm performance.

Radical business model innovation aims to find novel alternative value proposition through designing a boundary-spanning transactions pattern that a focal firm does transaction with customers, partners, vendors, and other stakeholders (Zott and Amit,

2007; Teece, 2010). Radical business model innovation either creates novel value proposition and innovates transactions for current market or enter into new market and industry (Zott and Amit, 2007). With the popularity of the new generation of network technology, fully recombination of resources and information sharing have broken established social resources structure, so that original solidified resources are flowing. Firms can find new opportunities to reconfigure resources and capabilities and obtain fast growth (Zott and Amit, 2013). For example, Shaanxi Blower Group regains rapid growth through re-positioning value proposition to service-oriented business model. NVC-lighting redefines the market value of lighting products, find a new profitable channel which beautify light environment. Moreover, radical business model innovation enable firms to break organizational inertia and institutional rigidity, so that, firms can adapt to dynamic environment. Therefore, the study hypothesize:

Hypothesis 2: Radical business model innovation has a positive effect on firm performance.

Business Model Innovation and Social Relationship

Since Chinese unique culture and regime, social relationship play an important role in business activities. Social relationship act as informal mechanisms which to get, apply and configure resource, help firms to reorganize resources according to requirement of business model innovation. However, it is quite different that the resources intraindustry and extraindustry relationship brought to firm (Geletkanycz and Hambrick, 1997). Intraindustry relationship may bring to firm resources which are often closely linked to the existing business model. In contrast, extraindustry relationship may bring more heterogeneity of resources to firm (Stam and Elfring, 2008). Social capital theory also point out that it is often opportunity which social relationships bring to firms. Social capital is only a potential resource. Firm can obtain resources through social relationship, even though it may not be used. The two type of social relationship might have different effect of business model innovation on firm performance.

Incremental business model innovation dedicated to improve profitability through reconfigure the established business model. During business model improvement, incremental business model innovation needs more resources attached existing business models. Intraindustry relationships are often embedded within the established value network. The closer intraindustry relationships are, the more companies are able to get resources from these partners. Cognitive overlap generated from closer relationship networks also guides enterprises to consolidate existing partnership, transaction process and product to carry out business activities (Christensen, 1997; Christensen and Raynor, 2003). Therefore, the more closely intraindustry relationship, the more successful incremental business innovation progress.

The extraindustry relationship can help companies acquire new resources without influenced by past experiences. Extraindustry relationship often bring more heterogeneous resources, it is difficult to directly be used to improve or consolidate the existing business model. These heterogeneous resources difficult to integrate, more importantly, it is difficult to blending with the existing resource base. Therefore, for incremental business model innovation, the value of extraindustry relationship resources is smaller and the integration risk is greater. Therefore, the study hypothesize:

Hypothesis 3a: Intraindustry relationship enhance the positive effect of incremental business model innovation on firm performance.

Hypothesis 3b: Extraindustry relationship weaken the positive effect of incremental business model innovation on firm performance.

Radical business models innovation requires a lot of resources to carry out the exploration (Zott and Amit, 2007) and trial-and-error (Sosna et al., 2010; Tongur and Engwall, 2014). New business models require heterogeneous resources as a support. Excessive closer intraindustry relationship is not only difficult to provide effective resources, but also be the biggest obstacle to oppose innovation (Christensen, 1997; Rosenkopf and Nerkar, 2001). Closely intraindustry relationship causes the company more dependent on existing resource base and business model, which emerged stronger inertia in dynamic environment (Christensen and Raynor, 2003). Excessive closer intraindustry relationships cause embedded relationship, it is so difficult for enterprises to break the shackles of the established relationship network to extend the new network.

Radical business models innovation often means to break existing transaction and cooperation structures, construct new transaction relationship, transaction process and profit model, it often requires a cooperation network different from existing business model. During this innovation process, the resources brought by intraindustry relationship is often difficult to help firm build new business model (Geletkanycz and Hambrick, 1997). Firm need to expand cooperation networks outside the industry they located. The higher the extraindustry relationship resources, the more acquired new resources, which is useful to complete the business model designment.

The extraindustry relationship was less affected by the established investment, which can bring to firms heterogeneous resources, and stimulate top management team creative thinking (Geletkanycz and Hambrick, 1997). Therefore, for radical business innovation, the value of extraindustry relationship resources is higher and it has lower risk. Extraindustry relationship resources

tend to be more easily absorbed and exploited. It is helpful for companies which develop a higher level of extraindustry relationship to get more heterogeneous resources, and to reduce the risk of business model innovation. Therefore, the study hypothesize:

Hypothesis 4a: Intraindustry relationship weaken the positive effect of radical business model innovation on firm performance.

Hypothesis 4b: Extraindustry relationship enhance the positive effect of radical business model innovation on firm performance.

METHODOLOGY

Sample and Data Collection

We used surveys of firms in China to test our hypotheses. China is one of the most important emerging economies, and is being a drastic upgrading of industrial structure. The companies were selected out of the firm list provided by the local governments, which from Suzhou Industrial Park, Qingdao National High-tech Industrial Development Zone, Xi'an Hi-tech Industries Development Zone and Shenzhen High-Tech Industrial Park.

We developed questionnaire based on previous literature review. With the consent of companies, the research personnel meet executives and fill in the questionnaire onsite. In order to avoid influence of common method bias, we invited two executives each sample to attend survey to complete different part of the questionnaire. To ensure that the respondents were knowledgeable, we selected the top managers or department managers as the respondents. We conducted the survey with manager A and B separately, and checked the questionnaire after the managers finished it.

A total of 500 firms were approached and 186 firms participated in the survey. Due to 12 firms failed to complete the questionnaire, our final sample includes 174 firms, which represented a response rate of 34.8%. Among the 174 responding samples, new generation of information technology enterprise were 56, high-end equipment manufacturing enterprises were 38, new materials enterprise were 23, new energy enterprises were 23, bio-pharmaceutical companies were 21, environmental service enterprise were 13.

To check non-response bias, Chi-square test and t-test was performed to compare the responding and non-responding firms along firm attributes such as firm size, age and ownership. The test result shows that responding and non-responding samples were insignificant difference, which indicated low possibility of non-response bias (Armstrong and Overton, 1977).

Measures

This research adopted mature scale to measure firm performance, business model innovation, social relationship and control variables (shown in Table 1).

This study used six indicators measuring firm performance, including: (1) Return on assets; (2) Return on sales; (3) Return On Investment; (4) Average Rate of Profit; (5) Sales growth; (6) Profit growth. In order to test possible bias which are guided subjective, this research also collected objective data of Sales margins, and make correlation analysis on objective and subjective performance. This study find that there is a significant correlation between the objective and subjective performance.

According to some scholars' research (Zott and Amit, 2007; Cavalcante et al., 2011), this study used six indicators measuring the incremental business model innovation, and used seven indicators measuring radical business model innovation (shown in Table 1).

Based on relevant research (Geletkanycz and Hambrick, 1997; Stam and Elfring, 2008; Boso et al., 2013), this study measured 11 relationships about companies between customers, suppliers, distributors, peers, government, industry associations, universities, research institutions, the media, executives of companies come from other industrials and other social organizations which are outside of company. This study adopted 11 indicators to measure whether companies have established a good relationship with these outside entity.

Previous researches present that firm size, firm age and the competitive environment will directly affect firm performance. In order to avoid bias which caused by right shift of distribution of numerical variables, this study used natural logarithm conversion value of firm age as measure-items, and used natural logarithm conversion value of the staff number of companies to measure firm size. This study used 1-5 Likert scale measures competitive environment: intense competitive within industry.

Reliability, Validity and Common Method Variance (CMV)

This study used Cronbach's α coefficient to test reliability. The result shows that the Cronbach's α coefficient of each scale are greater than 0.7 (shown in Table 1), indicating the scale has good reliability. This study used two indicators of AVE and loading values to test the validity of the scale. The result shows that the loading value of each item are above 0.6, and AVE value are all more than 0.5 (shown in Table 1), indicating the measurement has a better convergent validity, according to Fornell and Larcker

(1981) proposed standards. This study used AVE method to test discriminant validity of each variable. The result shows that the AVE square roots of each variable is greater than the correlation coefficient of the variable with other variables (shown in Table 2), indicating a better discriminant validity between each variable. The common method variance is an important bias in empirical research, Podsakoff et al. (2003) suggested that separate the source of questionnaire on measuring independent variable and dependent variable is the best way to avoid the common method variance. Therefore, this research invites two executives in each sample company, complete different parts of the questionnaire respectively. Questionnaire for measuring business model innovation, social relationship and control variables comes from executives A, and questionnaire for measuring firm performance comes from executive B.

Table 1: Constructs reliability and validity

Factors	Items	Loadings	Reliability/ validity
Firm performance	(1) Return on assets	0.865	$\alpha=0.879$ AVE=0.631
	(2) Return on sales	0.874	
	(3) Return On Investment	0.813	
	(4) Average Rate of Profit	0.778	
	(5) Sales growth	0.611	
	(6) Profit growth	0.798	
Incremental business model innovation	(1) Reconfigure business model to reduce transaction costs for participants.	0.773	$\alpha=0.932$ AVE=0.622
	(2) Reconfigure business model to simplify transaction process.	0.746	
	(3) Reconfigure business model to decrease transaction errors.	0.812	
	(4) Reconfigure business model to reduce marketing and sales cost, communication cost.	0.812	
	(5) Reconfigure business model to speed up transaction.	0.744	
	(6) Reconfigure business model to improve transaction efficiency.	0.820	
Radical business model innovation	(1) Design a new business model creative.	0.658	$\alpha=0.935$ AVE=0.568
	(2) Introduce a lot of new, diverse participant.	0.647	
	(3) Links participant together in novel ways.	0.681	
	(4) Redesign novel profit model.	0.846	
	(5) Creates new sources of revenues.	0.847	
	(6) Adopts new ideas and methods to conduct business.	0.875	
	(7) Overall, the company's business model is novel.	0.878	
Intraindustry relationship	(1) Establish a close personal relationship with end customers.	0.858	$\alpha=0.807$ AVE=0.668
	(2) Establish a good personal relationship with management staff of supplier.	0.848	
	(3) Establish a good personal relationship with management staff of distributor.	0.848	
	(4) Establish a good personal relationship with management staff of industry.	0.680	
Extraindustry relationship	(1) Maintain a good relationship with all sectors of local government.	0.621	$\alpha=0.877$ AVE=0.624
	(2) Establish a good relationship with various industry associations.	0.767	
	(3) Establish a good relationship with universities.	0.750	
	(4) Establish a good relationship with research institutions.	0.699	
	(5) Establish a good relationship with media institutions.	0.776	
	(6) Establish a good relationship with top management personnel in other industries.	0.749	
	(7) Establish a good relationship with various social organizations.	0.820	

Analysis and Results

Table 2 presents the basic characterization of variables in our model, and analyzes the correlation between each variable. The results of analysis show that incremental and radical business model innovation, intraindustry and extraindustry relationship, have significant correlation coefficient on firm performance, which lay the basic foundation for the regression analysis. In addition, all correlation coefficient of each variable are less than 0.6, which reduce the threat of multicollinearity (Aiken and West, 1991).

Table 3 reports the four steps of validation of theoretical model. In model 1, the study only examines the role of control variables, which together explain a significant share of the variance. Model 2 verified the effect of incremental and radical business model innovation on firm performance. We find that incremental and radical business model innovation did significantly contribute to firm performance with controlling firm age, size and intensity of competition, and regression coefficient of radical business model innovation on firm performance is very significant. The result indicates that both incremental and radical business model innovation have positive effect on firm performance. Overall, it is more evident that radical business model innovation improves firm performance more effective than incremental business model innovation. Therefore, Hypothesis 1 and Hypothesis 2 are supported.

In model 3-4, we add intraindustry relationship, extraindustry relationship and interaction between business model innovation and social relationship to examine the moderating effect of social relationship. The Model 4 shows that the coefficient of interaction between incremental business model innovation and intraindustry relationship is significantly positive. The result indicates that intraindustry relationship strengthens the positive of incremental business model innovation on firm performance. Therefore, Hypothesis 3a is supported.

Model 4 shows that the coefficient of interaction between radical business model innovation and intraindustry relationship is significantly negative. The result indicates that intraindustry relationship weakens the positive effect of radical business model innovation on firm performance. Therefore, Hypothesis 4a is supported.

Model 4 shows that the coefficient of interaction between incremental business model innovation and extraindustry relationship is significantly negative. The result indicates that extraindustry relationship weakens the positive effect of incremental business model innovation on firm performance. Therefore, Hypothesis 3b is supported.

Model 4 shows that the coefficient of interaction between radical business model innovation and extraindustry relationship is significantly positive. The result indicates that extraindustry relationship strengthens the positive effect of radical business model innovation on firm performance. Therefore, Hypothesis 4b is supported. In summary, Hypothesis Testing Results are shown in Table 4.

Table 2: Means, standard deviations (SDs), and correlations

	Mean	SD	1	2	3	4	5	6	7	8
1.Firm age	2.30	0.79	N/A							
2.Firm size	5.26	1.52	0.25*	N/A						
			*							
3. Intense competition	3.80	0.73	0.15*	0.22*	N/A					
				*						
4.Incremental business model innovation	3.65	0.65	-0.07	0.02	0.06	0.789				
5.Radical business model innovation	3.59	0.67	-0.07	-0.02	0.07	0.38*	0.754			
						*				
6.Intraindustry relationship	3.90	0.70	0.01	0.07	0.15*	0.38*	0.42*	0.817		
						*	*			
7.Extraindustry relationship	3.84	0.69	0.06	0.23*	0.19*	0.47*	0.35*	0.42*	0.790	
				*	*	*	*	*		
8.Firm performance	3.10	0.67	-0.01	0.01	-0.09	0.18*	0.26*	0.14*	0.18*	0.794
						*	*		*	

Notes: a. + $p < 0.1$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$;

b. The diagonal elements are square roots of average variance extracted (SRAVE) for constructs measured with multiple items. N/A refers to this item is not adaptive to analysis.

CONCLUSION AND DISCUSSION

Conclusion

This research aims to answer the question that how business model innovation alignment with social relationship to impact on firm performance. Based on innovation theory, business ecosystem theory and social capital theory, theoretical model was constructed. This study adopts 174 Chinese emerging technology companies as samples, the theoretical model was empirically tested. The test results basically support the theoretical framework which this research proposed. This study finds that incremental and radical business model innovation all have positive effect on firm performance, and radical business model is more effective. More importantly, this study finds that incremental and radical business model innovation fit with different social relationship to improve firm performance. We find that intraindustry relationship enhances the positive effect of incremental business model innovation whereas weakens the positive effect of radical business model innovation. We also find that extraindustry relationship weakens the positive effect of incremental business model innovation whereas enhances the positive effect of radical business model innovation.

Table 3: Regression results

Variables	Dependent variable: firm performance			
	Model 1	Model 2	Model 3	Model 4
Control variables				
1. Firm age	-0.125+	-0.138+	-0.151+	-0.147+
2. Firm size	0.115	0.113	0.125	0.101
3. Intense competition	-0.159**	-0.165***	-0.149***	-0.089
Independent variable				
4. Incremental business model innovation		0.139**	0.147**	0.145**
5. Radical business model innovation		0.181***	0.178***	0.179**
Moderators and Interactions				
6. Intraindustry relationship			0.118*	0.121*
7. Extraindustry relationship			0.167**	0.163**
8. Intraindustry relationship*incremental business model innovation				0.141**
9. Intraindustry relationship*radical business model innovation				-0.187**
10. Extraindustry relationship*incremental business model innovation				-0.266**
11. Extraindustry relationship*radical business model innovation				0.209**
R square	0.196	0.294	0.387	0.496
Adjusted R square	0.105	0.196	0.294	0.387
R square change		0.098***	0.093***	0.109***
F value	2.154**	2.267***	2.272***	2.213***

Notes: +, * Represent significance level; + P < 0.1; * P < 0.05; ** P < 0.01; *** P < 0.001, all tests are two tailed.

Table 4: Hypothesis Testing Results

Hypothesis	Content	Test Result
H1	Incremental business model innovation has a positive effect on firm performance	True
H2	Radical business model innovation has a positive effect on firm performance	True
H3a	Intraindustry relationship enhance the positive effect of incremental business model innovation on firm performance	True
H3b	Extraindustry relationship weaken the positive effect of incremental business model innovation on firm performance	True
H4a	Intraindustry relationship weaken the positive effect of radical business model innovation on firm performance	True
H4b	Extraindustry relationship enhance the positive effect of radical business model innovation on firm performance	True

Theoretical Contributions

This research contributes to both business model innovation and social capital literature. First, this study explores different type of business model innovation impact on firm performance with novelty perspective. We find that radical business model innovation has higher effect on firm performance. More importantly, this study further analyzed the moderating effect of social relationships, we find that although Chinese companies attach great importance to social relationship, the role of different types of social relationships have been obviously neglected. Firms can't benefit from all social relationship, because of different business model innovation requires different social relations to improve firm performance. The study identified contingency conditions which different social relationship has different moderating effect on business model innovation. Second, the study enriches large samples of empirical evidence on how business model innovation impact upon firm performance. Previous studies often were confined to case studies of individual company, which did not provide more empirical evidence, because of limitation of research content and context. This study used a large sample of 174 Chinese emerging technology companies to examine theoretical model, which improves universality and applicability of the conclusions.

Managerial Implications

This research also bears important managerial implications. First, firms should take more attention to organizational inertia in order to avoid traps during firms innovate or replicate a new business model. According to our finding, intraindustry relationship may stimulate incremental business model innovation forming or strengthening organizational inertia because of path-dependence, which ultimately lead companies failed in market competition and cause resources loss. Especially for firms in emerging economy such as China, firms often face such traps with industrial structure upgrading. Because of the weak technological base, Chinese companies should invest more resources on innovation strategies to develop new market or grasp market opportunity.

Second, firms need to build different types of social relationships according to different business model innovation strategies. Firms need to notice that not all types of social relationships are helpful to business model innovation. The results show that the radical business model innovation can create more values, and extraindustry relationship is more effective than intraindustry relationship. Firms need to span out of familiar relationship such as customers, suppliers, peers, to create closer relationship with universities, governments, and customers come from other industry, to enhance the promotion of business model innovation on firm performance.

Limitation and future directions

This study has limitation that need to deal with in future research. First, business model innovation typology can be defined from multiple dimension in addition to novelty used this research. For example, Taran et al. (2015) proposed a business model innovation typology which consist of three dimension including "Radicality", "Reach" and "Complexity". Firms can combine different type of business model innovation to improve firm performance, according to what resources and capabilities they have and environment around them. Therefore, future research needs to study either different type of business model innovation alignment with environment affect firm performance or the role of combination of different type of business model innovation.

Second, this research only considered external social capital without internal social capital. Given business model is a combination of boundary-spanning resources through which create and deliver value to customer, business model innovation should be related to the internal resources reconstruction. Therefore, internal social capital is also potential impact firm performance. Business model innovation may require different types of social capital to match. This research only concerns the impact of external social capital, future research may continue to study the moderating effect of internal social capital on firm performance.

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APPENDIX

The research is funded by program 2016KRM080.

Factors Motivating the Customers' SNS Brand Page Behavior: Comparison between China and Korea

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ABSTRACT

Purpose – The wide spread and usage of SNS brand pages in companies has renovated the brand strategy in the new era. Embedded in an organically grown network of social ties, SNS brand pages show great differences from the ordinary online brand community. Called upon by the new research opportunities, this paper investigates the motivating factors (functional benefits, hedonic benefits, economic benefits and intrinsic benefits) influencing customers' SNS brand page behavior (participation/commitment) in the cultural context of China and Korea, so as to provide meaningful implications to the companies' effective use of SNS brand pages, and help global companies in their development of brand strategies for the two countries.

Design/methodology/approach – In all, 407 Chinese and 384 Korean SNS brand page users were surveyed to conduct the above research agenda by structural equation modeling.

Findings – prior motivating factor constructs are valid in influencing the consumers' participation in and commitment to SNS brand pages in both countries, yet with dissimilarities in the significance and strength. Information seeking is not significantly correlated with the SNS brand page behavior in China, and convenience is found not correlate in Korea. Brand reputation in China and reward in Korea are the most influential factors of participation behavior. Interaction plays an important role in affecting commitment behavior in both countries. Participation has a positive impact on purchase intention in two countries, but only Chinese samples' commitment has a positive impact on purchase intention.

Keywords: SNS brand page, brand community, information seeking, reward, participation, commitment, purchase intention

INTRODUCTION

Social Network Site (SNS) has become increasingly popular around the world these years, and has changed the way individuals communicating with the companies and peer consumers. The relative brand information consumers gained from diverse sources will dynamically influence the consumers' consumption experience and even purchase behavior [41]. The appearance of SNS brand pages further develops to represent an emerging form of Information and Communications Technology (ICT) that provides constant connectivity among users worldwide. The wide spread and usage of SNS brand pages in companies has renovated the brand strategy in the new era. Companies can easily deliver varied contents regarding the brands, and timely communicate with the potential or existing customers [10].

Being a profile in a social network website and a mixed information warehouse co-established by different entities [28], SNS brand pages (also known as fan pages) form specific online brand communities. The SNS brand pages can help to direct messages and posts to subscribing users, lead to varied discussion topics related to the brand, and contribute to tight social networks among the subscribed users. Once the member consumers perceive the benefits they received as worthwhile, they are likely to become more active participants [46]. The consumers with commitment to the business [43] or those psychologically attached to the brand during the participation [41] will even generate their long-term commitment to the SNS brand pages.

However, the SNS brand page is more like an organically grown network of social ties, instead of an online brand communities based on pure brand-likeness [10,31]. Great differences still exist regarding the fundamental running functions between brand pages and online brand community.

Abundant literature have expanded the research of online brand community in exploring the participation or commitment behavior, discussing the antecedents [20,30,40]; investigating its behavioral consequences [9,22,72], and even discovering the potential cultural differences [1,71]. However, a lack of systematic work in examining the consumers' benefits and costs through the use of SNS brand pages has been pointed out [68], and new research opportunities are also called upon. Since the SNS brand page featured by the convenient mass communication and vast social connectivity will apparently differ from the ordinary online brand community, and accordingly lead to different influential roles of the recognized motivating factors.

It is therefore meaningful to explore the motivators-participation/commitment-intention relationship in the context of SNS brand pages. This paper will investigate the motivating factors influencing customers' SNS brand page behavior in the cultural context of China and Korea, so as to provide meaningful implications to the companies' effective use

of SNS brand pages, and help global companies in their development of brand strategies for the two countries. Extensive literature review is conducted in the second section. The research model and corresponding research hypotheses are accordingly proposed in section three, and followed by the research methodology in section four. The research results are discussed in section five. Theoretical and practical implications are depicted in section six. A brief conclusion and the limitations are described in the final section.

LITERATURE REVIEW

With the invention and dissemination of the Internet, people from all over world are able to form communities based on common interests, and are no longer restricted by geographically limits. Brand community, being “a specialized, non-geographically bound community, based on a structured set of social relations among admirers of a brand” [48], is formed on basis of the attachment to a product or brand. The common interests, socio-economic similarities or similar viewpoints can be the essential foundation of brand community. The members who join the community normally have strong attachment or commitment to the brand, willing to share a system of values, and bearing a sense of moral responsibility.

However, the SNS brand page, being a specific form of online community, still show some differences from the ordinary online brand community in the fundamental running functions. A brand page, also known as SNS brand page, is a profile on a social networking website that is potentially manageable by more than one registered user to represent a non-personal online identity. Organizations or brands owners make use of the SNS brand pages to direct messages and posts to subscribing users, promote a brand, and arouse the consumers’ awareness. It has been formed as a mixed information warehouse co-established by the business and its customers [28]. However, the registered fans may not “like” a SNS brand page because they want to be the real part of the community. Receiving discounts or freebies as the rewards of being followers, or truly attracted by the offline connections to be SNS “friends” also do not guarantee they are real loyal fans. It is because the SNS brand pages are embedded in an organically grown network of social ties, instead of pure brand-likeness value of the online brand communities [10, 31].

According to Uses and Gratifications Theory [58], consumers actively seek out to use new media such as SNS brand pages to satisfy their specific needs. In order to receive the perceived benefits, the consumers will actively participate or even commit to the SNS brand pages, so as to enhance knowledge, self-relax, construct social interactions, or even escape from the reality [44].

Participation in the SNS brand pages mainly refers to the consumers’ engaging activities like creating messages, disseminating information, and providing emotional support to others [9]. However, the definition of commitment is attitudinally rather than behaviorally based [42]. Commitment in the SNS brand pages mainly reflects the strong and positive psychological attachment of consumers to a specific brand [7]. This attachment may be originated from the prior internal emotional involvement towards the brands [76] or generated after active participation in maintaining the long-term relationship with the brands [11]. From this perspective, the participation and commitment behavior differ emotionally, so do the potential needs that the consumers pursue.

The potential benefits consumers pursue from the SNS brand pages can also be deemed as the motivating factors. Motivation is the force that initiates, directs, and maintains goal-oriented behaviors [26], and the participation or commitment behavior is investigated as an action driven by benefits (e.g., [10, 37]). Previous studies mainly focused on the benefits of online communities from the business perspective [4, 8, 9, 24, 42, 47, 63] though they separately explored the benefits-participation/commitment relationship. It is found that active participators are highly motivated by functional benefits (i.e. self-enhancement, problem solving support) and economic benefits (i.e. rewards), to participate in an online community [9]. The perceived benefit-commitment link is also tested to be positive by increasing the intrinsic benefits such as self-esteem or social benefits, and hedonic benefits like entertainment seeking [4, 8]), and functional benefits like learning benefits [24].

The different country context also play an important role in motivating people for using SNS [30, 62, 35, 71]. Different countries have varying inherent values, symbols, and even cultures, the behavior of social network users and their purchase intention may also vary. For instance, information-sharing behavior when using social network sites is different between Chinese and Americans [52]. Kim et al. even found that for brand-loyal Chinese consumers, experiential image is the most important motivator for purchasing the branded apparel, while social image with performance quality assurance play vital influences to Korean consumers [35]. As In the new context of SNS brand pages, there should be great differences on the motivating factors that can affect the participation and commitment behavior of customers from diverse countries.

THE RESEARCH MODEL AND RESEARCH HYPOTHESE

Participation, Commitment and Purchase Intention

Active participators of a SNS brand page typically show high levels of interest in the brand and in its products and services,

and continuously update their knowledge through inquiring with the business and communicating with other members. These frequent interactions with the brand can enhance the consumers' brand knowledge and positive attitudes [47], strengthen the consumer-brand bond. Generally speaking, consumers are likely to express their confidence and belief in the brand if they have continually received positive information and interaction from a community [13]. This kind of feeling can help to further reinforce the consumers' psychological attachment to the brand [41], generate consumer trust and loyalty towards the brands [19], and consequently even lead to their commitment to it [2, 23, 53]. Once the consumers develop to be committed followers of the SNS brand page, their commitment efforts then tend to generate enduring attitudes toward a brand, to maintain the relationship with the brand, and to avoid considering alternative offerings from other brands, by means of loyally following and deeply involving [21, 11].

However, the consumers' commitment behavior may also originate from the internal emotional attachment. According to social engagement theory [65], consumers tend to participate in the activities of their recognized social groups. Through committing to the unique SNS brand pages that the offline friends follow, the consumer can continue to interact with their friends of similar backgrounds or interests, and deliver social exchange activities by posting or receiving brand related messages. In this regard, commitment in the brand pages will conversely lead to the active participation, since the SNS brand page has been an extensive usage of the existing social ties.

Hence, the consumers' participation and commitment behavior in SNS brand pages interactively play an important role in building consumer-brand relationships, and also acts as an indispensable precondition to influence consumers' attitude and consequent behaviors [34, 19]. Consumer participation in the SNS brand community is found to significantly affect the online purchase behavior [3, 66]. Commitment to an online brand community is also found to be a primary factor contributing to consumers' continuous usage [39] and brand attachment like trust and loyalty [77]. Brand purchase intention, being the likelihood that a customer will buy a particular brand product/service [14] can further predict the actual buying behavior [19]. Therefore, the consumers' SNS brand page participation or commitment behavior will lead to favorable purchase intention. Here the hypothesis is proposed.

H1. Participation in the SNS brand page will have a significant positive co-relationship with the purchase intention.

H2. Commitment in the SNS brand page will have a significant positive co-relationship with the purchase intention.

Motivating factors of SNS brand page Behavior

As the Uses and Gratifications Theory indicated, consumers seek to use new media to satisfy their needs [58]. Once the perceived benefits are retrieved, the consumers will be motivated to engage in the related new media usage behavior. In the previous research [4, 8, 9, 24], the motivating factors of the consumers' online community behavior can be concluded into functional benefits, hedonic benefits, economic benefits and intrinsic benefits. The four categories of benefits can well define the factors that motivate the consumers to participate, commit, or even being loyal to the online communities. The consumer benefits that encourage active participation, commitment, and loyalty to the community are also found to be consistent [33]. In the study of Casalo et al. (2007) [12], functional benefits and economic benefits are tested to highly motivate the consumers' active participation in an online community. The functional benefits are reinforced in discussing the consumers' online community commitment behavior [24]. The important role of the intrinsic benefits and hedonic benefits also is investigated in other studies [4, 8, 56] specifically explored the motivators of loyalty to Facebook brand pages, and concluded that functional, hedonic and intrinsic benefits play important roles. Therefore, six motivating factors are proposed in this paper.

Functional benefits as the motivating factor

Functional benefits mainly refer to the concrete outcomes that the consumers can receive in using the social media. It normally connects with the information quality or system quality that the new tools can afford in consumers, such as information seeking or convenience seeking benefits.

Information seeking is the most frequently used functionality by the social media users, and the functional benefits consumers perceived from information seeking are found to significantly affect the consequent behavior [20, 51]. The motivation of information seeking encourages consumers to actively and positively take part in online brand community activities [40]. When the community participators are accustomed to seek valuable information, and if the community can always provide them with useful information, the consumers' will even exhibit stronger commitment to the community [38]. Convenience seeking is another important functionality referring the anytime-anywhere benefits consumer's perceived with less effort. The convenience function derives from the ease of usage in either computer-based websites or applications on small devices. Convenience seeking has been identified as one key gratification in using the new media of online community [49].

When the SNS brand page member consumers immerse themselves into the "information warehouse", they can find timely answers for their inquiries, and also spread useful information among fans without time or distance limitations. Besides,

information dissemination via brand pages is easy and convenient, and the convenience can also further facilitate the smooth interactions among member fans [36, 70]. Therefore, the gratification of two functionalities is expected to exert a significant and positive effect on users' attitude towards this service and their subsequent behavior. The following hypotheses are accordingly proposed.

H3-1. Information seeking will have a significant positive relationship with the consumers' SNS brand pages participation behavior.

H3-2. Convenience seeking will have a significant positive relationship with the consumers' SNS brand pages participation behavior.

H4-1. Information seeking will have a significant positive relationship with the consumers' SNS brand pages commitment behavior.

H4-2. Convenience seeking will have a significant positive relationship with the consumers' SNS brand pages commitment behavior.

Hedonic benefits as the motivating factor

Hedonic benefits (i.e. fun or entertainment seeking) refer to the various pleasure that members feel in the online brand SNS community [16, 48, 59], and the utility of feelings or affective states, like pleasure, fun, and enjoyment [72]. The intent to seek entertainment motivates the consumers to spend more of their leisure time on the related activities. Community members engaging in diverse activities (e.g. games, contests, polls) will arouse or elicit the positive emotions and passions [3] that can further motivate them to use the media.

Specifically, SNS brand pages facilitated by the new media can provide individuals with opportunities to gather and explore new things that they seldom experience offline. For instance, users can be entertained through Facebook in various ways like surfing on a friend's page, or learning what their friends are doing by reading through newsfeed on Facebook, and etc [61]. The entertained users are more likely to have a higher satisfaction level of use, which will further motivate them to participate or commit to the SNS brand pages [54]. Therefore the following hypotheses are proposed.

H3-3. Entertainment Seeking will have a significant positive relationship with the consumers' SNS brand pages participation behavior.

H4-3. Entertainment Seeking will have a significant positive relationship with the consumers' SNS brand pages commitment behavior.

Economic benefits as the motivating factor

Economic benefits (e.g. incentive seeking or rewards) are the general word describing the bonus or compensation that the consumers received through engaging in the online community. Gift certificates offered [25] or special promotions and coupons used [67] in online communities will inevitably strengthen the consumer-brand relationship. The consumers' incentive seeking behavior has been found to be one major reason for customers' loyal attitudes and continued participation in SNS brand communities [64]. According to Gummerus et al. [22], the more favorable the economic benefit is, the greater customers' satisfaction and loyalty will be, and the more likelihood that the consumers will continue engaging with it. The general word of reward is normally adopted to describe the incentives consumers perceived through a variety of compensation activities in the social network sites [45]. Therefore the following hypotheses are proposed.

H3-4. Reward will have a significant positive relationship with the consumers' SNS brand pages participation behavior.

H4-4. Reward will have a significant positive relationship with the consumers' SNS brand pages commitment behavior.

Intrinsic benefits as the motivating factor

Intrinsic benefits depict the internal psychological outcomes like self-esteem benefits and social benefits that one can perceive in using the new media. Fan-page membership can be used by the individual to show a peer group his social presence, and brand page membership turn to be the signal of a person's self-identity. If the users obtain rapid responses or replies, and can closely connect with others, the feeling of being recognized and paid attention to will lead to the sense of self-concept and self-esteem [75]. They can even share interesting encounters and joy with others, which will rapidly spread to all users of the community [48]. Therefore community interactivity is essential to trigger the consumers' intrinsic benefits, and satisfactory interactions with other community members can consequently encourage the consumers' community behavior [3]. Members of SNS brand pages are offered opportunities to continuously update their knowledge, and eventually leading to active participation or commitment [5]. In the study of Ruiz-Mafe et al (2014), the role of user interactivity of the Facebook brand page is confirmed to be essential in improving user attitude and loyalty [56].

Besides, the well-running interactivity can even enhance the member consumers' perceived functional and hedonic benefits.

Hence, the successful interaction can positively impact consumers' attitudes towards the brand, solidifies their bond with the products, and thus leads to their commitment [2, 53]. Thus the following hypotheses are proposed.

H3-5. Interaction will have a significant positive relationship with the consumers' SNS brand pages participation behavior.

H4-5. Interaction will have a significant positive relationship with the consumers' SNS brand pages commitment behavior.

Brand Reputation as the motivating factor

The SNS brand community offers consumers new way of knowing the brand, understanding the products, contacting the company, and communicating with the peer customers. However, the lack of the prior brand knowledge or the poor brand image may deter the consumers' interests to participate in the community. Since people make important buying decisions partly based on their level of trust in the product, salesperson, and the company image [27].

Therefore, Consumers tend to search for a reliable and responsible brand as this would help them largely avoid the innate risks of products and services [15]. If they observe a brand and its products or services as trustworthy, they try to actively and positively develop a sense of commitment and affection to the brand [7]. Hence the following hypotheses are proposed.

H3-6. Brand Reputation will have a significant positive relationship with the consumers' SNS brand pages participation behavior.

H4-6. Brand Reputation will have a significant positive relationship with the consumers' SNS brand pages commitment behavior.

In the study of Sung et al. (2010), six detailed motivators (i.e. interpersonal utility, convenience seeking, brand likeability, entertainment seeking, information seeking and incentive seeking) are declared to affect the consumer's community participation behavior [64]. In their research, brand likeability is specifically forwarded to represent the consumer's level of trust and preference in the brand.

Different Country Context as the influencing factor

It is commonly agreed that culture influences marketing efforts and consumer responses [68]. Evidences show that when making purchase decisions, Korean consumers are more likely to focus on physical appearances and to express concerns about personal achievements, as compared with Chinese consumers [74]. It is also found that brand-loyal Chinese consumers show more concerns to experiential image when purchasing the branded apparel, whereas Korean consumers will rather consider the social image with performance quality assurance [35]. In the research of Fan et al (2013) [18] who studied the website quality factors affecting flow and satisfaction between Korea and China, great differences are also resulted in the varied dimensions between the countries. Generally, the different country context play important role in motivating people for using SNS [30, 35, 62, 71]. Therefore, the following hypotheses are proposed.

H5. The motivators-participation/commitment-intention relationships of SNS brand pages show differences between Chinese and Korean consumers.

RESEARCH METHODOLOGY

Measurement Instruments

In order to well measure the latent variables, multi-item scales are adopted on the basis of previous studies (Table I). A five-point Likert scale was used to measure each item. The questionnaire was composed of three parts. Except the demographic profile session, a control session is also set to filter out the qualified respondents who have used SNS brand pages before and attain basic experiences. A separate part measuring the nine latent variables is followed at the end.

Table 1: Dimensions and measurement items

Dimensions	Items	References
Information seeking	The information of the SNS brand page is valuable for me The information of the SNS brand page is up-to-date for me The information of the SNS brand page is exact for me I think this SNS brand page is a valuable information resource	Ducoffe(1996); Yang et al.(2004)
Convenience	I can get any information very easy from this SNS brand page I can use this SNS brand page without any limited by time and place The SNS brand page is very convenient to use	Rohm&Swaminathan(2004); Mckinney(2004); To et al.(2007)
Entertainment seeking	The content of the SNS brand page is fun The content of the SNS brand page is pleasant The content of the SNS brand page is entertaining	Moon & Kim,(2001)
Interaction	I can get answers from the brand on this SNS brand page	Nambisan and Baron, 2009

	I can interact with others on this SNS brand page I can communicate with others on this SNS brand page I can give feedback to others on this SNS brand page	
Brand reputation	In my opinion this brand is respected from Society In my opinion this brand is positive I think favorably about this brand	Coulter, 1998; Day and Stafford, 1997; Stafford, 1996; Escalas and Stern, 2003
Reward	I can get bonuses following this SNS brand page I can get reward following this SNS brand page I can get more points following this brand page	Sung et al. (2010); Mengze SHI & Andrea (2014)
Participation	I frequently provide useful information to other members In general I do my best to participate in activities offered on the brand's SNS brand page I post messages and responses on the SNS brand page with great enthusiasm and frequency	Goodwin (1988); Kelley et al. (1990); Bowen (1990); Cermak et al. (1994)
Commitment	I feel I am part of a community around this SNS brand page I feel the good relationship with others in this SNS brand page I think is important for me to community with others in this SNS brand page I am an active supporter of this SNS brand page	Moorman et al. (1992)
Purchase intention	I intend to remain loyal to this brand in the future I will not stop buying this brand I will have the intention of continuing to buy this brand	Zeithaml et al. (1996)

Data collection

Data was collected from the members of different SNS brand pages (e.g. Coca Cola, BMW, Starbucks, and so on), and the demographic details of the sample profile are provided in Table II. A total of 384 Korean consumers and 407 Chinese consumers ranging from 20~40 years old respond to the survey. All participants were frequent fan-page users. More than 50 percent respondents use their SNS brand pages at least once a week, and 62.2 percent Korean respondent even use their SNS brand pages over one time a day. The research model is analyzed adopting the software of SPSS 20.0 and AMOS 21.0.

Table 2: Demographic profiles of the respondents

Characteristics	China		Korea	
	n	%	n	%
Gender				
Male	180	44.2	183	47.7
Female	227	55.8	201	52.3
Age				
<20 years old	38	9.3	20	5.20
20~40 years old	359	88.2	333	86.7
>40 years old	10	2.5	16	4.20
frequency of use SNS brand				
<1 time(1day)	83	20.4	70	18.2
>1 time(1week)	201	49.3	225	58.6
>1 time(1month)	60	14.7	83	21.6

Common method bias test

As the data for independent and dependent variables are all self-reported and collected from a single source. Several procedural and statistical remedies suggested by Podsakoff et al. (2003) [51] are adopted to minimize the potential common

method bias (CMB) problem[50].

First, participants were assured of the anonymity and confidentiality of their responses in the survey so as to minimize problems of social desirability. Second, measurement items of the same construct are put in different place to reduce the participants' perception of any direct connection between these constructs. Finally, Harman's one-factor test is used to statistically test the severity of CMB. Principal factor analysis with Varimax rotation was conducted to assess whether a single method factor explained a majority of the variance. The results revealed more than one factor with an eigenvalue above 1, with the first factor accounted for 37.83% of the total variance. Therefore, CMB is unlikely to be a serious concern in this study.

Reliability and validity test

A CFA with maximum likelihood estimation in AMOS21.0 was conducted for assessing the measurement model's construct reliability and validity. The reliability of the individual items in the questionnaire was tested by checking the internal consistency which was measured by reliability coefficients called Cronbach's alpha. As in Table III, Cronbach's alpha values for all the constructs are greater than 0.7. In addition, all of the composite reliabilities (CR) are also found to be 0.8.

Table 3: Factor loadings, Cronbach's Alpha, averaged variances expected and composite reliabilities

Constructs	Items	Factor loading		Cronbach's Alpha		AVE		CR	
		China	Korea	China	Korea	China	Korea	China	Korea
1.Information seeking	Items1	.833	.739	0.898	0.792	.70	.50	.90	.80
	Items2	.803	.555						
	Items3	.843	.773						
	Items4	.843	.724						
2. Convenience	Items1	.874	.822	0.839	0.741	.65	.51	.96	.93
	Items2	.808	.701						
	Items3	.730	.596						
3. Entertainment seeking	Items1	.847	.741	0.900	0.808	.75	.59	.90	.81
	Items2	.885	.794						
	Items3	.868	.757						
4. Interaction	Items1	.840	.567	0.901	0.800	.70	.49	.90	.80
	Items2	.860	.569						
	Items3	.826	.809						
	Items4	.805	.824						
5. Brand reputation	Items1	.842	.710	0.882	0.807	.71	.59	.88	.81
	Items2	.848	.875						
	Items3	.827	.705						
6. Reward	Items1	.844	.857	0.894	0.793	.74	.58	.90	.80
	Items2	.880	.776						
	Items3	.855	.618						
7. participation	Items1	.824	.677	0.871	0.747	.70	.52	.87	.76
	Items2	.807	.659						
	Items3	.864	.791						
8. commitment	Items1	.811	.778	0.879	0.845	0.88	.65	.88	.88
	Items2	.715	.676						
	Items3	.837	.817						
	Items4	.812	.771						
9. Purchase intention	Items1	.845	.812	0.905	0.895	.76	.74	.91	.90
	Items2	.875	.872						
	Items3	.896	.897						

Construct validity consists of convergent validity and discriminant validity. In general, convergent validity can be claimed when t-values are 2.0 or above, standardized factor loadings are 0.5 or above, or averaged variances expected (AVEs) are 0.5 or above [6]. Discriminant validity is confirmed when all the AVEs exceed the minimum level of 0.5[17, 32]. As it is depicted in Table III, all the factor loadings exceed 0.5 and the smallest AVE exceeds 0.6, which demonstrates adequate construct validity.

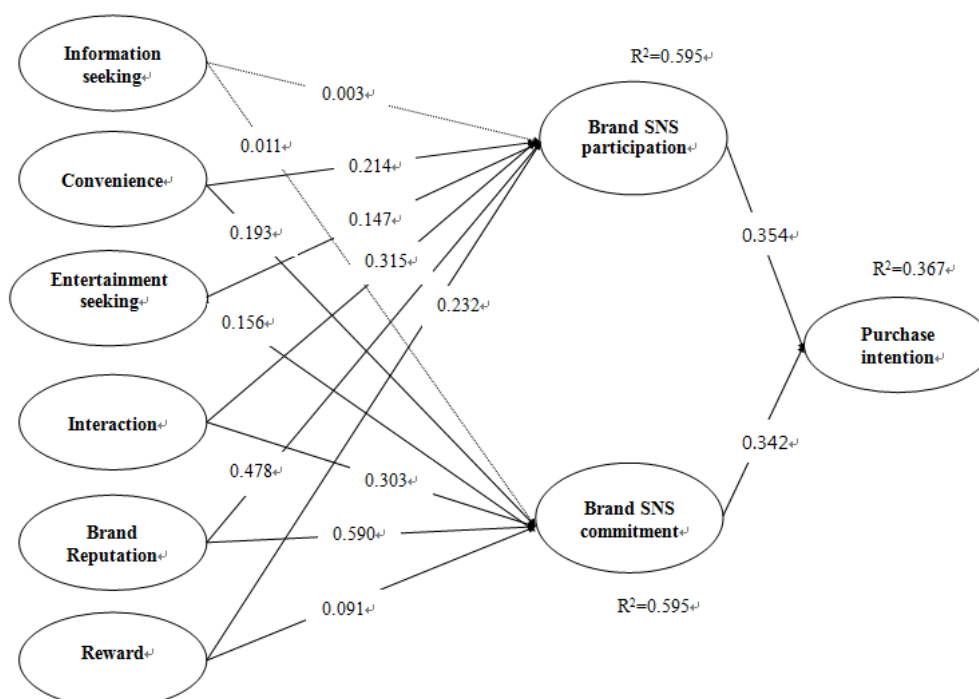
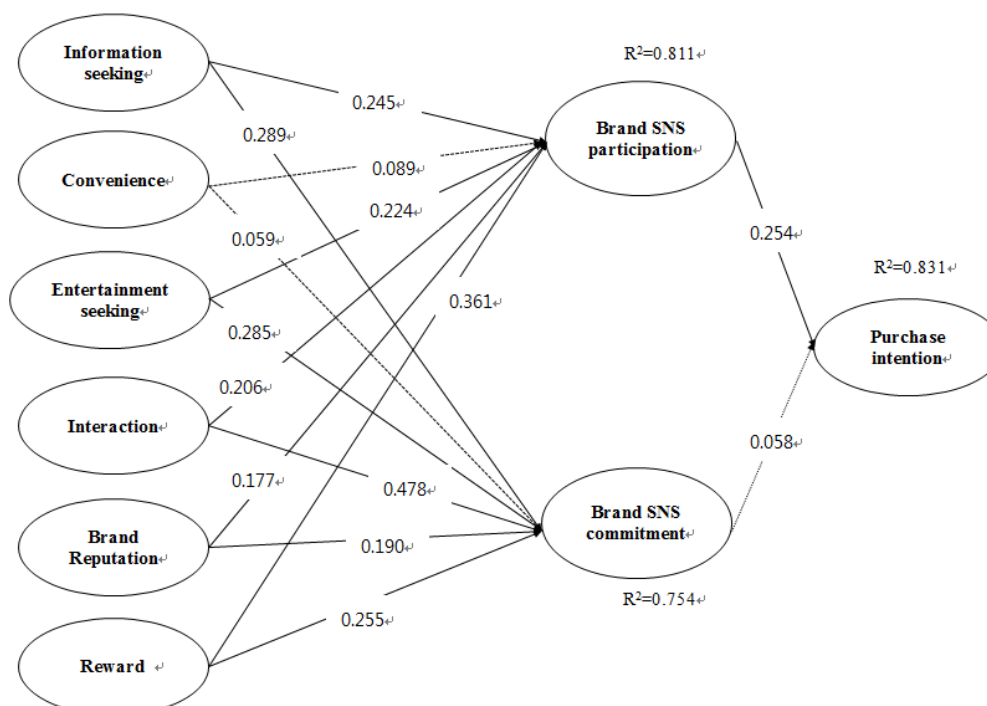
Research model and hypothesis testing

The effects and the statistical significance of the parameters in the SEM were tested using a bootstrapping procedure in AMOS21.0. The test results indicate the structural model of both samples have good fitness, as it is shown in Table IV. The graphical description of the research results for China and Korea samples are presented in Fig. 1 and Fig. 2, including both the path coefficients and the variances explained. Almost all of the proposed hypotheses are significant, except for some variables. In detail, H3 is supported in Korea, but not in China, which indicate information seeking has no significant relationship with either participation or commitment behavior of Chinese consumers. H4 is supported in China but not in

Korea, which means the proposed positive relationship between convenience and the consumers' SNS brand behavior is not found significant in Korea. In addition, no relationship is found between commitment and purchase intention in Korea.

Table 4: Structural model fitness indexes

	χ^2	χ^2/df	GFI	AGFI	PGFI	RMR	NFI	IFI	TLI	CFI	RMSEA
China	958.660	2.556	.859	.825	.693	.041	.903	.939	.928	.938	0.062
Korea	877.905	2.341	.869	.838	.701	.059	.843	.903	.887	.902	0.059

Figure1: The path coefficients and R² for the constructs for China SampleFigure2: The path coefficients and R² for the constructs for Korea Sample

RESULTS AND DISCUSSIONS

There are four main findings in the research. Generally speaking, the motivating factors that can gratify the consumers'

benefit needs will lead to SNS brand page behavior among Chinese and Korean consumers, though the significance and the strength of the motivating factors show dissimilarities in the two countries.

First of all, the motivating factor constructs of SNS brand page behavior generally confirms to the prior dimensions in online community, i.e. functional benefits, hedonic benefits, economic benefits and intrinsic benefits [4,8,9,24]; . Most motivating factors, like entertainment seeking, reward, brand reputation, and interaction, are found to significantly correlate with the consumer's SNS brand page participation or commitment behavior in both countries, and further lead to purchase intentions.

Second, non-significant motivating factors are found to be different between China and Korea. For Chinese consumers, information seeking is not significantly correlated with the SNS brand page participation and commitment behavior in China, whereas convenience is found not correlate to the SNS brand page behavior in Korea. The free access to the worldwide information in Korea, and the partial Internet control of China may explain the findings. This is because the virtual identity in SNS community is required to be officially verified in Korea as compared to that in China, and Korean consumers may freely access to worldwide information from facebook, twitter, google and ect. Consequently, Korean consumers in the safe and free Internet environment, turn to find that convenience does not seem to be a significant problem to participate in or commit to the SNS brand page communities. In China, it happens that some important and sensitive information about the brand may not be easy to obtain, and most members have few chances to get interesting or useful information. Thus the information seeking benefit appears to be nonsignificant in affecting the consumers' SNS brand page behavior.

Third, the most influential motivating factors of SNS brand page behavior also show diversity in both countries. Brand reputation in China and reward in Korea are the most influential factors of participation behavior. Interaction plays an important role in affecting commitment behavior in both countries. The significant strong effect of brand reputation in China still connects with the Internet environment. Due to the lack of diverse and rich information in China, brand reputation appears to be an importance reference to most consumers in SNS brand community. The finding that reward strongly affects the Korean consumers' SNS brand page participation also complies with the prior literature [64,67,75], which conclude that Korean consumers took part in SNS brand communities mostly because of gift certificates, special promotions and coupons. The tight connection between interaction and SNS brand page behavior is related with the unique features of SNS brand pages. Being a profile on a social networking website, SNS brand pages are embedded in an organically grown network of social ties, and have far more posts, replies, and views than the "product information sharing" community. The discussion topics among the tightly connected fans accordingly may reach to a wide range, from products and brands, to interesting happenings. Thus the brand page followers can gain more benefits through community interactions.

Finally, SNS brand page participation and commitment behavior is found to act like mediating factors to positively affect purchase intention in China, whereas only participation behavior correlate with the purchase intention in Korea. In addition, the strength of the effect is greater in China than in Korea. A possible explanation is that committed Korean consumers are likely to take part in the SNS brand page community for benefits like interaction, entertainment, information and rewards, and their commitment behavior does not connect with further purchase intention. Once they actively participate in the related behavior, their purchase intention may be ignited. Chinese consumers' participation and commitment behavior are intertwined, and do not show great differences on further influences towards purchase intention. This may also indicate that the committed Chinese consumers in SNS brand page communities are also those who actively participate in the related activities.

Theoretical and Practical Implications

The research has two theoretical implications. Through focusing on the SNS brand page community, which is different from general online community, the study restressed the integrative relationships between motivations, participation/commitment, and purchase intention. The findings will enrich the brand community literature, and also contribute the insights for the new research background. In addition, the investigation in two different countries – China and Korea will add some hints to the prior research, in distinguishing consumers' traits from different countries and offering practical support for varied marketing tactics.

There are in general two practical implications.

First of all, in view that SNS brand pages are effective communication means for companies of nowadays, and are useful for the customer-brand relationship, brand managers should consider how to fully utilize this new tool to offer members various gratifications. Marketers should build more sustainable and vigorous SNS brand pages. The inherent benefits are also advised to be clearly identified so that the members can easily seek their needed benefits when visiting brand pages. This will further provide opportunity to convert lurkers into active members. Interesting, entertaining or innovative information, sweepstakes, online events, and rewards are some of the means brand pages can adopt. In addition, companies should also well design the SNS brand pages to support higher interactivity function. Classification of forums by topic attributes makes members easily to join the discussions of interested topics, and use it to make more friends. Group chat

mechanism also creates an interesting community atmosphere. More peripheral functions like easy navigation, topic ranking, and etc. can also be possible choices. Companies should also follow their SNS brand pages, answering questions and solving problems immediately, and communicate proactively even when the information is negative [31, 57, 55]. Finally, more comprehensive scales (e.g., user frequency or log-in time) for measuring a member's behavior can also be developed so as to understand the members' participation and commitment behavior.

Second, Managers of global companies need to understand that the environmental, economic and cultural differences between different countries will lead to varied consumer attitudes and behavior. Therefore dissimilar tactics should be adopted for consumers from different countries. Upgrading brand reputation and image can encourage Chinese consumers to actively take part in and commit to SNS brand page community. Company should have some dedicated employees to join their SNS brand pages, and actively respond to brand information inquiries of the members. This will help to minimize the damage to their brand. Monetary rewards such as lotteries, sales, and coupons are suggested to be offered in the SNS brand pages for Korean consumers.

Conclusion and Limitations

In this study, the role of SNS brand pages is stressed as new online community service for the customer-brand relationship. The SNS brand pages participation and commitment behavior, the various motivation factors, and their mediating role to affect purchase intention are investigated in both China and Korea. This study offers new empirical evidence results and meaningful insights for managers of global companies to thoroughly understand the SNS brand pages behavior and their differences in China and Korea markets.

Some limitations of the current research will concurrently provide interesting directions for future study. The moderating effects of demographic variables can be tested to reflect the varied influence of segmented consumers. The effort to distinguish between the consumers and providers, and more cross national studies are also needed.

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Facets of Visual Aesthetics of Mobile Website

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ABSTRACT

With the advent of the era of mobile commerce, user browse mobile website on mobile devices is in the majority. The current literature focused on the web aesthetics. However, there is no related visual aesthetics scale for mobile website. Our purpose in this study was to verify the essential characteristics of aesthetics by conceptualizing, constructing, refining, and testing a multiple-item scale, VisMWA, designed to measure aesthetics in the mobile environment. The results showed that five factors and 26 key indicators of VisMWA. The VisMWA scale developed by present study will be able to provide enterprise the standard when they are designing mobile website; and makes it become high-aesthetics mobile website to increase the visitors.

Keywords: Mobile commerce, Mobile Visual Aesthetic, Scale development.

INTRODUCTION

Advancements in mobile device technology and the prevalence of mobile devices such as smart phones and tablet computers have profoundly influenced consumers' modes of mobile technology usage, consumption patterns, and everyday life. The International Data Corporation estimated that by 2016, 44% of the world's population (approximately 3.2 billion people) would be connected to the Internet, of which 2 billion people would be connected through mobile devices. Countries such as China, India, and Indonesia would serve as the main sources for Internet population growth. The International Data Corporation predicted that in the next 5 years, the number of people who use mobile devices to connect to the Internet would grow by 25% annually, entailing that mobile devices would gradually replace personal computers as the main device for connecting to the Internet [1]. Mobile commerce is gradually developing into a future mainstream.

The aesthetics of human-computer interaction has been receiving increasing attention in recent years [21]. For example, the iMac was considered an aesthetic revolution in personal computing. Therefore, concerning the visual aesthetics of websites, they should be evaluated prudently, and various methods have been used for this purpose. Single-item measures were conventionally the most widely used method for such evaluations until Lavie and Tractinsky proposed multiple-item measures, in which the visual aesthetics of a website are categorized into two dimensions, namely classical and expressive aesthetics [16]. These categories have been widely accepted and used by subsequent scholars. To date, Moshagen and Thielsch obtained the most fruitful results in visual website aesthetics research, bridging the gaps in the studies of Lavie and Tractinsky and other subsequent scholars by further categorizing visual website aesthetics into simplicity, diversity, colorfulness, and craftsmanship [21]. The Visual Aesthetics of Website Inventory (VisAWI) was developed on the basis of these four dimensions. This inventory compensates for the insufficiencies of previous studies, which have conducted measurements by using the single-item method to investigate classical and expressive aesthetics. Therefore, the present study adopted the VisAWI as a basis for exploring the visual aesthetics of mobile websites.

The present study developed a Visual Aesthetics of Mobile Website Inventory (VISMWA) on the basis of the VisAWI. Despite the discussed trend of mobile devices and mobile websites, few studies have focused on the visual aesthetics of mobile websites, and even fewer studies have explored the aesthetic constructs of such websites. Thus, a research gap exists between website aesthetics and mobile aesthetics, which entails that several key questions require further investigation, such as what factors constitute the aesthetics of mobile websites and what criteria can be used to determine the aesthetic value of a mobile website. The present study therefore addressed this research gap by developing the VISMWA, which can be used to determine whether significant differences exist between websites of high and low aesthetic values.

LITERATURE REVIEW

Website Aesthetics

From a historical perspective, the emergence of aesthetic value changed people's idea of beauty. In ancient times, people valued the existence and perceptions of beauty [8] because of the pleasant mood that beauty generates. However, during the Renaissance, the rules of beauty approximated a set of laws; beautiful designs were considered to accurately reflect the beauty of nature [15].

Generally, beauty can be assessed from subjective and objective perspectives. During the Renaissance, beauty was considered objective; consequently, the beauty of artworks in this period was measured according to proportion and symmetry [9][22]. By contrast, the subjective aesthetic perspective claims that aesthetics serves as a bridge between beauty and affection; different judgements of beauty derive from differences in individual backgrounds [22][24].

In modern times, aesthetics plays an essential role in users' affectional attitude toward web pages. To satisfy users, the aesthetic characteristics of a website must be attractive to users, particularly the home page. As the visitor's first impression of a website, the home page has a strong effect on whether a visitor will continue browsing a website or whether they will revisit. However, a user's first impression of a home page tends to be very subjective. To ensure that users clearly express and delineate their

aesthetic ideas, a few scholars have adopted quantitative methods to measure aesthetics [14][23][27].

Lavie and Tractinsky proposed using classical aesthetics and expressive aesthetics to evaluate the aesthetics of websites[16]. Classical aesthetics refers to aesthetic ideas that can be traced back to ancient times, namely orderliness in webpage design, such as symmetry, clean, and organization. Expressive aesthetics assesses the creativity and expressivity of website design including its originality, sophistication, and whether it has a fascinating design. Subsequent scholars have investigated the aesthetics of human-computer interaction on the basis of these two dimensions.

Lavie and Tractinsky's classical aesthetics and expressive aesthetics dimensions have been widely adopted by other scholars in the field of visual aesthetics. Subsequent scholars have conducted a considerable amount of research on the aesthetic features of website [6] [7] [19] [26]; however, relatively few arguments have been developed regarding psychology-related attributes, practicality, and effects of the features, and none of the aforementioned studies have extended the framework proposed by Lavie and Tractinsky. Therefore, Moshagen and Thielsch developed the VisAWI, dividing visual aesthetics into dimensions of simplicity, diversity, colorfulness, and craftsmanship [21]. Simplicity refers to how simple the layout of a webpage is and whether it enables users to experience homogeneity, orderliness, clarity, and balance. Diversity refers to the visual richness of a website, including the levels of dynamics, variety, creativity, and novelty. Colorfulness means the level to which users perceive the color combinations of a webpage as attractive and elegant. Finally, craftsmanship indicates the level to which users perceive the thoughtfulness that has been put into the design of a website, which is achieved by the website designers using modern technology-based craftsmanship.

Mobile Aesthetics

Since the launch of the iPhone in 2007, smartphones have become a key mobile device for communication, information transmission, and entertainment. This rapid transformation has affected the design and usability mobile device user interfaces. Smartphones are now viewed as the mainstream device of future mobile devices [5].

Simplicity is a key dimension of webpage aesthetics. Choi and Lee asserted that simplicity can be used to measure the aesthetic value of mobile websites and further discussed the influences of webpage aesthetics on user satisfaction. Simplicity comprises visual aesthetics, information design, and task complexity. In an investigation of 205 mobile device users, Choi and Lee identified a positive relationship between the design simplicity of interfaces and user satisfaction.

In recent years, usability has received increasing recognition as a key construct of successful mobile websites and applications. Baharuddin, Singh, and Razali investigated the usability of mobile applications and inferred 10 crucial dimensions of usability, which have served as a basis for subsequent studies [3]. The 10 dimensions are effectiveness, efficiency, satisfaction, usefulness, aesthetic value, learning ability, simplicity, intuitiveness, understandability, and attractiveness. Because few usability-related studies pertaining to mobile websites have been conducted, the present study adopted the aforementioned dimensions to explore their relevance in this context.

METHODS

The present study aimed to develop a VISMWA, with which the abstract concepts of aesthetics can be accurately expressed using the measurements of each item. A questionnaire survey was employed as the data collection method. The survey measure development framework proposed by Hinkin was used as the development method in the present study [13]. The inventory development steps are detailed in the following paragraphs.

Step 1 is item generation, namely to develop items to identify appropriate constructs. Deductive and inductive approaches can be applied to generate items. Using deduction to generate preliminary items requires an appropriate theoretical basis and sufficient information. A thorough literature review and arrangement must be conducted to define the theoretical constructs. By contrast, induction is applied when the constructs cannot be clearly defined, or when no sufficient theoretical basis exists to generate items; this involves a preliminary survey to collect opinions. Step 2 is questionnaire administration. At this stage, representative respondents are interviewed to assess the validity of the questionnaire content, after which the constructs suggested by the respondents are added to the final questionnaire. Step 3 is initial item reduction. Upon completion of data collection, a factor analysis is performed to reduce the number items. The elimination criteria are items that obtain factor loadings of less than 0.4 on all factors, or those with factor loadings of more than 0.4 on two factors. Each construct must contain at least three homogeneous items. Cronbach's α values are used to evaluate the internal consistency of the constructs; a result of higher than 0.7 indicates high reliability. Step 4 is confirmatory factor analysis (CFA). Although the aforementioned scale can be used to determine whether it exhibits favorable internal consistency and content validity, it is not quantitative. Therefore, CFA is used to determine whether the factor structure satisfies the expectation. In Step 5, convergent/discriminant validity are tested to ensure that the developed scale has satisfactory content validity and internal consistency (reliability). Construct validity is further used to determine whether a new scale is adequate to serve as a reference for future studies. Convergent validity and discriminant validity are two key indicators; high convergent validity confirms that items in the same construct are related, whereas high discriminant validity confirms that items in different constructs are unrelated. In recent years, structural equation modeling has been widely used to test for convergent validity and discriminant validity.

Item Generation

On the basis of the VisAWI proposed by Moshagen and Thielsch, the present study developed the VISMWA to measure users' opinions of the aesthetics of mobile websites. The proposed scale comprised four dimensions (simplicity, diversity, colorfulness, and craftsmanship) with a total of 13 items.

Because of the slight differences between the aesthetic characteristics of mobile websites and regular websites, the present study adapted the VisAWI by extending it to suit the characteristics of mobile websites. This was achieved through both deductive and inductive approaches were adopted to develop the new scale items. For the deductive approach, relevant papers on website aesthetics and mobile aesthetics published within the past 10 years were collected; subsequently, the key terms of these papers were arranged according to the constructs of the VisAWI. For the inductive approach, a focus group interview was held to determine which items of mobile website aesthetics were overlooked in the deduction step and to identify items that are unique to mobile website aesthetics and have not been used in previous studies on website aesthetics

Developing The Preliminary Constructs

The proliferation of mobile devices offers Internet users various methods to browse mobile websites. Regarding browsing behavior, users typically value the readability of the textual content on mobile websites, specifically the convenience to read and browse. Therefore, usability was added to the VISMWA.

The supportability of mobile devices has received increasing attention [17]. This concept refers to designs such as guiding instructions on webpages and buttons and hyperlinks that function as intended. Therefore, supportability was added to the VISMWA.

Interactions between general users and companies on mobile websites differ slightly from those on general websites such as the applicability of location-based services (LBSs) on mobile websites. Therefore, the relevance of technology has been increasingly addressed [2]. Mobile websites enable companies to provide LBSs, customized information, and even message-sharing functions for mobile device users (e.g., through Facebook, LINE, and Twitter). Accordingly, technology was added to the VISMWA. The research model in Figure 1 lists the factors we used to measure our VISMWA construct.

Questionnaire Administration

The proposed questionnaire was administered on the Internet. Prior to completing the questionnaire, the respondents were asked whether they had previously used a mobile website; only those who answered yes proceeded to the questionnaire. The literature review shows that mobile websites are currently an emerging trend that has not achieved a state of maturity. Therefore, the respondents of this study were early mobile website users. In total, 785 respondents filled out the questionnaire: 381 respondents evaluated a website with high aesthetic value and 404 respondents evaluated a website with low aesthetic value. Respondents who exhibited a lack of understanding of aesthetics were excluded from further analysis. Finally, 342 (89.7%) questionnaires pertaining to high-aesthetic value websites and 62 (15.3%) questionnaires pertaining to low-aesthetic value websites were considered valid. In the questionnaire survey, the questionnaires for the websites of high and low aesthetic values were distributed separately, which might explain the exceptionally high rate (84.7%) of invalid questionnaires in the low aesthetic value website group (low group). Thus, the respondents demonstrated a tendency of giving high scores when completing the questionnaire. A 5-point Likert scale was employed to rate the questionnaires. All of the subsequent analyses focused on the high-aesthetic value website group (high group). Questionnaires on the low-aesthetic value website were collected to identify any notable differences between the responses of the high and low groups. Several independent constructs and items were included in the questionnaires to enable estimation of criterion-related validity.

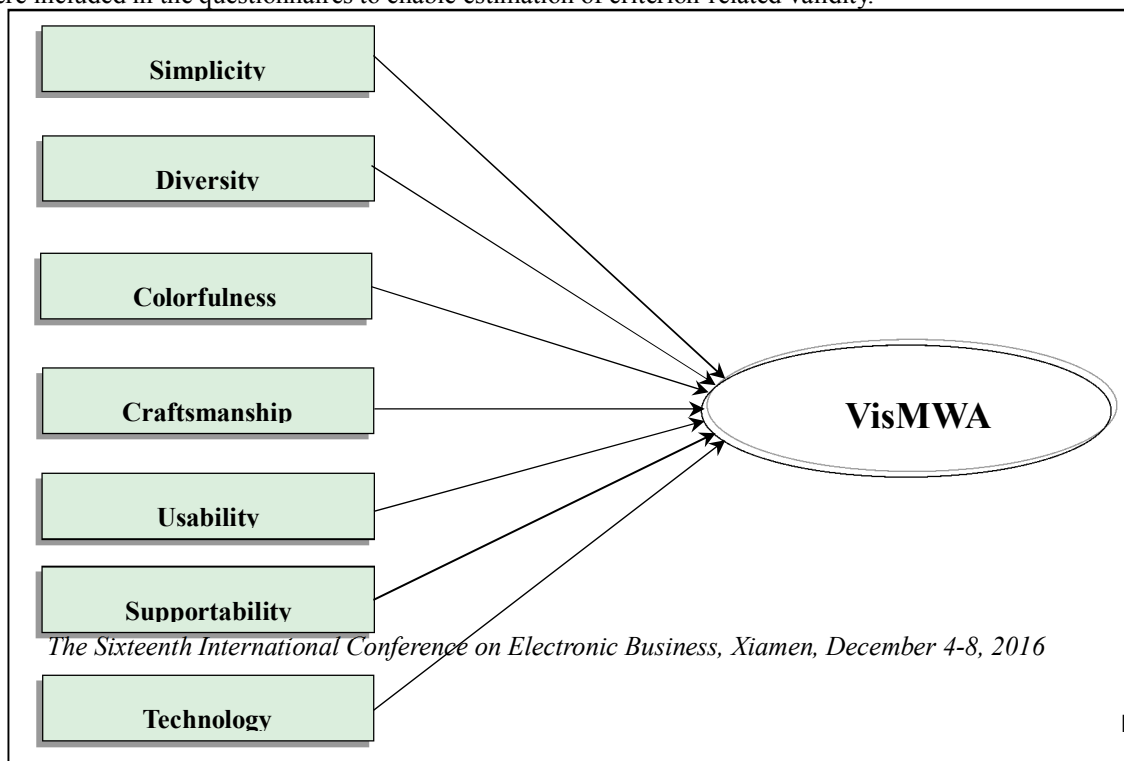


Figure 1: Research Model

Dimension	Operational definition
Simplicity	The extent to which users perceive the layout of a mobile website as simple and harmonious.
Diversity	The extent to which users perceive the visual richness of a mobile website.
Colorfulness	The extent to which users perceive the attractiveness and elegance of the color combinations of a mobile website.
Craftsmanship	The extent to which users perceive the thoughtfulness of a mobile website design, which is achieved by the website designers using modern technology-based craftsmanship.
Usability	The extent to which users perceive the ease of use of a mobile website.
Supportability	The extent to which users perceive the smoothness in browsing a mobile website.
Technology	The extent to which a mobile website is constructed using appropriate technologies.

DATA ANALYSIS

The reliability and validity of the proposed scale were established through a descriptive statistical analysis, item analysis, exploratory factor analysis (EFA), and CFA. To verify the scale structure, SPSS version 21, and AMOS version 21 were used for a path coefficient analysis and model fit examination. A z-test was conducted to eliminate outliers, which were identified as responses with z-scores higher than 3 or lower than -3. Descriptive statistics were used to summarize the demographic characteristics and information of the respondents. The results of the item analysis served as the basis for determining the reliability of the scale; missing values were checked to ensure data completeness. The corrected item-total correlation was then calculated, which refers to the product-moment correlation coefficient between the total of all items (containing a specific item) and the total of all remaining items (eliminating a specific item). An EFA was conducted following the item analysis. The factor structure of the constructs was built, in which observed variables with factor loadings lower than 0.4 were eliminated. Finally, the extracted factor structure was adopted for the CFA in order to assess the convergent validity and discriminant validity of the instrument. Because of the low number of valid questionnaires in the low group, 500 bootstrapped samples were used during the CFA.

Item Analysis

The comprehensiveness of the items in the proposed scale (33 items in total) was reexamined using the answers provided by the respondents who had browsed mobile websites. A z-test was employed to identify and eliminate extreme values (those with an absolute z-score of >3), resulting in 39 questionnaires being eliminated from the high group. Scale items were then eliminated according to the Cronbach's α values and corrected item-total correlations. The corrected item-total correlation evaluates the correlation between a construct and its constituent items. Simplifying factors in a construct prevents the generation of multiple meaningless factors in a subsequent factor analysis. After correction, items with an item-total correlation coefficient of 0.2–0.8 were considered appropriate. Items with a Cronbach's α value of less than 0.7 were also eliminated. At this stage, all items met the item-total correlation coefficient and Cronbach's α criteria; thus, no items were eliminated.

Exploratory Factor Analysis

EFA was employed to assess the 33 scale items to validate the factor structure of the VISMWA. A total of 342 questionnaires were analyzed. A Kaiser-Meyer-Olkin measure of >0.7 and significance in Bartlett's test of sphericity indicated that the collected data did not form an identity matrix and were therefore appropriate for the EFA.

At this stage, EFA was used to analyze the 33 scale items. Principal component analysis with varimax orthogonal rotation was employed as the extraction technique to verify the scale dimensions; factors with eigenvalues of ≥ 1 were retained.

A total of five factors comprising 26 scale items were extracted. These five factors explained 58.4% of the total variance in the items. Because the number of valid questionnaires in the low group ($n = 62$) did not meet the minimum sample size for a CFA (200), 500 bootstrapped samples were used during the CFA. Table 1 compiles the factor loadings of the 26 scale items based

on the data of the high group; the results show that all five factors were retained. Figure 2 presents the final model and definitions of the scale constructs.

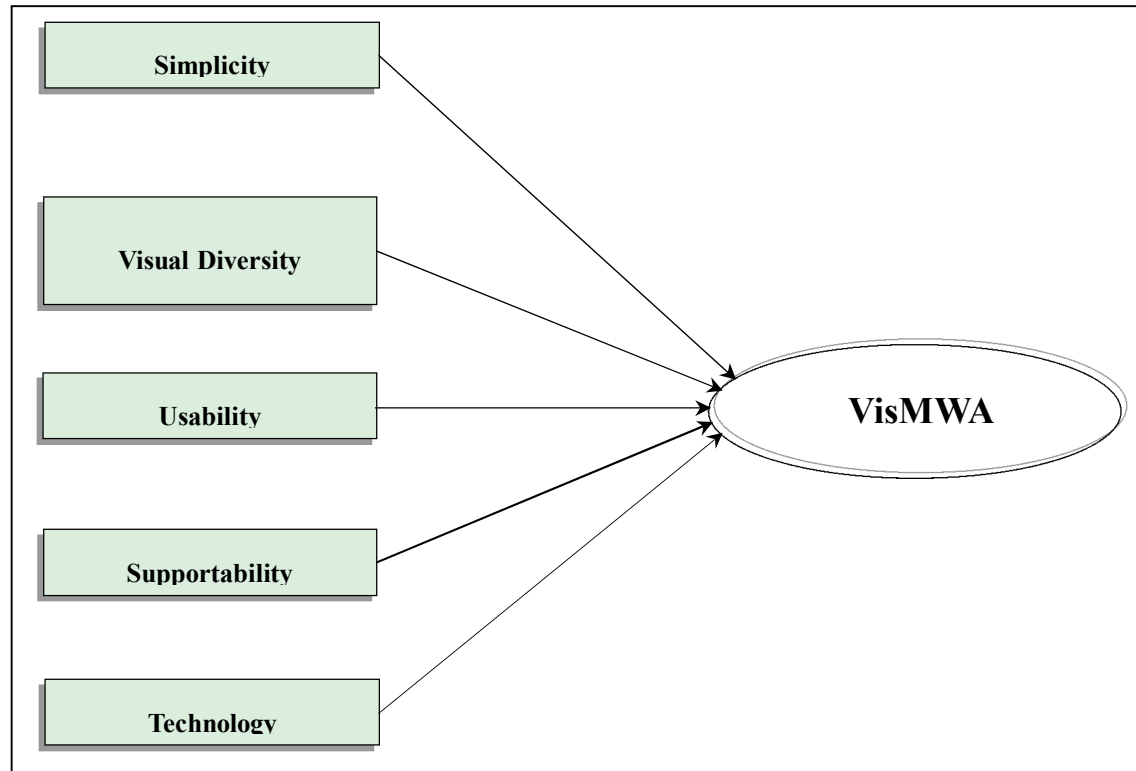


Figure 2: Finalized model of VisMWA

Dimension	Operational definition
Simplicity	The extent to which users perceive the layout of a mobile website interface to be simple and harmonious.
Visual Diversity	The extent to which users perceive the visual richness of a mobile website (e.g., the graphical interface elements and colors).
Usability	The extent to which users perceive the ease of use of a mobile website interface.
Supportability	The extent to which users perceive the smoothness in browsing a mobile website.
Technology	The extent to which a mobile website is constructed using appropriate technologies.

Table 1: Factor Loadings of the 26 items on VISMWA

Factor	Item	Simplicity	Diversity	Usability	Supportability	Technology
Simplicity	The configuration of the webpages of the mobile website is easy to understand.	.690	.209	.253	.119	.131
	The structural layout of the mobile website is complete.	.676	.236	.186	.243	.033
	The configuration of the elements on the mobile website exhibits vertical and horizontal symmetry.	.638	.167	.129	.184	.038
	The pages of the mobile website are organized in an orderly manner.	.739	.083	.253	.191	.034
	The shapes and sizes of the elements on the mobile website are highly similar.	.509	.014	.198	.318	.113
	The structural layout of the mobile website is harmonious.	.666	.189	.218	-.015	.074
Visual Diversity	The overall structural layout of the mobile website is lively.	.206	.659	.069	.104	.132
	The overall design of the mobile website exhibits diversity.	.146	.671	.154	.133	.303

	The mobile website has a unique webpage design.	.150	.649	-.089	-.077	.358
	The webpage of the mobile website exhibits a multilayered design.	.278	.682	.149	.029	.180
	The mobile website has a colorful design.	-.001	.771	.127	.334	-.094
	The color combinations of the mobile website are high-contrast.	.086	.609	.071	.028	.099
	The mobile website has an innovative webpage design.	.207	.732	.101	-.128	.202
Usability	The mobile website employs a self-adaptive webpage design techniques.	.104	.148	.655	.107	.239
	The design of the mobile website makes it easy to use.	.303	.122	.753	.133	.151
	The design of the mobile website makes it easy to browse.	.380	.129	.763	.093	.092
	The mobile website can be viewed on different operating systems.	.058	-.001	.636	.375	.170
	The design of the mobile website makes the webpages easy to read.	.358	.186	.668	.162	.204
Supportability	The mobile website provides users with guidance and instructions.	.315	.122	.352	.409	.326
	All buttons on the mobile website function normally.	.227	.089	.131	.807	.172
	All hyperlinks on the mobile website function as intended.	.165	.031	.223	.803	.145
	The mobile website provides vertically stacked menus.	.168	.099	.092	.576	.371
Technology	The mobile website is animated.	.277	.325	.219	.147	.494
	Message-sharing functions are embedded in the mobile website.	.001	.146	.168	.248	.691
	Customized information is provided on the mobile website.	.069	.187	.212	.171	.681
	Offering location-based services on mobile websites is essential.	.032	.213	.152	.036	.633
Eigenvalue		11.6	2.92	2.1	1.4	1.3
Variance explained		35.2%	44%	50.3%	54.5%	58.4%

Confirmatory Factor Analysis

A CFA was conducted to examine whether the factors extracted using EFA were suitable constructs for the VISMWA. The measurement model constructed with AMOS was used to calculate the path coefficients and model fit. The procedure for eliminating the items with path coefficients of <0.5 was repeated until a favorable model fit was achieved.

Model fit indices were key indices used to assess the relationships between scale items and the overall model. Table 3 details the model fit indices that had been recommended by previous scholars and were adopted in the CFA of the proposed scale model. The indices in the table show that the proposed model obtained a close fit to the data (i.e., the RMSEA, GFI, AGFI, and CFI were 0.063, 0.869, 0.841, and 0.903, respectively).

Table 2: CFA and reliability results

Factor	Items	Factor loadings	Average variance extracted	Composite reliability
Simplicity	The configuration of the webpage of the mobile website is easy to understand.	.786	0.555	0.8814
	The structural layout of the mobile website is complete.	.794		
	The configuration of the elements on the mobile website exhibits vertical and horizontal symmetry.	.729		
	The webpages of the mobile website are organized in an orderly manner.	.807		
	The shapes and sizes of the elements on the mobile website are highly similar.	.635		
	The structural layout of the mobile website is harmonious.	.704		
Visual Diversity	The overall structural layout of the mobile website is lively.	.745	0.5479	0.894
	The overall design of the mobile website exhibits diversity.	.789		
	The mobile website has a unique webpage design.	.744		
	The webpage of the mobile website exhibits a multilayered design.	.769		
	The mobile website has a colorful design.	.698		
	The color combinations of the mobile website are high-contrast.	.626		
	The mobile website has an innovative webpage design.	.796		
Usability	The mobile website employs a self-adaptive webpage design techniques.	.737	0.6424	0.8993
	The design of the mobile website makes it easy to use.	.861		
	The design of the mobile website makes it easy to browse.	.850		
	The mobile website can be viewed on different operating systems.	.716		
	The design of the mobile website makes the webpages easy to read.	.832		
Supportability	The mobile website provides users with guidance and instructions.	.688	0.6389	0.8746
	All buttons on the mobile website function normally.	.893		
	All hyperlinks on the mobile website function as intended.	.886		
	The mobile website provides vertically stacked menus.	.707		
Technology	The mobile website is animated.	.718	0.5654	0.8385
	Message-sharing functions are embedded in the mobile website.	.794		
	Customized information is provided on the mobile website.	.782		
	Offering location-based services on mobile websites is essential.	.710		

Table 3: Model fit indices of the proposed model

Model fit index	Criterion guidelines	CFA result
Chi-square		682
Degrees of freedom		289
Absolute fit measures		
GFI	$> .80$ [20]	0.869
RMSEA	$< .10$ [25]	0.063
Normed chi-square / df	< 3 [12]	2.36
Incremental fit measures		
CFI	$> .90$ [11]	0.903
Parsimony fit measure		
AGFI	$> .80$ [20]	0.841

Note. RMSEA = root mean square error of approximation, GFI = goodness of fit index, AFGI = adjusted goodness of fit index, CFI = comparative fit index.

Figures 3 and 4 present the VISMWA analysis results. Figure 3 shows the first-order CFA model, in which the items with all factor loadings higher than 0 or those without factor loadings approximating or exceeding 1 in the path coefficients were examined. Figure 4 illustrates the second-order CFA model, in which the relationships between the VISMWA items and the five factors were determined. This figure shows that the path coefficients of the five factors and items were all higher than 0.5, suggesting strong relationships between the factors and items.

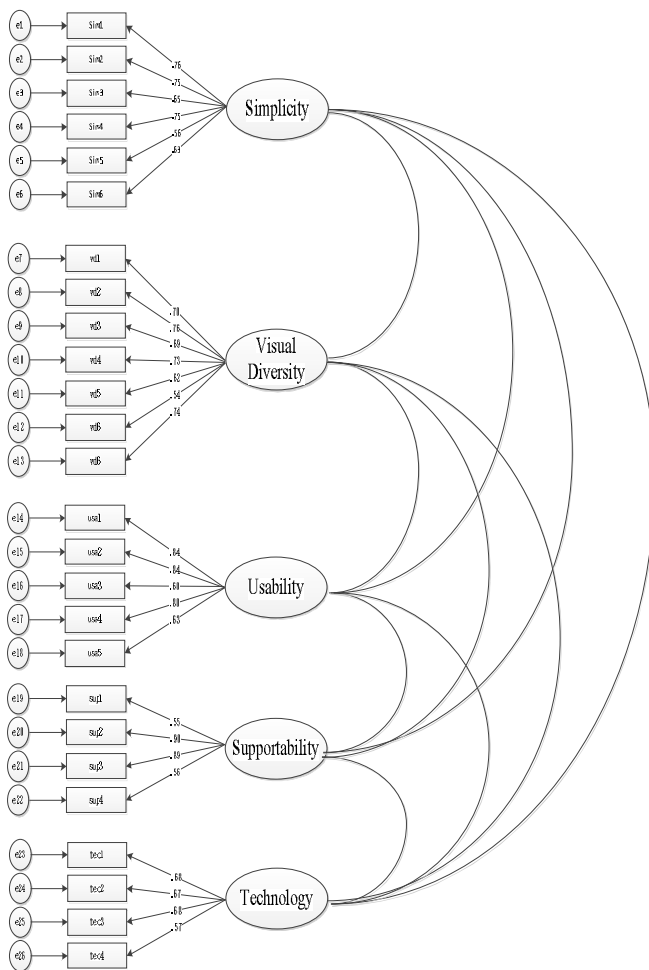


Figure 3: First-order CFA model

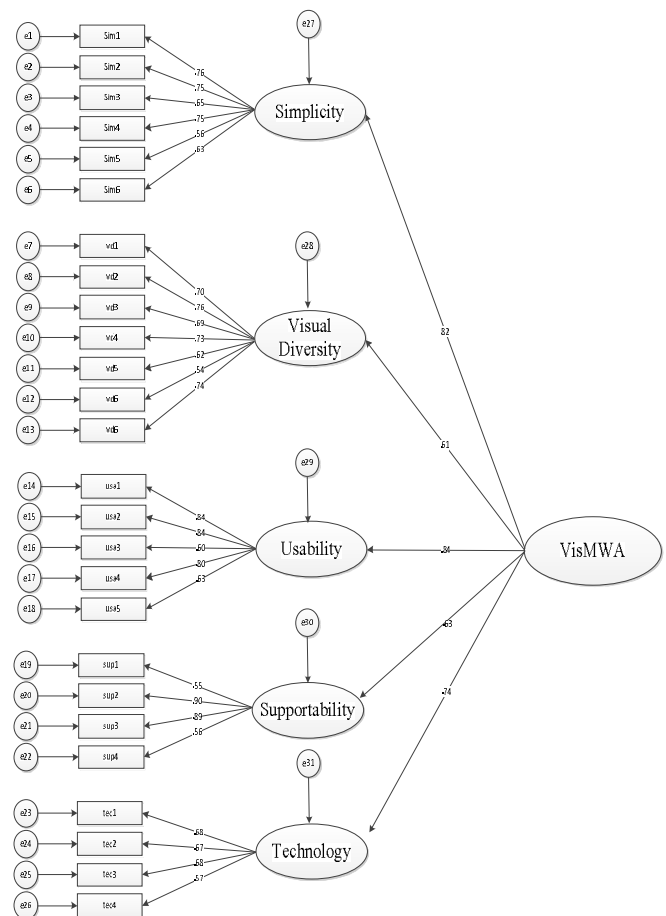


Figure 4: Second-order CFA model

Estimating Reliability and Validity

Reliability is as a key indicator of whether a scale produces consistent and stable results. Cronbach's α was adopted as an indicator of scale reliability; a Cronbach's α value of larger than 0.7 entails strong covariance and satisfactory internal consistency of the scale, thus confirming the scale to be favorable. In addition, validity refers to the extent to which a scale accurately measures what it is designed to measure. The following section and Table detail the validity, convergent validity, discriminant validity, and criterion-related validity of the VISMWA.

Validity Analysis

Cronbach's α is used to measure a scale's reliability and the internal consistency of all items of the same factor. Table 4 shows the Cronbach's α values of all factors in the proposed scale. A Cronbach's α value of larger than 0.7 indicates favorable internal consistency and reliability. Table 4 shows that all the factors of this scale attained a Cronbach's α value of >0.7 , indicating favorable reliability.

Table 4: Validity analysis results

Dimension	Cronbach's α value
Simplicity	0.84
Visual Diversity	0.86
Usability	0.86
Supportability	0.8
Technology	0.74

Convergent Validity and Discriminant Validity

The final VISMWA contained five factors and 26 items. Normalized factor loadings were employed to calculate the composite reliability (CR) and average variance extracted (AVE) of the constructs. Table 2 shows that all CR and AVE values are higher than 0.7 and 0.5, respectively, suggesting that this scale attained favorable convergent validity.

The AVE of a dimension indicates the explanatory power of all items in the construct relative to this dimension; the higher the AVE is, the greater the convergent validity becomes. Fornell and Larcker indicated that the convergent validity of a scale can be verified using the normalized factor loadings and AVE of all comprising factors [10]. If all factors in a construct have factor loadings and AVE values higher than 0.5, then this construct is considered to exhibit satisfactory convergent validity. Table 2 shows that the proposed scale attained favorable convergent validity.

The square root of AVE and correlation coefficients are commonly applied indices for measuring the discriminant validity of a scale. A factor with a square root of AVE higher than the correlation coefficients between that factor and the other factors is considered to exhibit adequate discriminant validity. Table 5 tabulates the square root of AVE and correlation coefficients of all factors in the proposed scale, showing that all factors met these criteria. Thus, this scale attained favorable discriminant validity.

Table 5: Square root of AVE and correlation coefficients

	Simplicity	Diversity	Usability	Supportability	Technology
Simplicity	.74				
Visual Diversity	.44**	.74			
Usability	.61**	.37**	.80		
Supportability	.52**	.34**	.57**	.80	
Technology	.40**	.50**	.50**	.51**	.75

Note. Bold type indicates the square root of variance extracted

Criterion-Related Validity

Criterion-related validity refers to the correlation of this scale with other existing criteria. This type of validity indicates whether the proposed scale can be applied to previous studies. The greater the correlation of this scale and other existing criteria is, the more satisfactory the criterion-related validity of this scale becomes.

Several previous studies have indicated that the aesthetics of general websites affect shopping enjoyment, shopping process value, and trust in m-commerce websites (m-trust); empirical results have indicated that all three of these factors are significant [4] [18]. In the present study, general websites were replaced with the VISMWA for a regression analysis of these three factors to determine whether these factors correlated significantly with the VISMWA.

Shopping enjoyment, shopping process value, and m-trust were measured on a 5-point Likert scale with scores ranging from 1 (strongly disagree) to 5 (strongly agree). The Cronbach's α values of these three factors were 0.88, 0.89, and 0.77, respectively. Table 6 presents the regression results; the coefficient from regression analyses is referred to as the β coefficient. Factors with a higher β coefficient had a greater influence on VISMWA. Table 6 shows that the β coefficients of shopping enjoyment, shopping process value, and m-trust were 0.69, 0.67, and 0.69, respectively, all of which achieved significance; thus, the VISMWA exhibited favorable criterion-related validity.

Table 6: Subsequence influence of the VISMWA

Factor	Criterion variables		
	Shopping enjoyment	Shopping process value	m-trust
VISMWA	.69**	.67**	.69**
R ²	.48	.45	.49

Note: * $p < .05$, ** $p < .01$

Independent Samples t Test

This study conducted an independent samples t test to verify the validity of the VISMWA, specifically investigating whether significant differences existed in the assessment results between the high and low groups. The level of significance was set at 0.05. The respondents of both groups were assigned randomly; no relationship existed between the respondents of these two groups. Table 7 shows that the scores differed significantly between the high and low groups ($t = 16.93$, $p < 0.05$).

Table 7: Results of the t test

Independent variables	Mean (standard deviation)	<i>t</i> value	<i>p</i> value
Group		16.93**	0.003
High Group	94.36 (12.24)		
Low Group	72.39 (8.79)		

Note: * $p < .05$, ** $p < .01$

Conclusion

We adopted EFA and CFA to examine the VISMWA model. The first model comprised seven factors and 33 items, which were obtained through deductive and inductive approaches. In the official questionnaire survey, the VISMWA was reduced to five factors according to the EFA results. Eight items that did not satisfy the criteria were eliminated from the final scale. We also conducted a CFA to validate whether the five-factor model exhibited satisfactory model fit. To enhance the scale validity, we performed a *t* test to verify whether significant differences existed in the questionnaire results between the high and low groups.

We did not propose new theories or revise existing theories in the present study, nor did we investigate the relationships between the model variables. However, through a strict procedure, we developed a scale that can serve as a basis for future studies in developing new theories. Our study contributes to research on the visual aesthetics of mobile websites. Related studies have been ongoing over the last decade; the proliferation of mobile devices in recent years has contributed to the emergence of numerous business activities on mobile websites. The development of the VISMWA is thus fundamental to researching the effectiveness of such websites. The EFA results indicate that colorfulness and craftsmanship on the visual aesthetics inventory should be combined with diversity and be renamed “visual diversity” on the basis of the similarity of their item attributes. Consequently, as shown in Figure 4, the final factors of this scale and the factor definitions, diversity in the context of mobile websites covers the diversity, colorfulness, and craftsmanship of an interface. The uniqueness of mobile commerce has motivated an increasing number of users to migrate from e-commerce platforms to mobile commerce platforms; hence, a comprehensive definition of the visual aesthetics of mobile websites is essential. This paper serves as a milestone in the exploration of the visual aesthetic design of mobile websites.

We developed the scale model through a strict procedure and applied a comprehensive verification process. Data of the verification indices indicate that the proposed VISMWA is a satisfactory model of a sufficiently large scale. Finally, we verified the scale validity by examining the correlation between the VISMWA and another scale on the aesthetics of mobile websites. The results show that this scale correlated significantly with shopping enjoyment, shopping process value, and m-trust, thus confirming the scale reliability. We categorized mobile websites into the high and low groups according to their aesthetic value to increase the generalizability of the results. In addition, we examined the relationship between the website aesthetic values and subsequent user behavioral intentions. Finally, we confirmed that significant differences existed between the high and low Groups.

The research limits of the present study are as follows: Regarding the samples, because we adopted a convenience sampling method, the sampling method might not be strict enough. Respondents were mostly students aged 20–25 years. Concerning the questionnaire survey, 85% of the questionnaires collected in the low group were invalid. We inferred that the respondents tended to give high scores when filling the questionnaire; however, this tendency generated a considerable number of invalid questionnaires. We suggest that future studies adopt laboratory experiments, in which the respondents can view both mobile websites with high and low aesthetic value to reduce the number of invalid questionnaires. We initially proposed seven factors, which were subsequently integrated into five factors. Nevertheless, along with technological advancements, new functions of mobile devices continue to be developed. We recommend that future scholars propose relevant factors in a timely manner to measure the visual aesthetics of mobile websites.

In summary, we developed the VISMWA to determine the expected aesthetic value of mobile websites. The results indicate positive relationships between the aesthetic value of mobile websites and shopping enjoyment, shopping process value, and m-trust. Companies using mobile websites can also apply the research results to induce purchasing intentions in the consumers, thereby improving their potential revenue through mobile websites.

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Platform Performance Based On The Network Externality

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ABSTRACT

An increasing number of markets today are organized around platforms that enable consumers to access and/or purchase various goods and services. Considering the presence of network externality, we study the precondition in which whether the buyer will join the platform. Moreover, this paper investigates the performances of platform in the supply chain in which the leadership belongs to the retailer. We find the optimal decision-making strategies, and the sellers will join the online platform when the network externality is large enough. In addition, the retailer's optimal profit and demand on offline platform will increase with the rising of network externality, whereas their demand on online platform will decrease, and the manufacturer's optimal profit and demand on online platform will increase.

Keywords: online/offline platform, network externality, supply chain, platform performance.

INTRODUCTION

Network effects consumption is becoming very crucial for businesses and has attracted a wide range of economics researchers' interests. There exist many platform markets, such as online advertising (between web properties and advertisers), job boards (between job seekers and recruiters), and payment card systems (between merchants and consumers), etc. Rochet [13] labels these markets two-sided markets. Some examples of two-sided markets are video game consoles, newspapers, smartphones, e-books, credit cards, shopping malls, and social networking sites. Some of them are offline platforms (for example, shopping malls, credit cards, newspapers) and some others are online platforms such as. Uber is also one online platform. Instead of calling a taxi, we can use private car on Uber. Nagi and Chau [10] pointed out that people could get what they want in the sharing economics.

Ravi [12] pointed out the platform providers typically perform two primary function: (1) they match agents on the two sides, enabling transactions between them, and (2) they add to the quality of the transaction in different ways. That means the utility of an agent on both sides depends partly on the number of agents on the other side of the platform, that is cross-market network effects. Dai and Kauffman [3] verified that consumers generated the positive effects on the suppliers and negative effects on the other consumers.

The effect of network externalities on the seller's investment has long been studied in the economics literature with particular emphasis on the platforms' profit. Yet this stream of researches typically study direct network effects, and ignore the strategic interactions with the seller side of the market. To some extent, this paper complements this stream of research by using an analytical model to characterize the seller's choice between offline platform and online platform.

In the real world, many retailers choose the online platform to get more profit. For example, we can buy a same computer in the JD store or on the manufacturer's official website. Many scholars researched the behaviors of the retailers and the manufacturers in the view of supply chain, and focused on the supply chain where the manufacturer joined the online platform. But few of them study the retailer's behavior to join the online platform. In this paper, we consider a game-theoretic model where the retailer is dominant. The retailer firstly decides their price of unit product, and then the manufacturer makes decisions. The manufacturers can sell their products through the traditional retailers (we call this channel as offline platform) or the Internet (i.e. online platform). The retailers can sell their goods directly or through the online platform. The precondition of joining the online platform is their profit function of manufacturer must be larger than zero (This zero is generated by standard reservation utility, not the real zero. The below is the same). And for the buyer, their utility must be larger than zero.

With the precondition, this paper research the performance of this type of supply chain and analyze why it will exist. At the same time, the seller can make their right decisions when meeting different network externalities.

The remainder of this paper is as follows: Section 2 reviews the related literatures. In section 3, we develop a mathematical model of two different platforms. In section 4, we analyze the outlets of the seller to choose based on their profit function. Finally, section 5 gives some conclusions and managerial implications.

LITERATURE REVIEW

There exist many literatures relative to the platform. Most of researcher study platform form and platform performance. For example, Katsamakos and Bakos [8] studied the effect of platform ownership structures' influences (independent, consumer-owned, supplier-owned) in a monopoly setting. Andrei and Julian [6] researched the economic tradeoffs that drive organizations to position themselves closer to or further away from a multi-sided platform business model. In this paper, we consider the platform ownership is independent, not belongs to the seller and the buyer.

The economic theory of two-sided markets (Parker and Van Alstyne 2000b, Rochet and Tirole 2003, Parker and Van Alstyne 2005) [13] [11] explores the unique features that set these markets apart from traditional products and services. In particular, two-sided markets exhibit a special form of indirect network effects (Katz and Shapiro 1985) [9] such that the number of users on one side of the market depends on the number of users on the other side. For example, video game developers will develop games only for platforms that have a sufficiently broad installed base of gamers.

In some literatures, researchers study the market competitions in the presence of network externality, which indicates that the buyers' utility is an increasing function of the number of sellers on the same platform. Ravi and Rajib [12] make their research based on this hypothesis. For instance, buyers can obtain greater utilities when the number of the sellers on the same platform increases. In turn, sellers can get more profit as the number of buyers increase. The reasons are that there will be more products and transactions on the platform if the number of sellers and buyers both increases. The buyer can get what they want in time and the seller can complete the transactions efficiently. If sellers can provide complementary products, both sides can get higher utility. Little literatures research the choice of platform, and only assume both sides agree to join the platform.

Many literatures focus on the pricing coordination. Andrei and Hanna [2] studied the effect of different levels of information on two-sided platform profits under monopoly and competition. And they showed that platforms with more market power prefer facing more informed users. More information will intensify the price competition and amplify the effect of price. Armstrong M (2006) [1] once studied both monopolistic and competing platform and found that pricing structure was mainly affected by strength of network externality, the costs structures and whether the customers were single-home or multi-homing. Multi-homing is that an entity can join more than one platform simultaneously.

Some literatures studied the coordination of the platform. Andrei and Daniel [5] presented first-party content and coordination in two-sided markets. And they found that the strategic use of first-party content by two-sided platform is driven by two key factors: the nature of buyer and seller expectations. Edward and Anderson [4] researched the platform performance investment in the presence of network externalities. They carried out a full analysis of three distinct settings: monopoly, price-setting duopoly and pricing-taking duopoly. They concluded that the conditions under which offering a platform with lower performance but greater availability of content can be a winning strategy. Ravi and Rajib [12] studied the co-opetition between differentiated platform in two-sided markets. In their study, they highlighted the importance of technology. They pointed that collaboration might provide incentives for a dominant platform. Andrei and Julian [7] presented an article named marketplace or reseller. In their research they clarified how intermediaries to choose between functioning as marketplace (in which suppliers sell their products directly to buyers) or as a reseller (by purchasing products from suppliers and selling them to buyers).

THE MODEL

In this section, firstly, two modes of supply chain will be presented. The first one aims to show a traditional supply chain, without using the platform. The second model will demonstrate where and how these platforms can be applied, in order to make the supply chain more efficient.

The Figure. 1 presents the first conceptual mode: a traditional and simplified supply chain.

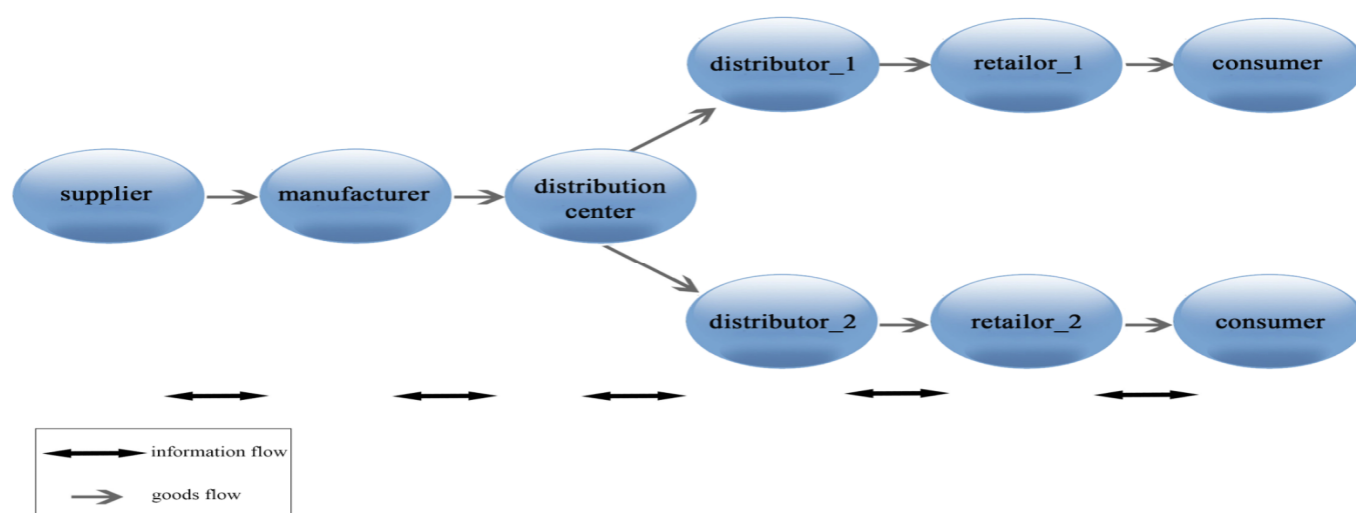


Figure 1: Traditional conceptual mode

The Figure. 2 presents the second conceptual mode: The O2O mode. The supply chain's constituent entities are almost the same as Figure.1. Nevertheless, the main difference between them is the platform. The manufacturer and the retailer both can

choose the online and offline platform under the condition that they can bring profit. Based on the consumer's utility function and the influence of network externalities, this article focuses on the retailer's and the manufacturer's choices of the online and offline platform.

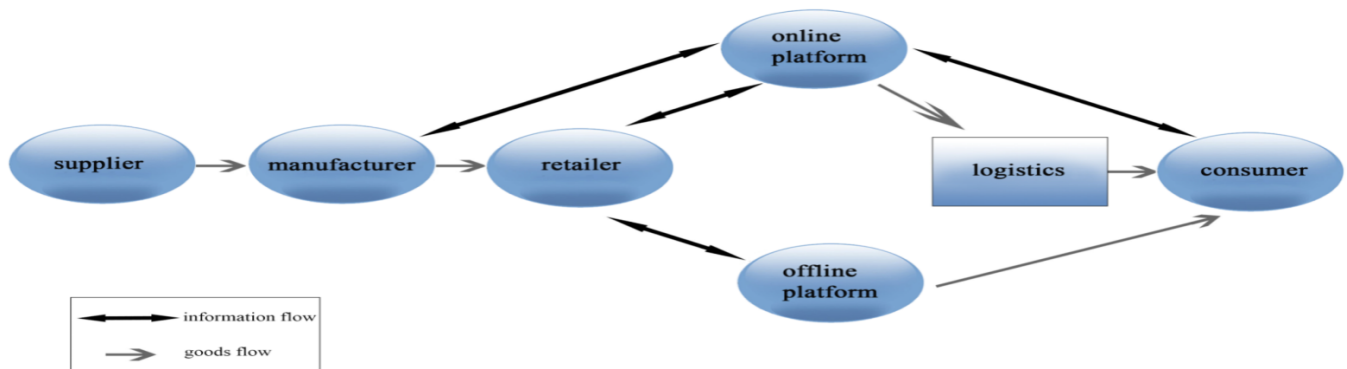


Figure 2: The supply chain in O2O mode

Secondly, we develop a two-sided market model that we use to analyze platform performance investment decisions in the presence of cross-network externalities. The seller's choice is based on the profit function: the profit should be larger than zero. The buyer's strategy is based on the platform's given price, the number of the seller on the platform and the strength of network effects.

In this model, we assume that the product and the service which two platforms offer are heterogeneous and the manufacturer indirectly choose the offline platform through the retailer. We have also assumed that the manufacturer and the retailer both select the offline platform first and buyers at most can join one platform (single-home). Furthermore, without loss of generality, we consider the buyer only buy one product at a certain time. We denote the number of potential buyers for joining the platform by n_i and n_j . While $i=1,2$ and $j=3$ represent the buyer's choice of offline retailer, online retailer and online manufacturer. Moreover, we assume that product prices are heterogeneous, so we use p_i and p_j represent the price of the per unit product charged by the retailer and manufacturer. Finally, there are r_i retailers and m_j manufacturers on the platform.

The frequently used notations are listed in Table 1.

Table 1: the notation of the paper

i	The buyer's choice of offline retailer and online retailer, $i = 1, 2$
j	The buyer's choice of online manufacturer, $j = 3$
n_i	The number of potential buyers for joining the retailer's platform
n_j	The number of potential buyers for joining the manufacturer's platform
θ_i, θ_j	The buyers type distribution and complies with $U(0,1)$
p_i	The price of the per unit product charged by the retailer
p_j	The price of the per unit product charged by the manufacturer
V_i	The value estimates of retailer's unit product
V_j	The value estimates of manufacturer's unit product
r_i	The number of the retailer on the platform
m_j	The number of the manufacturers on the platform
β	The alternative or monopolistic degree relative online platform to offline platform
γ	The manufacturer's degree of credibility in the minds of consumers
ω	The unit product's wholesale price
l	The retailer's earning of unit product and $l = p_i - \omega$

c_1	The manufacturer's cost of unit good on offline platform
c_2	The retailer's cost of unit good on offline platform
k_1	The manufacturer's allocation efficiency relative offline platform to online platform
k_2	The retailer's allocation efficiency relative offline platform to online platform
α_i	The strength of network effects of buyers who select retailer's platform and belong to (0,1)
α_j	The strength of network effects of buyers who select manufacturer's platform and belong to (0,1)

As shown in Figure 3, The retailer can choose online and offline platform (i.e. multi-home) and buyers only select one platform (i.e. single-home). Buyers and sellers make their own decisions according to a series of parameters.

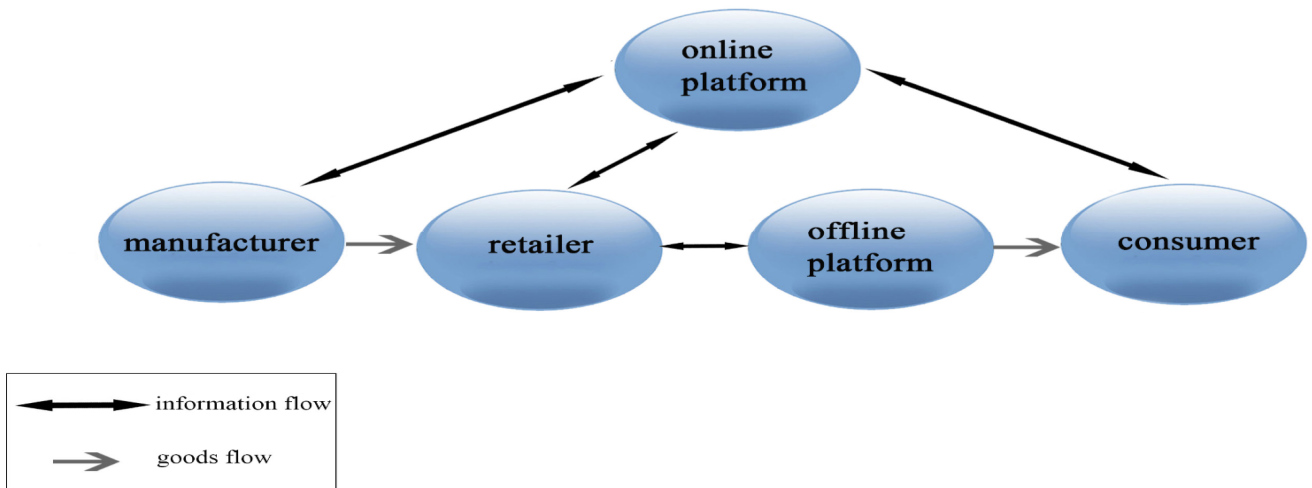


Figure 3: The choice of the manufacturer and the retailer

In particular, first, we assume that the manufacturer and the retailer both select the online platform under certain conditions and we will analysis the prerequisite when we have built the model later. As a result, the net utilities to a consumer on the retailer's offline platform, the manufacturer's online platform, the retailer's online platform are given by:

$$U_1 = V_1 + r_1 \theta_1 \alpha_1 - p_1 - (1 - \beta) V_1 (V_2 + V_3) \quad (1)$$

$$U_2 = V_2 + m_2 \theta_2 \alpha_2 - p_2 - \beta \gamma V_1 (V_2 + V_3) \quad (2)$$

$$U_3 = V_3 + r_3 \theta_3 \alpha_3 - p_3 - \beta (1 - \gamma) V_1 (V_2 + V_3) \quad (3)$$

According to equation (1), for retailer's offline platform, the buyer's individual rationality (participation) constraint is:

$$U_1 \geq 0 \quad (4)$$

So we can get:

$$\theta_1 \geq \frac{p_1 + (1 - \beta) V_1 (V_2 + V_3) - V_1}{r_1 \alpha_1} \quad (5)$$

As a result, according to (5), the number of buyers who join retailer's offline platform is:

$$D_1 = n_1 \int_{\frac{p_1 + (1-\beta)V_1(V_2+V_3) - V_1}{\alpha_1 r_1}}^1 d\theta = n_1 \frac{r_1 \alpha_1 - p_1 - (1-\beta)V_1(V_2+V_3) + V_1}{r_1 \alpha_1} \quad (6)$$

Similarly, we can get the number of buyers who join the other platform is:

$$D_2 = n_2 \frac{m_2 \alpha_2 - p_2 - \beta \gamma V_1(V_2+V_3) + V_2}{m_2 \alpha_2} \quad (7)$$

$$D_3 = n_3 \frac{r_2 \alpha_3 - p_3 - \beta(1-\gamma)V_1(V_2+V_3) + V_3}{r_2 \alpha_3} \quad (8)$$

In the supply chain structure where the retailer is the leader, the retailer decides the earning of unit product on offline platform and the online platform's price of unit product to maximize their profits. While also in this supply chain structure, the manufacturer decides the wholesale price and the online platform's price of unit product to maximize their profits.

The manufacturer's total profits of offline platform and online platform is:

$$\Pi_M = (\omega - c_1)D_1 + (p_2 - k_1 c_1)D_2 \quad (9)$$

Lemma 1. The manufacturer's profits function is a concave function of the wholesale price and the online platform's price of unit product, so when the manufacturer's profit reaches the maximum, the two prices' optimal value are:

$$p_2 = \frac{m_2 \alpha_2 - \beta \gamma V_1(V_2+V_3) + k_1 c_1 + V_2}{2} \quad (10)$$

$$\omega = \frac{r_1 \alpha_1 - (1-\beta)V_1(V_2+V_3) - l + c_1 + V_1}{2} \quad (11)$$

The retailer's total profits of offline platform and online platform is:

$$\Pi_R = (p_1 - \omega - c_2)D_1 + (p_3 - k_2 c_2)D_3 \quad (12)$$

Lemma 2. The retailer's profits function is a concave function of the earning of unit product on offline platform and the online platform's price of unit product, so when the retailer's profit reaches the maximum, the two prices' optimal value are:

$$l = \frac{r_1 \alpha_1 - (1-\beta)V_1(V_2+V_3) + c_2 - c_1 + V_1}{2} \quad (13)$$

$$p_3 = \frac{r_3 \alpha_3 - \beta(1-\gamma)V_1(V_2+V_3) + k_2 c_2 + V_3}{2} \quad (14)$$

So when the manufacturer and retailer both select the online platform, the final optimal value for these parameters are as following:

$$\omega^* = \frac{r_1 \alpha_1 - (1-\beta)V_1(V_2+V_3) - c_2 + 3c_1 + V_1}{4} \quad (15)$$

$$p_1^* = \frac{3r_1 \alpha_1 - 3(1-\beta)V_1(V_2+V_3) + c_2 + c_1 + 3V_1}{4} \quad (16)$$

$$p_2^* = \frac{m_2 \alpha_2 - \beta \gamma V_1(V_2+V_3) + k_1 c_1 + V_2}{2} \quad (17)$$

$$p_3^* = \frac{r_3 \alpha_3 - \beta(1-\gamma)V_1(V_2+V_3) + k_2 c_2 + V_3}{2} \quad (18)$$

$$D_1^* = n_1 \frac{r_1 \alpha_1 - (1-\beta)V_1(V_2+V_3) - c_1 - c_2 + V_1}{4r_1 \alpha_1} \quad (19)$$

$$D_2^* = n_2 \frac{m_2 \alpha_2 - (1-\beta)V_1(V_2+V_3) - k_1 c_1 + V_2}{2m_2 \alpha_2} \quad (20)$$

$$D_3^* = n_3 \frac{r_3 \alpha_3 - (1-\beta)V_1(V_2+V_3) - k_2 c_2 + V_3}{4r_3 \alpha_3} \quad (21)$$

$$\Pi_M^* = n_1 \frac{[r_1 \alpha_1 - (1-\beta)V_1(V_2+V_3) - c_1 - c_2 + V_1]^2}{16r_1 \alpha_1} + n_2 \frac{[m_2 \alpha_2 - \beta \gamma V_1(V_2+V_3) - k_1 c_1 + V_2]^2}{4m_2 \alpha_2} \quad (22)$$

$$\Pi_R^* = n_1 \frac{[r_1 \alpha_1 - (1-\beta)V_1(V_2+V_3) - c_1 - c_2 + V_1]^2}{8r_1 \alpha_1} + n_3 \frac{[r_3 \alpha_3 - \beta(1-\gamma)V_1(V_2+V_3) - k_2 c_2 + V_3]^2}{4r_3 \alpha_3} \quad (23)$$

Finally, we need to consider the prerequisite: Both profits should be greater than zero. So for the manufacturer, their optimal profit must be satisfied:

$$\Pi_M^* \geq 0 \quad (24)$$

Let $A_1 = \frac{n_1[r_1 \alpha_1 - (1-\beta)V_1(V_2+V_3) - c_1 - c_2 + V_1]^2}{16r_1 \alpha_1}$, $A_2 = \beta \gamma V_1(V_2+V_3) + k_1 c_1 - V_2$. So according to formula (24), we can get:

$$\alpha_2 \geq \frac{2A_2 m_2 - \frac{4m_2 A_1}{n_2} + \sqrt{\left(\frac{4m_2 A_1}{n_2} - 2A_2 m_2\right)^2 - 4m_2^2 A_2^2}}{2m_2^2} \quad (25)$$

For the retailer, their optimal profit must be satisfied:

$$\Pi_R^* \geq 0 \quad (26)$$

Let $A_3 = \beta(1-\gamma)V_1(V_2+V_3) + k_2 c_2 - V_3$, so according to formula (26), we can get:

$$\alpha_3 \geq \frac{2A_3 r_3 - \frac{4r_3 A_1}{n_3} + \sqrt{\left(\frac{4r_3 A_1}{n_3} - 2A_3 r_3\right)^2 - 4r_3^2 A_3^2}}{2r_3^2} \quad (27)$$

It means when α_2 and α_3 satisfy formula (25) and formula (27), the manufacturer and the retailer will choose the online platform.

THE NUMERICAL ANALYSIS

According to previous assumptions, these parameters' values can be set: $V_1 = 0.6$, $V_2 = 0.4$, $V_3 = 0.5$, $\gamma = 0.6$, $k_1 = 0.5$, $k_2 = 0.1$,

$m_2 = 5$, $\alpha_1 = 0.7$, $\alpha_2 = 0.6$, $\alpha_3 = 0.5$, $r_3 = 5.5$, $r_1 = 7$, $c_1 = 0.5$, $c_2 = 0.3$ and $\beta = 0.7$. In these settings, there are different

values of V , we can see that the estimations of the value of the same products provided by different and same sellers but different platform are not the same. So does the c . Both entities' allocation efficiencies relative offline platform to online platform are clarified by diverse k . γ express the online platform manufacturer's degree of credibility in the minds of consumers. m and r denote the number of two sellers. Intuitively, the number of retailer is bigger than the manufacture. α clarifies the strength of network effects. As many consumers are more likely to use the online platform, so the monopolistic degree β is a little higher. According to formula (24) and (26) and controlling other variables constant, we can get these prerequisites are $0 < \alpha_2 < 1$ and $0 < \alpha_3 < 1$.

So for the retailer, their demand of products on different platform can be shown in Figure. 4.

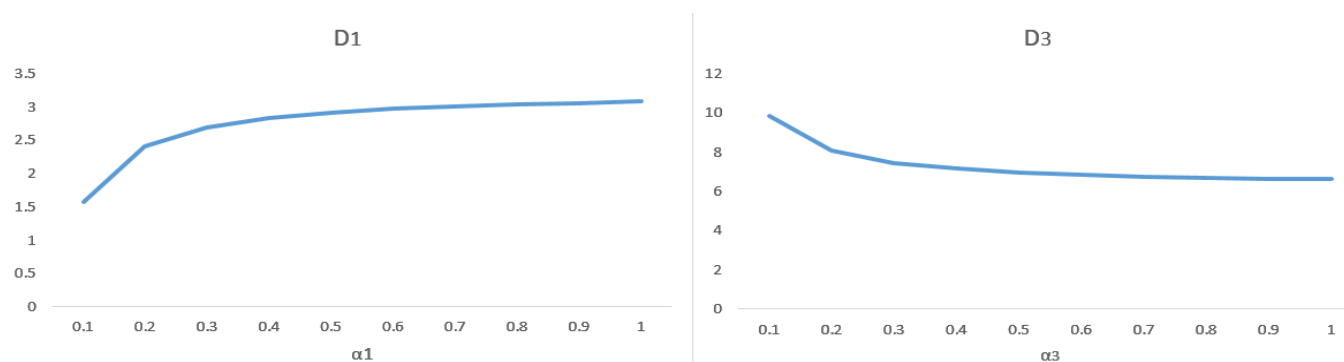


Figure 4: The retailer's demand on different platform

As shown in Figure. 4, we can conclude that their demand on offline platform will increase with the increase of network externality. But the demand will decrease on online platform with the increase of network externality. Figure. 5 shows the retailer's profit. We can see their profits increase with the increase of network externality. That's why although the demand on online platform decreases, but they will also choose to introduce the online platform.

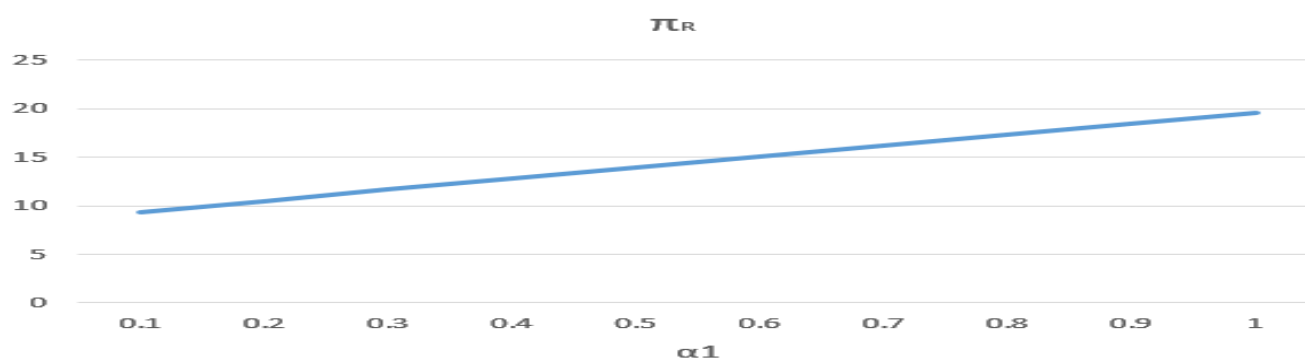


Figure 5: The retailer's profit

For the manufacturer, as shown in Figure. 6, we can see that their demand on online platform and profit both will increase with the increase of network externality. That's because when there are more consumers on the online platform and in turn the manufacturer's profit will increase.

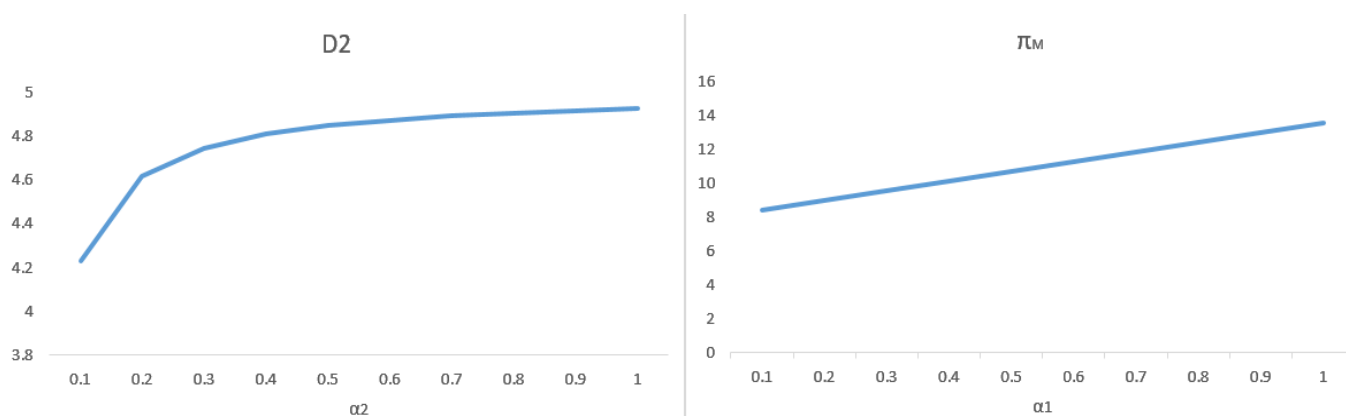


Figure 6: The manufacturer's demand and profit

Overall, when the prerequisites meet (i.e. the two entities' profits are satisfied), they will both select to join the online platform. And the consumer can get more conveniences and utilities. That's why this form of supply chain appears and exists.

CONCLUSION AND MANAGERIAL IMPLICATION

In this paper, we research the platform performance based on the network externality. We consider a realistic structure which the retailer can also choose the online platform. In the structure where the leadership belongs to the retailer, we consider a game-theoretic model to study the platform performance.

Our study of platform performance under the affecting of network influence has yielded several important insights that should be of managerial interest.

Firstly, when the sellers both meet the precondition, the seller's strategic use of when and whether to join the platform is determined by the relationship with buyers' participation and the strength of network externality. However, whether the buyer join the platform is determined by their utility that is partially affected by the number of sellers who join the same platform. Secondly, when the manufacturer and the retailer both choose the online platform, we can get the optimal decision-making strategies. For example, the optimal price of per unit product on different platform, the optimal wholesale price and so on. Third, in this supply chain, the retailer's optimal demand on offline platform and profit will increase with the increase of network externality. However, their optimal demand on online platform will decrease. They will join the online platform to make more profits. The manufacturer's optimal demand and profit will increase with the increase of network externality. Fourth, as the seller can choose the two platforms, so there exist many different modes of supply chains and generates a new form of supply chain.

We have made a few simplifying assumptions in developing our model. For example, consistent with many literatures, we only study a single-period model and assume the buyer can only choose one platform. While we believe the intuition of our results applies to cases with different assumption, future research might investigate how such assumptions (e.g., independent of sellers' utility) affect the conditions in the proposition.

Finally, future research could divide the platform into monopoly platform and competitive platform, so we can further discuss the seller's choice between two platforms or among three platforms. We also might conduct a comprehensive analysis of sellers' decisions which include different first-party content, technology and market share.

ACKNOWLEDGEMENTS

The authors would like to thank for Science and Technology Department of Sichuan Province (No. 2016ZR0042), the Research Center for Sichuan Liquor Industry Development, China (No. CJY15-03) and Sichuan University (No. skqy201648, skqy201523).

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The Influence Of Belief And Justice On Brand Loyalty In Social Commerce

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Abstract

This paper presents a research model to examine factors influencing brand loyalty and these relationships in social commerce. The model comprises four research hypotheses with five constructs, including behavioral beliefs, normative beliefs, control beliefs, justice and brand loyalty. The constructs are measured by well-supported measures in the literature. The hypotheses are tested via an empirical study of social commerce. Structural equation modeling is used to analyze survey data collected from 363 usable responses. The results show that, in the order of importance, control beliefs, behavioral beliefs and normative beliefs are the major factors contributing to justice and in turn enhance brand loyalty for the social commerce as a whole.

Keywords: Behavioral Beliefs, Normative Beliefs, Control Beliefs, Justice, Brand Loyalty, Social Commerce

INTRODUCTION

Brand loyalty is a key factor in establishing and sustaining successful social commerce. Social commerce is rapidly emerging as an extension of e-commerce, primarily due to the increased popularity of social networking sites (SNSs) such as Facebook, LinkedIn, and Twitter [14]. These sites provide functions (such as the Facebook “Like” and “Share” buttons and is “comment” function) that make it easy for users to share information with their friends or other users. Because social networks can enhance a product’s competitive advantage by creating commercial activities within the social network environment, maintaining customer brand loyalty by online merchants has become a common practice

To achieve the advantages of brand loyalty, business in the community website, justice are a key factor. Existing studies have empirically examined the moderating effect of habit on the link between trust and brand loyalty [6] and the relationship between satisfaction and brand loyalty (eg., [3] [22]). Little is known about the implications that the inter-relationship between beliefs and justice has for effective brand loyalty in social commerce. Consumers shopping online about three of common belief are that it can save time, save money, and help find the products that best meet the needs. But how do these beliefs, alone or in combination, affect online purchasing behavior [12]. The theory of consumption values [30] provides an appropriate conceptual framework to examine how consumption values and beliefs influence consumer decisions. For instance, how consumers allocate time, money while shopping is a key problem [12]. This study is to explore the influence of belief and justice on the brand loyalty.

The online shopping process can be considered as an exchange of time, effort and money for the receipt of products or services in a virtual store [18]. From this perspective, online shopping and outline shopping programs are similar, such as consumers, product information, negotiation and procurement. The original concept of justice assumes that perceived justice affects all types of social exchange behaviors [18]. In an online context, distributive justice refers to the extent to which consumers feel that their transactional efforts are fair, when compared to the outcomes offered by e-vendors [17]. Procedural justice for web stores concerns consumers’ perception of fairness, in terms of the policies, procedures and criteria offered by vendors in their transactions [31]. Online shopping of the main communication medium is the user interface with the system. System should be trusted and liked by the user. Accordingly, interactional justice reflects the perceived fairness of a communication between system interface and online consumers [18]. Therefore, this paper uses justice theory to investigate consumer’s behavior in online shopping.

To address improvement to brand loyalty in the context of social commerce, a research model is developed in this study to investigate the factors influencing brand loyalty. This study bundles Theory of Planned Behavior (TPB) and justice theories to illustrate and, provide a more complete explanation of back working mechanisms. To verify this research model, an empirical study of Taiwanese consumers using social commerce sites was conducted.

The remainder of this paper is organized as follows. Section 2 presents the theoretical framework and hypothesis development. The data collection method and research design are described in Section 3, and this study’s findings are presented in Section 4.

Finally, Section 5 provides a discussion of the results, and Section 6 concludes this study, offering directions for future research.

THEORETICAL FRAMEWORK AND HYPOTHESIS DEVELOPMENT

Research model

Figure 1 shows the whole research model and relationships in factors. Four hypotheses were tested with respect to this model.

Each hypothesis is indicated by the letter H and a number. The arrows indicate the hypothesized relationships.

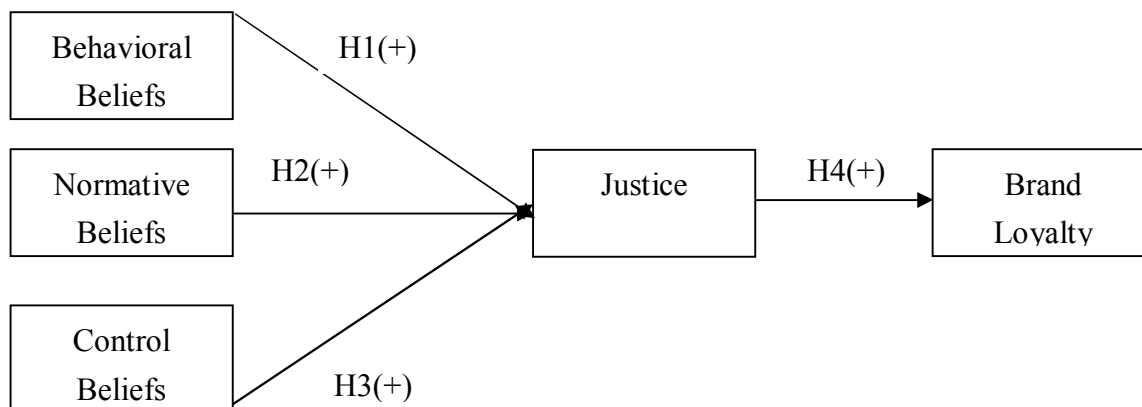


Figure 1: The research model

Behavioral Beliefs

Behavioral Beliefs is related to behavioral intention, is the individual wants to take a specific action. Guided and whether you decide this behavior a way of expression under the selection process behavior. It refers to the subjective intention that behavior is consistent with the implementation of expected results. Based on the above definition, a corollary of this study the following hypothesis:

H1: Behavioral Beliefs are positively related to Justice.

Normative Beliefs

Normative belief is related to social influence. TPB postulates the influence of other people through normative belief in impacting individuals' behavior. Justice may be under the influence of family, friends or other people. The influence of people around human is the major point of normative beliefs. Justice may also be influenced by normative beliefs, because it involves the exchange of information. The information may come from other people's recommendations. Based on the above definition, a corollary of this study the following hypothesis:

H2: Normative Beliefs are positively related to Justice.

Control Beliefs

Control beliefs are also known as personal beliefs about the ease or difficulty of implementation is the expected behavior^[19]. These control beliefs' factors based on past experience to constrain the future of behavioral intentions. If justice is the expected behavior, the effect is likely to be influence by control beliefs. Based on the above definition, a corollary of this study the following hypothesis:

H3: Control beliefs are positively related to Justice.

Justice

Much research on service recovery has generally identified consistent relationships between justice perception and customer satisfaction [17]. In a study of the hotel and restaurant sectors, Martinez-Tur et al. (2006) reported that all of the three justice dimensions; distributive, procedural and interactional justice, are important predictors of customer satisfaction. Pizzutti and Fernandes (2010) argued that customer satisfaction is significantly determined by all three justice dimensions; distributive, procedural and interactional justice, in a study of the e-retailing sector. This study further found that distributive justice has a greater effect on customer satisfaction and that procedural justice has the smallest influence on customer satisfaction. And manifest satisfaction is directly and unequivocally related to true brand loyalty because manifest satisfaction means the explicit evaluation of the brand which (in the case of a positive evaluation) leads to commitment to the brand [20]. Satisfaction is the predecessor of brand loyalty, intention to rebury the product and behavior of brand towards its customers [27]. Brand loyalty can increased by the satisfaction of customer and repeat the purchase of the same product services [36].

Satisfied customers have a higher likelihood of repeating purchases in time [35]. Now companies are trying to increase consumer satisfaction, because satisfied customers than other cosumers have higher chance to buy back the same products, and which the satisfied customers tend to be loyal customers.

H4: Justice is positively related to brand loyalty.

RESEARCH METHOD

To develop the survey instrument, a pool of items was identified from the literature for measuring the constructs of the research model. Data from an online survey sample were collected to assess the instrument's validity and reliability and to test the hypothesized relationships of the research model.

All measures of the survey instrument were developed from the literature. Where appropriate, the manner in which the items were expressed was adjusted to the context of online auction site. The English version was developed first, then translated into Chinese, and then back-translated into English. When the back-translated English version was checked against the original English version, some questions were reworded to improve the accuracy of the translation. The expressions of the items were adjusted, where appropriate to the context of online auction site industry. The items measured on a seven-point Likert scale, ranging from 'strongly disagree' (1) to 'strongly agree' (7).

In order to improve the content and appearance of the 21-item questionnaire, a pre-test it was performed on a sample comprising four academic researchers and four Ph.D. students. The respondents were asked to complete the questionnaire and provide comments on the wording, understand ability and clarity of the items, as well as on the overall appearance and content of the instrument. The responses suggested that all statements were retained and only minor cosmetic changes were needed. After a further review by two other academic researchers, the instrument was deemed ready to be sent to a large sample in order to gather data for testing our research model.

RESEARCH RESULTS

Structural equation modeling (SEM) with AMOS 21.0 was used to analyze the hypothesized relationships of the research model. SEM aims to examine the interrelated relationships among a set of posited constructs simultaneously, each construct is measured by one or more observed items (measures). It involves the analysis of two models: a measurement (or factor analysis) and a structural model. The measurement model specifies the relationships between the observed measures and their underlying constructs, with the constructs allowed to inter-correlate. The structural model specifies the posited causal relationships among the constructs.

Assessment of the measurement and structural model

The measurement model specified for the research model was assessed to ascertain the extent to which the observed measures (surveyed items) were actually measuring their corresponding construct. The 19 items of the survey instrument were first analyzed to assess their dimensionality and measurement properties. All items loaded significantly and substantially on their underlying constructs, thus providing evidence of convergent validity. Using a confirmatory factor analysis, all items were found to perform well and were thus retained in the model.

The chi-square of the measurement model was significant ($\chi^2 = 481.946$, $df = 289$, $p < 0.005$), with the value of (χ^2 / df) smaller than 2, indicating an ideal fit [5]. The large chi-square value was not surprising, since the chi-square statistic has been shown to be directly related to sample size [21]. To assess the overall model fit without being affected by sample size, alternative stand-alone fit indices less sensitive to sample size were used. These indices included the goodness-of-fit index (GFI), the adjusted goodness-of-fit index (AGFI), the comparative fit index (CFI), and the root mean square error of approximation (RMSEA) [21]. For a good model fit, the GFI should be close to 0.90, AGFI more than 0.80, CFI more than 0.9, and RMSEA close to 0.06 [21]. An assessment of the measurement model suggests an acceptable model fit (GFI = 0.908; AGFI = 0.881; CFI = 0.974; NFI = 0.938; RMSEA = 0.043).

To assess the reliability of the constructs, composite reliability (CR) was facilitated. All of the composite reliability values, ranging from a low of 0.845 to a high of 0.999, exceeded the recommended cut-off value of 0.80 [21]. A 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 measurement error [21]. In addition, an assessment of discriminant validity between the constructs supported the model fit. The overall fit of the structural model is acceptable, since all measures of fit reach an acceptable level ($\chi^2 = 481.946$, $df = 289$, $\alpha = 0.01$; GFI = 0.909; AGFI = 0.881; CFI = 0.974; NFI = 0.938; RMSEA = 0.043).

Common method bias

Following the suggestion of [32], Harmon's one-factor test was run to ensure that common method variance did not account for our findings. Unrotated principal components analysis revealed six factors with eigenvalues greater than 1, which accounted for 72.200% of the total variance. The first factor did not account for the majority of the variance (23.303%). This assessment offer evidence that no single factor emerged that accounted for most of the variance.

This thesis examined the data for empirical evidence of common methods bias by conducting a confirmatory factor analysis (CFA) which included a construct representing an unmeasured methods factor. It is assumed that common method variance is not a serious threat if the one-factor model has a poor fit with the data [15]. To develop the one-factor model, the step is to load all of the measurement items into a single factor. The CFA results indicated that the one-factor model did not fit the data ($\chi^2 = 656.510$, $df = 295$; GFI = 0.880; AGFI = 0.846; CFI = 0.952; NFI = 0.916; RMSEA = 0.058). Thus, the result concluded that common method bias does not appear to be a problem in the study.

Hypotheses testing

Figure 4 shows the structural model with the coefficients for each path (hypothesized relationship), where solid and dashed lines indicate a supported and unsupported relationship respectively. Behavioral Beliefs (H1: $\gamma = 0.213$, $t = 2.830$, $p < 0.05$) is significantly associated with justice. Normative Beliefs (H2: $\gamma = 0.131$, $t = 3.683$, $p < 0.001$) is significantly associated with justice. Control Beliefs (H3: $\gamma = 0.453$, $t = 6.366$, $p < 0.001$) is significantly associated with justice. Justice (H4: $\gamma = 0.689$, $t = 9.919$, $p < 0.001$) is significantly associated with brand loyalty.

DISCUSSION

Conforming to the hypothesis, justice has the positive influence on brand loyalty. In Taiwan's social commerce, justice plays the significant role in brand loyalty. Justice can promote consumers to enhance the brand loyalty. Thus, sellers and buyers should reinforce their belief so as to improve justice and in turn achieve the competitive advantage of brand loyalty.

Belief is positively associated with the justice in Taiwan's social commerce. The belief means that the value of a product depends on the total number of users. Punj (2011) pointed out that beliefs influence purchase behavior can assist online merchants to create more value for consumers.

CONCLUSION AND FUTURE RESEARCH

This empirical research is among the earliest studies attempting to address the issues of justice to improve brand loyalty in the social commerce. In order to address this important issue in the social commerce was investigated in this study to explore factors influencing the justice and brand loyalties. The contributions of this thesis are described as follows. First, provided insights into how the positive effect of belief reinforces justice in order to achieve the brand loyalty. Second, this paper extends current research by highlighting the roles of control beliefs, behavioral beliefs and normative beliefs in online brand loyalty. The findings of the study provide practical insights in understanding how social commerce should re-examine belief between sellers and buyers that would improve justice, in order to enhance brand loyalty for the social commerce as a whole.

Despite these contributions, this study suffers from methodological limitations typical of most empirical surveys. For data collection, even through the necessary steps were taken to detect and eliminate items that would result in an invalid sample, it was still difficult to determine the real identity of the respondents because most of them refuse to provide their true personal information for an internet survey. Another concern is that the respondents may complete the questionnaires using different accounts or computers for the purpose of receiving rewards. Finally, the findings only reflect the setting of Taiwan's social commerce marketplace. Nevertheless, the number of businesses involved in cross-country or cross-sectional e-commerce is increasing worldwide, such as in the United States, Europe, and Asia-Pacific. To address these inherent limitations, future research on cross-country studies of various forms of SNSs would be worth conducting to examine regional differences in the development of social commerce activities.

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Network Effects In Two-Sided Electronic Market: A Cross-Country Empirical Analysis Of Online P2P Lending Market

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ABSTRACT

With a two-sided model, this paper reports an empirical research investigating online Peer-to-Peer lending marketplaces, PPDai.com in China and Prosper.com in US. We observe that the platform's profit-maximizing pricing strategies for the agents in the online P2P lending marketplaces are mainly related to the network effects between and within the two sides. Agents' inter-group and intra-group network externalities depend on the demand-supply relationships, which is unlike the assumptions of negative intra-group network externalities and positive inter-group network externalities in the previous theoretical research of electronic commerce. Besides, as assumed in the theoretical model, it demonstrates significant negative price elasticity of demand and supply on both platforms. Based on the theoretical model and empirical results, we analyze the two platforms' profit-maximizing pricing strategies, and explain the rationality and deficiency of the strategies. The findings enhance our understanding of the two-sided electronic market, which could shed light on how the platforms make price strategies in this kind of electronic market.

Keywords: two-sided market, pricing strategy, network externalities, online Peer-to-Peer lending

INSTRUCTIONS

Background

The development of new technologies for information and communication has brought informational intermediation to the forefront of the "new economy" [1]. Different forms of new industries have emerged and been growing rapidly in last two decades, and many of these industries have appeared to match the context of "two-sided market" (see summarized examples of two-sided market by Evans [2]). In these markets, intermediaries or "platforms" enable interactions among distinct groups of agents and attempt to gain the two sides with rational price to each side [3], where each side derives network externalities from the participation of members on the other side. Rochet and Tirole[4] strictly define a two-sided market as one in which the volume of transactions between end-users depends on the structure and not only on the overall level of the fees charged by the platform.

As a main part of "new economy", electronic commerce has been growing rapidly for twodecades and penetrated almost all industries [5], as well as creating new industries such as online auction houses and digital marketplaces [6]. Many online marketplaces show characteristics whereby two groups of agents – the buyers and the sellers – come together and interact with one another via the enabling marketplace [7]. Bakos[8] describes two functions that are provided by electronic marketplaces: (1) matching buyers and sellers; and (2) facilitation of transactions. According to the emerging theory of two-sided markets, a significant number of fast developing electronic marketplaces (i.e., eBay, Taobao, Tmall, Amazon and 360Buy) can be characterized as two-sided market. During last two decades, many electronic marketplaces continue to flourish, and are generating enormous volumes of trades [3]. For example, Tmall, the largest online B2C marketplace in the world, has more than 400 million members and its maximum daily transaction value is about ¥91.22 billion right in 2015; eBay has about 164 million active global users and the total value of transactions in 2015 was more than 82.0 billion US dollars. However, during this fast developing process, most of electronic marketplace providers have been bothered by the profitability problem. In order to attract users, many electronic platforms are free for the users, and sometimes even subsidize the consumers in the form of sales promotion. Under this situation, some famous commercial websites, such as Commerce One had gone into bankruptcy.

Furthermore, although much of the electronic commercial in its early years focused on online selling (e-commerce), a wider variety of e-business initiatives (collectively described as e-business) have emerged in recent years [9], such as online lending, online social networks and online media. These new kinds of electronic marketplaces have different business models and pricing strategies from the electronic selling. When the diverse nature and magnitude of the possible interactions in the new electronic markets present challenges to the industries as well as the scholars [7], more new opportunities are also offered. Despite the differences among different types of electronic marketplaces, they usually face the same challenging issues: What kind of network externalities users have in the marketplace? what kinds of factors will affect user network externality? how do user network externalities affect the platform's profit-maximizing pricing strategy? and how to price services for different kinds of users to maximize the platform's profit? It is going to be helpful for us to figure out the difference among the different forms of electronic markets through answering these questions for different kinds of marketplaces, which is useful for the development of electronic market.

Intend to find some answers of these questions, this study takes a new form of two-sided electronic market, online Peer-to-Peer (P2P) lending, to conduct empirical study by using the transactional data of Prosper.com in US and PPDai.com in China. Our objectives are: (1) to quantify user network externalities in the marketplaces; (2) to explore what kind of factors would influence on the user network externalities; (3) to find the user's reaction to the platform's price strategy; and (4) to investigate how network effects and prices impact on the platform's profit-maximizing pricing strategies. The rest part of this paper is organized as follows. In Sect. 2, we review the related literature. The two-sided market model for online P2P lending is built in Sect. 3. Sect. 4 displays the empirical results and the detailed analysis. Finally, we summarize the study in Sect. 5.

Literature review

Along with the fast development of different types of two-sided markets, there has been a recent surge of interest in two-sided market platforms [7], and the related literature is accumulatively proliferated [10]. These research outcomes are applicable to various markets, such as bank card, advertising-supported media, dating agencies, software platforms, telecommunication, and shopping malls. A considerable research of two-sided market method in electronic commerce has appears in recent years.

To date, the literature on two-sided electronic market has concentrated on different research questions. Katsamakas[11] builds a two-sided model for an operating system platform to compare industry structures based on a proprietary platform (such as Windows) with those based on an open source platform (such as Linux), while Hagiu[12] identifies an economic welfare tradeoff between two-sided open platforms and two-sided closed platforms connecting consumers and producers. According to the standard two-sided market model of Armstrong [13], Economides and Tåg[14] discuss the desirability of departing from network neutrality to allow residential Internet access providers to initiate a positive fee to the content and applications side of the market, besides the price it charges to users/subscribers. Lin et al. [15] model the innovation race among sellers in both finite and infinite horizons to examine a platform's optimal two-sided pricing strategy. Reisinger[16] analyzes two-part tariffs and Liu and Serfes[17] focus on the price discrimination.

Moreover, there has been active research on electronic marketplace in the direction of network externalities. Yoo et al. [18], Bakos and Katsamakas[19], Belleflamme and Toulemonde[20], Li et al.[7] and Li et al. [3] analyze the effects of two types of network externalities on the pricing strategies in an independent intermediary electronic marketplace. Yoo et al. [18] consider the intra-group network effects and switching costs with regard to the optimal price of a monopolistic B2B marketplace. Close to Yoo et al. [18], Li et al. [3] extend the quantity of services and theoretically analyze a monopolistic e-marketplace with the introduction of negative intra-group externalities within members of the two groups. Bakos and Katsamakas[19] discuss how the electronic intermediary to invest in technologies for each side by modelling endogenous network effects. Compare to other models, Li et al.[7] explicitly model the possibility of both positive and negative cross-group and within-group network effects, and consider the effect of competition between the sellers as well as the competition between platforms on the price they charge the buyers.

Although a considerable literature theoretically discusses the network effects and pricing strategies of electronic marketplace, several empirical challenges exist when attempting to test the theory of two-sided market. To estimate the theory, the researcher requires meaningful data on both sides of the market, such as price and quantity observations, as well as exogenous variation that will identify parameters of interest that drive the equilibrium decisions of platforms[21]. As a result of these requirements, researchers have turned to payment systems and media, especially for the newspaper and magazine markets, where advertising and circulation information has been made available, such as German[22], Canadian[23], U.S.[21]. In the field of payment systems, Rysman[24] and Akerberg and Gowrisankaran[25] estimate the network effects among users. Related empirical studies concerned with the two-sided characteristics of electronic market are also mainly focusing on estimating users' network effects. In order to validate the network externality assumed in the theory, Kraemer et al.[6] develop a growth empirical model for the platform and empirically analyze the network effects on eBay, and Gupta et al.[26] present a model to value the "free" customers wherein buyer and seller growth arise from marketing actions and direct and indirect network effects by apply the model to an anonymous auction house's monthly data. Similar to each other, both Kraemer et al.[6] and Gupta et al.[26] only empirically analyze network effects in two-sided electronic markets, but do not quantify the interactive effects between price and network externality. Chu and Manchanda[27] state that previous work often focused on the benefits (or costs) a user obtains from additional users from either the same or the opposite user group, but not simultaneously from both sides. In order to solve the problem of the requirement of complex data to support the empirical research, Hildebrand[28] develops a semi-structural approach to identifying network effects on two-sided monopoly platforms without data on prices and quantities.

Early empirical studies of two-sided market, such as Rysman[24], Akerberg and Gowrisankaran[25], Kraemer et al.[6] and Gupta et al.[26]—mainly emphasize the network effects among users and how important it is to take the view that these markets are two-sided markets. Unlike these studies, this research uses the transaction data of online Peer-to-Peer market, not only empirically estimates the network effects among users in two-sided electronic market, but also analyzes the effects of platform's pricing strategies and how network effects and prices impact on the platform's profit. The research is helpful to understanding the characteristics of two-sided electronic market as well as makes up for the deficiency of the empirical research.

As a new application of IT technology in the financial industry, online P2P lending market matches people who need loans with the willing lenders. Without banks as intermediaries, borrowers and lenders in online P2P lending markets could communicate and trade with each other directly. The loan without any mortgage may cause inherent risk of defaults. In order to solve the problem of information asymmetry, most of the scholars[i.e., 29, 30, 31] focus on human behaviour in the online P2P lending market, especially the effects of social network on the loan performance. However, little attention has been paid on the pricing strategy of online P2P lending market. As a new form of electronic two-sided market, online P2P lending market has the characteristics, such as wide-range consumers, unlimited time and region, and fast information transmission, that an electronic market generally has. Besides, it also has some differences from the electronic commerce (online selling) that usually is discussed in previous research. The emergence of online P2P lending provides us with a good opportunity to fill the gap of insufficient empirical analysis of the electronic market, especially the new form ones. With the daily transaction data of Prosper.com in US and PPDai.com in China, we empirically analyzing the users' network externalities and price sensitivities, as

well as the platforms' pricing strategies, based on the two-sided market theory. From the implications for practice, this study enhances our understanding of the electronic markets, which could shed light on how to make pricing strategies for the platforms. From the implications for research, the empirical findings of this new form of electronic markets also imply the lack of previous literature, and put forward some new research directions.

The two-sided market model for online P2P lending

Theoretic models of two-sided market

Based on the business model of online P2P lending, we build a monopoly two-sided market model derived from the one built by Armstrong [13]. Consider there are two groups of homogeneous agents in the market, we assume that the utility of a representative agent in a group is determined by the inter-group externality, the cost for using the platform and intra-group network externality [3, 7]. The two-sided agents' utility models in online P2P lending marketplace is formalized in equation (1).

$$u_i = \alpha_i n_j + \beta_i n_i - \gamma_i i r - p_i, u_j = \alpha_j n_i + \beta_j n_j + \gamma_j j r - p_j \quad (1)$$

In equation (1), n_i and n_j respectively represent the number of agents in each group; p_i and p_j are the prices charged by the platform for the two types of agents. Parameter α_i (α_j) measures the benefit or loss that a group- i (group- j) agent (agent i (j)) hereafter) undertakes via interacting with agents in group- j (group- i). Parameter β_i (β_j) measures the benefit or loss of agent i (j) who receives from other agents in the same group.

Suppose the numbers of members in each group who join the platform are the functions of the agents' utility $n_x = \phi_x(u_x)$, $x \in (i, j)$, the platform's profit model could be expressed as,

$$\pi = [p_i - f_i] \phi_i(u_i) + [p_j - f_j] \phi_j(u_j) \quad (2)$$

where f_i (f_j) is the per-agent cost that incurs at the platform in group i (j). The platform's profit function can be rewritten as equation (3).

$$\pi = [\alpha_i \phi_j(u_j) + \beta_i \phi_i(u_i) - u_i - f_i] \phi_i(u_i) + [\alpha_j \phi_i(u_i) + \beta_j \phi_j(u_j) - u_j - f_j] \phi_j(u_j) \quad (3)$$

Let η_i be the price elasticity of agent i , $\eta_i = p_i \phi_i' / \phi_i$, then the platform's profit-maximizing price p_i should satisfy $p_i = \frac{\eta_i}{1 - \eta_i} (\alpha_j \phi_j + \beta_i \phi_i - f_i)$. The platform's profit-maximizing price is determined by the cost of services, inter- and intra-group network externalities, and the agent's price elasticity. Assume the agent's price elasticity is negative, the relationship of agent's network effect and platform's costs determines the platform's pricing strategies. When the agent's network effects ($\alpha_j \phi_j + \beta_i \phi_i$) are greater than the variable cost (f_i), the platform should subsidize the agent. However, if the platform's variable cost (f_i) is greater than the agent's network effects ($\alpha_j \phi_j + \beta_i \phi_i$), the platform could charge positive fee and take profit from the agent. On the other hand, given the value of agent i 's network effects ($\alpha_j \phi_j + \beta_i \phi_i$), the platform should charge or subsidize more (less) when the agent has higher (lower) price elasticity (η_i). The relationships among platform's profit-maximizing price, agent's network effects, and price elasticity are shown in Fig. 1.

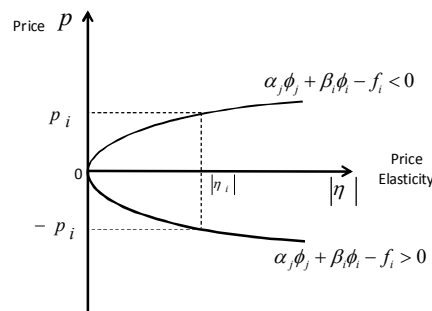


Figure 1: The relationship among profit-maximizing price, the agent' network effect and price elasticity
Online P2P lending market

Online P2P lending market has achieved a great success since Zopa at UK, the earliest online P2P lending marketplace, was launched in 2005. Harvard Business Review announced it to be one of the 20 breakthrough ideas for 2009 [32]. Generally speaking, there are two kinds of online P2P lending marketplaces, profit marketplace (such as Prosper and PPDai) and non-profit marketplace (such as Kiva and Wokai). In this study, online P2P lending market refers to the profit market. In a profit-oriented online P2P lending marketplace, the platform helps borrowers and lenders complete the transactions, and charges them fees. In general, the business model of online P2P lending is displayed in Fig. 2.

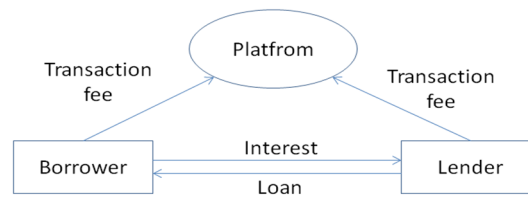


Figure2: Business model of online P2P lending

Usually, there are several steps in the transactions process in online P2P lending market. First, borrowers and lenders should register on the platform by providing the needed personal information to the platform. Second, if a borrower wants to borrow money, she/he could create and publish a loan requested listing. The listing should include the listing information (e.g., amount of money needed, the maximum interest rate, loan period, and loan purpose) and borrower's personal information (e.g., gender, job, and income). The third step is bidding process. During the period the listing published in the marketplace, it could be viewed and bid by lenders. The listing can be bid by more than one lender. The borrower could obtain the loan if listing is fully funded. After the listing is funded, the platform will deposit the funds to the borrower and make sure the listing becomes a loan. In this step, the platform charges transaction fees for both borrower and lender. The last step is the repayment of the loan. According to the agreement, the borrower repays the principals as well as interests of the loan to the lenders.

The empirical model

(1) The utility models of two-sided users

In online P2P lending market, a necessary condition for a borrower to obtain loan is that lenders' total bid amount (Supply) is equal to or greater than the borrower's requested loan amount (Demand) during auction time. When the total bid amount is greater than the borrower's demand amount in a listing, the bidders with lower bidding interest rate finally fund the loan. Borrowers' demand usually could not be satisfied because of the insufficient supply amount, and lenders could not always lend money to the borrowers because of the failed listings or failed bid with higher bidding interest rate than other lenders. Then, in the marketplace, the total transaction amount is usually smaller than total supply amount and total demand amount. For each period t , we could have borrowers' total demand amount ($DAMT_t$), lenders' total supply amount ($SAMT_t$), and the total transaction amount ($TAMT_t$).

Suppose the borrower could have positive utility in the transaction if and only if the requested listing could be successfully funded, while the lender could gain the income in the transaction if and only if the bid amount could be successfully lend to borrowers. So, under the certain conditions during a period in the marketplace, the successful rate of borrowers' demand and the successful rate of lenders' supply could reflect the utilities gained by borrowers and lenders as a whole. The successful rate of borrowers' demand in period t is represented by SD_t , which is equal to $TAMT_t / DAMT_t$. The successful rate of lenders' demand in period t is represented by SS_t , which is equal to $TAMT_t / SAMT_t$.

In the marketplace, whether a borrower could fund the loan or not is determined by the lenders' supply and the competition with other borrowers. For a lender, whether he/she could lend money or not is determined by borrowers' demand and the participation of other lenders. Following the assumptions in the theoretical analysis of two-sided market, user's utility is directly influenced by the number of two-sided users as well as the platform's transaction fees. The total number of borrowers and lenders are added into the empirical models to capture inter- and intra- group network effects, which are respectively represented by TB_t and TL_t . However, borrowers of different successful transactions usually have different transaction fees because of different loan amounts, credit grades and/or loan periods, and lenders have different transaction with each others because of different credit grades, interest rates and/or bid amount. In this research, we use average transaction fee rates to indicate the level of transaction fee in each period, which are shown as average borrower transaction fee rate Pb_t and average lender transaction fee rate Pl_t in the empirical model. Besides, in online P2P lending market, the interest could also directly affect the utilities gained by borrowers and lenders, respectively. And we add the average interest rate of the listings, which is denoted as IR_t in the empirical models. Furthermore, we consider the control for the effects of total demand amount $DAMT_t$. We get the following empirical specifications,

$$\begin{cases} \ln SD_t = \alpha_1 \ln TL_t + \beta_1 \ln TB_t + \lambda_1 \ln AVBfrate_t + \theta_1 \ln AVIR_t + \gamma_1 \ln DAMT_t + \varepsilon_1, \\ \ln SS_t = \alpha_2 \ln TB_t + \beta_2 \ln TL_t + \lambda_2 \ln AVLfrate_t + \theta_2 \ln AVIR_t + \gamma_2 \ln DAMT_t + \varepsilon_2 \end{cases} \quad (4)$$

where the subscripts 1 and 2 refer to the two groups of agents, and t is date. SD_t and SS_t are the success rates of demand and supply on day t . Pb_{it} (Pl_{it}) represents the average transaction fee rate of borrowers (lenders), and λ_1 (λ_2) means the borrower's (lender's) price elasticity. Besides, α , β are the coefficients of total numbers of two-group agents, which are used to measure the inter-group network externality and intra-group network externality; θ and γ are the coefficients of average interest rate and total demand amount on day t ; ε_1 and ε_2 are the random error terms of two equations.

(2) Platform's profit function

In two-sided marketplace, platform's profit is usually affected by the platform's price strategies, size of users, and network effects among users[i.e., 3, 13, 33]. About the relationships between platform's profit and the users' fee rates, the assumption of profit-maximizing price indicates the quadratic linear relationship. So, we build the platform's profit function is shown as equation .

$$Up_t = c_3 + \alpha_{31} TB_t + \beta_{31} TL_t + \gamma_{31} AVBfrate_t + \gamma_{32} AVBfrate_t^2 + \chi_{31} AVLfrate_t + \chi_{32} AVLfrate_t^2 + \theta_3 AVIR_t + \varepsilon_3 \quad (5)$$

Empirical analysis

Dataset

The archival data are collected from two major online P2P lending marketplaces, PPDai.com and Prosper.com. PPDai is a leading online P2P lending marketplace in China, found in August 2007. It provided over 50 million RMB in loan facilitation for over 600,000 registered users since it had been launched. Prosper was founded in February 2006 in US, which is one of the largest and earliest online P2P lending marketplace in the world. Right now, it has more than 1.6 million members and over \$500 millions in funded loans.

The daily transaction data of PPDai from 18th June 2007 to 15th June 2011 used in this study was provided by the company directly, while the daily transaction data of Prosper from 16th August 2006 to the present is downloadable from Prosper's website. Prosper was shut down by Securities and Exchange Commission during 2008 and 2009 twice because of the legal problem, and it re-opened on 13th July 2009 till now. Fig. 3 gives the Prosper's daily total loan amount from 16th August 2006 to 7th March 2011 with discontinuities between year 2008 to 2009.

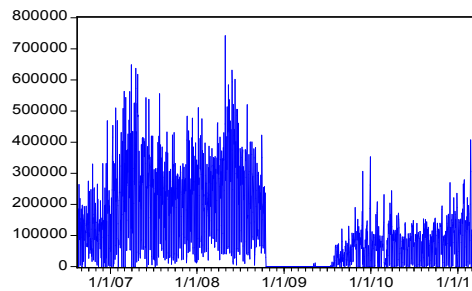


Figure 3: Prosper's daily total loan amount during 2006-08-16 to 2011-03-07

From the Prosper's daily total transaction amount, we can see that the platform's transaction was influenced by the events. Considering the effectiveness of the data analysis, we only use the data before Prosper was shut down by the government in this study.

Data processing

Usually, mostly transactions in online P2P marketplaces last more than one day, and the data such as the total bid amount, interest rate bid by lenders are changing over time. In order to simplify the problem, we take a snapshot of a transaction on the day it is built. There are several reasons. Firstly, borrower sets the attributes of the listing such as demand amount, interest rate, loan period according to the current situation of market. Second, the attributions of a listing become the most important factors influence the lenders' decisions, such as the bid amount and bid interest rate. Third and most important, more and more listings that successfully fund the loan could complete the transaction on the creation date because the increase of the market.

Some data in empirical model could simply get from the dataset provided by the platforms, such as the total demand amount ($DAMT_t$), total transaction/loan amount ($TAMT_t$), total supply/bid amount ($SAMT_t$), total number of two-sided users (TB_t, TL_t). However, some data such as platform's profit ($Pprofit_t$), average interest rate ($AVIR_t$), average borrower transaction fee rate

($AVBfrate_t$) and average lender transaction fee rate ($AVLfrate_t$) need to pre-processed through the available data.

On both PPDai and Prosper, the platforms charge transaction fees for the two-sided users when the listing is fund successfully, and we choose the successful listings to count the average transaction fee rates. Take Prosper.com for example, the lenders' average transaction fee rate on each date is calculated as follow two steps.

First, we get the lenders' total transaction fees of loan i according to the Prosper's rule.

$$Lfee_{ti} = \sum_{j=1}^{Months} (SLoanAmt_{ti}^j \times Days_{ti}^j \times Lfrate_{ti} / 365) \quad (6)$$

Then, we add all loans' total lenders' transaction fees on date t . And by using the total lender transaction fee to be divided by the total loan amount on the same date, we get the average lender transaction fee rate $AVLfrate_t$ of the day.

$$AVLfrate_t = \sum_i Lfee_{ti} / \sum_i LoanAmt_{ti} \times 100 \quad (7)$$

According to the borrower's price strategies set by Prosper, we calculated the borrowers' average transaction fee rate as equation (8) and (9).

$$Bfee_{ti} = IF(Bfrate_{ti} \times LoanAmt_{ti} < BMfee_{ti}, BMfee_{ti}, Bfrate_{ti} \times LoanAmt_{ti}) \quad (8)$$

$$AVBfrate_t = \sum_i Bfee_{ti} / \sum_i LoanAmt_{ti} \times 100 \quad (9)$$

Form the total transaction fees of two-sided users, could work out the platform's total income of transaction fees on date t .

$$Pprofit_t = \sum_i Bfee_{ti} + \sum_i Lfee_{ti} \quad (10)$$

As shown in the part of online P2P lending's business model, the interest rate could directly influence on the utility of two-sided users, which becomes to be an very important factor influencing on the lenders' decisions. So, we count not only successful but also failed listings into the calculation of average interest rate on each date, which is shown in equation (11) and (12).

$$Interest_{ti} = \frac{(Damt_{ti} \times IR_{ti} \times Months_{ti} / 12)}{(1 - Power(1 + IR_{ti} / 12, -Months_{ti}))} - Damt_{ti} \quad (11)$$

$$AVIR_t = \sum_i Interest_{ti} / \sum_i Damt_{ti} \times 100 \quad (12)$$

Empirical results

Under the consideration of the interactions between borrowers and lenders, we estimate the empirical models via simultaneous equation method. Table 1 and Table 2 present the estimation results based on equation (4), where the dependent variables of the two models are (the success rate of borrower demand) and (the success rate of lender supply). We use the superscripts and to separately denote PPDai and Prosper.

PPDai has changed only once for both the borrower transaction fee and lender transaction fee since it was launched. So there is only one dummy variable of price in each model. Table 1 shows the 3SLS (Three-Stage Least Squares) estimation results of PPDai.

Table 1: 3SLS estimation results of PPDai(N=1,456)

Borrower			Lender		
	Coefficient	p-value		Coefficient	p-value
Total number of lenders (α_1^{pd})	1.11e-04	<.001	Total number of borrowers (α_2^{pd})	4.48e-05	<.001
Total number of borrowers (β_1^{pd})	-2.91e-05	<.001	Total number of lenders (β_2^{pd})	-8.12e-05	<.001

Borrower fee (λ_1^{pd})	0.004	0.799	Lender fee (λ_2^{pd})	-0.078	<.050
Total demand amount (γ_1^{pd})	-2.48e-08	<.001	Total demand amount (γ_2^{pd})	1.70e-07	<.001
Time trend (θ_1^{pd})	-2.10e-04	<0.010	Time trend (θ_2^{pd})	5.35e-04	<.001
R^2	0.667		R^2	0.424	
\bar{R}^2	0.667		\bar{R}^2	0.422	

The estimation result shows that most of the variables' coefficients are statistically significant under the 1% level, except the two dummy variables of prices. The coefficient λ_1^{pd} is not significant at 10% level, while λ_2^{pd} is significantly negative at 5% level. It indicates that the borrower's success demand rate (SD_t^{pd}) was not significantly influenced by the adjustment of borrower transaction fee rate on 16th April 2009, and lender's success supply rate (SS_t^{pd}) was reduced after the platform's increase of lender transaction fee rate on 5th March 2009 to some extent.

During the period between 16th August 2006 and 12th October 2008, Prosper had adjusted the borrower transaction fee and lender transaction fee three times. We use the same 3SLS model to test the effects of these price adjustments, which are implemented by adding in three dummy price variables in each equation to represent the four different fee rates. The empirical results are shown in Table 2.

Table 2: 3SLS estimation results of Prosper (N=786)

Borrower			Lender		
	Coefficient	p-value		Coefficient	p-value
Total number of lenders (α_1^{ps})	7.48e-06	<.001	Total number of borrowers (α_2^{ps})	-3.27e-06	<.100
Total number of borrowers (β_1^{ps})	-2.00e-06	<.001	Total number of lenders (β_2^{ps})	2.34e-05	<.001
Borrower fee 1 (λ_{11}^{ps})	-0.02	<.001	Lender fee 1 (λ_{21}^{ps})	-0.07	<.001
Borrower fee 2 (λ_{12}^{ps})	-0.009	<.002	Lender fee 2 (λ_{22}^{ps})	-0.003	.764
Borrower fee 3 (λ_{13}^{ps})	0.001	.868	Lender fee 3 (λ_{23}^{ps})	0.004	.838
Total demand amount (γ_1^{ps})	-7.15e-09	<.001	Total demand amount (γ_2^{ps})	-6.84e-09	<.050
Time trend (θ_1^{ps})	-2.86e-04	<.001	Time trend (θ_2^{ps})	-0.002	<.001
R^2	0.242		R^2	0.229	
\bar{R}^2	0.235		\bar{R}^2	0.222	

The 3SLS model produces insignificant estimates of λ_{13}^{ps} , λ_{22}^{ps} and λ_{23}^{ps} . The coefficients α_2^{ps} and γ_2^{ps} are significant under the levels of 10% and 5%, respectively. The rest of the coefficients are all estimated to be significant under 1% level. The results indicate that the last adjustment of borrower fee did not obviously affect the borrower success rate. For the lenders, the last two adjustments of lender fees did not obviously affect the lender success rate.

Demand-supply relationship

The estimated results of PPDai show negative effect of total demand amount on the success rate of demand amount ($\gamma_1^{pd} = -2.48e-08$), and positive effect of total amount on the success rate of supply amount ($\gamma_2^{pd} = 1.69e-07$). However, the value of two coefficients are both negative for Prosper ($\gamma_1^{ps} = -7.15e-09$, $\gamma_2^{ps} = -6.84e-09$). These results suggest that the increase of demand amount decreases the success rates of borrower demand on both two platforms, while increases the success rate of supply on PPDai and decreases the success rate of supply on Prosper. Comparing the two platforms, the relationships between borrower's demand and lender's supply are different. Table 3 gives the descriptive statistics of SD_t and SS_t .

Table 3: Descriptive statistics of the success rates of demand and supply on PPDai and Prosper

	PPDai (N=1,456)		Prosper (N=786)	
	SD_t^{pd}	SS_t^{pd}	SD_t^{ps}	SS_t^{ps}
Mean	0.201	0.774	0.073	0.556
Median	0.107	0.952	0.071	0.562
Max	1.000	1.000	0.169	0.841
Min	0.000	0.000	0.001	0.023
Std. Dev.	0.239	0.347	0.023	0.102

The mean value of SD_i of PPDai is 0.201, and that of Prosper is 0.073. On PPDai, a higher ratio of borrower demand could be satisfied than on Prosper. From the supply aspect, the mean value of SS_i of PPDai is 0.774, but Prosper's value is 0.556. The success rate of supply on PPDai is much higher than on Prosper. The success rates of demand on both two platforms are much less than the success rates of supply. The amounts of total demand and supply are shown in Fig.4.

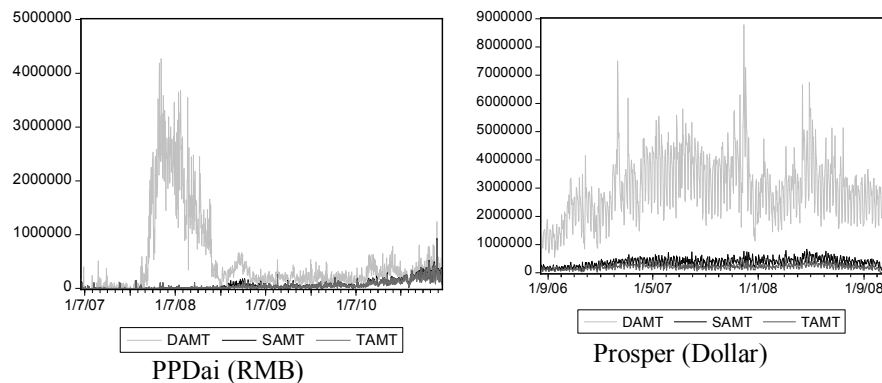


Figure 4: Daily total demand, supply and transaction amounts on PPDai.com and Prosper.com

After several fluctuations, borrower demand amount (DAMT) and lender supply amount (SAMT) on PPDai tends to be equal.

However, on Prosper, Borrower's demand is much higher than lender's supply.

The estimate results and the demand-supply relationships in two marketplaces indicate that higher demand of money will lead to more intensive competition among borrowers, which will in turn reduce the success rate of demand. On Prosper, there are about 89.6% listings failed to fund the loan, and about 44.9% of them are failed because of insufficient supply amount from lenders. When borrower demand amount is quite larger than the lender supply amount, the supply money is diluted and diversified, and hence reduce the success rate of supply. Prosper's success rate of supply could be increased when there is less demand or more lenders participate into the transactions. On PPDai, the median value of SS_i^{pd} is 0.952, indicating that a high success rate of supply. Comparing to the Prosper, the smaller gap between demand amount and supply amount on PPDai, which means the higher density of supply amount with a higher success rate. Because of the cooperative relationship between borrower and lender, a higher demand will lead to more supply. This could explain the positive effects of borrower demand on the success rate of supply.

From the relationships between lender's supply and borrower's demand on two platforms, we can conclude that (i) borrowers always compete with each other on both platforms because of the less supply amount than demand amount, and the success rate of demand is negatively affected by the total demand; (ii) how the demand amount influences the lenders' success rate of the trade is correlated with the demand-supply relationships in the marketplace.

Price sensitivity

Since PPDai was in operation, its pricing strategy has undergone a very slight change. PPDai charges two kinds of transaction fees, service fee and money transfer fee (including the deposit fee and cash withdrawal fee). Table 4 shows the transfer fees on PPDai.

Table 4: PPDai's transaction fees

Borrower			
Time	Service fee rate	Money transfer fee	
		Deposit	Cash withdrawal
2007-06-18	Duration ≤ 6 months: 2% Duration > 6 months: 4%	1%	≤ 10,000: 1RMB ≤ 30,000: 3RMB > 30,000: 6RMB
2009-04-16	Duration ≤ 6 months: 2% Duration > 6 months: 4%	1%	≤ 30,000: 3RMB > 30,000: 6RMB
Lender			
Time	Service fee rate	Money transfer fee	
		Deposit	Cash withdrawal
2007-06-18	0	1%	≤ 10,000: 1RMB ≤ 30,000: 3RMB > 30,000: 6RMB
2009-03-15	0	1%	≤ 30,000: 3RMB > 30,000: 6RMB

On PPDai, borrower service fee rate is 2% of the loan amount when the duration of the loan is less than or equal to 6 months, which is increased to 4% when the loan duration is more than 6 months. PPDai has not charged the service fee for lender all the time, while charged 1% of the loan amount as the deposit fee. Before the date of 15th March 2009, the cash withdrawal fee for all users was ¥1 when the transfer amount was less than ¥10,000. Right now, the transfer fee for cash withdrawal is set to be ¥3 for the amount less than ¥30,000, and ¥6 for the amount more than ¥30,000.

Compare to the other two types of fees, the cash withdrawal fee that a borrower must pay to PPDai is relatively less, which means the increase of the cash withdrawal fee is relatively small to the total fees the borrower pays to the platform. The simultaneous regression result shows that coefficient λ_1^{pd} is not statistically significant. It indicates that the success ratio of demand is not significantly influenced by the change of borrower's transaction fee rate. On the other hand, without service fee, a lender pays much less fee to the platform than a borrower has to. The change of the cash withdrawal fee is relatively large to the total fees that lender pays to the platform. The estimated coefficient of dummy price variable of lender (λ_2^{pd}) is significantly negative. It means that the increase of transaction fee will decrease the success supply rate (SS_t^{pd}), indicating the lender's negative price elasticity on PPDai.

The main transaction fee charged by Prosper is the service fee. Different from PPDai's strategy of pricing, Prosper had revised the transaction fee several times for both borrowers and lenders during 5th February 2006 to 12th October 2008, which are shown in Table 5.

Table 5: Prosper's transaction fees

Borrower											
Time	AA	A	B	C	D	E	HR	NC	BMfee_A-NC	BMfee_AA	BFRate_Rank
2006-2-5	1%	1%	1%	1%	1%	1%	1%	1%	25	25	1
2007-2-12	1%	1%	1%	1%	1%	2%	2%	2%	25	25	2
2008-1-4	1%	2%	2%	3%	3%	3%	3%	3%	25	25	3
2008-9-24	2%	2%	2%	3%	3%	3%	3%	3%	75	75	4

Lender											
Time	AA	A	B	C	D	E	HR	NC	LFRate_Rank		
2006-2-5	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	1		
2007-2-12	0.5%	0.5%	1%	1%	1%	1%	1%	1%	2		
2007-10-30	0.5%	1%	1%	1%	1%	1%	1%	1%	3		
2008-4-15	1%	1%	1%	1%	1%	1%	1%	1%	4		

There are eight credit grades (AA, A, B, C, D, E, HR, NC) on Prosper. AA is the highest credit grade, while NC is the lowest. The transaction fee rates charged by Prosper are different for borrowers (lenders) with different credit grades. Besides, Prosper sets different minimum fees for borrowers with different credit grades in each transaction, displayed as BMfee_A-NC and BMfee_AA in Table 5. BFRate_Rank and LFRate_Rank respectively represent the ranks of the borrower and the lender fee rates. Fig. 5 shows the Prosper's daily average transaction fee rates paid by borrowers (AVBfrate) and lenders (AVLfrate).

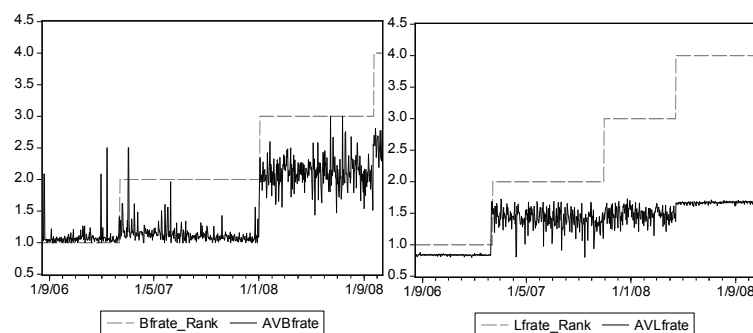


Figure 5: Daily average transaction fee rates of borrower (AVBfrate) and lender (AVLfrate) on Prosper

The fluctuations of average transaction fee rates on Prosper could explain the significant and insignificant coefficients of the price dummy variables in the regressions of Prosper. The average transaction fee rate for the borrower was significantly raised after Prosper's first and second price adjustments. The regression results also show that borrower's demand success rate was significantly lower than before after the platform increasing the borrower fee rate at first and second times. On the other hand, the average lender transaction fee rate increased a lot after the platform's first adjustment, while the increase of AVLfrate through last two price adjustments is not so significant. This could explain why the coefficients of λ_{22}^{ps} and λ_{23}^{ps} are statistically insignificant in the estimated regression. The three dummy price variables' coefficients, λ_{11}^{ps} , λ_{12}^{ps} and λ_{21}^{ps} , are all significantly negative,

indicating that both the success rates of demand and supply are obviously decreased with the increasing transaction fee rates. The results also support the user's negative price elasticity assumption ($\eta_i < 0$) in the theoretical part.

Network externalities

The estimated results of PPDai display that there are significant positive inter-group network effects between borrowers and lenders ($\alpha_1^{pd} = 1.11e-04$, $\alpha_2^{pd} = 4.48e-05$), and significant negative intra-group network effects among borrowers ($\beta_1^{pd} = -2.91e-05$) and among lenders ($\beta_2^{pd} = -8.12e-05$) as well. For Prosper, borrowers have positive inter-group network effects from total number of lenders ($\alpha_1^{ps} = 7.48e-06$) and negative intra-group network effects from total number of borrowers ($\beta_1^{ps} = -2.00e-06$). On the other hand, it appears the negative inter-network effects from total number of borrowers to lenders ($\alpha_2^{ps} = -3.27e-06$) and positive intra-group network effect among lenders ($\beta_2^{ps} = 2.34e-05$), which is different from the estimated results of PPDai. The results could be explained by the business model of online P2P lending market, and the demand-supply relationships of two platforms (as we mentioned in part 4.3).

In online P2P lending market, borrowers usually compete with each other for the lenders, which is called "inside competition" in online selling market[7]. It exists positive inter-group externalities from lenders to borrowers, and borrowers' negative intra-group externalities in both two marketplaces. However, lenders usually do not only compete with each other for borrowers, but also coordinate with each other by bidding the listing together. The two-sided relationship among lenders means any network effects could be possible, and this is affected by the demand-supply relationship in the marketplace. On PPDai, the gap between borrowers' demand and lenders' supply is becoming smaller and smaller. Lenders on PPDai have positive inter-group network externality and negative intra-group network externality. However, on Prosper, larger demand amount than supply amount lead to many listings failed because of insufficient supply amount. The dilution of lenders' supply indicates that the funding probability could be increased to some extent when more lenders participate into transactions, or on the other hand, less demand is requested by borrowers. This explains the reason why lender has negative inter-group and positive intra-group network externalities.

Platform's profit-maximizing pricing strategies

In the theoretical model, the platform's profit-maximizing price is given as $\frac{\eta_i}{1-\eta_i}(\alpha_j\phi_j + \beta_i\phi_i - f_i)$. The empirical results show that

agents in the two marketplaces are sensitive to the platforms' pricing strategies. The success rates of borrowers' demand and lenders' supply decrease when the price increases, which is consistent to agent's negative price elasticity ($\eta_i, i \in (1, 2)$) assumed in the theoretical model. Whether platform should charge or subsidize the agent depends on the relationship of agent's total network effects ($\alpha_j\phi_j + \beta_i\phi_i$) and platform's variable service cost. Suppose the platform's service cost of agent i is f_i ($f_i > 0$), platform's profit-maximizing pricing strategy for the agent i mainly depends on the agent's inter-group network effect to the other group of agents ($\alpha_j\phi_j$) and the agent's intra-group network effect ($\beta_i\phi_i$).

By using the mean values of the total number of agents in each group and the empirical results, we could calculate the user's network effects $\alpha_j\phi_j + \beta_i\phi_i$ of the two platforms. The results are shown in Table 6.

Table 6: Network effects of agents and platform's profit-maximizing pricing strategies

	PPDai		Prosper	
	Borrower	Lender	Borrower	Lender
Mean value of total user number (TB, TL)	12,998.24	6,015.682	103,527.4	528,47.23
Inter-group network externality (α_j)	4.48e-05	1.11e-04	-3.27e-06	7.48e-06
Intra-group network externality (β_i)	-2.91e-05	-8.12e-05	-2.00e-06	2.34e-05
Total network effect ($\alpha_j\phi_j + \beta_i\phi_i$)	-0.109	0.949	-0.380	2.011
Value of $\alpha_j\phi_j + \beta_i\phi_i - f_i$	Negative	Unknown	Negative	Unknown
Pricing strategy	Charge fee	Subsidy: $f_i < 0.949$ Charge fee: $f_i > 0.949$	Charge fee	Subsidy: $f_i < 2.011$ Charge fee: $f_i > 2.011$

Both PPDai and Prosper should charge borrower to cover the platforms' costs, while whether charge or subsidize lender depends on whether the platform's variable cost and the lenders' total network effects. Lenders on Prosper have much stronger network effects than on PPDai because of the positive intra-group network externality and positive inter-group network externality.

As far as we know, one typical characteristic of electronic commerce is its large population of users, which enables significant economies of scale [34]. An online platform usually has very low variable costs when it has a large-scale number of users. In the electronic market, when the user has strong network effects and the platform has a very low variable costs, the platform should provide the service for free or even subsidize the users. For example, in China, Taobao charges no fee from buyers and sellers;

Amazon and Dangdang usually have sales promotions; 360buy sells products with low prices to attract buyers. As a new form of electronic commerce, online P2P lending market has attracted a large number of users. Taking PPDai and Prosper for instance, PPDai has about 40,000 active users on 15th June 2011, while Prosper has about 280,000 active users on 12th October 2008. So, the platform should subsidize lenders to maximize the profits when the average variable costs are small enough. Comparing to PPDai, Prosper has a larger number of users as well as stronger positive network effects of lenders, which suggests that it is more likely setting a lower lender fee for Prosper. However, the truth is that PPDai only charges lenders low money transfer fees and Prosper charges a high average lender fee rate. Finally, PPDai's supply amount tends to be at the same level of the demand amount, while Prosper's demand amount is much higher than the supply amount. Based on these analysis, we conclude that Prosper had a higher lender fee rates above the optimal level.

CONCLUSIONS AND DISCUSSIONS

Using the daily transaction data of PPDai.com and Prosper.com, this study analyzes the characteristics of online P2P lending marketplaces. We find that it exists positive inter-group network effects between borrowers and lenders, and negative intra-group network effects among borrowers and among lenders on PPDai. On Prosper, borrowers have positive inter-group network effects from the lenders and negative intra-group network effects, while lenders have positive intra-group network effects and negative inter-group network effects. The unsuccessful rate of listings on Prosper is high because of the less supply than demand, and the success rate of supply could be increased when more lenders bid the listings or less demand is required by borrowers. The empirical results show that the users' network externalities are influenced by the demand-supply relationships in the online marketplaces, which is different from the conclusions of previous literature of electronic market [i.e., 3, 18, 26]. The literature of online marketplace usually discusses the market with the characteristics of two groups of agents – the buyers and the sellers. In this kind of market, the participation of one group raises the value of participating for the other group, while the participation within the group reduces the value of participating because of the competition. So, in much of the literature, positive inter-group network effects and negative intra-group effects are modeled and analyzed [i.e., 3, 7]. However, the business model of online P2P lending leads to two-sided relationships (competing and coordinating) among lenders, which means any network effects of lenders could be possible. The empirical findings of online P2P lending suggest that as agents in the same group have intensive competition, it probably exists negative intra-group network externality. Besides, it will exist positive intra-group network externality if the agents in the same group collaborate rather than compete with each other in the transactions. Due to the diverse of electronic market, a wider variety of e-business initiatives [9], and any kinds of network effects are also possible, which present unique challenges as well as chances in the modeling and analysis.

About how the agents react to the prices in the context of P2P lending, the estimated results show that the success rates of demand and supply on both platforms will be reduced when the transaction fees for two-sided users set by platform are significantly increased, which implies the negative price elasticity. Based on the theoretical model and estimated results, we analyze the platforms' profit-maximizing pricing strategies for borrowers and lenders with several findings. We suggest that both PPDai and Prosper subsidize the lenders and recover the loss on the borrowers. The Platforms should charge fees for borrowers all the time, but whether charge positive fees for lenders or not depends on the relationship between the lenders' total network effects and platform's variable cost. Consistent with the empirical results of platforms' pricing strategies in this study, both PPDai and Prosper set much higher transaction fees for borrowers than the fees for lenders, respectively. Comparing the two platforms, lenders on Prosper have a much higher positive network effects than on PPDai, and Prosper has much larger users population than PPDai. Theoretically, Prosper is more likely to set a lower lender transaction fee. However, Prosper set a much higher lender transaction fee than PPDai. This might be the reason why Prosper has a relatively larger demand than supply, while the demand and supply on PPDai tends to be equal along the time.

By applying the theory of two-sided market to the online P2P lending marketplaces, the study enhancing our understanding of the characteristics of the two-sided electronic marketplaces, which could be shed light on the platforms' pricing strategies. Moreover, the empirical findings also point out the insufficient works done by previous research, which are the theoretical contributions of this paper. However, we think that some further works are still needed in our future research. As a new type of market, online P2P lending marketplaces do not have intense competition between them because they usually adopt different business models, which is the support of the monopoly model in this study. However, as far as we know, the platforms' business models are becoming more and more similar to each other with the development of the market. For example, with a decade development, the main electronic commerce platforms in the same field (C2C, B2C and B2B) usually have quite similar operation modes with each other nowadays. Prosper transferred the mode of operation to the LendingClub's this year. This study does not include the competition in the model, which might limit our research outcomes to be applied to future analysis of online P2P lending and other electronic markets. Second, due to the limitation of platforms' cost data, we could not evaluate the platforms' profit-maximizing pricing strategies for lenders and give the profit-maximizing price levels for borrowers and lenders. Third, users' network effects on platform's price may vary with the development of the platform as Lin et al. [15] assumed that increasing network size may have complex effects on the innovation incentives in the platform market. We observe that the network externalities is related to the demand-supply relationships in the marketplaces, and how to qualify the relationships is also the one direction of our future works. Given to the limitations of this study, we treat our results as illustrative. However, the limitations offer opportunities for future work, and this research will try to do further research by solving these problems.

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Toward a Better Understanding of The Virtual Economy Platforms

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ABSTRACT

Understanding the virtual world (VW) platforms, the virtual currency (v-currency) exchange rate, and the marketplace is critical to the success of the virtual economy (v-economy). However, the current knowledge on VW platforms, marketplace, and currency exchange rate is incomplete. Drawing on the v-economy dimensions, this study proposes a diagram that produces a suitable integration of dimensions, which provides high chances of improving the v-economy activities in the VW. The finding indicates that there are three dimensions that could integrate together to improve a v-economy platform, and these are a dynamic platform, a free currency exchange rate, and a free marketplace.

Keywords: Virtual economy, virtual world, virtual marketplaces, exchange rate, virtual currency

INTRODUCTION

Since the early days of the internet, individuals have been interacting with others through a virtual representation of themselves. This kind of interaction ranges from web communication, typing chatting, forums, virtual worlds/environments, etc. The different online ways of communication have become very intrinsic parts of modern day-to-day life. Especially with the ability to shop and buy using these communication platforms.

The virtual environment is the representation of the surrounding nature and imagined environment digitally. This digital representation can be in two-dimensions (2-D), such as the web, and 2-D virtual worlds or three-dimensions (3-D), such as some social and virtual worlds (Second Life, World of Warcraft, Entropia Universe). These virtual environments are also called Massively Multiplayer Online Role Playing Games (MMORPGs).

Scarle et al. (2012) study has defined the minimum set of features for the existence of the virtual environment, which are the Environment (platform), the Avatar (representation), and the communication (interaction).

Environment (platform): Environment is the place where the virtual representation and communication take place. The user should be able to interact and communicate with the surrounding environment and with the virtual items in this platform [23].

Personal representation (Avatar): The avatar is the virtual representation of the users in the virtual worlds. Avatars allow users to be able to communicate and interact with each other, as well as with items and their surrounding environment [23].

Communication (interaction): It is the way avatars communicate with each other in the virtual environment. There are different ways of communication in the virtual environment, such as typing, voice, interacting [23].

BACKGROUND

The use of the virtual environment for business (v-economy) – where e-commerce activities take place in the virtual worlds through buying and selling – has expanded rapidly day after day. Different virtual economies activities can take place in the v-economy, such as meetings and commercial conferences, advertising and marketing campaigns, learning and educational centers, private businesses, research and development, customer relationships and customer engagement.

V-economy or Real Money Trade (RMT) refers to the trading of VW currency, virtual items, and services for real money. V-economy is not isolated from the real world economy; they have created a “dual economy” where transactions can take place between virtual and real economy with the possibility of exchanging real money flowing in and out the VW economy and the real world economy.

V-economy environments start getting more attention from academics in the last few years. This can be a normal reaction to the rapid increase in the v-economy market. According to DFC Intelligence, in 2007, it was expected that the worldwide online game revenue would pass US\$ 13 billion by 2012, going up from US\$ 4.5 billion in 2006. In 2012, subscription revenue was still expected to remain the largest portion of the market [3]. However, it was forecasted that in the same year (2012) trading virtual and digital items will account for over 40% of the market size [3]. As the famous economist named Edward Castronova said in his TED talk, *We're witnessing what amounts to no less than a mass exodus to virtual worlds and online game environments* [17].

Obviously, virtual economic platforms involve unique characteristics and features that are very different from the traditional real market economy. Highlighting the differences between the two economies and clarifying in depth the characteristics of v-economy can be very beneficial/essential for business, market analysis, and traders for driving successful business strategies. The objective of this paper is to understand the v-economy factors and elements, and their potential implications on business

success.

Table 1. Examples of using virtual environment for different business purposes

Business activity	Example
Meetings and commercial conferences	San Francisco-based non-profit TechSoup hosts its monthly all-hands meeting in SL, where as many as 50 people meet in the VW [28]. IBM has been known for hosting offsite staff meeting in Second Life [15], [28].
Advertising and marketing campaign	Nissan has already several driving campaigns using 3D models of their existing cars in real life. Users have tried driving the free cars in the VW and left comments on their blogs and websites [15].
Learning and education	Texas A&M University hosts lecturers in SL that anybody can attend [28]. Wong (2006) wrote that Harvard Law School now has a virtual extension in SL in which virtual teachers teach the courses and students can interact with each other. Emory University used to teach a combined business and political science course on SIMsim Island, located in SL as well [1].
Private business	Anshe Chung has made over US\$ 1 million (270,000,000 Linden Dollar) through developing real estate and virtual islands, crafting landscape, and providing virtual homes for participants who are ready to pay [1], [8] It has been reported by Thomas (2010) that Erik Novak bought Crystal Palace Space Station in Planet Calypso (Entropia Universe) with US\$ 333,000. The sale price includes the ownership of the station, the surrounding land, as well as the associated virtual hunting and mining rights.

VW CLASSIFICATIONS

Avatars in VWs can interact with the surrounding virtual objects and other contactable end-user avatars [9], [15], [19]. Like humans, avatars can exchange instant messages, virtual objects, and virtual money. They may also communicate through chatting, displaying different gestures, voice conversations, and the like [20].

Henttonen et al. (2009) grouped existing VWs into four categories. These categories include a static game world (game oriented environment with limited content creation), a dynamic game world (game oriented environment with unlimited content creation), a static VW (a socially oriented environment with limited content creation), and a dynamic VW (a socially oriented environment with unlimited content creation).

Figure 1 outlines the three most popular VW types (Second Life (SL), Entropia Universe (EU), World of Warcraft (WOW)) based on four main dimensions, which are the marketplace, the content creation, the exchange rate, and the VW orientation.

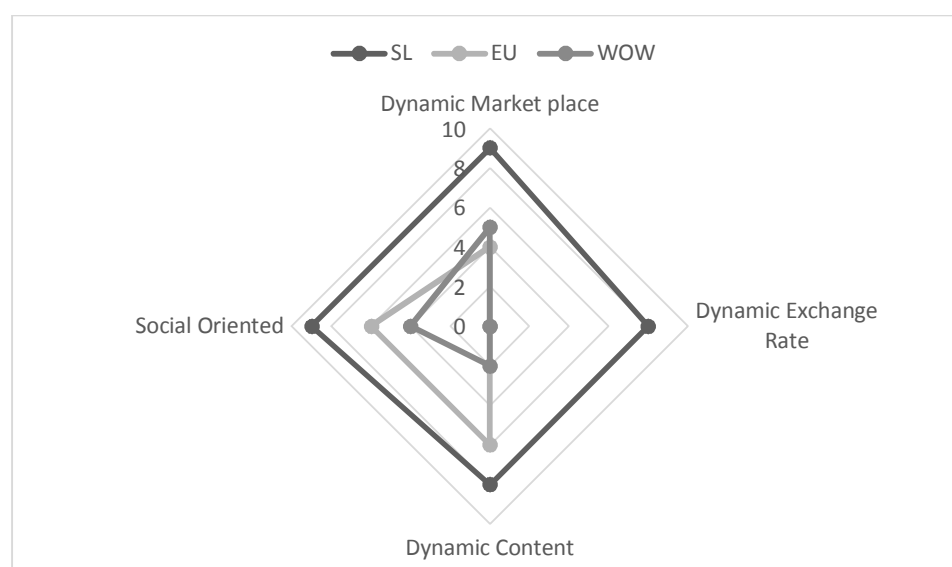


Figure 1 VW classifications

To further refine the differences between these three types of VW, this research focuses on the dynamic game world (DGW) and the dynamic VW (DVW) because these categories offer a high level of flexibility, interactivity, and integration and are suitable platforms when considering v-economy research. There is no tangible limitation (other than any technological limitation) in the VW. Hence, software developers can convert anything imaginable into a form of virtual reality [9].

There are different elements of virtual commerce (v-commerce) in these VWs, such as the marketplace, the virtual currency, and the exchange rate. A marketplace is the platform where users can buy/sell goods from/to other players or other users, it can take place inside the VW (in-world) (WOW auction house), outside the VW but supervised by the game developer (SL marketplace), and outside the VW but supervised by the game developer (eBay or similar platforms). V-currency exchange rate is the exchange rate that users can utilize to exchange money from v-currency, such as Linden\$ (L\$) or PED to real money, such as US\$. There are different types of the exchange rate mechanism, such as the fixed exchange rate (the v-currency is equal to fixed real currency, such as PED), the flexible exchange rate (the v-currency have a changing exchange rate, which changes based on the demand and supply of this currency, such as L\$), or no exchange rate from v-currency to real currency, such as WOW Gold.

Figure 1, is mapping the different VWs based on two dimensions, which are the marketplace type and the exchange rate mechanism.

This study of SL, WOW, and EU considers the differences between different VW types, and unlike most of the previous studies, it is not focused on one type of VW [7], [10], [11], [24], [29], [32].

Jung (2011) classified VWs into two types, which are the social virtual worlds (SVWs) (e.g., SL, EU, and there) and the gaming virtual worlds (GVWs) (e.g., WOW). Some studies have included EU and similar VWs under the category of SVW (e.g., Jung, 2011), while other studies have included EU and similar VWs under GVW category (e.g., Kieger, 2010,). Other studies, such as [7], describe EU as a VW, which attempts to combine a gaming-focused VW with a socially oriented VW. This study believes that EU and similar VWs are sitting in the stage between SVWs and GVWs, as shown in Figure 1, which will be called in this study as Mixed VW (MVW). Based on this assumption, the VW types will be categorized into three main categories, which are the SVWs, GVWs, and MVWs.

SVWs, MVWs, and GVWs. Second Life (SL), as the SVWs, does contain some gaming activities, but these are developed by the end-user and not by the SL developers. At the other extreme, Entropia Universe (EU) is a dynamic gaming world, which also includes very high-level social activities and collaboration. In 2013, Entropia Universe listed a moon for a development-and-management-rights bid starting from US\$ 150,000. The winner is now allowed to operate their own moon in Entropia Universe [5], [16]. There are various extensive differences between the social-related and game-related activities in these differing VWs. There are also different features available for creating a dynamic content and interactions with other end-users.

World-of-Warcraft (WOW) allows end-users to just explore the landscape, fight monsters, and complete quests (Calvert, 2010). The v-currency used in WOW is Gold. In the past, exchanging gold with real money happened illegally, outside the control of Blizzard Entertainment (the WOW game developer). In April 2015, the new token trading system was introduced by Blizzard for its WOW VW (BBC News, 2015).

V-ECONOMY DIMENSIONS

From a v-economy point of view, there are three dimensions that can affect the v-economy activities in the VWs. As explained in Figure 2, these dimensions are the marketplace, the exchange rate, and the platform. Figure 2 classifies the different constants under each dimension. Firstly, the marketplace can be a fixed marketplace, such as the auction house in WOW [4], [31], A dynamic marketplace, such as SL's marketplace (XStreet SL) [13], [25], or a semi-dynamic marketplace, such as EU's marketplace (auction) [6], [20], [27], as explained in Figure 2.

Secondly, the exchange rate is also classified in this study to three types: a fixed exchange rate, such as the exchange rate in EU (1 USD = 10 PED) [7], [18], [21], a dynamic exchange rate, such as the SL currency exchange rate (1 USD equal to an average of L\$270) [22], [32], and a semi-dynamic exchange rate, such as SL again; the reason we include SL in the semi-dynamic exchange rate as well [2] is that the game developer (Linden Lab) controls the exchange rate or financial transactions in the cases of attacks, spams, etc. to secure the exchange rate value. The different exchange rate classifications are explained in Figure 2.

Thirdly, the virtual platform, which can be a limited platform in which there is no possibility of adding or editing content in the VW (e.g., WOW) [9], a dynamic platform in which the users have a very high level of customizing the virtual platform (e.g., SL) [9], and a semi-dynamic platform in which the user has the ability to edit in the virtual platform but with limitations (e.g., EU). These three types of platforms are explained in Figure 2.

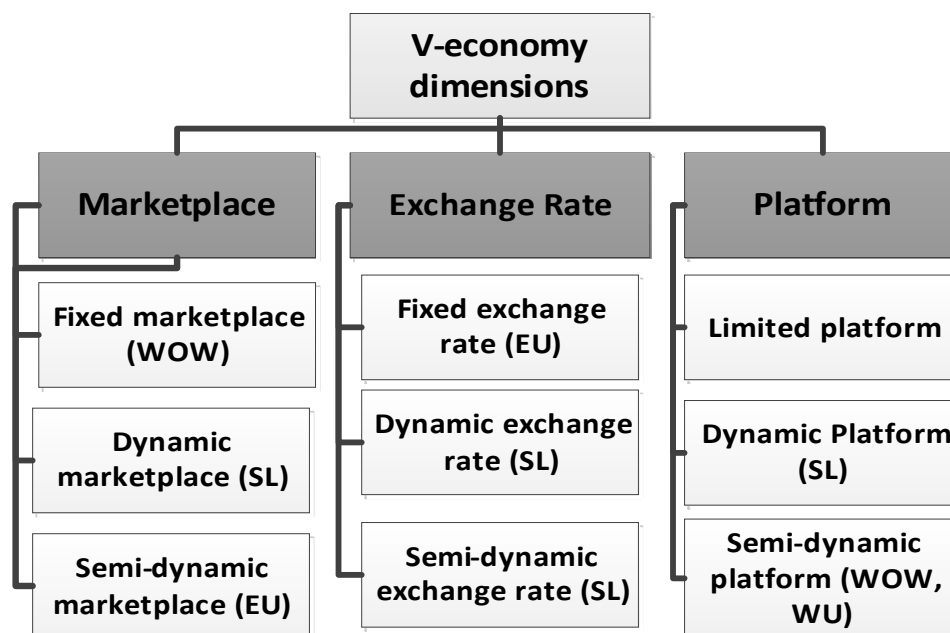


Figure 2. V-economy dimensions and exchange rate classifications

FINDING AND CONCLUSION

The purpose of this paper was to investigate, from the economist's point of view, into the VW marketplaces, v-currency exchange rate, and VW platforms, and their implications on v-economy phenomena.

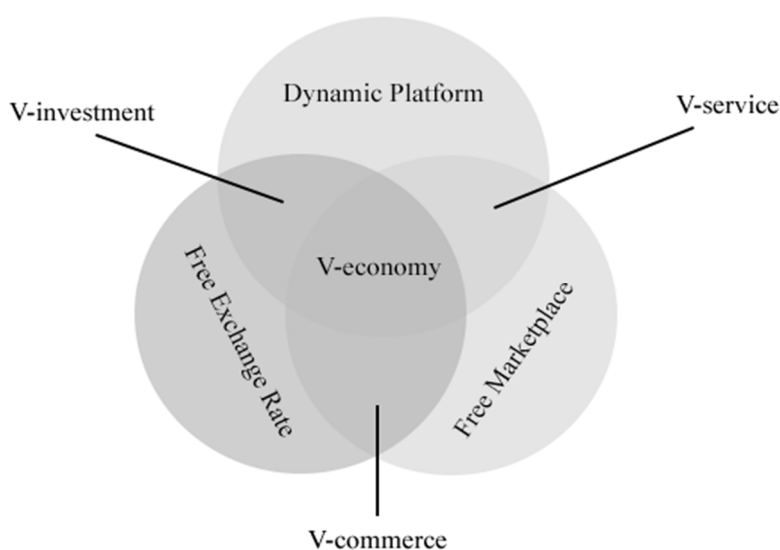


Figure 3. Describe the diagram

Figure 3 illustrates our conceptual model of the success factors for the v-economy in the VW. Through this conceptual model, for example, VW developers can understand their readiness to provide a successful platform for V-economy. At the same time, companies can assess the platform that they need to enter and the suitability of their platform for their commercial and economic activities. As explained in Figure 2, there are three v-commerce dimensions, which are the marketplace, the exchange rate, and the platform. A dynamic platform, supported by a free marketplace and a free real-money exchange rate, will provide the highest possibility for a successful v-economy platform.

A dynamic platform, supported by a free marketplace only, will provide a suitable platform for virtual exchange (v-exchange), while a dynamic platform, supported by a free real-money exchange rate only, will provide a suitable platform for virtual investment (v-investment). Finally, a free marketplace, supported by a free real-money exchange rate, will provide a suitable platform for virtual commerce (v-commerce).

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Entropy Weight Measure Model of Online Influential Users' Relative Social Capital

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ABSTRACT

Based on the perspectives of information resource management and social capital measurement, this paper studies how influential users acquire, accumulate, and use their social capital in social networks to explore the general rules, which enterprises use influential users' relative competitiveness in their topic areas of expertise to advertise precisely. The paper describes the social capital differences among influential users by introducing and calculating users' relative social capital. Results show that user's social capital values in different fields are dissimilar, and the scope and intensity of social capital among different users are relative. The proposed method is proved to be effective and reasonable.

Keywords: online user influence, influence social capital, relative social capital measure, entropy weight measure model.

1 INTRODUCTION

Online celebrities with increased popularity have become prime businessbrokers of enterprises indeveloping social network marketing. Onlinecelebrityis a type of online users who have information influence, and they are important marketing resources for enterprises in promoting their brands or products[13]. The relationship formed by online users interacting and following one another is a type of social network. In this network, users release, spread, and interact valuable information to exert information influence on other users, thereby acquiring, accumulating, and utilizing their social capital and manifesting their network influence[7][31]. User's influence is characterized by the user's personal attributes and social attributes, andonline celebrity's commercial value is the important embodiment of his or her online influence social capital value. So what type of users is suited to an enterprise for advertising? Which user can maximize the advertising effects? To solve the above problems, we need study online influential users' social capital and its relativity. Therefore, researching the measure method of online users' relative social capital is a major concern in optimizing online advertising management ROI (Return on Investment) decision andin maximizing social marketing effects.

In the exiting research literatures, scholars studied online users' influence and the method to identify influential users mainly from the following four aspects. (1) From the perspective of physics, scholars explored and described the network topology, link levels, and social relationship among online users, then obtained users' online influence using the social network analysis method[1][5]. (2) From the perspective of information communication, scholars studied users' behavior in selecting information and the concern relationship among users, then obtained users' online influence throughthe PageRank algorithm[14][27]. (3) From the perspective of communication, scholars analyzed the propagation characteristics and coverage of users' influence, then developed the propagation probability model of online influence to obtain users' online influence[2][30]. (4) From the perspective of information management, scholars researched users' personal features and social attributes according to users' behavior in releasing and choosing information, then built the multi-dimensional information entropy measure model of users' online influence to accumulate users' influence[15].

In summary, althoughthe methods to identify influential users from different perspectives have been explored, how online users acquire, accumulate, and use their social capital in social networks has not been comprehensively studied from the perspective of social capital measurement. The rapid rise of Internet celebrity economy urges people to study the general rule on how enterprises utilize influential users to advertise, that is, the business logic of influential users helping enterprises conduct precise advertisements in social networks. Using influential users to advertise for enterprises is actually not a new

topic. Enterprises generally select a spokesperson based on the influence ranking of users provided by network platforms. However, none effective control method is available to determine whether the advertising performance is optimal. In order to help enterprises identify the suitable influential users to advertise, and fully exert users' relative competitiveness in their topic areas of expertise, we need explore how users obtain, accumulate, and use their social capital, and study the measure method of online influential users' relative social capital.

In this paper, we comprehensively investigate how influential users acquire, accumulate, and use their social capital based on information resource management and social capital measurement theories, to explore the general rules that enterprises use influential users to push online social advertisements in social networks. The social capital differences among users can be manifested by users' online influence differences, that is, users' relative social capital. On the basis of the feature performance of social capital in users' personality and sociality, we build the measure index system and multi-dimensional information entropy measure model of online influential users to calculate users' relative social capital. The proposed entropy weight measure model can provide marketing management decision support and practical methods for enterprises in selecting suitable influential users to conduct precise advertisements and maximize advertising effects.

2 MEASURE INDEX SYSTEM OF ONLINE INFLUENTIAL USERS' RELATIVE SOCIAL CAPITAL

2.1 Social Capital and Its Relativity

On social network platforms, the "self-interest" and "altruistic" purposes and the need for social interaction and self-realization, guide users to build their social network by publishing, spreading, and interacting biased information with other users to acquire and accumulate online influence. Lin (2011) believed that social capital is resources in social networks, mainly including power, authority, and wealth [19]. Granovetter (1973) thought that social capital in social networks is flowing, and can be divided into "information" and "influence" [11]. Online users' social capital refers mainly to their online influence. User attracts others' attention with his or her personality and sociality to exert his or her information influence, and accumulate social capital by selectively publishing, spreading, and interacting with topic information in his or her focus areas [16]. Given the differences in online users' education background, domain authority, and social relations, the scope and effect of their influence are also dissimilar [3][18], which shows the characteristics of online users' relative social capital.

Individual online user's social capital can be characterized by user's personality and sociality. Users' personality data include mainly their status, authority, knowledge, and experience; the sociality data include the trust relationship and information interaction among users [4][24][25][28]. In this paper, the argument basis of relative social capital is the performance differences in users' personal attributes and social attributes. Thus, we consider online users' personality and sociality data as the measure indexes of users' social resources, relationship strength, and capacity to calculate users' relative social capital. Here we qualitatively describe online influential users' relative social capital taking public big V and professional big V as examples, shown in Figure 2.1.1.

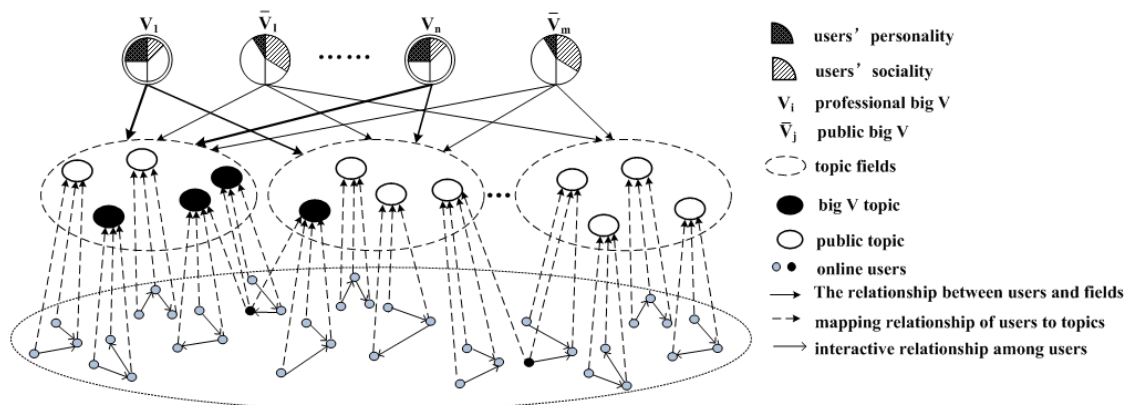


Figure 2.1.1 Structure diagram of online influential users' social resources, relationships, and capacity

Figure 2.1.1 describes the interrelationship between online users' social capacity and their discourse influence. In the figure, V represents online user, and the accumulation of shadow block in V circles represents the total social capital owned by user, decided by user's personality and sociality. Owing to the differences in users' cultural background, knowledge construction, experience, and social interaction ability, they also have different information influence effect on other users when discussing on one or more professional topics. As is shown in Figure 2.1.1, while the fields public big Vs' topics involved are broader than those of professional big Vs, the focusing degree of their topic content is not well. Unlike public big Vs, professional big Vs have the ability to provide professional content in their areas of expertise. In these fields, their information effect is better than that of public big Vs. For example, in the field of liquor, senior wine tasters are professional big Vs, and the tendentious product recommendation information they publish can easily gain online fans' recognition, acceptance, and purchase. Accordingly, they own higher influence strength than public big Vs in the area of liquor.

In summary, online influential user's relative social capital refers to the comparative advantage that user can better exert his or her professional influence than other users, during the process of acquiring, accumulating, and using his or her social resources, relationships, and capacity with his or her personality and interaction ability. The relativity is mainly reflected in the following aspects: (1) the total social capital values among different individual users are relative; (2) user's social capital values in different fields are different; (3) even if two users have equal amounts of social capital, the scope and effectiveness of their online influence are still relative.

2.2 Measure Indexes of Relative Social Capital

On social network platforms, users obtain the discourse power and influence through their personality, industry reputation, and ability to supply professional content and online social activities. Based on the criteria, users spread their values, lifestyle, and consumer preferences to other users to exert their information influence and achieve the purpose of continuously gaining business interests. Therefore, the personality measure indicators (such as personal experiences, knowledge background, and field authority) and the sociality measure indicators (such as trust relationships, participations, and interactions) must be defined and revealed to investigate online users' relative social capital.

(1) Measure indexes of personality

In social networks, user's personality is mainly reflected by user's individual and ability characteristics[23]. Falcone et al. (2011) found that "trust" is an important basis for users to obtain and accumulate social capital[9]. Feng (2010) found that information published by certified high-grade users can be easily trusted by consumers in online communities[10]. Zhu et al. (2015) found that talented users usually own high popularity and attract other users to establish a connection with them in social networks[33]. Online user's personal ability mainly refers to user's ability to provide professional content, which can be measured by the quantity and quality of texts published, and the number of user's followers[20][29]. Accordingly, we select user's level, status of identity authentication, number of followers, number of texts published, and number of high-quality texts, as measure indexes of users' personality to describe the features of users' relative social capital reflected by personality data.

(2) Measure indexes of sociality

In social networks, if user A focuses on user B, and acquires information or other online resources from B by interacting with B, then such process can provide B with the right to A[8]. The social network platform is an open information interactive system, which allows users to publish information to attract other users' attention. If user's information text is clicked, replied, or spread by others, the text is considered to have an influence on others; the more attention and more frequent interaction, the more significant its influence is. Yamaguchi et al. (2010) found that a user followed by many discourse authorities may also be an authority on the Internet[32]. Thus, we select average text clicks, average text replies, and number of high-level users' reply as measure indexes of users' sociality to describe the features of users' relative social capital reflected by sociality data. The measure index system of online influential users' relative social capital is shown in Table 2.2.1.

Table 2.2.1 Measure index system of online influential users' relative social capital

First-grade indexes	Second-grade indexes	Index description	References
Personality	User's level	User's level on the network platform.	[9] [10]
	User's identity authentication	If the user's identity is authenticated, then the value is 1; otherwise, the value is 0.	
	Number of followers	The total number of user's followers.	[17] [20] [29] [33]
	Number of texts published	The number of texts published in the statistical period.	
	Number of high-quality texts	The quality of single text is judged comprehensively by its keywords, word count, picture number, and hyperlink number.	
Sociality	Average text clicks	The ratio of total text clicks to text number in the statistical period.	[8]
	Average text replies	The ratio of total text replies to text number in the statistical period.	
	Number of high-level users' reply	The number of high-level users' reply in the statistical period.	[32]

3 MEASURE MODEL OF ONLINE INFLUENTIAL USERS' RELATIVE SOCIAL CAPITAL

Information entropy is proposed by Shannon and is used mainly to measure the value of uncertain information and its influence [26]. Zhang et al. (2012) measured the quality of listed companies' internal control information using the entropy method [34]. Ding et al. (2012) applied measure indexes, such as fuzzy absolute entropy, relative entropy, and interactive entropy, to measure the value of fuzzy information [6]. He et al. (2014) used the entropy weight model to build a three-dimensional measure index system composed of quality entropy, timeliness entropy, and interaction entropy to measure the information influence of group complaints on the Internet [15]. Using information entropy to measure the value of uncertain information is reasonable and feasible.

On social network platforms, users obtain and accumulate their social capital resources and relationships by releasing and spreading valuable information to enhance their online influence further. User's online influence is represented by user's personality and sociality information, thereby having the information value. The user's topics cover relatively wide areas, and the social capital values owned by the user in different fields are also different. We suppose that the field of users' topics focus is known on one network platform; the social capital values in different specialties of the field can be calculated by the relevance between texts supplied by the user and the specialty, combined with user's total social capital.

3.1 Definition of Measure Indexes of Relative Social Capital

Definition On the social network platform, we suppose the field of users' topics focus as $F, F = \{f_1, f_2, \dots, f_k, \dots, f_m\} (k=1, 2, \dots, m)$; and f_k indicates the k th specialty of the field. For any user U_i , we record the vector composed of relevance between U_i and various specialties as $R_i, R_i = \{r_{i1}, r_{i2}, \dots, r_{ik}, \dots, r_{im}\} (k=1, 2, \dots, m)$; and r_{ik} indicates the relevance between U_i and the k th specialty. The property items of U_i are composed of user's personality data, sociality data and the relevance between U_i and various specialties, recorded as $U_i = \{x_{i1}, x_{i2}, x_{i3}, x_{i4}, x_{i5}, y_{i1}, y_{i2}, y_{i3}, R_i\}$. $x_{i1}, x_{i2}, x_{i3}, x_{i4}, x_{i5}$ represent user's level, user's status of identity authentication, number of followers, number of texts published, and number of high-quality texts of U_i . These data are used to access the value of user's personality information. y_{i1}, y_{i2}, y_{i3} represent average text clicks, average text replies, and number of high-level users' reply. These data are used to access the value of user's sociality information.

3.2 Determination of Index Weight

Different users' personality and sociality data are dissimilar. A weight must be provided to every index item when calculating online influential users' social capital. Different weights may lead to different calculation results; thus, the weighting method must be properly selected. Weighting method that combines subjective and objective factors is a common method to optimize index weight. Entropy weight method is a widely used objective weighting method [21] [35]. The method calculates the entropy value of each index to reflect the information amount it provided. Notably, the index with small entropy value has high importance. In this paper, we consider the objective and subjective evaluation factors, using the experts' grading method to

determine the weight of first-grade indexes first, and then adopting the entropy weight method to calculate the weight of second-grade indexes.

On the social network platform, n users are selected. The process of calculating second-grade indexes weight is described below.

(1) Build the initial matrix.

$$D = \begin{bmatrix} x_{11} & L & x_{15} & y_{11} & L & y_{13} \\ x_{21} & L & x_{25} & y_{21} & L & y_{23} \\ M & M & M & M & M & M \\ x_{i1} & L & x_{i5} & y_{i1} & L & y_{i3} \\ M & M & M & M & M & M \\ x_{n1} & L & x_{n5} & y_{n1} & L & y_{n3} \end{bmatrix}$$

(2) Process data dimensionless.

The data must be normalized to eliminate the adverse effects caused by the non-uniform dimension. All indexes are positive indexes, and the larger their values, the better. The normalization method is given as follows:

$$x'_{ia} = \frac{x_{ia} - \min_a(x_{ia})}{\max_a(x_{ia}) - \min_a(x_{ia})} (i = 1, 2, L, n; a = 1, 2, L, 5) \quad (1)$$

$$y'_{ib} = \frac{y_{ib} - \min_b(y_{ib})}{\max_b(y_{ib}) - \min_b(y_{ib})} (i = 1, 2, L, n; b = 1, 2, 3) \quad (2)$$

The matrix after normalizing can be expressed by

$$D' = \begin{bmatrix} x'_{11} & L & x'_{15} & y'_{11} & L & y'_{13} \\ x'_{21} & L & x'_{25} & y'_{21} & L & y'_{23} \\ M & M & M & M & M & M \\ x'_{i1} & L & x'_{i5} & y'_{i1} & L & y'_{i3} \\ M & M & M & M & M & M \\ x'_{n1} & L & x'_{n5} & y'_{n1} & L & y'_{n3} \end{bmatrix}$$

(3) Calculate the proportion of indexes $p_{ia}(x)$, $p_{ib}(y)$.

$$p_{ia}(x) = \frac{x'_{ia}}{\sum_{i=1}^n x'_{ia}} (i = 1, 2, L, n; a = 1, 2, L, 5) \quad (3)$$

$$p_{ib}(y) = \frac{y'_{ib}}{\sum_{i=1}^n y'_{ib}} (i = 1, 2, L, n; b = 1, 2, 3) \quad (4)$$

(4) Calculate the entropy value of each index e_a , e_b .

$$e_a = -k \sum_{i=1}^n p_{ia}(x) \ln p_{ia}(x) (i = 1, 2, L, n; a = 1, 2, L, 5) \quad (5)$$

In this formula, $k = \frac{1}{\ln n}$, and when $p_{il} = 0$, $p_{il} \ln p_{il} = 0$. The entropy value of e_b can be calculated in a similar way.

(5) Calculate the weight of each index.

$$\omega_a = \frac{1 - e_a}{\sum_{a=1}^5 (1 - e_a)}, \omega_b = \frac{1 - e_b}{\sum_{b=1}^3 (1 - e_b)} \quad (6)$$

In this formula, $\sum_{a=1}^5 \omega_a = 1$, $\sum_{b=1}^3 \omega_b = 1$.

3.3 Relevance Between Online Influential User and Each Specialty

The relevance between one user and one specialty depends on the closeness between text content supplied by the user and specialty content. The value can be obtained by calculating the cosine similarity between user's text content vector and specialty content vector built through the TF-IDF method[12]. TF-IDF formula is expressed as follows:

$$TF-IDF(t, d) = \frac{tf(t, d) \times \log(N / n_t + 0.01)}{\sqrt{\sum_{i=1}^m [tf(t, d) \times \log(N / n_t + 0.01)]^2}} \quad (7)$$

$TF-IDF(t, d)$ is the weight of word item t in text d ; $tf(t, d)$ is the frequency of word item t in text d ; N is the number of texts; n_t is the number of texts, which contain word item t ; m is the number of word items in text d ; the denominator is the normalized factor of weights of word items.

On the social platform, the specialties are collections of users' texts. We assume that T is the set of the word items of all specialties in one field, $T = \{t_1, t_2, \dots, t_n\}$. Then, the text sets of any specialty f_k and any user U_i can be represented by an n -dimensional vector containing these word items, recorded as $Sf_k = (S_{f1}, S_{f2}, \dots, S_{fp}, \dots, S_{fn})$, $SU_i = (S_{u1}, S_{u2}, \dots, S_{up}, \dots, S_{un})$. S_{fp} , S_{up} indicate the average weight of word item t_p in texts of specialty f_k and texts of user U_i , respectively.

(1) Calculate S_{fp} , S_{up} .

We assume the number of texts in specialty f_k is Nf_k , then S_{fp} is calculated from the following formula:

$$S_{fp} = \frac{\sum_{j=1}^{Nf_k} [TF-IDF(t_p, d_j)]}{Nf_k} \quad (8)$$

d_j is the text in specialty f_k ; $TF-IDF(t_p, d_j)$ is the weight of word item t_p in text d_j , which can be obtained from Formula(7).

Assuming that the number of texts U_i supplied is NU_i , then S_{up} is calculated from the formula as follows:

$$S_{up} = \frac{\sum_{l=1}^{NU_i} [TF-IDF(t_p, d_l)]}{NU_i} \quad (9)$$

d_l is the text published by U_i ; $TF-IDF(t_p, d_l)$ is the weight of word item t_p in text d_l , which can be obtained from Formula(7).

(2) Calculate the relevance between user U_i and specialty f_k .

The relevance r_{ik} between user U_i and specialty f_k can be obtained by calculating the cosine similarity between user text content vector and specialty content vector. The formula is expressed as follows:

$$r_{ik} = \frac{\sum_{p=1}^n S_{fp} S_{up}}{\sqrt{\sum_{p=1}^n S_{fp}^2} \sqrt{\sum_{p=1}^n S_{up}^2}} \quad (10)$$

3.4 Measure Model of Online Influential Users' Relative Social Capital

On the social network platform, we suppose the measure index set of the social capital of any user U_i is recorded as $U_i = \{x_{i1}, x_{i2}, \dots, x_{i5}, y_{i1}, y_{i2}, y_{i3}\}$. The personality value of U_i is $IP(U_i)$, and the sociality value of U_i is $IS(U_i)$. Their calculation formulas are as follows:

$$IP(U_i) = \alpha \sum_{a=1}^5 \omega_a x_{ia} \quad (11)$$

$$IS(U_i) = \beta \sum_{b=1}^3 \omega_b y_{ib} \quad (12)$$

Thus, the total social capital formula of U_i is as follows: $C(U_i) = IP(U_i) + IS(U_i)$ (13)

α and β indicate weight of first-grade indexes and weight of second-grade indexes, respectively.

Given the difference in users' knowledge background, domain authority, and social relationships, different users' online influence is also dissimilar. The effect values of user's online influence in different specialties are also different, thereby indicating the difference in the relative social capital.

We assume the field of users' topics focus as F , and F includes m specialties. The vector composed of the relevance between U_i and various specialties is $R_i, R_i = (r_{i1}, r_{i2}, \dots, r_{ik}, \dots, r_{im})^T (k=1, 2, \dots, m)$; and r_{ik} indicates the relevance between U_i and the k th specialty. The relative social capital $RC_{U(i)}$ of U_i in each specialty can be calculated as follows:

$$RC_{U(i)} = C(U_i) \times R_i^T \quad (14)$$

The social capital of U_i in specialty f_k can be calculated as follows:

$$RC_{U(ik)} = C(U_i) g_{ik} \quad (15)$$

$C(U_i)$ is the total social capital of user U_i .

4 EMPIRICAL STUDY AND RESULT DISCUSSION

4.1 Data Collection and Processing

To describe and calculate users' relative social capital quantitatively, we choose the "car home forum website" as the experimental platform; and collect data by observing active users in product forums of "Jeep" brand community. We assume that "Jeep" brand community is the field of users' topic focus, and the product forums are specialties in the field. In experiment, we consider "day" as the observation unit. The data collection period is six months, from Sept. 1, 2015 to Feb. 29, 2016.

(1) Data collection. In the experiment, we use web crawler tool GooSeeKer (www.gooseeker.com) to grab the data of product forums and user and save these data as XLSM file. Product forum's data include forum's name, user's name, time of publication, number of forum essence posts, and text content of essence posts. User's data include user's name, user's level, user's status of identity authentication, number of fans, number of posts, text content of posts, time of publication, number of comments, number of clicks, level of people commenting, number of essence posts, and text content of essence posts.

(2) Data processing

1) Product forum data.

- ① The number of forum essence posts is the total amount of essence posts published in the statistical period.
- ② Keywords of product forum. We apply ICTCLAS (Institute of Computing Technology, Chinese Lexical Analysis System) [22] to segment the text content of essence posts on each product forum, and then mark and count keywords of each product forum.

2) User data.

We suppose essence post number is more than 1 for the initial threshold, and delete users whose essence post number is 0.

- ① The status of user's identity authentication refers to whether the user is certificated as a car owner; the value is 1 if certificated, and the value is 0 if otherwise.
- ② The number of user's followers refers to his or her number of fans.
- ③ The number of user's texts published refers to the number of posts user published in the statistical period.

- ④ The number of user's high-quality texts refers to the number of essence posts user published in the statistical period. The quality of single text can be comprehensively calculated by its keywords, word count, picture number, and hyperlink number. In "Jeep" brand community, high-quality text is generally classified as essence post.
- ⑤ Average text clicks are the ratio of total clicks of user's posts to his or her number of posts in the statistical period.
- ⑥ Average text replies are the ratio of total replies of user's posts to his or her number of posts in the statistical period.
- ⑦ Number of high-level users' reply is the total number of high-level users' replies of user's posts published in the statistical period.
- ⑧ Keywords of user's text content can also be obtained using a similar approach of obtaining keywords of product forum.

The processed data only keep the entire number, and these data are stored in the product forum information table and the user information table. The selected partial user data are shown in Table 4.1.1.

Table 4.1.1 List of partial user data in the statistical period

User (U _i)	Personality					Sociality		
	User's level	User's identity authentication	Number of followers	Number of texts published	Number of high-quality texts	Average text clicks	Average text replies	Number of high-level users' reply
U ₁	16	1	812	23	14	30805	84	246
U ₂	23	1	1164	18	13	5468	37	178
U ₃	20	1	390	19	13	5642	36	148
U ₄	7	0	78	15	6	3027	31	51
U ₅	15	1	63	16	6	21085	45	35
U ₆	15	0	466	25	20	13265	52	84
U ₇	10	1	224	7	4	2423	32	23
U ₈	7	1	126	16	2	16020	60	58
U ₉	8	0	42	15	14	12133	47	53
U ₁₀	10	1	16	8	1	43068	155	100

4.2 Data Calculation

(1) Determine the weight of each index

We invite 10 experts from MBA to determine the weights of first-grade indexes, and then normalize the above index data to calculate the weights of second-grade indexes. The results are shown in Table 4.2.1.

Table 4.1.2 Weights of first-grade and second-grade indexes

First-grade indexes	Weight	Second-grade indexes	Weight	Comprehensive weight
Personality	0.55	User's level	0.229	0.126
		User's identity authentication	0.184	0.101
		Number of followers	0.307	0.169
		Number of texts published	0.119	0.065
		Number of high-quality texts	0.162	0.089
Sociality	0.45	Average text clicks	0.229	0.135
		Average text replies	0.442	0.199
		Number of high-level users' reply	0.259	0.117
Total	1	—	—	1

(2) Calculate user's social capital

We first normalize the data in Table 4.1.1, and then combined with the weight data in Table 4.2.1, we calculate each user's social capital according to Formulas (11)–(13). The result is shown in Table 4.2.2.

Table 4.2.2 Social capital value of online users

Online user U_i	Personality value $IP(U_i)$	Sociality value $IS(U_i)$	Social capital value $C(U_i)$
U_1	0.408	0.290	0.698
U_2	0.492	0.100	0.592
U_3	0.360	0.084	0.444
U_4	0.061	0.017	0.078
U_5	0.227	0.089	0.316
U_6	0.283	0.099	0.383
U_7	0.169	0.001	0.171
U_8	0.154	0.107	0.261
U_9	0.102	0.072	0.173
U_{10}	0.128	0.359	0.488

On the basis of the data in Table 4.2.2, we acquire the distribution curves of personality value, sociality value, and social capital value of each user, as shown in Figure 4.2.1.

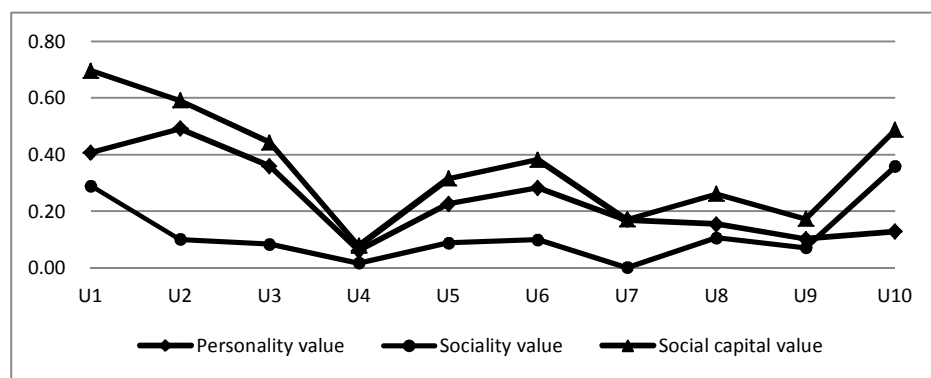


Figure 4.2.1 Distribution curves of users' social capital values, personality values, and sociality values

(3) Calculate user's relative social capital

Considering U_1 , U_2 , U_7 , U_9 , and U_{10} as examples, we first mark and count the keywords of product forum and U_i using a word segmentation tool, and then calculate the relevance between users and each specialty according to Formulas (8)–(10). The result is shown in Table 4.2.3.

Table 4.2.3 Relevance between users and each specialty

User U_i	Wrangler P_1	Guide P_2	Grand Cherokee P_3	Free Light P_4
U_1	0.601	0.727	0.000	0.000
U_2	0.888	0.000	0.000	0.000
U_7	0.000	0.000	0.689	0.000
U_9	0.810	0.000	0.124	0.000
U_{10}	0.143	0.081	0.900	0.078

We calculate user's relative social capital value in different specialties according to Formulas (14)–(15). The result is shown in Table 4.2.4.

Table 4.2.4 User's relative social capital value in different specialties

User U_i	Wrangler P_1	Guide P_2	Grand Cherokee P_3	Free Light P_4
U_1	0.419	0.507	0.000	0.000
U_2	0.526	0.000	0.000	0.000
U_7	0.000	0.000	0.118	0.000
U_9	0.140	0.000	0.021	0.000
U_{10}	0.070	0.040	0.439	0.038

The social capital value distribution of U_1 , U_2 , U_7 , U_9 , and U_{10} in each specialty is shown in Figures 4.2.2 and 4.2.3.

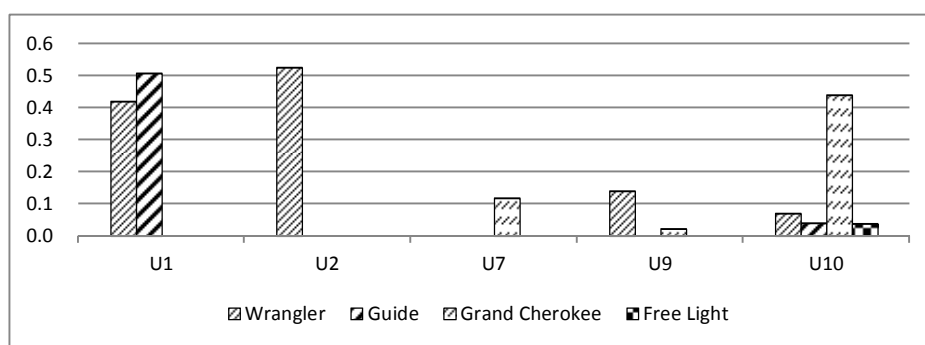


Figure 4.2.2 Social capital value distribution of users in each specialty

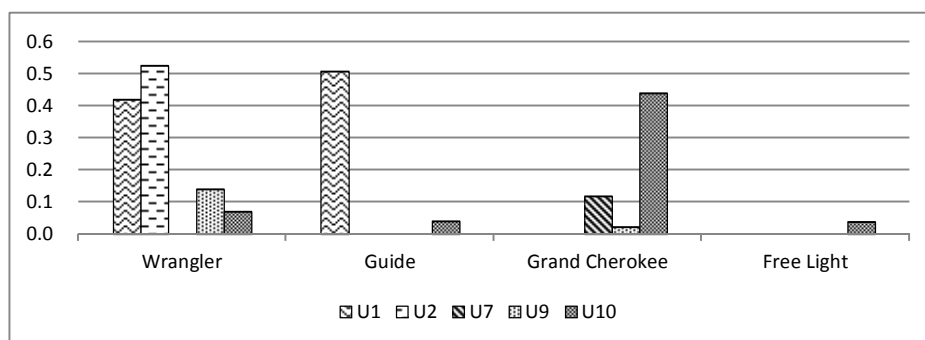


Figure 4.2.3 Relative social capital value of users in each specialty

4.3 Results, Discussion, and Analysis

As shown in Figure 4.2.1, online user's social capital is determined by user's combined personality and sociality data. The total social capital values of users owning different experiences and background are dissimilar. Even if two users have equal amounts of social capital, their personality and sociality values may also be different, such as the case of U_7 and U_9 . Figure 4.2.2 and 4.2.3 show that the strengths of user's social capital values in different specialties are different, and the scope and intensity of social capital among different users are relative. As shown in Figure 4.2.2, U_{10} has online influence in all product specialties, and this user's influence strengths in various product specialties are different. U_2 and U_7 have online influence in only one product specialty, and the intensity of U_2 's social capital in "Wrangler" is higher than that of others' social capital. Although the social capital amounts of U_7 and U_9 are close, the specialty scope and strength of their social capital are still relatively different. In Figure 4, the social capital values of U_1 , U_2 , U_9 , and U_{10} in "Wrangler" in the descending order is $U_2 > U_1 > U_9 > U_{10}$. However, their total social capital in the descending order is $U_1 > U_2 > U_{10} > U_9$. Thus, even if user's social capital value is high, this user's relative social capital in one specialty may be low.

In summary, the social capital of online users depends on their personality and sociality and is relative. User's social capital values in different fields are different. Furthermore, the amount, scope, and intensity of social capital among different users are relative. The results show that relative social capital can fully define the scope and strength of user's online influence.

The above conclusions have targeted decision support value for enterprises in pushing social advertisements with the aid of online influential users. Apart from the total amount of user's social capital, personality features, and sociality features are another important factors that must be considered by enterprises when choosing an online celebrity to endorse advertisements. Such consideration can help enterprises in maximizing user's relative advantage in using his or her area of expertise and further maximize the utility value of this user's social capital. Furthermore, with the aid of users' relative social capital, enterprises can establish a match mechanism between online celebrity and marketing objectives. Enterprises can also determine and cultivate online celebrities with commercial potential to improve their online advertising effects.

5 CONCLUSIONS

Researching the measure method of online influential users' relative social capital can help enterprises in determining a suitable online celebrity that matches their target advertisement to maximize the advertising effects. In this study, we comprehensively investigate how influential users acquire, accumulate, and use their social capital based on information resource management and social capital measurement theories. We also explore the general rules used by enterprises to facilitate influential users in pushing online social advertisements in social networks. The characteristics of relative social capital embodied in user's personality and sociality attributes are verified. On the basis of these characteristics, we build the measure index system and information entropy measure model of the relative social capital of online influential users to obtain a measure method of relative social capital. The proposed method can provide decision support theory and practical method for enterprises when selecting influential users to conduct precise advertisement.

The main conclusions are as follows:

(1) In social network platforms, users' social capital refers mainly to their online influence. Given the difference in users' cultural background, knowledge construction, experiences, and social interaction, the scope and strength of users' social capital are also dissimilar. The relative difference is the users' relative social capital, which is represented by users' personality and sociality data. On the basis of these data, we build a measure index system and information entropy measure model of online influential users' relative social capital and obtain a measure method of relative social capital.

(2) The empirical research shows that the model method can effectively evaluate the utility value of social capital and define the difference in the specialty scope and the strength of social capital among users. The method can help enterprises in building the matching relations between influential users and target advertisements. In this age of Internet celebrity economy, enterprises must not only consider the total amount of users' social capital but also regard the marketing objectives, observe the relative advantage of users' social capital in their fields of expertise to maximize the utility value of users' social capital, and provide decision support for advertising performance management. Compared with the approach that determines online advertising spokesperson using influential users' list, the proposed method is more scientific and reasonable.

Future research work mainly focus on the following issues: the optimization of the measure index system of users' social capital; the dynamic evaluation of online influential users' relative social capital; and the matching relations between online users and marketing objectives based on the relative social capital. Solving these problems can help enterprises cultivate and select online advertising spokespersons at a low cost and thus maximize the advertising effects.

ACKNOWLEDGMENT

This work described in this paper was partially supported by National Key Basic Research Program of China(2013CB329603), and was also supported by National Science Foundation of China (Project Nos. 71490725), the Ministry of Education of Humanities and Social Science Project (Project Nos. 14YJA630015).

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Information Entropy-based Social Capital Measure Method of Online Influential Users

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ABSTRACT

Measuring online user influence is a major research topic in social marketing performance maximization. In this study, we comprehensively investigate how online influential users gain, accumulate, and use their social capital from the perspective of information resource management and social capital measurement. First, we define the social capital of online influential users and the attribute characters and relationships reflected fully by personality and sociality index data. We then construct a social capital measurement indicator system and information entropy model of online users. After the calculations of this model, we finally form a social capital measure method of online influential users. The rationality and validity of proposed model are tested by experimental study on real datasets.

Keywords: Online user influence, Social capital of influence, Individual social capital measurement, Information entropy measure method.

1 INTRODUCTION

“Online celebrities” gain increasing popularity on the Internet, and their commercial value of influence attracts much interest and wide concern in the society. Some of them realize their commercial value rapidly and become social advertising endorsers pursued by a large number of enterprises. “Online celebrity” refers to a class of online users who own unique charisma, high industry visibility, and professional content supply capacity. Given that information interaction via the Internet is unaffected by time and space limit, online celebrities construct their social network and control it by publishing, spreading, and interacting various kinds of valuable information. They accumulate and use their social capital, thereby integrating and utilizing social resources and relationships; consequently, they exert online influence on the values, lifestyles, and information selection behavior of other online users[14]. Online influence is an important manifestation of individual social capital and is an important marketing resource of enterprise implementation of Internet strategy[15]. Therefore, determining how to measure the social capital of online influential users and calculate their online influence is important. Such determination depends on a clear realization of the process during which the online influential users gain, accumulate, and use their social capital. Therefore, we provide a social capital measure method of online influential users. Measuring online user influence is a scientific issue in social marketing performance maximization and a major topic in enterprise Internet marketing management.

Much research on social capital has achieved several achievements. For example, Lin Nan[18][19] considered social capital as resource, ability, and influence embedded in the social network, and involves mainly prestige, power, and wealth. Wellman B[31], Marsden PV[23][24], and Wei Jianwen, Zhao Yandong et al.[35][36] studied the attributes of individual cognition, structure, and relationship in the offline social network. They also used “name-generator”[5] and “position-generator”[20] to measure individual social capital. BianYanjie and Li Yu[1][2] and Zeng Mingbin and Zhou Chaowen[37] adopted the “Chinese New Year Greeting Network,” the “Maximum Banquet Network,” and other offline social networks to measure individual social capital among social groups. At present, the Internet social media develop rapidly and increasing online users affected by “online celebrities.” have begun to gather, accumulate, and take advantage of their social capital of online influence to achieve their commercial value. A few users with business sense have regarded their online influence as realizable social capital for online rent seeking, and enterprises use their full capability to find influential “online celebrities” as spokespersons to push social advertisements[12]. Research about online user influence is also abundant. Considerable research has been conducted on information choice behavior and social interaction behavior of user. The research focus is mostly on the formation process and development of online user influence, and the attributes and correlation of influence from the physical

topology[32][38], link structure[6][30], and interactive relationship[3][16]. The online user influence is usually obtained by calculating the occurrence of user network behavior. The social capital value of online influential users has begun to cause social concern, but the social capital formation of online users has not been explored from the perspective of social capital measurement. Its law of value is still unclear, and no effective method is available for computing the social capital of influential users. The social capital utility value of online influential users is an important decision basis for enterprises in selecting social advertising spokespersons for their Internet strategy implementation. Therefore, how online influential users gain, accumulate, and use their social capital must be comprehensively studied, the element composition and relationships in this process must be determined, and the general rule of formatting and making the most of social capital must be revealed to form a social capital measure method of online influential users.

In the present study, we comprehensively investigate how online influential users gain, accumulate, and use their social capital from the perspective of information resource management and social capital measurement. Accordingly, we can explore the measure method of online influential users. First, we define the social capital of online influential users and the attribute characters and relationships reflected fully by personality and sociality index data. We then construct a social capital measurement indicator system and information entropy model of online users. After the calculations of this model, we finally form a social capital measure method of online influential users. The research achievements enrich the theory system of information resource management and social capital measurement, and provide theoretical basis and practical method for enterprises in implementing Internet strategy and decision support for online advertising management.

2 SOCIAL RELATIONSHIP MAP OF SOCIAL NETWORK PLATFORM USERS

Online influential users publish and spread topic information that shows their specific opinion tendency to attract considerable attention and interact with other online users. Subsequently, they construct a manageable social network on which they can exert influence. The constituent elements in this social network are the big V users, general users, the mapping relation between user and topic, and the interactive relationship among users created by information choice behavior (Figure 2.1).

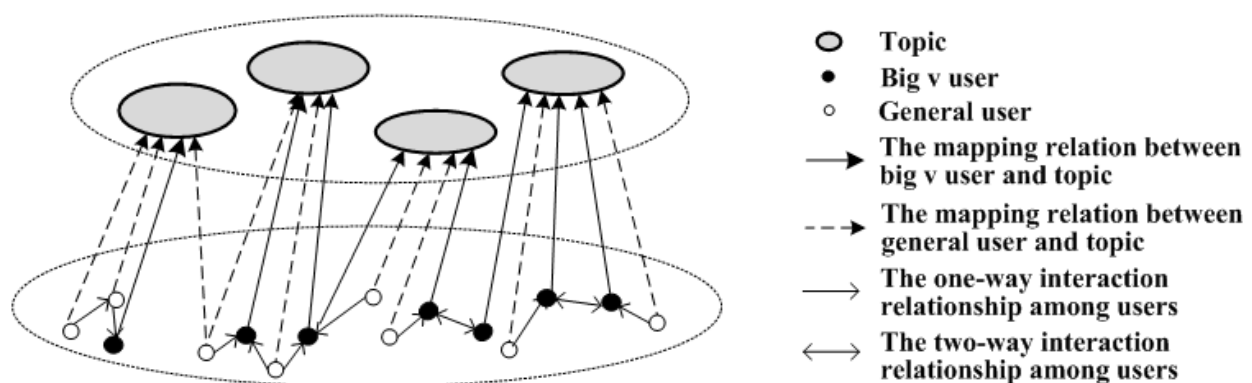


Figure 2.1 Social network structure diagrams among online users

On the Internet, assuming that any user i posts valuable topic information, user j immediately notices this information and conducts one or more interactive behaviors among “Read,” “Reply,” and “Share.” Accordingly, the social network forms. In this network, the following three kinds of interactive relationships exist between the two users:

- (1) Read. User j reads the topic information posted by user i , thereby establishing the reading relationship.
- (2) Reply. User j not only reads but also replies the topic information, thereby establishing the replying relationship.
- (3) Share. User j reads the topic information and shares it with others, thereby establishing the sharing relationship.

At this point, the basic social network map between user i and user j can be constructed as shown in Figure 2.2.

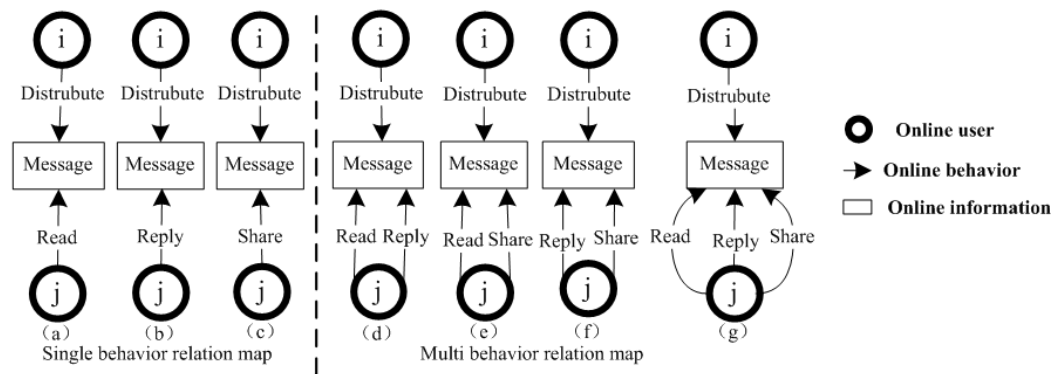


Figure 2.2 Basic social network map between two online users

As shown in Figure 2.2, the online influential users take good advantage of their unique personality and sociality to publish, spread, and interact topic information that shows their specific opinion tendency. This information attracts much attention and interest of other online users, and leads to emotional resonance and trust among those individuals. In this social network, each individual member can create, accumulate, and use social capital relying on the trust relationship. As individual social scope and dabbled content increase, the social capital of online users also gradually increases. The commercial value of these online users are thus discovered and given much attention by the society and enterprises.

3 SOCIAL CAPITAL EVALUATION INDEX SYSTEM OF ONLINE INFLUENTIAL USERS

Coleman JS[7], O'ConnorLG et al.[25], and Barnes-Mauthe M et al.[4] found that characteristic properties, such as online authority, discourse quality, propagation aging, and interaction relationship, are important for individual social capital. These characteristic properties are also the data sources manifesting the personal charisma and social interactive skills of an individual in a social network. After analyzing the online behavior of online users, we choose “personality” and “sociality” as the two dimensions for the social capital measurement index system of online influential users.

Individual social capital in the social network can be measured in two kinds of environment: online and offline. In this study, we measure mainly the individual social capital of online users.

3.1 Social Capital Indexes of “Personality”

The cultural literacy, speech quality, trustworthiness, own experience, and social status of social members can be used as attributes of “personality” to measure their social capital[8][21][27]. When adopted to online network, these offline attributes can be described as attribute data, such as user level, fan number, text number, and text quality[34][39]. FalconeRino et al.[13] and Pal A et al.[26] found that the trust among users is an important source of gaining and accumulating social capital. They also revealed that the individual attributes, such as authentication, community level, and fan number, can enhance the degree of trust. WoudstraL et al.[33]^l believed that the total number and quality of text posted by users can promote the dissemination of information, thereby helping users to gather high social capital resources and relationship. Zhang Peng Yi[39] and Leticia Bode et al.[22] discovered that, when the network platform users participate in more interactive topic, their speech becomes more powerful and they can gain, accumulate, and take advantage of their social capital more easily. Therefore, we select the user identity authentication, user level, fan number, text number, high-quality text number, and self-reply number as the second grade indexes to reflect “personality.”

3.2 Social Capital Indexes of “Sociality”

The degree of concern, interactive collaboration, and communication frequency are the effective social capital indexes for evaluating “sociality”[9][28][40]. When mapped into network platform, these indexes manifest as the text hits, the number of reply and share, and the participant number in discussions[6][17].Zuo Wenming et al.[41]found that the user who can interact with other influential users must own high social capital commercial value. On this basis, we choose average text hits, average

number of text replies, and average number of high-rank participants in discussion as the second grade indexes to measure “sociality.”

Accordingly, the social capital evaluation index system of online influential users is obtained (Table 3.2.1).

Table 3.2.1 Social capital evaluation index system of online influential users

First grade index	Second grade index	Index description	References
Personality	User identity authentication	The value is 1 if the user identity is authenticated and 0 if otherwise.	[13],[26]
	User level	The rank of user in the community.	
	Fan number	The total number of valid fans after the zombie powder.	
	Text number	The total number of texts posted by the community user.	[22],[28] [34],[39]
	High-quality text number	The quality of single text is judged comprehensively by its key words, word count, picture number, and hyperlink number.	
	Self-reply number	The number of replies provided by user to other users.	
Sociality	Average text hits	The ratio of the total number of text hits and the text number.	[6],[17],[41]
	Average number of text replies	The ratio of the total number of text replies and the text number.	
	Average number of high-rank participants in discussion	The ratio of the total number of high-rank participants and the text number.	

4 INFORMATION-ENTROPY BASED SOCIAL CAPITAL MEASURE MODEL OF ONLINE INFLUENTIAL USERS

Information entropy is proposed by Shannon and is used to measure the uncertainty value of information and its influence [29]. Cheng Qiyue, Qiu Wanhua, et al. [10] used timeliness entropy to calculate the size of bullwhip effect in supply chain and evaluate the efficiency of command process. Liang Changyong, Zhaoshuping, et al. [11] constructed environmental emergency severity level of assessment methods based on information entropy theory. He Jianmin and Hu Mengna [17] used the three-dimensional index system composed of the quality, transmission timeliness, and interaction degree of complaint text to construct an information entropy model for obtaining the influence of complaint text. Thus, information entropy is an effective method for measuring information influence.

On the social network platform, online users post, spread, and interact all kinds of information, and the information value is the main basis used by other users in judging its usefulness. The information influence depends on the “personality” value and “sociality” value of individual social capital [14]. Therefore, information entropy can be used to measure the social capital of online users. Based on the two-dimensional social capital index system, we propose an information entropy model to measure the individual social capital. We form a set of social capital measure methods of online influential users, and this set may provide decision support for enterprises.

4.1 Definition of Social Capital Measure Indexes

Definition On the social network platform, we suppose an arbitrary user as u_i , and U as a set of users $U = \{u_1, u_2, \dots, u_i, \dots, u_n\}$ ($i=1,2,\dots,n$). The social capital indexes of u_i are $C_i = \{c_i^{p1}, c_i^{p2}, \dots, c_i^{pg}, c_i^{s1}, c_i^{s2}, \dots, c_i^{sk}\}$, ($i=1,2,\dots,n; g=1,2,\dots,6; k=1,2,3$) where $c_i^{p1}, c_i^{p2}, \dots, c_i^{p6}$ denote the identity authentication, user level, fan number, text number, high-quality text number, and self-reply number; and $c_i^{s1}, c_i^{s2}, c_i^{s3}$ denote the average text hits, average number of text replies, and average number of high-rank participants in discussion.

4.2 Determination of Social Capital Measure Indexes Weights

The personality and sociality of each user significantly differ and different indexes weights can produce different results. Thus, the index weighting method must be properly selected. Zhou Wei and Li Xiaojing [42] used the entropy weight assignment

method to calculate the weights of indexes combined with objective and subjective factors. This method avoids the undesirable manual setting of weight and results in reasonable and effective evaluation system. In this study, we consider the objective and subjective evaluation factors also use the expert grading method to determine the weights of first grade indexes first, and then adopt the entropy weight assignment method to calculate the weights of second grade indexes. Finally, we obtain the synthetic weight. The method of calculating indexes weights is given below.

Step 1. Determine the weights of first grade indexes using expert grading method, and select n experts to percentile scores on the importance of first grade indexes, as follows:

Table 4.2.1 Expert grading method to determine the weights of first grade indexes.

First grade indexes	Experts				Average score
	1	2	...	n	
Personality	s_{11}	s_{12}	...	s_{1n}	$\bar{s}_1 = \frac{1}{n} \sum_{j=1}^n s_{1j}$
Sociality	s_{21}	s_{22}	...	s_{2n}	$\bar{s}_2 = \frac{1}{n} \sum_{j=1}^n s_{2j}$

Therefore, the weight proportion of “personality” and “sociality” is $\bar{s}_1 : \bar{s}_2$. After normalization, the two-dimensional weights of

the first grade indexes are α_1, α_2 , where $\alpha_i = \bar{s}_i / \sum_{i=1}^2 \bar{s}_i$, $\alpha_1 + \alpha_2 = 1$.

Step 2. Using the entropy weight method, calculate the weights of second grade indexes, as follows:

(1) Build the initial matrix as follows:

$$D = \begin{matrix} u_1 \\ u_2 \\ \vdots \\ u_n \end{matrix} \begin{bmatrix} c_1^{p1} & \Lambda & c_1^{p6} & c_1^{s1} & c_1^{s3} \\ c_2^{p1} & \Lambda & c_2^{p6} & c_1^{s1} & c_1^{s3} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ c_n^{p1} & \Lambda & c_n^{p6} & c_1^{s1} & c_1^{s3} \end{bmatrix}$$

(2) Data dimensionless processing. Given that the dimension of each index is distinct, the data for comparison must be normalized. All indexes in this study are positive indexes, and the greater the index values, the better. The normalization method is as follows:

$$c_i^{pg} = \frac{c_i^{pg} - \min_g (c_i^{pg})}{\max_g (c_i^{pg}) - \min_g (c_i^{pg})}, (i=1,2,\Lambda, n; g=1,2,\Lambda, 6),$$

$$c_i^{sk} = \frac{c_i^{sk} - \min_k (c_i^{sk})}{\max_k (c_i^{sk}) - \min_k (c_i^{sk})}, (i=1,2,\Lambda, n; k=1,2,3).$$

The matrix after normalizing can be expressed by

$$D' = \begin{matrix} u_1 \\ u_2 \\ \vdots \\ u_n \end{matrix} \begin{bmatrix} c_1^{p1} & \Lambda & c_1^{p6} & c_1^{s1} & c_1^{s3} \\ c_2^{p1} & \Lambda & c_2^{p6} & c_1^{s1} & c_1^{s3} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ c_n^{p1} & \Lambda & c_n^{p6} & c_1^{s1} & c_1^{s3} \end{bmatrix}$$

(3) Calculate the proportion of indexes as follows:

$$p(c_i^{pg}) = \frac{c_i^{pg}}{\sum_{i=1}^n c_i^{pg}} (i=1,2,\Lambda, n; g=1,2,\Lambda, 6),$$

$$p(c_i^{sk}) = \frac{c_i^{sk}}{\sum_{i=1}^n c_i^{sk}} (i=1,2,\Lambda, n; k=1,2,3).$$

(4) Calculate the entropy value of each index as follows:

$$E_g = -a \cdot \sum_{i=1}^n p(c_i^{pg}) \ln p(c_i^{pg}), (g=1,2,\Lambda,6) \text{ where } a=1/\ln n, \text{ When } p(c_i^{pg})=0, p(c_i^{pg}) \ln p(c_i^{pg})=0.$$

The entropy value of E_k can be calculated in the same way.

(5) Weight each index as follows:

$$\omega_g = \frac{1-E_g}{\sum_{g=1}^6 (1-E_g)}, (g=1,2,\dots,6); \omega_k = \frac{1-S_k}{\sum_{k=1}^3 (1-S_k)}, (k=1,2,3) \text{ where } \sum_{g=1}^6 \omega_g = 1, \sum_{k=1}^3 \omega_k = 1.$$

Thus, based on the weights of first grade indexes α_1, α_2 , the weights of second grade indexes are $\omega'_g = \alpha_1 \omega_g (g=1,2,\Lambda,6), \omega'_k = \alpha_2 \omega_k (k=1,2,3)$.

4.3 Social Capital Measure Model of Online Influential Users

On the social network platform, for an arbitrary user such as u_i , the set of social capital indexes is $C_i = \{c_i^{p1}, c_i^{p2}, \Lambda, c_i^{pg}, c_i^{s1}, c_i^{s2}, \Lambda, c_i^{sk}\}, (i=1,2,\Lambda, n; g=1,2,\Lambda, 6; k=1,2,3)$, the personality value is $IP(u_i)$, and the sociality value is $IS(u_i)$. Their calculation formulas are given below.

$$IP(u_i) = \sum_{g=1}^6 \omega'_g c_i^{pg}, (i=1,2,\Lambda, n; g=1,2,\Lambda, 6) \quad (1)$$

$$IS(u_i) = \sum_{k=1}^3 \omega'_k c_i^{sk}, (i=1,2,\Lambda, n; k=1,2,3) \quad (2)$$

The total social capital value of u_i is $ISC(u_i)$.

$$ISC(u_i) = IP(u_i) + IS(u_i) \quad (3)$$

5 EMPIRICAL RESEARCH AND RESULTS

5.1 Data Collection and Pretreatment

We conduct an empirical research by choosing the “autohome.com.cn” as the research platform and the “Golf” brand community members as research object to measure social capital of online users and examine the rationality and validity of the proposed model. We collect the source data of their social capital index attribute daily and the observation period lasts six months, from June 1, 2015 to November 30, 2015.

(1) Data collection. We obtain the required data of 80 online users from GooSeeKer (www.gooseeker.com), and store them in an Excel file. The captured data mainly include user name, registration time, last login time, identity authentication, user level, the number of concerns, fan number, text number, high-quality text number, self-reply number, text hits, text replies, and the rank of participants.

(2) Data processing and explanation. We assume that the high-quality text number is higher than or equal to 1 (as the initial threshold) and reject the invalid users. We reorganize the social capital index data of the remaining 50 online users in an Excel file. The main workflow is as follows:

- 1) Use identity authentication. The value is 1 if the user identity is authenticated and 0 if otherwise.
- 2) User level. The rank of user in the community.
- 3) Fan number. The total number of valid fans after the zombie powder.
- 4) Text number. The total number of texts posted by the community user.
- 5) High-quality text number. Text quality is obtained by calculating the comprehensive text key words, text word counts, and picture and link number counts in the “Golf” brand community. The high-quality text is generally listed as the essence post. Accordingly, we use the essence post number as the high-quality text number for calculation.

6) Self-reply number. The total number of replies provided by user to other users.

7) Average number of text hits. The ratio of the total number of text hits and the text number.

8) Average number of text replies. The ratio of the total number of text replies and the text number.

9) Average number of high-rank participants in discussion. The ratio of the total number of high-rank participants and text number. The level of general users in the “Golf” brand community is less than 15. As a result, we consider users whose level is beyond 15 as high-rank participants.

The data processed by the above procedure only retain the entire digital items and are stored into the “Golf” brand community user data table. The interception of index data of a few users at the beginning and end of the observation period is shown in Tables 5.1.1 and 5.1.2.

Table 5.1.1 Part of online user index data in “Golf” brand community at the beginning of observation

User number	Personality value $IP(u_i)$						Sociality value $IS(u_i)$		
	User identity authentication	User level	Fan number	Text number	High-quality text number	Self-reply number	Average text hits	Average number of text replies	Average number of high-rank participants in discussion
u_1	1	13	502	250	28	5422	7773	406	46
u_2	0	8	138	190	6	7000	1996	9	9
u_3	1	10	199	88	6	3866	4126	123	12
u_4	1	15	3862	216	7	40120	6986	429	54
u_5	1	16	422	308	9	45665	6016	316	34
u_6	1	23	7869	158	69	20004	21255	1622	159
u_7	1	22	989	198	106	10256	16649	1348	124
u_8	1	17	4865	224	57	10524	8841	698	89
u_9	1	25	4475	166	145	57125	17692	1556	199
u_{10}	1	28	3658	1089	386	60223	24865	2296	301
...

Table 5.1.2 Part of online user index data in “Golf” brand community at the end of observation

User number	Personality value $IP(u_i)$						Sociality value $IS(u_i)$		
	User identity authentication	User level	Fan number	Text number	High-quality text number	Self-reply number	Average text hits	Average number of text replies	Average number of high-rank participants in discussion
u_1	1	14	662	290	39	7800	9566	423	57
u_2	0	9	162	236	10	9023	2498	25	13
u_3	1	10	217	116	7	5455	3275	83	11
u_4	1	17	5958	321	16	47778	7172	408	64
u_5	1	17	2612	480	12	52185	10698	427	33
u_6	1	25	10442	194	86	23189	24041	1847	144
u_7	1	24	1988	235	152	19998	29857	2665	201
u_8	1	18	5127	288	63	17078	9451	708	92
u_9	1	28	6876	207	189	92848	23482	2183	255
u_{10}	1	29	5289	1439	420	79944	20049	1889	289
...

5.2 Calculation of Social Capital

(1) Determine the weights of indexes

We invite 10 experts from MBA to determine the weights of first grade indexes. We then employ the entropy weight method to calculate the weights of second grade indexes. Finally, we obtain the comprehensive weights of the two grade indexes. The results are shown in Table 5.2.1.

Table 5.2.1 Weight of first grade and second grade indexes.

First grade index	Weight	Second grade index	Weight	Comprehensive weight
Personality	0.55	User identity authentication	0.155	0.085
		User level	0.227	0.125
		Fan number	0.265	0.146
		Text number	0.118	0.065
		High-quality text number	0.164	0.090
		Self-reply number	0.071	0.039
		Average text hits	0.382	0.172
Sociality	0.45	Average number of text replies	0.344	0.155
		Average number of high-rank participants in discussion	0.274	0.123
Total	1	—	—	1

Table 5.2.1 shows that, in the first grade indexes, personality value is more important to social capital value than sociality value. In the second grade indexes, fan number and user level highly contribute to personality value, while text average hits highly contribute to sociality value.

(2) Numerical calculation of social capital

After normalizing Tables 5.1.1 and 5.1.2 according to Table 5.2.1 and using the proposed social capital model, we calculate the social capital value of these online users at the beginning and end of the experimental observation. The calculation results are presented in Table 5.2.2.

Table 5.2.2 Social capital value of online users at the beginning and end of the observation

Online user u_i	Personality value $IP(u_i)$		Sociality value $IS(u_i)$		Social capital $ISC(u_i)$	
	Beginning	end	beginning	end	beginning	end
u_1	0.140	0.210	0.086	0.133	0.226	0.343
u_2	0.008	0.012	0.001	0.051	0.009	0.063
u_3	0.099	0.112	0.025	0.033	0.124	0.145
u_4	0.233	0.248	0.085	0.095	0.318	0.343
u_5	0.184	0.241	0.062	0.085	0.246	0.326
u_6	0.355	0.360	0.317	0.301	0.672	0.661
u_7	0.224	0.406	0.249	0.411	0.473	0.817
u_8	0.256	0.289	0.132	0.146	0.388	0.435
u_9	0.348	0.412	0.303	0.367	0.651	0.779
u_{10}	0.309	0.411	0.288	0.387	0.597	0.798
...

On the basis of the data in Table 5.2.2, we draw the comparison chart of personality value, sociality value, and total social capital of 50 observation objects during experimental observation (Figures 5.2.1–5.2.4).

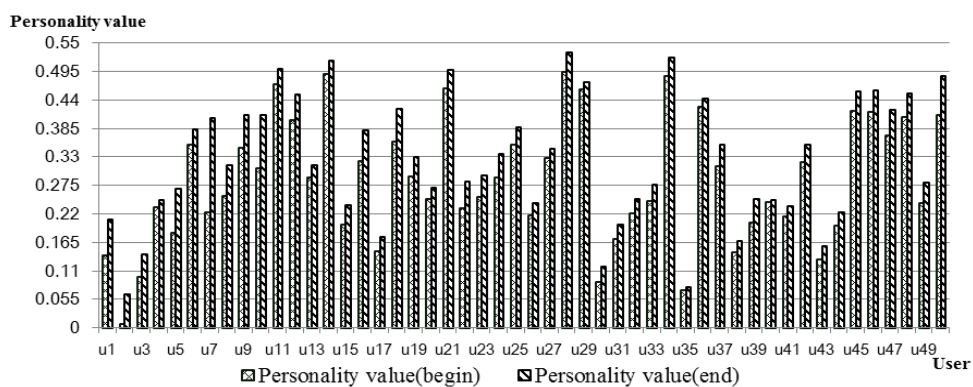


Figure 5.2.1 Column bar comparison chart of personality value

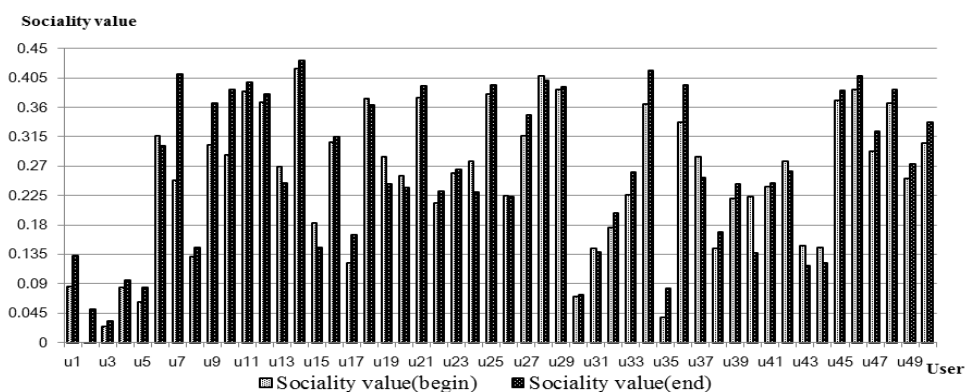


Figure 5.2.2 Column bar comparison chart of sociality value

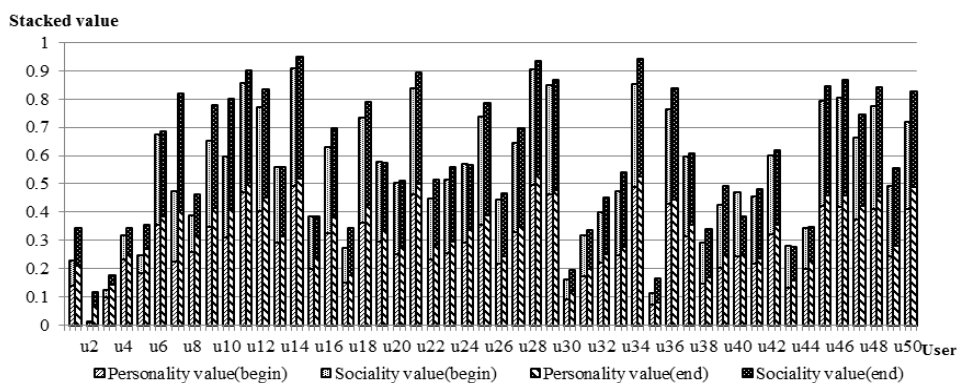


Figure 5.2.3 Stacked bar comparison chart of personality and sociality value

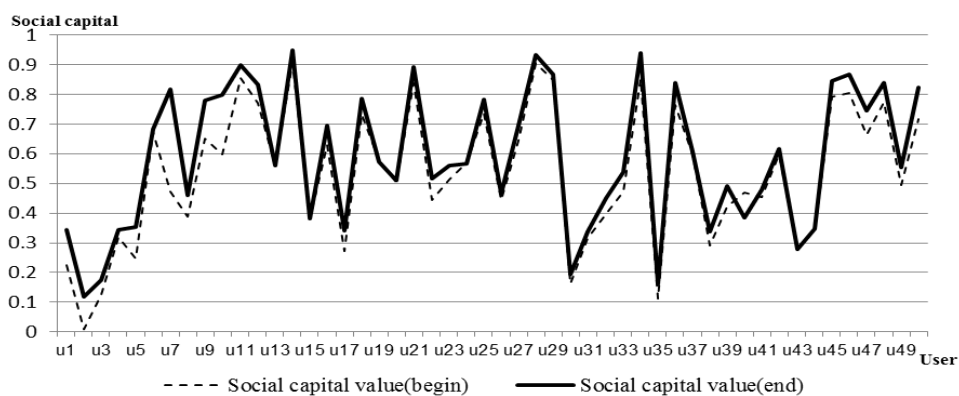


Figure 5.2.4 Line comparison chart of total social capital

(3) Dynamic social capital map of online users

Given that the change of index data in this study cannot be recorded obviously in a daily basis, we use “week” as a unit to observe data. The social capital index data of u_7 and u_{10} in six months are shown in Table 5.2.3.

Table 5.2.3 Social capital dynamic change of online users u_7 and u_{10}

Observation	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	T_{10}	T_{11}	T_{12}
IP	0.224	0.227	0.233	0.235	0.241	0.249	0.255	0.264	0.271	0.277	0.278	0.283
u_7 IS	0.249	0.251	0.253	0.267	0.273	0.281	0.299	0.317	0.32	0.324	0.341	0.348
ISC	0.473	0.478	0.486	0.502	0.514	0.53	0.554	0.581	0.591	0.601	0.619	0.631
IP	0.309	0.314	0.319	0.323	0.323	0.334	0.334	0.339	0.346	0.346	0.346	0.349
u_{10} IS	0.288	0.301	0.307	0.311	0.313	0.322	0.324	0.331	0.323	0.325	0.325	0.32
ISC	0.597	0.615	0.626	0.634	0.636	0.656	0.658	0.67	0.669	0.671	0.671	0.669
Observation	T_{13}	T_{14}	T_{15}	T_{16}	T_{17}	T_{18}	T_{19}	T_{20}	T_{21}	T_{22}	T_{23}	T_{24}
IP	0.287	0.299	0.314	0.32	0.328	0.349	0.362	0.371	0.378	0.389	0.395	0.406
u_7 IS	0.345	0.361	0.362	0.371	0.377	0.382	0.386	0.391	0.399	0.404	0.407	0.411
ISC	0.632	0.66	0.676	0.691	0.705	0.731	0.748	0.762	0.777	0.793	0.802	0.817
IP	0.349	0.355	0.363	0.37	0.381	0.388	0.391	0.394	0.402	0.407	0.409	0.411
u_{10} IS	0.321	0.339	0.344	0.35	0.359	0.37	0.368	0.371	0.384	0.39	0.393	0.387
ISC	0.67	0.694	0.707	0.72	0.74	0.758	0.759	0.765	0.786	0.797	0.802	0.798

On the basis of the data in Table 5.2.3, we draw the social capital dynamic change chart of u_7 and u_{10} (Figures 5.2.5–5.2.7).

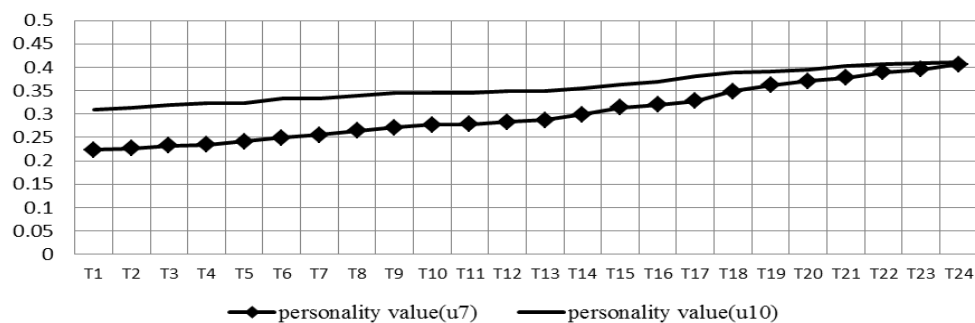


Figure 5.2.5 Dynamic change comparison chart of personality value

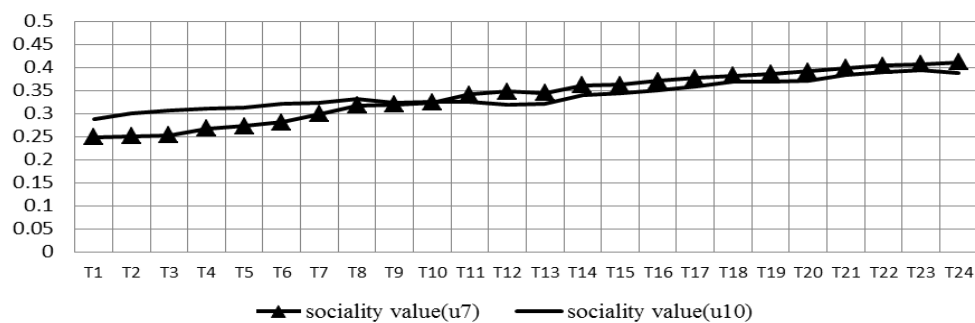


Figure 5.2.6 Dynamic change comparison chart of sociality value

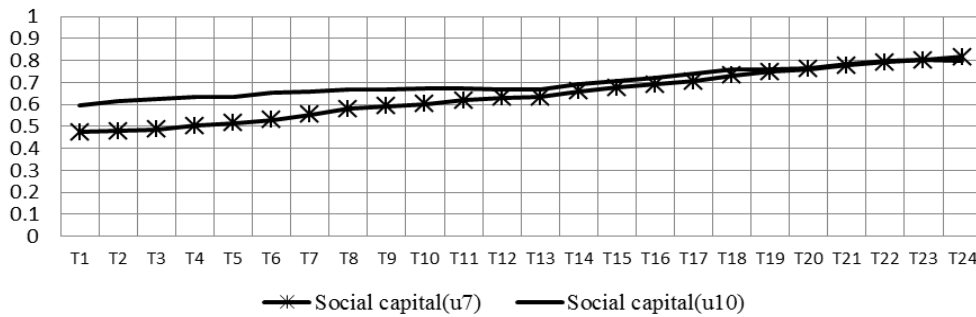


Figure 5.2.7 Dynamic change comparison chart of total social capital

5.3 Experimental Results and Discussion

On the social network platform, the social capital of online influential users is determined by “personality” and “sociality.” The experimental results from Figures 5.2.1 to 5.2.4 indicate that, although influential users own the same amount of total social capital, they show different kinds of influence on their “personality” and “sociality,” such as u_{10} and u_{37} . In addition, the “personality,” “sociality,” and total social capital values of online users change with time, and the change rates vary from one to another. For example, the growth rates in “personality,” “sociality,” and total social capital value of u_7 are all higher than in those of u_{10} . At the end of observation period, personality value: $u_7 < u_{10}$, sociality value: $u_7 > u_{10}$, and the total social capital value: $u_7 > u_{10}$ (Figures 5.2.5–5.2.7).

The social capital of online individual users mainly reflects as online influence, which is identified by personality and sociality index data. The social capital influence embodied by personality depends on its personal resources, which are represented by personal attribute. They are the internal factors distinguishing a user from other users in the social network. Meanwhile, the social capital influence created by the sociality depends on the social resource, relationship, and ability of online user in this social network, which are represented by social attributes. They are the external factors used to differentiate online users.

The experimental results show that enterprises can establish the dynamic evaluation of social capital value and the selection mechanism of advertising spokesperson candidates based on the acquisition and utility features of individual social capital. From the beginning of influence germination, enterprises can track and pay close attention to the growth of influential users and constantly reevaluate the comprehensive performance in terms of pushing online advertisements. Thus, enterprises must analyze the social capital value from the two-dimensional measure index system composed of personality and sociality. Enterprises must make the most out of the relative advantage of the social capital of online users. They must also find the most suitable candidate to be the advertising spokesperson who can assist them in achieving advertising performance maximization.

Apart from selecting online influential users, the social capital formation and increasing rates of online users must also be analyzed according to the specific objectives and requirements of enterprise advertising. Enterprises must discover the potential influence characteristics of users with rapidly increasing social capital utility and excavate the potential burst of their social capital. In this way, enterprises can develop upfront training and investment plan, thereby obtaining good advertising performance with small advertising investment.

6 CONCLUSIONS

The proposed information entropy-based social capital measure method of online influential users is used to explore an effective way for calculating online influence of users and provide references for enterprises on choosing suitable online users to push advertisements. This area is a major research issue in social marketing performance maximization.

In this study, we comprehensively investigate how online influential users gain, accumulate, and use their social capital from the perspective of information resource management and social capital measurement. First, we define the social capital of online influential users and the attribute characters and relationships reflected fully by personality and sociality index data. We

then construct a social capital measurement indicator system and information entropy model of online users. After the calculations of this model, we finally form a social capital measure method of online influential users. The research achievements enrich the theory system of information resource management and social capital measurement, and provide theoretical basis and practical method for enterprises in implementing Internet strategy and decision support for online advertising management.

The main research work and conclusions are as follows:

1) On the social network platform, influential users fully utilize their unique personality charm and social abilities to publish, spread, and interact valuable information to attract attention and interest of other users. They then build their own social network and gain social resource, relationship, and ability, which can help them increase and accumulate individual social capital. From the perspective of information resource management and social capital measurement, we investigate the online information selection and interactive behavior attributes of online users. After comprehensively studying how online influential users gain, accumulate, and use their social capital, we obtain the general rule of individual social capital utility. On this basis, we draw a social relationship map of online users forming during online social interactions, then reveal the social capital elements and composition of online influential users, which reflect as attribute data of user personality and sociality, and establish a social capital measurement indicator system and information entropy model of influential online users. We finally form a social capital measure method of online influential users. The rationality and validity of the proposed model are tested by experimental study on real datasets.

2) The individual social capital value of online influential users dynamically varies with time. The total value of individual social capital changes according to their own “personality” and “sociality.” This conclusion may help enterprises in establishing a relationship between the online influence and the factors of advertising performance. When pushing social network advertisement, they can make a targeted choice among those influential online users who own the advantage of “personality” or “sociality” as advertising spokesperson according to the marketing goals. In addition, enterprises can develop upfront training and investment plan for online users with rapidly increasing social capital utility. Such planning can offer significant support for mining potential “online celebrities.” Unlike the way of selecting advertising spokesperson by using the influential user ranking offered on sites, our measure method is more scientific and reasonable.

ACKNOWLEDGMENT

This work described in this paper was partially supported by National Key Basic Research Program of China(2013CB329603), and was also supported by National Science Foundation of China (Project Nos. 71490725), the Ministry of Education of Humanities and Social Science Project (Project Nos. 14YJA630015).

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How Media and Behavioral Characteristics of Mobile Instant Messenger Affect Intimacy and Fatigue? The Moderating Effect of The Communication Context

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ABSTRACT

Mobile instant messenger has become a part of our daily life because a smartphone is the primary communication device. To communicate other friends, they use a mobile instant messenger more frequently than giving a phone call. This study aims to investigate why people communicate others through a mobile instant messenger based on media and behavioral characteristics, which affect intimacy and fatigue. We expect this study would contribute for understanding the communication with a mobile instant messenger.

Keywords: Mobile Instant Messenger, Media Synchronicity Theory, Mobile Communication, Intimacy, Fatigue.

INTRODUCTION

Nowadays it is hard to find smartphone owners who do not use a mobile instant messenger service. Since a smartphone became popular, a mobile instant messenger service (e.g., KaKaoTalk, WhatsApp, WeChat, etc.) has been one of the most commonly used applications in the world. Typical behavioral patterns in the communication might be to leave a message through a mobile instant messenger, rather than a phone call. Many people prefer communicating with a mobile instant messenger to directly talking on the phone even though a phone call is more clear and fast way to deliver a message than a mobile instant messenger. Thus, it is necessary to investigate why people use a mobile instant messenger for communicating others. Many prior researches about a mobile messenger have been conducted based on Technology Acceptance Model (TAM) or Theory of Planned Behavior (TPB), which used typical variables such as perceived usefulness, perceived ease of use, intention to use, and etc [2, 10, 18, 21, 24, 33, 36, 37]. These researches was meaningful when the target product was in the early stage, but if it was in the mature stage, a different approach would be more appropriate. This study mainly focused on the communication with a mobile instant messenger rather than intention to use it. To the end, we investigated how media and behavioral characteristics of a mobile instant messenger would influence intimacy and fatigue based on media synchronicity theory and other prior researches

LITERATURE REVIEW

Media Synchronicity Theory

There are two media theories that explain the role and the effectiveness of the media in the communication process; one is media richness theory, and the other is media synchronicity theory. Media richness theory [11] argued that every communication media has different ability to reproduce information sent over it, so the degree of this ability known as a media richness influences the communication among users. In other words, the performance and the quality of the communication would be determined by how clear information delivered by a media is. Therefore, the main driver for choosing a communication media is to decrease possible misinterpretation of messages or information. Dennis and Valacich [13] proposed an alternative media theory – media synchronicity theory because media richness theory was not good enough to explain why to select one media over others. Synchronicity refers to a state in which “individuals are working together at the same time with a shared pattern of coordinated behavior [12],” so media synchronicity theory argued that communication would be improved when selected media could appropriately support the synchronicity required by a communication process [12, 13].

Communication consists of two fundamental processes: conveyance and convergence. The conveyance process means that new information is transmitted and processed among communication participants (senders & receivers), so the conveyance process could be enhanced by using a media that has a low synchronicity. Because communication participants spend a certain amount of cognitive resource to read, understand, and integrate information, they should have enough time to process it. On the other hand, the convergence process refers to the process of mutually agreeing with the meaning of the information among communication participants, so required cognitive resource in the convergence process is less than that in the conveyance process. Because most information is already delivered and processed in the conveyance process, the convergence process would require relatively less time for reaching the mutual agreement and understanding among participants. If the main goal of communication is to delivery or distribute information to participants (conveyance process), a media with low synchronicity would be more appropriate. When, conversely, the main goal of communication is to make the mutual agreement (convergence process), a media with high synchronicity would be more appropriate [12, 13].

Media synchronicity theory has been used to explain how a media affect communication. For example, Cho et al. [9] examined the relationship between diverse media and communication overload, and argued that the synchronicity of media played an important role in communication overload. Ryoo and Koo [48] claim that employees could work, find solutions, and achieve their goals with ICT (information and communication technologies) because ICT is alternative source of knowledge creation, and it is moderated by media synchronicity. Chan [6] analyzed how university students used CMC (computer-mediated communication) technologies for interpersonal communication depending on their shyness and sociability, and found that shy

individuals were more likely to use low synchronous media. In general, media synchronicity theory figures out the characteristics of media based on the synchronicity and proposes the role of media in the communication, so this study would like to examine the mobile instant messenger service based on media synchronicity theory.

The communication performance could be enhanced by selecting appropriate media based on the characteristics and the goal of the communication, and media synchronicity theory argued that it would be plausible to figure out which media would be more appropriate than others based on the synchronicity. Media synchronicity is determined by five media transmission capabilities: transmission velocity (or immediacy of feedback), parallelism, symbol variety (or symbol sets), rehearsability, and reprocessability [10, 11]. Transmission velocity (or immediacy of feedback) means how fast a message can be delivered to a recipient and how quickly he/she responds, so it can refer to the ability to support quick bidirectional communication. Parallelism refers to the number of conversation that can be co-exist effectively. For example, a mobile instant messenger is enable to take place many simultaneous conversations while a telephone can allow only one conversation at one time. Symbol variety (or symbol sets) is the variety of ways to express or communicate information. In other words, it means the number of ways that a information can be encoded in the communication. Rehearsability means that a sender can rehearse or examine a message before sending it out to a receiver, so some media, which have high rehearsability, gives a sender the opportunity to edit a message for ensuring the expression of the intended meaning. Reprocessability refers to the ability to reexamine and process again a received message for better understanding or reference [12, 13]. Because there is no best medium to fit in every situation, communication performance would depend on the matching the synchronicity of a given media with a given situation.

Communication with Mobile Instant Messenger Service

Since smartphone became popular, interpersonal communication with mobile internet has dramatically increased. SNS (social network service) would make individuals to interact with a variety of people, whom they have never met before, and mobile messenger services such as KaKaoTalk would provide many opportunities for communicating with a wide circle of friends and acquaintances more deeply and emotionally. Therefore, an explosion of mobile communication with a smartphone enables people to build or reinforce interpersonal relationship and intimacy [3, 5, 34, 49, 52]. For example, people would like to talk with others about even trivial things through a mobile instant messenger because they want to keep and strengthen the interpersonal relationship [20]. They create a virtual social space in a mobile instant messenger by exchanging message with friends, and express their identities with a various forms of message [22, 34]. Communication with a mobile instant messenger would lead users to experience emotional interaction with others.

Mobile instant messenger service enables users to easily engage in a long-distance communication [17, 34, 42]. Because a sender don't need to wait receivers' responses, they send out what they want to tell. After, then, receiving replies from their friends, they continue talking about it. It means that all users are ready to communicate with friends, who are registered in a mobile instant messenger service, at anytime and anywhere, so they might feel close even though they are physically far away. Kang and Jang [20] argue that the virtual space, to the extent of which users experience in a mobile instant messenger service, has become more concrete and richer, so the borderline between the real world and the virtual space would be blurred. Because, for example, communication participants feel like sharing their daily life through a mobile instant messenger, they would not make a clear distinction between the real and the virtual [20]. In addition, users could interact with friends and share information in real-time if they want. Lim [34] argued that the absence of a chatting room in a mobile instant messenger was interpreted as the cessation of the communication with others for users, and reported a user's testimony, "I felt connected with others by keeping chatting rooms opened, and it makes me perceived that my social relationship is sustained and I have conversation partners." Because people always carry their smartphone everywhere, a mobile communication has become a part of their daily life, and it intensively makes them feel that they are connected with friends emotionally [20, 34]. This characteristic could be one of reasons why people love to use a mobile instant messenger, and Lee et al. [31] named it as the interpersonal communication continuity.

Another characteristic of a mobile instant messenger service could be benevolence. In the context of business, benevolence refers to the ability to take care of consumers' interests ahead of its own self-interest and express sincere concern about it [7]. Dijike and Cremer [14] examined the impact of leaders' benevolence on procedural fairness and endorsement of prototypical leaders, and benevolence was defined as a leader's activity for supporting the group's interest. In general, benevolence can be defined as the quality of someone who involves an activity of kindness to support and help others. Under the context of communicating with others using a mobile instant messenger, benevolence would be a kind of motivation, rather than an activity or personality. If you want to talk someone who is far from you, the simple and easy way would be to give a phone call, but he/she might be too busy to receive. That is one of reason why some people prefer a mobile instant messenger to a phone call [31, 34]. Because senders do not know under what kind of situations receivers are, sending out messages through a mobile instant messenger would make receivers respond at any time they feel comfortable. Lee et al [31] suggested that this kind of benevolence would be one of emotional characteristics that users experienced when communicating with a mobile instant messenger. Benevolence in a mobile instant messenger would be highly related to media synchronicity. If receivers are under difficult situation for responding to incoming messages immediately, they could confirm messages and communicate with senders later. A mobile instant messenger enable users to experience this benevolence in the communication process [34, 38]. The title of your paper should be in bold face, all caps, single-spaced, and centered across the top of the first page.

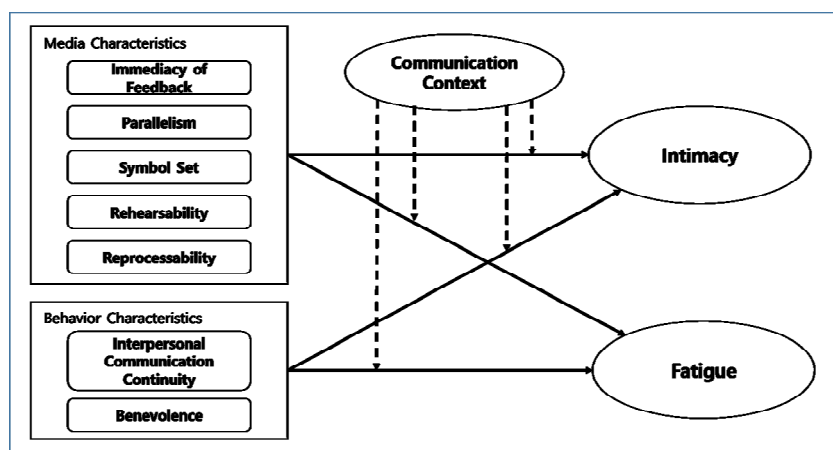
Fatigue and Intimacy

Since ICT (Information and Communication Technology) became a part of our daily life, a variety of social issues related to ICT has been raised. Although, for example, smartphone has positive impact on information exchange, social relationship and communication [15, 19], there are the dark side of ICT such as stress caused from the overuse of ICT devices [46, 50]. Prior studies about digital fatigue argued that people would feel difficulty for using online services and complicated digital devices, and be tired of managing social network and communication [26, 32]. Checking out friends' postings and adding comments with a smartphone could disturb users' daily works [23], and the pressure for maintaining social relationship and the information overload would lead to digital fatigue [32]. Fatigue refers to mental or physical exhaustion, tiredness, and languidness [25]. Hart et al. [16] defined fatigue as a subjective evaluation about uncomfortableness, tiredness, and low motivation, and Piper et al. [45] proposed it as a subjective feeling about tiredness. Fatigue is one of the most common side effects when using a mobile communication [31]. In this study, we defined fatigue as a subjective evaluation about mental or physical pressure and exhaustion caused from using a mobile instant messenger.

Intimacy is an essential aspect in the interpersonal relationship [30] because people has motivation for interacting others and building up warm and close interpersonal relation. Interpersonal process model of intimacy explained intimacy as general perception which was generated from repeated interpersonal interaction over time and it was affected by self-disclosure, partner disclosure, and partner responsiveness [30, 47]. Communication mediated by internet has been used to manage or maintain the interpersonal relationship established in the offline [53], and recently people perceived internet as an alternative communication channel for building a new relationship [4]. People would easily devote themselves to a variety of interactions through internet-based communication and it results in increasing the interpersonal relationship and emotional intimacy [3, 41, 49, 52]. People would using online communication for confirming their identities through interaction, expressing their emotional status, sharing private part of their daily life, and forming connectedness and intimacy [40, 43, 44, 51]. Thus, intimacy can be interpreted as a positive outcome of interpersonal communication, while fatigue can be perceived as a negative outcome.

HYPOTHESES

To identify which factors influence the communication with a mobile instant messenger, this study focused on media synchronicity theory and prior researches about the communication. Based on the literature review, we built up the research model for explaining how media and behavioral characteristics affect intimacy and fatigue. A mobile instant messenger such as KakaoTalk and WeChat has become one of the most important and frequently used apps in nowadays, so we figure it our based on media synchronicity theory, which proposed five dimensions (transmission velocity, parallelism, symbol variety, rehearsability, and reprocessability). To the end, we propose the research model and investigate how media and behavioral characteristics affect intimacy and fatigue (see Figure 1).



<Figure 1> Research Model

First of all, a mobile instant messenger has a wide range of transmission velocity. Transmission velocity is the speed of delivering a message to receivers, so messages would reach to receivers immediately if transmission velocity is high [12]. Also, high transmission velocity could allow receivers to respond incoming messages quickly. In general, a mobile instant message enable to deliver messages to intended receivers as soon as sending it out, but it is another story whether receivers read it immediately or not. If receivers are really busy or do not pay attention to their smartphone, they would check out messages later. It means that receivers can decide to read messages now or later even though a mobile instant messenger deliver it as soon as senders send it out. It is one of interesting characteristics of a mobile instant messenger, so we used immediacy of feedback, rather than transmission velocity, in this study. Interpersonal process model of intimacy [30] suggests that communication partners' feedback has a positive impact on the formation of intimacy. The qualitative research about a mobile instant messenger revealed that people felt uncomfortable for late response from receivers and interpreted receivers' fast responses as respect or care about

them [34]. On the other hand, Kim and Lee [26] found that frequent interactions and information exchange on SNS led to increasing digital fatigue because they felt pressure to respond others quickly. Cho et al [9] argued that communication overload would increase in a low synchronous media rather than a high synchronous media. Because a high synchronous media forces people to respond immediately to senders, their mental pressure would not be cumulated. If they use a low synchronous media, the number of unresponded messages might increase over time and as a result they would feel the mental pressure [9, 11, 28]. These lead to the following hypotheses.

H1: the immediacy of feedback in a mobile instant messenger is positively related to intimacy

H2: the immediacy of feedback in a mobile instant messenger is positively related to fatigue

Parallelism refers to the width of the medium, which means how many the concurrent messages effectively take place over [12]. If you want to send out messages to many people through the old media such as telephone, you should do it one by one, but the new media such as a mobile instant messenger enable them to do simultaneously. Because of the limited cognitive capacity and mental resource of human being, handling many task at the same time would result in cognitive overload, and it makes people feel fatigue [8]. For example, Kwak et al. [29] argued that performing other activities during chatting with friends on a mobile instant messengers would cause information overload and it makes people tired. On the other hand, the simultaneous communication with a variety of friends would enable users to get more chances for building up and keeping good relationship [31]. Compared to desktop PCs, smartphone is free from special limitation for connecting internet, so people are easily engaged in the communication at anytime and anywhere. A mobile instant messenger would be appropriate media for people who want to communicate others freely. Therefore, it leads to the following hypotheses.

H3: Parallelism in a mobile instant messenger is positively related to intimacy

H4: Parallelism in a mobile instant messenger is positively related to fatigue

Symbol sets is the height of the medium, which means a variety of ways to encode information for communication [12]. Because people use different types of symbols to deliver what they want to say in their communication process, it is essential and fundamental. People can communicate with a variety of ways such as a handshake, facial expression, moving the head, and a voice tone in a face-to-face conversation, but a text-based mobile communication (e.g., SMS and a mobile instant messenger service) is relatively limited. Information transmission and processing efficiency is affected by symbol sets. For example, text-based media such as email would relatively take more time to encode than a voice mail, while it might be reversed in decoding a message [12]. When communicating others with a mobile instant messenger, most information would deliver in the text format, so people have difficulty to express their emotion on the screen. Also, they want to deliver their subtle emotional nuance to communication partner, but the text is not good enough to do. Therefore, people in mobile instant messenger would use a variety of emoticons (or emoji) to express their emotion [27, 35]. However, they might be unsure whether their emotion clearly and exactly deliver through emoticons, so they tend to show their emotion more actively and exaggeratedly [1, 34]. This exaggerated expression would make people feel tired for using a mobile instant messenger. It leads to the following hypothesis.

H5: Symbol set in a mobile instant messenger is positively related to fatigue

After sending messages out through a mobile instant messenger, it is impossible to set back a clock before sending it out. Senders should be careful to write a message and examine it before press the button. Lee [34] conducted the depth interview which focused on college students' daily experience about using a mobile instant messenger, and found that they felt some pressure when they needed to write messages carefully. If the communication takes place through a mobile instant messenger, all messages would be kept until exiting and closing the chatting room, so these characteristics make people feel tired. Prior studies about SNS argued that SNS users felt pressure and fatigue for using SNS because of managing and maintaining human relationship on SNS [25, 39]. Nowadays many people actively use a mobile instant messenger for building, managing, enhancing, and expanding their human relationship. If, however, they write improper message and send it out, it could easily give some damage on their human relationship. Therefore, it leads to the following hypotheses.

H6: Rehearsability in a mobile instant messenger is positively related to fatigue

H7: Reprocessability in a mobile instant messenger is positively related to fatigue

A mobile instant messenger enables people to communicate others anywhere and anytime, so it will be helpful to maintain good relationship with their friends [17, 42]. When talking friends with a mobile instant messenger, they open a chatting room and invite them. After finishing talk, they usually keep opening the room, rather than closing it. A user testified that keeping chatting rooms opened in the mobile instant messenger would make her feel sharing her daily life with her friends through the mobile instant messenger [20]. This virtual space could enhance their intimacy with friends by emotional connection through the

mobile instant messenger. Lee et al [31] also argue that people might feel like communication continuing when they open the chatting room. On the other hand, one of reasons why people use a mobile instant messenger rather than a phone call is that they do not know the current situation a communication partner is facing. If they are busy and difficult to receive a phone call, a mobile instant messenger would be better way to communicate [34]. Because people take care of others' situation, they would contact their friends with a mobile instant messenger, not phone call. This benevolence would give positive impact on their human relationship. Therefore, it leads to the following hypotheses.

H8: Interpersonal communication continuity in a mobile instant messenger is positively related to intimacy

H9: Benevolence in a mobile instant messenger is positively related to intimacy

Nowadays a mobile instant messenger is widely used for personal and business, so the impacts of media and behavioral characteristics would vary depending upon whether it is used for personal or for business. For example, the immediacy of feedback would be more critical to people who use it for business than those who do for personal. Symbol set would be less important in the business communication than in the personal communication. Rehearsability and reprocessability would have more impact in the business communication. Also, interpersonal communication continuity and benevolence would be meaningful when people use a mobile instant messenger for personal, rather than for business. Also, Dennis and Valaich [13] suggest that communication consists of two processes, conveyance (transmission of information) and convergence (mutual agreement for understanding). The performance of media would vary depending on the media synchronicity, and the communication context (business vs. personal) would give different weight on conveyance and convergence processes. Thus, it leads to the following hypothesis.

H10: The communication context moderates the effects of media synchronicity and behavioral characteristics on the intimacy

H11: The communication context moderates the effects of media synchronicity and behavioral characteristics on the fatigue

CONCLUSION

In sum, this study aims to demonstrate why people prefer using a mobile instant messenger to giving a phone call based on the media synchronicity theory and other researches. Since the diffusion of smartphone changed our daily life, the interest about a mobile instant messenger dramatically increases. Many prior researches about a mobile instant messenger were based on Technology Acceptance Model (TAM) or Theory of Planned Behavior (TPB), which used typical variables such as perceived usefulness, perceived ease of use, intention to use, and etc. These researches was meaningful when the target product was in the early stage, but because the market of a mobile instant messenger was in the mature stage, we would like to focus on the communication itself, rather than the intention to use a mobile instant messenger. Specifically five characteristics of the media synchronicity and two behavioral characteristics are expected to affect intimacy and fatigue when using a mobile instant messenger, and the degree of the impact of these factors are expected to vary depending on the communication context (personal vs. business). Based on the theoretical background and our prediction, it would be expected to provide the useful insight about a mobile instant messenger.

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The Adoption of *Twitter* for Financial Reporting – The Company Size and Industry Sector Effect

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ABSTRACT

This study uses the adoption of *Twitter* for financial reporting as an example to investigate how company size and industry sector may affect companies' adoption of new innovation. The sample comprises 880 financial reporting related tweets from 82 Australian Securities Exchange (ASX) companies' *Twitter* accounts. The results show that financial reporting on *Twitter* is gaining momentum in Australia and ASX companies with larger market capital sizes are more likely to adopt *Twitter* for financial reporting. While Information System and Telecommunication Services companies are early adopters of *Twitter* for financial reporting, they disclose fewer types of financial reporting information on *Twitter* than early adopters from other industry sectors. This shows that the access to resources may be more important than knowledge of innovation, for companies that want to fully adopt new technology.

Keywords: Technology adoption, *Twitter*, corporate disclosure.

SUMMARY OF RESEARCH

Technology adoption is an essential topic in modern business practice. With the influence of internet and other information technology, an efficient application of new technology, including internet and social media, is key to managing business communication. Financial reporting is an important aspect of today's business activity, as financial reporting notifies current and potential investors about the companies' financial performance [4]. Recent empirical studies [2, 12] have shown that corporate disclosure on *Twitter* is significantly related to the reduction of information asymmetry in the stock market. At the same time, there is anecdotal evidence that stock markets respond to corporate rumours [3, 10] and leakage of information [5] on *Twitter*, with unexpected stock price movement. These challenges of using *Twitter* for financial reporting have raised concerns from regulators [1, 11] and industry professionals [6, 8]. This study investigates the adoption of *Twitter* for financial reporting by ASX companies to contribute further understanding of how companies' market capital sizes (a proxy for companies' size) and industry sector may affect companies' adoption of new technology.

This study applies the technology adoption argument from Rogers [9] diffusion of innovation theory. In his diffusion of innovation theory, Rogers [9] argues that access to resources and knowledge of innovation are key factors that affect companies' adoption of a new technology. In this study, the 'new technology' is represented by the sample companies' adoption of *Twitter* for financial reporting. Prior literature [2,7] is consistent with Rogers [9] diffusion of innovation theory. For example, Blankespoor, Miller & White [2] argue that IT firms tend to be early adopters of technology, which is in line with Rogers [9] discussion that the knowledge of innovation is one key factor that affects companies' adoption of a new technology. In the study of financial reporting by ASX companies by Prokofieva [7], nearly half of the sampled ASX announcement events are from Mining companies. Despite the lower recording of companies' adoption for financial reporting from different industry sectors [7], it is reasonable to argue that Mining companies may be the early adopters of *Twitter* for financial reporting, since they disclose relatively large amounts of financial reporting tweets. A brief observation of the ASX companies' market capital sizes shows that Mining companies have comparably large market capital size. This finding from Prokofieva [7] and observation of ASX companies' market capital sizes are in line with Rogers [9] diffusion of innovation theory, who argues that the access to resource is one key factor that affects companies' adoption of a new technology.

Based on the above discussion, this study develops the following hypotheses:

H1: There is a positive association between ASX companies' market capital sizes and the adoption of *Twitter* for financial reporting.

H2: ASX companies from certain industry sectors that are close to technology are more likely to adopt *Twitter* for financial reporting.

Targeting ASX top companies as the initial sample, this study identifies 191 corporate *Twitter* accounts and collects 64,933 tweets that are disclosed prior to 30th November 2013. Through filtering and thematic analysis, 880 financial reporting tweets from 82 corporate *Twitter* accounts are confirmed for further investigation. An articulation of the posting times from the first financial reporting tweets in these 82 sampling *Twitter* accounts shows that the adoption of *Twitter* for financial reporting has been increasing (see Figure 1). This indicates that the use of *Twitter* for financial reporting is gaining momentum in Australia.

Regression analyses on the listed companies' market capital size present that listed companies with larger market capital sizes are more likely to adopt *Twitter* for financial reporting, regardless of whether these listed companies have already adopted *Twitter* for other business information disclosure. Further, ASX companies from various industry sectors present different *Twitter* adoption patterns for financial reporting. For example, while Information System and Telecommunication Services companies are more likely to adopt *Twitter* for financial reporting, Health Care and Consumer companies are less likely to do

so even they have already adopted *Twitter* for other business uses. From the aspect of financial reporting content on *Twitter*, a large proportion of the financial reporting information is related to 'Earnings', 'Income/Expenditure' and 'Issue New Capital'.

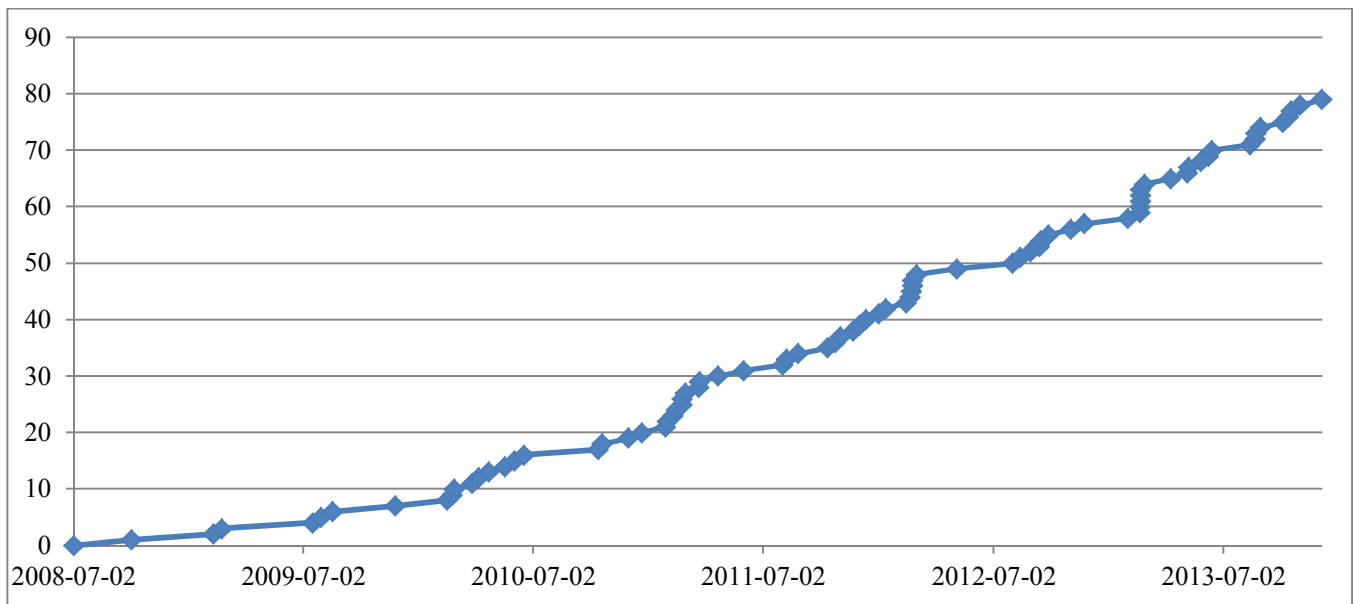


Figure 1: The Development of Financial Reporting *Twitter* Accounts over Time

This study concludes with a comparison between *Twitter* adoption for financial reporting and the contents of financial reporting information. Figure 2 shows the coverage of financial keywords by each individual industry sector. For example, companies from the Materials industry sector discuss 21 out of 23 financial keywords at least once in their tweets. At the same time, nearly 30% of Materials sector companies discuss at least one financial keyword. The results of *Twitter* adoption for financial reporting are incorporated in Figure 4. As illustrated in Figure 4, ASX companies that belong to the industry sectors that have high adoption rates of *Twitter* for financial reporting, such as Materials and Energy, cover more financial keywords and have higher percentages of companies that discuss at least one of the financial keywords. This indicates that as companies in these industry sectors are more likely to adopt *Twitter* for financial reporting, they also tend to disclose more types of financial reporting information. In contrast, Information Technology and Telecommunication Services companies show different patterns of *Twitter* adoption for financial reporting and the contents of financial reporting information. Although the adoption rates of *Twitter* for financial reporting are relatively high for companies in these two industry sectors, and the results of previous binary regression analyses show that companies in these two industry sectors are more likely to adopt *Twitter* for financial reporting, the numbers of financial keywords that are covered by companies in these two industry sectors are not so large as other industry sectors. This indicates that while Information Technology and Telecommunication Services companies have high adoption rates of *Twitter* for financial reporting, they tend to only disclose certain types of financial information. This finding presents that the access of resources may be more important than the knowledge of innovation, if a company want to fully adopt a new innovation. It also provides a potential explanation for why Information Technology and Telecommunication Services companies disclose fewer type of financial reporting information, even though they are more likely adopt *Twitter* for financial reporting.

The results and discussions of this study provide several contributions to the current literature and the business world. First, this study outlines the current use status of *Twitter* as a financial reporting channel, which has been developing continuously. Second, this study presents that ASX companies with larger market capital sizes and from industry sectors that are close to technology, such as Information Technology and Telecommunication Services, are more likely to adopt *Twitter* for financial reporting. These findings are consistent with Rogers diffusion of innovation theory [9], who argues that access to resources and knowledge of innovation are key factors that affect companies' adoption of new innovation. Third, this study explores the content of financial reporting on *Twitter*, and reveals that the access to resources may be more important than the knowledge of innovation, if a company wants to fully adopt a new innovation. This finding provides new evidence to Rogers diffusion of innovation [9], in the discussion of how access to resources and knowledge of innovation may play different roles in affecting companies' adoption of new innovation.

As recent studies suggest the increasing use of *Twitter* by ASX companies during corporate announcement periods could reduce the level of information asymmetry in the stock market [2, 7], an understanding of the development of *Twitter* for financial reporting and its current status is warranted. Therefore, this study contributes to the current literature of financial reporting on *Twitter* in the Australian context. The results confirm that the use of *Twitter* for financial reporting has been increasing, which indicates the importance of research in this area and calls for further studies.

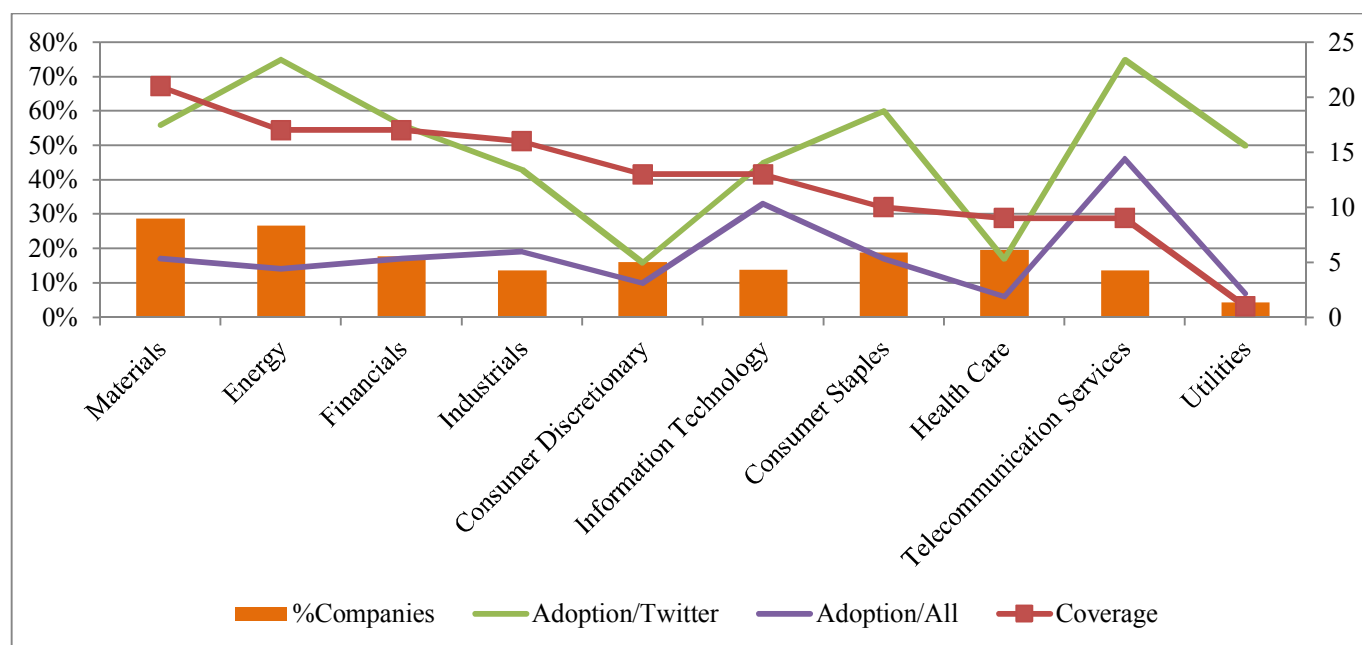


Figure 2: Comparison of Financial Keywords Appearance and Twitter Adoption across Industry Sectors

This study investigates companies' adoption behaviours of *Twitter* for financial reporting. Although *Twitter* is widely recognised as a low cost and high speed communication channel, the results of this study show that the adoption of *Twitter* for financial reporting is more popular for listed companies with larger market capital sizes and the ones from certain industry sectors. However, previous studies [2, 7] recognise that listed companies with relatively smaller market capital sizes could benefit more from increased disclosure on *Twitter*, when compared to companies with larger market capital sizes. This study identifies a potential lack of understanding among listed companies with smaller market capital sizes, regarding the benefits of using *Twitter* for financial reporting. The results indicate this lack of understanding. For industry practitioners, it is important to review the potential concerns or obstacles from small listed companies. At the same time, it is essential to investigate an effective approach that promotes the use of *Twitter* for financial reporting. For literature development, the identification of this lack of understanding calls for further research, such as interviews with managers from listed companies with small market capital sizes to review their concerns and obstacles regarding adopting *Twitter* for financial reporting.

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Enhancing Social Media Marketing with A Brand Post Management Process

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ABSTRACT

In recent years, enterprises are increasingly using social media to enhance the marketing effects about their brands and services. As such, brand pages on social media sites with brand posts placed are commonly used for effecting desired marketing features such as advertisement of services and assistance of customers. Therefore, it has become an important objective for enterprises to enhance the effects of their brand pages via sufficient management mechanisms. For this purpose, we present in this paper a management process that focuses on the organization, execution, and control of brand posts to enhance their marketing effects.

Keywords: Social media, marketing, brand page, brand post, management process.

INTRODUCTION

In recent years, social media have been popular for their well supports on the connection, production, and sharing of interested contents among individuals [1]. The growth and popularity of social media have then made enterprises to consider the potential of using these media to promote their marketing features into a word-of-mouth (WOM) model [2] where many benefits can be expected [3]. As such, enterprises are increasingly using social media nowadays towards these benefits by exploring their intrinsic social perspectives that include, for instances, communities and their network structures among users [4], characteristics and personalities of users [5-7], social interactions and their patterns and motivations among users [8-13], identities and brands of users [14,15]. Afterwards, brand communities (or brand pages) are found to be a successful platform for increasing sales [16,17]. In addition, they are also useful for improving the relationship with participant customers and enhancing their perception about brands and services [18,19]. Since brand pages facilitate the interactions among customers for exchanging opinions about the brands or services, they promote these customers into a WOM model and hence become a powerful tool for marketing. Therefore, more recent research has focused on empirical studies about the effects of brand pages. For instances, [20] explores the factors that could attract customers into loyal brand fans, while [21] discusses the popularity of brand posts and their effectiveness on marketing. In addition, [22] addresses the online engagement factors on brand pages and [23] estimates the preferred features of the contents of brand posts.

In summary, there are already many studies about the use of social media and among which specific discussions about the effectiveness of using brand pages on marketing have been presented. However, while these presented works have conducted the success of marketing activities on social media, little attention has been paid on the management issues about the use of brand pages and the popularity of brand posts for obtaining their enhanced effects on marketing. Therefore, to address these deficiencies, we present in this paper a management process that focuses on the organization, execution, and control of brand posts for obtaining their enhanced effects on marketing. In general, the process starts from the identification of the desired features for achieving the marketing goals of brand posts, through the creation of the actual posts for realizing these features, and finally ends with the execution of placing these posts on brand pages and then the control of these posts for enhancing their effects on the goals.

This paper is organized as follows. Section 2 presents the management process with four specific steps. The process is illustrated with an example of two posting goals and the desired features for their achievement. Finally, Section 3 has the conclusions and future works.

THE MANAGEMENT PROCESS

In general, as shown in Figure 1, the brand post management process has the following four steps:

Step 1—Identifying Desired Features about Brand Posts

The first step is to identify the desired features about the brand posts to be posted for enhancing their effectiveness on marketing. Initially, consider the many existing studies in [20-26] about the brand posts for marketing, three types of typical features may be considerably included in brand posts as follows.

1. The characteristics of posts – that addresses the distinguishing features or distinctive qualities of the posts. This for instances may include (1) vividness that reflects the richness of the posts for stimulating the different senses [27] and hence may contain such internals as dynamic animations, contrast colors, and bright pictures; (2) interactivity that emphasizes the interactions among customers and the brand where customers may initiate or react for a communication by means of interactive media such as browsing links and question/survey options; and (3) Categorization that addresses the intrinsic attributes of the posts underlining the category these posts belong to such as brand-specific entities (e.g., name, logo, address, etc.) and the layouts of these entities.

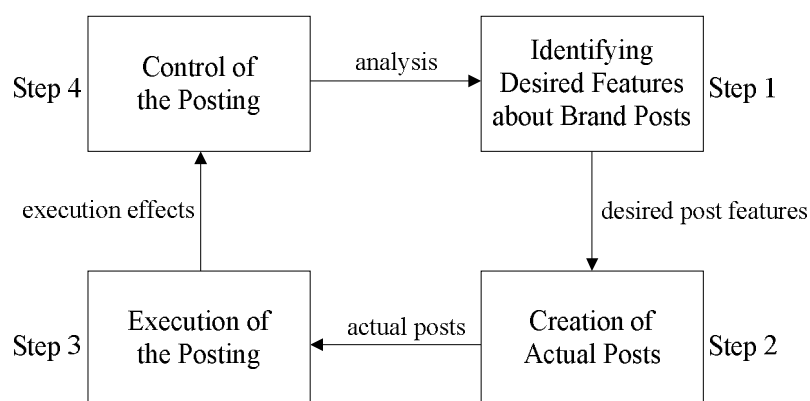


Figure 1: the brand post management process

2. The contents of posts – that refer to the contents of the posts for motivating the participations of customers. This for instances may include (1) informative that focuses on the presence of information (e.g., knowledge, reference, keyword, value, etc.) for stimulating the information-seeking desires of customers; (2) responsiveness that addresses the response of requests (e.g., question, complaint, suggestion, etc.) for satisfying the expectations from customers; (3) entertainment that emphasizes the use of sophisticated media (e.g., photo, video, link, etc.) for customers to perceive fun, exciting, and cool; and (4) remuneration that reflects the use of compensations (e.g., sweepstake, coupon, etc.) for motivating the participations of customers in the contents of the posts.
3. The posting of posts - that addresses the distinguishing features about the actions for the posting. This in general may include (1) timing that refers to the (e.g., scheduled or occasional) times of the posting where all designed posts are placed on the brand pages in accordance with the scheduled times (e.g., place a scheduled post for advertisement) or occasional times (e.g., place an occasional post for priority response); (2) position that addresses the locations (e.g., top, middle, bottom) of the posts on the brand pages (e.g., on the top for more notices or on the middle for succeeding previous posts), and (3) repetition that refers to the repeated (e.g., regular or irregular) posting of the posts (e.g., repeat a regular posting for an advertisement).

To identify the desired ones from these above considerable features, it is not uncommon to think of the posting purposes of the brand posts where the achievement of these purposes is measurable. For instance, increasing the engagement of customers on the brand is a common purpose of posting designed posts on brand pages and its measurement is taken by the average number of likes divided by the number of customers who ever like the pages. Therefore, the identification of desired features may be achieved by adapting the many existing goal-oriented requirements elicitation approaches [28-30] with the following steps:

1. Identify and ensure the desired posting purposes (i.e., marketing goals) of the brand posts. With the method in [30], this may be achieved by first identifying relevant stakeholders such as brand owners and customers. A selected group from these stakeholders is interviewed for driving and clarifying the purposes of the posting.
2. Normalize and prioritize these identified goals for their considerable achievability. Since the scales or extents of all identified goals may be quite contradicted or redundant, normalization is thus necessary for adjusting their scales or extents to balance their considerable achievability. After then, these normalized goals can be prioritized for scheduling their achievement.
3. Identify the desired features about these posts for achieving such normalized and prioritized goals. As one may conceive, this can be achieved by identifying from those considerable features the desired ones that have well-recognized capabilities to contribute on the achievement of these goals.

As a result, the desired features can be identified by exploring the desired posting purposes (i.e., marketing goals) of the brand posts. Figure 2 illustrates an example of two posting goals and the desired features for their achievement:

1. Increasing # of Click-Through – causing the interests of customers to click on the posts for exploring their contents; this is hopefully achieved by anchoring in these posts (1) the vividness/interactivity characteristics; (2) the knowledge/reference/keyword-addressed and photo/video-featured contents; and (3) the scheduled posting of these posts on the top of the brand pages with specific times of repetition.
2. Increasing Customer Engagement – causing the engagement of customers on the brands; this is considerably achieved by

imposing in these posts (1) the vividness characteristics; (2) the knowledge/value-addressed and photo/video-featured contents; and (3) the scheduled posting of these posts on the middle of the brand pages with specific times of repetition.

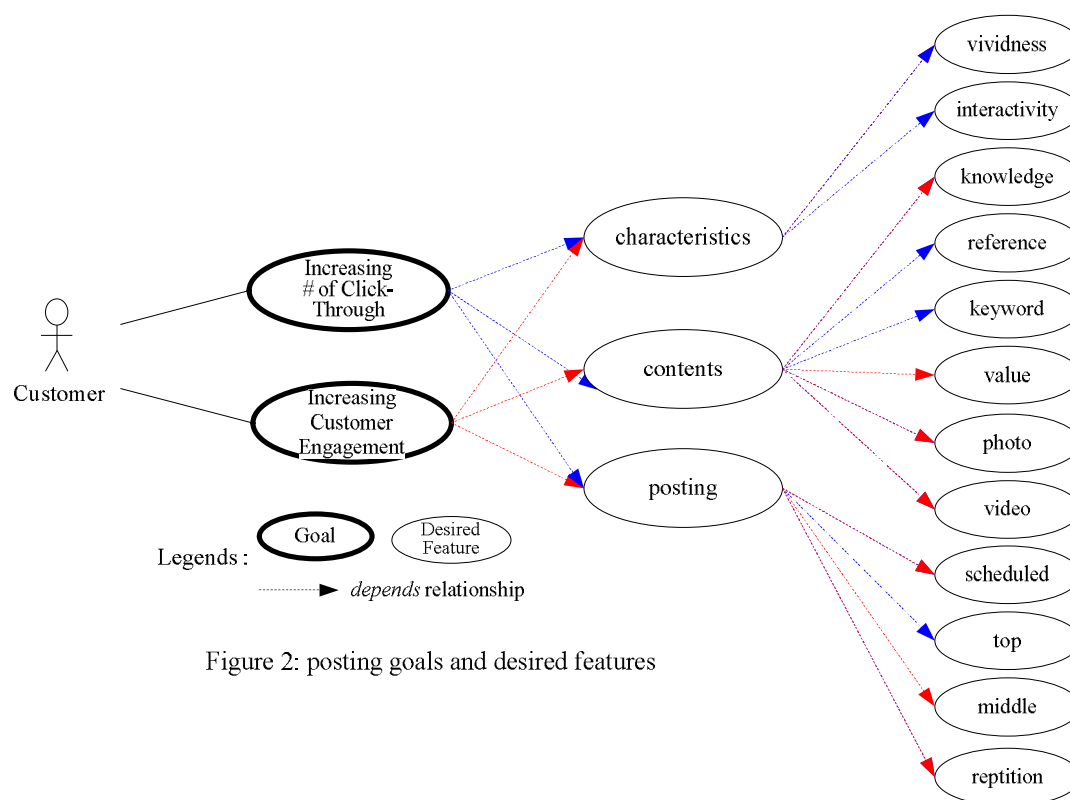


Figure 2: posting goals and desired features

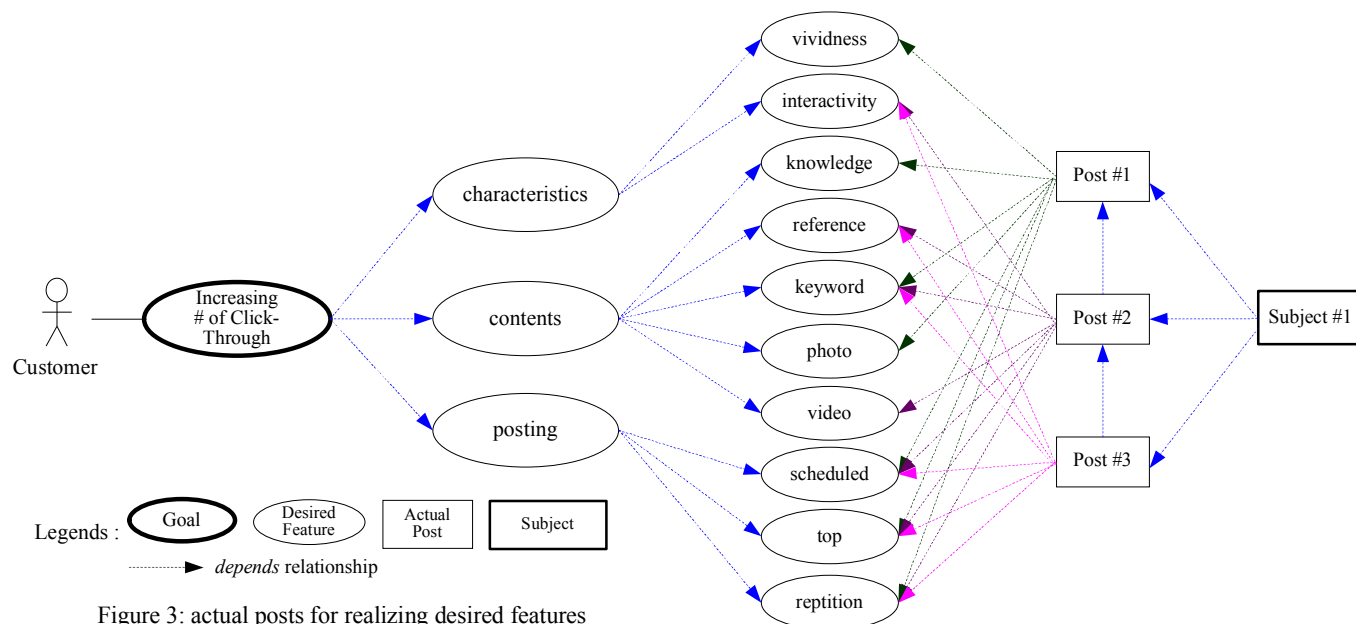


Figure 3: actual posts for realizing desired features

Step 2 – Creation of Actual Posts

The next step is to create the actual posts for realizing the desired features identified above. In general, this can be achieved by (1) determining a series of brand-relevant subjects with respect to a desired marketing goal; (2) organizing and designing a series of brand posts around the subjects that collectively realize the desired features (that is, the characteristics, contents, and posting actions of these posts are designed for realizing these features); and (3) creating each post that has its characteristics, contents, and posting actions to realize a designed part of the desired features. It should be noticed that as discussed in the above (2) for organizing and designing a series of brand posts around relevant subjects that collectively realize the desired features, there may have various considerations about the allocation of the desired features into respective posts. For instance, for organizing brand posts around an occasional subject that is expected to be attractive for customers only in a short time period, it is better to create few posts for each of them realizing more desired features such that their posting can be accomplished in a short time period. In contrast, for a stable subject that is recognized to attract customers for a longer time period, more posts may be

created for each one realizing part of the desired features such that their posting can provide a longer period of subject-related contacts with customers.

As a result, the actual posts can be created by organizing a designed series of brand posts around brand-relevant subjects with respect to a desired goal. Figure 3 illustrates an example of three consecutive actual posts for realizing the desired features towards the achievement of the Increasing # of Click-Through goal:

1. Post #1 has the Vividness characteristics, the knowledge/keyword-addressed and photo-featured contents, and the posting actions of a scheduled posting on the top of a brand page with specific times of repetition.
2. Post #2 follows then by having the Interactivity characteristics, but the reference/keyword-addressed and video-featured contents, and as well the posting actions of a scheduled posting on the top of a brand page with specific times of repetition.
3. Post #3 follows finally by having also the Interactivity characteristics, but the reference/keyword-addressed contents, and as well the posting actions of a scheduled posting on the top of a brand page with specific times of repetition.

Step 3 – Execution of the Posting

The third step is to execute the posting by placing the actual posts created above on brand pages. As one may conceive, such a posting (completed by executing the posting actions determined above) for actual posts represents the actual placement of their features on brand pages. It is noticed that the success of the posting can be verified by confirming the consistence between the desired features of these posts and their actual presentation on the posted pages.

Continue on the example of the three actual posts in Figure 3, they shall be posted consecutively on the top of a brand page by a planned schedule (e.g., placing a post per day) and the posting shall be repeated with desired times (e.g., three times of the repeated posting of these three posts in the planned schedule).

Step 4 – Control of the Posting

With the execution of placing the actual posts, the final step is to explore the execution effects of the posting in terms of the respective measures on the desired goals. As in above, such execution effects (collected measures) represent the achievement of these goals and hence can be used in an analysis for recognizing the strengths/weaknesses of the current posting. After then, with the analysis results, relevant artifacts about the current posting such as the desired goals, the desired features about current posts, and the actual characteristics/contents/posting actions of current posts may need to be revised/adapted and then be used in the next lifecycle of the four-step post management process.

Continue on the example of the three actual posts in Figure 3, their scheduled consecutive posting on the top of a brand page would result in the generation of some quantitative measures (e.g., the number of clicking on the posts for exploring their contents) about their execution effects on the achievement of the **Increasing # of Click- Through** goal. Since the posting shall be repeated three times, the measures collected from these three executions can be used for verifying its effects on the achievement of the desired goal. After then, an analysis for recognizing the strengths/weaknesses of the posting shall be conducted. With the analysis results, relevant artifacts about the posting may need to be revised/adapted and then be used in the next lifecycle of the above four steps.

CONCLUSIONS

In this paper, we present a management process that focuses on the organization, execution, and control of brand page posts for obtaining their enhanced effects on marketing. In general, the process starts from the identification of the desired features for achieving the marketing goals of brand posts, through the creation of the actual posts for realizing these features, and finally ends with the execution of placing these posts on brand pages and then the control of these posts for enhancing their effects on the goals. For illustration, the process is initially applied to the posting of brand posts on the Facebook fan page for the hair treatment product MHM.

In recent years, enterprises are increasingly using social media to promote their marketing features into a well-known beneficial WOM model. To this trend, there are already many studies about the use of social media where the use of brand pages has been discussed a lot for addressing its effectiveness on marketing. However, while these presented works have conducted the success of marketing activities on social media, little attention has been paid on the management issues about the use of brand pages and the popularity of brand posts for obtaining their enhanced effects on marketing. However, in our opinion, such a management mechanism for the use and popularity of brand posts should not be negligible since a well-considered process is critical for directing the use of the brand pages on marketing in a systematic and managed manner. Therefore, the process presented herein provides an effort on this need.

Thereafter, we will continue to explore the practical applications of the process on Facebook fan pages for enterprise brands where its effects on marketing shall be particularly addressed. It should be noted that these practical applications may encompass

various marketing categories such as Foods, Electronics, and Clothes. The usability of applying such a systematic and managed process on the brand posts for enhancing their effects on various categories of marketing will be carefully experienced.

ACKNOWLEDGEMENTS

The work in this paper is supported by the Ministry of Science and Technology in Taiwan under the Grant MOST 104-2410-H-130-025.

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Task-Technology Fit and Culture: Perceptions of and Media Feature Preferences for The Task of Delivering Bad News

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ABSTRACT

Task-technology fit (TTF) suggests that what drives technology utilizations is individuals' subjective evaluations of fit. The technology aspect that gives rise to task-technology fit has received extensive attention, and researchers recently called for more attention to the task aspect. In this paper, we examine how culture may affect the task aspect of TTF, consequently leading to differences in subjective evaluations of fit and ultimately technology utilizations. Moreover, we distinguish the two mechanisms via which culture may affect the task aspect of task-technology fit, i.e., task perception and task response. Focusing on the task of delivering bad news, we examine cultural differences (China vs. Non-China) in the perception of and responses to (in terms of media feature preferences) the task of delivering bad news. Data was collected using surveys from clients of a multinational public relations company. Results show that there was no difference in task perception for delivering bad news between Chinese and Non-Chinese participants, marginally supported difference in the preferences for rehearsability, and no difference in the preference for symbol sets.

Keywords: Task-technology fit, culture, media feature, media preference, bad news communication, task perception, task response.

INTRODUCTION

Task-Technology Fit (TTF) theory [1] argues that “for an information technology to have a positive impact on individual performance, the technology must be utilized, and the technology must be a good fit with the tasks it supports” (p.213). Implicit in their arguments is that what drives people's *utilization* of technology is their subjective evaluations of fit while what determines *performance* is objective fit, a point that was made explicit only recently [2]. However, a review of the literature shows that existing research on TTF focused extensively on objective fit [3]. We argue that subjective evaluations of fit, which drive utilization, deserve more attention as “systems must be utilized before they can deliver performance impacts” [1, p.216]. One driver of subjective evaluations of fit is culture. The impacts of culture on the technology side of TTF (and consequently subjective evaluations of fit) have received extensive attention in the IS literature [see 4 for reviews, 5]. For example, Straub [6]'s cross-cultural comparison found that Japanese workers have lower perceptions of social presence and information richness towards e-mail compared to their US peers, leading Japanese workers to be less likely to choose email compared to US workers. However, the potential impacts of culture on the task aspect of TTF have received little attention. Goodhue [2], when reflecting on the progress of TTF research, argued that “a key missing construct that is too often not part of our thinking is the task of the user and the fit of the IT artifact to that task” (p.221).

Culture may affect the task aspect of TTF via two major mechanisms [7], i.e., how individuals perceive the task (i.e., task perception) and how individuals respond to the task should they have the same perception (i.e., task response). On one hand, researchers have long recognized that an individual's perception of task characteristics is socially constructed [e.g., 8, 9]; on the other hand, culture may affect an individual's “ideal response” or “logics of action” to the focal task holding the task perception constant. That is, even if individuals perceive the focal task similarly, they may still have different answers regarding “how should I respond to the task?”

The influence of culture is likely to be especially prominent for communication tasks. Culture is argued to be the foundation for communication. For example, Samovar et al.[10] argued that “culture and communication are inseparable because culture not only dictates who talks with whom, about what, and how the communication proceeds, it also helps to determine how people encode messages, the meanings they have for messages, and the conditions and circumstances under which various messages may or may not be sent, noticed, or interpreted.” (p.24). Previous studies related to culture and communication media tend to treat culture as simply the *context* of the study without paying much attention to how culture affects *perceptions of and/or responses to* (in terms of media choices or preferences) the communication task. Hence, we believe that a focus on how culture interacts with task perceptions and/or task responses potentially impacting communication media fit evaluations may produce a potentially more fruitful investigation. Moreover, consistent with recent emphasis on media features [11], we focus on understanding feature-level evaluations of fit – that is to say, we investigate the perceived fit of certain media features for a communication task.

The communication task we examine in this paper is delivering bad news. We choose this particular communication task for two major reasons. First, delivering bad news is a communication task where cultural differences are likely to be more notable. Researchers recognized that when communicating, individuals are likely to have three potentially competing and overlapping goals: task efficiency (i.e., communicating effectively), relationship preservation (i.e., maintaining existing relationships between message senders and receivers), and self-presentation (i.e., maintaining a positive image with the receivers as well as others who

become party to the contents of the communication) [e.g., 12, 13]. Subjective evaluations of TTF depend on individuals' assessments of a medium's fit to one, two, or all three of these goals. In the task of delivering bad news, there are conflicts between the three goals, which provides space for cultural differences to emerge. Second, delivering bad news is an unpleasant task that many people struggle with. Hence, focusing on this task may provide practical understandings regarding what kinds of media are deemed appropriate for delivering bad news and why.

In summary, culture may affect the task aspect of TTF via affecting task perceptions and/or responses, consequently leading to subjective evaluations of fit. Focusing on the task of delivering bad news, we seek to address the following two research questions:

RQ1: Are there cultural differences in task perception regarding delivering bad news?

RQ2: Are there cultural differences in task response (i.e., media feature preferences) regarding delivering bad news?

The remainder of this paper is organized as follows. We first discuss the theoretical bases, i.e., task-technology fit and media synchronicity theory. Next, we discuss the chosen communication task (i.e. delivering bad news), and also the perceptions of and responses to (in terms of media feature preferences) this task. Finally, we discuss the relevant culture phenomenon for delivering bad news (i.e., face) and how cultural differences in the emphasis on face may lead to differences in the perceptions of and responses to the task of delivering bad news, leading to our hypotheses.

This paper contributes to the literature in the following ways. First, we extend the TTF research by examining how culture affect the task aspect of TTF, consequently leading to different subjective evaluations of fit and ultimately different technology choices. Second, we distinguish the two mechanisms via which culture may affect the task aspect of TTF, i.e., task perception and task response. Current research often blurs the two mechanisms together, leading to an inadequate understanding regarding why exactly does culture make a difference. In this paper, we examine potential cultural differences in individuals' task perceptions and/or task responses for a frequently occurred communication task (i.e., delivering bad news). Also, consistent with the recent emphasis on understanding communication medium at the feature level, we extend previous study by focusing on understanding feature-level evaluations of fit.

LITERATURE REVIEW

We integrate two theoretical domains to develop an understanding of individuals' media feature preferences for a certain communication task (see Figure 1). We start with TTF [e.g., 14] which provides a general understanding of the need for individuals to evaluate technology characteristics and task characteristics in order to develop a perspective on the fit of a given technology to a given task. Next, we turn to media synchronicity theory [11] which focuses specifically on communication tasks, elaborates two communication processes (i.e., conveyance and convergence), and indicates that how a technology gets used (i.e., appropriation factors) is also important. Further, it adds additional insight by opening the black box of technology to offer a set of media capabilities (consisted of media features) that individuals need to be aware of in order to assess media fit.

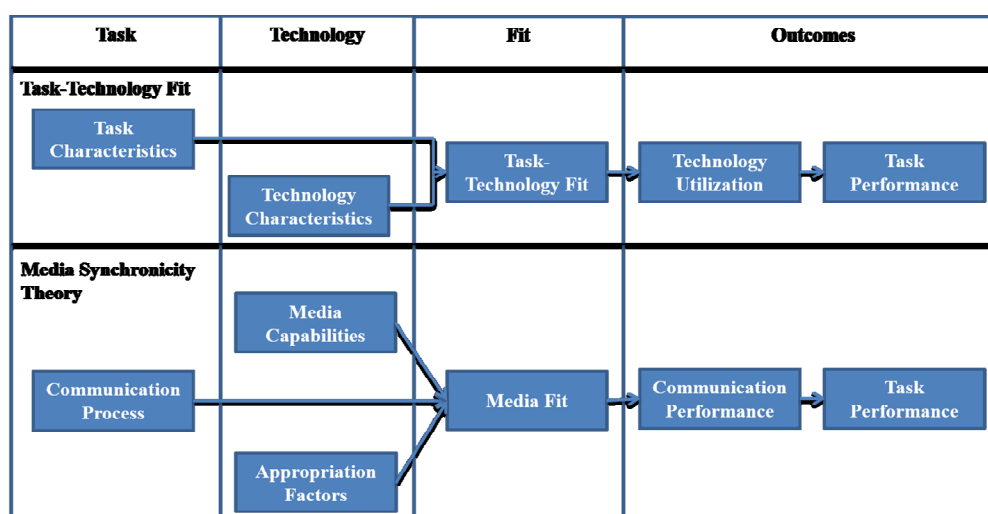


Figure 1: Theoretical Bases

Task-Technology Fit





Empirical studies of TTF have supported the impact of fit on technology utilization (or adoption) at both individual and organizational levels [e.g., 15, 16]. However, what is implicit in TTF arguments is that the “fit” evaluation driving technology utilization or adoption is actually the individual’s subjective evaluation of fit. Individuals can interpret the same technology or task characteristics differently resulting in different evaluations of fit, leading to different technology utilizations or adoptions [14, 16]. While past studies have focused on subjective evaluations of fit resulting from differences in *technology* interpretations (e.g., the characteristics of a certain technology and how technology characteristics should be used), the other possibility (i.e. differences in *task* interpretations) has been understudied. One important factor that may lead to different task interpretations is culture [e.g., 8]. For example, freely sharing different opinions may be seen as a way to contribute to the organization in some cultures, but may be interpreted negatively (e.g. embarrassing or challenging to the organization’s leadership) in other cultures [e.g., 17, 18].

In summary, TTF essentially argues that interpretations of technology characteristic *and* of task characteristics affect subjective evaluations of fit, which consequently effects technology utilization and ultimately performance. One research direction deserving greater attention is subjective evaluations of fit due to the potential cultural differences in the *task* interpretations.

Media Synchronicity Theory

Media synchronicity theory (MST) focuses on the fit between media capabilities and communication processes underlying the task [11, 19]. According to MST, a communication task has two underlying processes, a conveyance process, the focus of which is to transmit information and enable the analysis of information, and a convergence process, the focus of which is to develop shared understandings. MST argues that for a conveyance process, which usually involves transmission of large amounts of information as well as retrospective processing and deliberation, higher processing capability characterized by less natural symbol sets, higher rehearsability and higher reprocessability is beneficial; while for a convergence process, which involves rapid, back and forth transmission of small amounts of information, less processing and more verification to develop shared understandings, higher transmission capability characterized by higher transmission velocity, lower parallelism and more natural symbol sets is beneficial. A summary of MST can be found in 错误!未找到引用源。 .

Table 1: Communication Processes and Media Capabilities in MST (Dennis, et al 2008)

Underlying Communication Process			
Conveyance Process: Transmission – new, diverse, larger Processing – retrospective, deliberation		Convergence Process: Transmission – familiar, distilled, smaller Processing – verify, adjust, negotiate	
Supporting Media Capability for Each Communication Process			
 		 	
Processing capability		Transmission capability	
Feature	Definition	Feature	Definition
Rehearsability (+)	The extent to which the medium enables the sender to rehearse or fine tune a message during encoding before sending.	Transmission velocity (+)	The speed at which a medium can deliver a message to intended recipients.
Reprocessability (+)	The extent to which the medium enables a message to be reexamined or reprocessed, during decoding, either within the context of the communication event or after the event has passed.	Parallelism (-)	The extent to which signals from multiple senders can be transmitted over the medium simultaneously.
Symbol sets (-)	The number of ways a medium allows information to be encoded for communication.	Symbol sets (+)	The number of ways a medium allows information to be encoded for communication.

Note: +/- indicates the direction for the influence of features on media capabilities. For example, rehearsability is positively related to processing capability.

The Task of Delivering Bad News

In organizations, individuals deliver bad news routinely [20, 21], e.g. telling employees that their performance does not meet requirements. When people are delivering bad news, they are facing not just the *objective*, instrumental goal (i.e. effectively communicating the news), but also more *subjective*, relational (i.e., maintaining relationship with receivers) and self-presentational (i.e., preserving one’s image in the eyes of others) goals [12]. The dilemma here is that in the situation of delivering bad news, there are conflicts between the instrumental goal, and the relational and self-presentational goals [e.g., 13, 22]. That is, to achieve the instrumental goal individuals may have to compromise relational and self-presentational goals. From the message senders’

perspective, researchers have found that delivering bad news, apart from being psychologically unpleasant to message senders, may have negative impacts on the interpersonal relationships between message senders and receivers, even if message senders are simply transmitters (instead of decision makers) of the bad news; the bad news communication may also affect the self-presentation of both message senders and receivers [23-26]. As a result, message senders are reluctant to deliver the bad news, often delaying the delivery [27], positively distorting the bad news [28], and sometimes not transmitting the bad news at all [22].

Task Perception of Delivering Bad News: Face Challenging

Politeness theory [29] suggests that the difficulty of delivering bad news may be due to the implicit social norm to not harm *others'* face. Face can be defined as "the respectability and/or deference which a person can claim for himself from others, by virtue of the relative position he occupies in his social network and the degree to which he is judged to have functioned adequately in that position as well as acceptably in his general conduct" [30, p.18]. From the message senders' perspectives, if they cannot enhance others' face, they are at least expected to help save others' face [31], such as avoiding criticizing people in public [17]. Hence, message senders may perceive the task of delivering bad news to be face challenging for message *receivers*, a situation that message senders generally try to avoid considering the potential damages to relational and self-presentational goals [30].

Task Response to Delivering Bad News: Media Feature Preferences

Modern communication media provide a variety of features that may facilitate the task of delivering bad news. Applying MST to the problems associated with delivering bad news, it would appear that the *conveyance* process may be more problematic. That is, message senders are not effectively transmitting the information they are supposed to transmit, compromising the instrumental goal for relational and self-presentational goals of the communication. Existing research on bad news communication suggests that the three features comprising processing capability (i.e., symbol sets, rehearsability, and reprocessability) are highly relevant to bad news communication. Specifically, the amount of social cues transmitted (i.e., symbol sets) has been found to be associated with social presence, and consequently, how people communicate [e.g.,32]; rehearsability is also relevant according to the findings that *senders* may fine tune a negative message before sending so that they are comfortable with the content of the message [e.g.,28]; reprocessability should be considered as well because research has found that *receivers* often have trouble processing messages upon receiving bad news [e.g.,33] but may or may not be able to re-reprocess the messages after the initial emotional period fades away depending on the level of reprocessability provided by the communication medium. While the study of message *receivers'* preferences for communication media would likely make for an interesting study, it is beyond the scope of this study. As such, we focus on the two media features relevant to message *senders*, i.e., symbol sets and rehearsability.

Symbol Sets

The feature of less natural symbol sets may be preferred for the favorable impacts on the relational and self-presentational goals of the communication. The inability of some media to transmit symbol sets may influence social perceptions [34, 35]. That is, when social cues are reduced, the social context and presence of others is also reduced [32, 36, 37], creating interpersonal distance, a sense of detachment, and a lower sense of personal responsibility about the content of the message [13]. The reduced social contexts and presence of others may reduce the embarrassment of the bad news receivers [38], help preserve the self-presentation of receivers who do not need to be so concerned about their self-presentations (e.g., reactions) in front of others upon receiving the news, and help main the relationship between message senders and receivers. Thus, message senders may prefer the media feature of less natural symbol sets to make the bad news communication less face challenging for receivers.

Rehearsability

Message senders may prefer high rehearsability for the relational and self-presentational goals of the communication. In general, media with high rehearsability provide individuals opportunities to frame the message to make sure that the message is delivered appropriately. In the case of delivering bad news, rehearsability enables message senders to craft the message so that they are comfortable with the message and have an opportunity to consider potential face-challenging impacts on receivers caused by the bad news. The carefully crafted message is likely to help preserve interpersonal relationship between message senders and receivers, and the self-presentation of message receivers. A recent review on emotion and computer-mediated communication (CMC) found that the opportunity to carefully think about and craft the message before-hand is a major reason for the preference of CMC over face-to-face communication in emotional communication [39]. Thus, message senders are likely to prefer the media feature of high rehearsability to deliver bad news.

In summary, bad news communication is face-challenging to the message receivers, and may impair the interpersonal relationship between senders and receivers and damage the self-presentations of message receivers. To mitigate the face-challenging impacts on receivers and the potential damages to the interpersonal and self-presentational goals of communication, message *senders* may prefer the media features of less natural symbol sets and higher rehearsability to deliver the bad news.

Cultural Differences in Face Challenging Perception and Media Feature Preference

Although the concept of face is not unique to China, it originated in China and is of greater importance in Chinese society [30]. In China, face plays a dominant role in social relations and communications [40], and people demonstrate a great concern for face [41],

42]. Cardon [40] provided a model of face practices in the Chinese culture (e.g., giving face, protecting face, vying for face, and not considering face practices). For each individual, while it is not necessary to strive to gain face, losing face is a serious matter that affects one's ability to function effectively in society [30]. The greater emphasis on face concern in Chinese culture may affect message senders' perceptions of the task of delivering bad news (i.e., face challenging) and their responses to the task of delivering bad news (i.e., media feature preferences).

The impact of culture on perception has been recognized [e.g., 7, 43, 44]. "Perception is a retrospective process: though the experience is immediate, it derives from recall and reconstruction" [9, p.228]. Individuals' cognitive values create a screen between the situation and their eventual perception of the situation and affect individuals' field of visions (i.e., the directions they look and listen), selective perceptions (i.e., what they actually see and hear), and interpretations (i.e., how they attach meaning to what they see and hear) [45]. Thus, when individuals face a task, their culturally-bounded cognitions make them more sensitive to certain aspects of the task and affect their "perception and judgment of the affective components" [9, p.229] of the task.

While individuals in general may perceive the task of delivering bad news to be face challenging for message receivers [46], individuals within different cultures may perceive so to varying extent. Due to the greater emphasis on face in Chinese society in general, we expect that message senders from China will perceive delivering bad news to be more face-challenging for receivers than message senders from other cultures where face is emphasized to a lesser extent. Our argument can find support in research on conflict where cultural differences in how individuals perceive the same conflict have been found. For example, individuals from Western cultures may perceive conflict to be more beneficial than peers from other cultures such as Japan [e.g., 47]. Thus, we hypothesize

H1: Message senders from culture where face is greatly emphasized (i.e., China) will perceive the task of communicating bad news to be more face-challenging.

Culture may also affect how individuals respond to the task holding the task perception constant. Culture may affect individuals' ideal types [48], decision rules [49], or logics of action [7], consequently leading to different responses. For example, research on consumer product choices found that, when there are conflicts between product quality and price, individuals from East Asian cultural, which emphasize "moderation and harmony in a conflict" [50, p.158], are more likely to choose compromise products (i.e., balanced between quality and price) than their North American peers who have higher tendency to sacrifice one for the other. More related to face, conflict research has found that cultural differences in face concerns led to differences in conflict management styles. For example, individuals from China, who have higher concern for others' face, are more likely to use the avoiding style to manage conflict than their US peers who are more likely to use the dominating style [e.g., 51].

The greater emphasis on face concerns in a culture may also lead individuals within that culture to have higher preferences for media features appropriate for protecting receivers' face. Cultural differences in the emphasis on face lead to differences in the priority of relational and self-presentation goals compared to the instrumental goal of the communication [e.g., 47]. Consequently, individuals within culture where face is greatly emphasized may have higher preferences for media features (i.e., less natural symbol sets and high rehearsability) that may make the bad news communication less face-challenging to the receivers, and hence help achieve the relational and self-presentation goals of the communication.

H2: Message senders from culture where face is greatly emphasized (i.e., China) are more likely to prefer less natural symbol sets and high rehearsability to deliver bad news.

METHOD

We collected data from clients of a multinational public relations company located in four countries (i.e., China, Germany, Sweden and UK) using policy capturing [e.g., 52]. Each participants was presented, in random order, with two scenarios (Appendix), a bad news scenario and a good news scenario developed from previous studies [e.g., 22, 30, 32]. After each scenario, questions regarding face challenging concern and media feature preferences were asked.

Surveys were distributed to a contact person, who was exclude from the study, in each client company so that appropriate participants within their organization (i.e., people who perform the role of delivering bad/good news as described in the scenarios) could be identified. In total, 143 participants were identified. Participants from UK were provided with English surveys, those from China were provided with Chinese surveys, and those from Germany and Sweden were provided with surveys in both English and their native language (i.e., German or Swiss) and had the freedom to choose the version that they were more comfortable completing. The response rate was 43.2% (i.e., 62 out of 143). Demographic information for our participants is provided in Table 2.

Table 2: Demographic Information Summary

Gender	54.8% Male, 45.2% Female
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Age	Mean =37.7, std= 6.58
Work experience	Mean= 14.22, std=7.12

Measures

Objective Task Characteristic. This was manipulated using different communication scenarios developed from existing literature [e.g.,22]. We treated objective task characteristic as a dummy variable with bad news scenario coded as 1 and good news scenario coded as 0.

Culture. Literature on face suggests that face plays a more dominant role in China than Western cultures. Hence, a China vs. Non-China comparison may maximize the potential cultural differences on task perceptions and/or task responses related to delivering bad news. We asked participants “with which culture do you primarily identify” and the collected data was treated as a dummy variable with China coded as 1, and the other countries coded as 0.

Task Perception (i.e., Face Challenging Perception). Task perception was measured by asking participants to what extent do they perceive the communication as described in each scenario will cause the employee (i.e., message receiver) to lose face (i.e., experience embarrassment or a loss of dignity /prestige). A score 7 (out of 7-point Likert scale) indicates that participants perceive the communication to be highly face-challenging for receivers.

Task Response (i.e., Media Feature Preference). To capture media feature preferences, we asked participants “when choosing a medium to deliver this news, what capabilities would you like the medium to provide?” Preference for each feature was measured with a single item following Carlson and George [53]. Rehearsability was captured by the item, “[the medium] should enable me to carefully think about the message before delivering it to the employee,” and less natural symbol set was captured by “[the medium] should provide some buffering between the employee and I.” Preferences for both features were measured using 7-point Likert scale.

Control Variables. We controlled for participants’ gender, age and work experience, which might affect participant’s responses to the task.

Hypothesis Testing

Descriptive statistics are listed in Table 3. We first checked to make sure that our manipulation of message valence (i.e., good vs. bad) was successful. Results (Figure 2) demonstrate that participants perceive the bad news scenario to be significantly more face challenging to receivers than the good news scenario ($p < 0.0001$). Hence, our manipulation of message valence was successful.

Table 3: Descriptive Statistics

Variable	Mean	s.d.	1	2	3	4	5	6	7
1.Rehearsability	5.94	1.029	.277**	1.000					
2.Less Natural Symbol Sets	4.21	1.892	.271**	.334**	1.000				
3.Face concern	3.48	1.987	.172**	.239**	.568**	1.000			
4.Objective Task Characteristic	0.50	0.501	-0.049	.200**	-0.037	0.000	1.000		
5.Culture	0.31	0.462	0.454	0.002	0.573	1.000			
6. Age	37.70	6.578	0.059	-0.087	0.022	0.000	-.164*	1.000	
7. Experience	14.22	7.122	.140*	-0.101	0.050	0.000	-0.116	.895**	1.000
8. Gender	0.45	0.499	0.067	0.035	0.007	0.000	-0.111	-.216**	-.134*

+: $p < 0.1$, *: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$

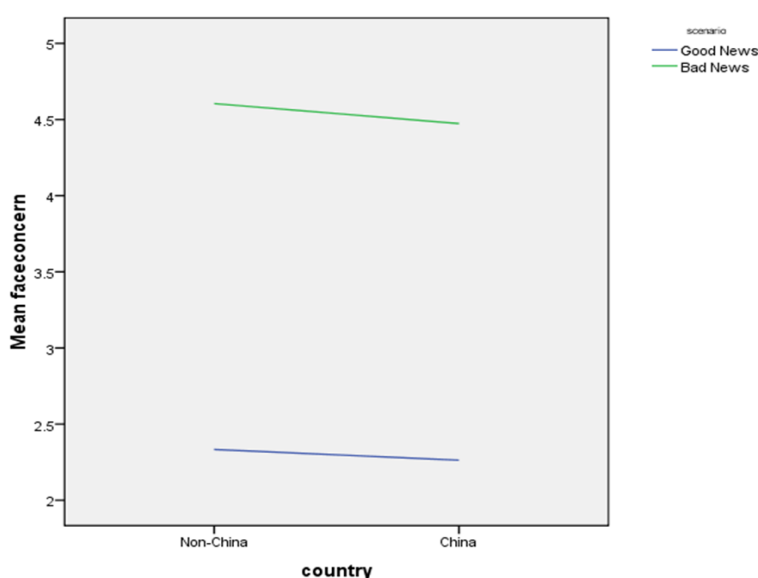


Figure 2: Face Challenging Perception by Scenario and Culture

The test of H1 (i.e., cultural differences in face challenging perception) is essentially a measurement invariance/equivalence test. Existing research on measurement invariance test focused on multi-item composite measures [see 54, 55 for reviews]. For single item measure as in our case (i.e., face challenging perception is measured using a single-item), the test of measurement invariance across populations (i.e., culture) can be executed by looking at the correlation between face challenging perception and culture. That is, whether culture predicts face challenging perception. Results show that subjects from China do not differ in their face challenging perception with their Non-China peers. Thus, H1 was not supported. Future analysis shows that the majority of variances is within-culture variance, suggesting the absence of hidden culture-level effect [e.g.,56].

To test H2 (i.e. cultural differences in media feature preferences for delivering bad news holding the face challenging perception constant), we ran multivariate regression¹ in SPSS with preferences for the two media features as the dependent variables, objective task characteristic (good news vs. bad news), culture (China vs. Non-China) as well as their interactions as independent variables, and individuals' face challenging perception, gender, age and working experience as covariates. Results are as follows (

Table 4).

Table 4: Multivariate Regression Results

Variables		Rehearsability	Less Natural Symbol Sets
Independent Variables	Objective Task Characteristic (Bad news=1, Good news=0)	-0.080	0.054
	Culture (China=1, Non-China=0)	-0.175	0.535
	Culture*Objective Task Characteristic	0.513+	0.850
Covariates	Face Challenging Perception	0.123**	0.289***
	Age (Male=1, Female=0)	-0.034	0.049
	Work Experience	0.048*	-0.065+
	Gender	0.122	0.180
Adjusted R-Square		9.3%	15.6%

+: p<0.1, *: p<0.05, **: p<0.01, ***:p<0.001

The positive impacts of face challenging perception on rehearsability and less natural symbol sets suggest that the more face challenging the task is perceived to be, the higher people's preference for rehearsability and for less natural symbol sets. Moreover, further analysis showed that the impacts of face challenging perception on the preference for the two features are significantly different ($F= 5.88$, $P<0.001$), suggesting that as the communication task is perceived increasingly challenging to receiver's face,

¹ We repeated the analysis using MANOVA and got similar results.

the sender's preference for less natural symbol sets increases faster than that for rehearsability. The interaction between culture and objective task characteristic tests H2, which argued that, holding the face challenging perception constant, participants from China are more likely to prefer the features of less natural symbol sets and rehearsability to deliver bad news. Results showed that H2 was marginally supported for rehearsability, but not for less natural symbol sets.

DISCUSSION

TTF has received extensive attention in the IS literature. While TTF has been tested in many different cultures, most research treated culture as simply the *context* of the study without examining how culture affects TTF, for example, how culture affects individuals' subjective evaluations of fit and consequently technology utilization or adoption. Between the two elements giving rise to fit, the technology side of TTF has received more attention. Recently, researchers have called for more attention to the task side of TTF [2]. Our intent was to understand how culture affects the task aspect of TTF, and consequently subjective evaluations of fit. Specially, we distinguished the two mechanisms via which cultural differences may occur, i.e., task perception (how individuals perceive the focal task) and task responses (how individuals respond to the focal task holding their task perception constant). The task we examine in this paper is delivering bad news. Understanding how individuals perceive this task and how they respond to this task (in terms of media feature preferences) may shed light on how to "appropriately" (e.g., leveraging certain media features) carry out this important yet unpleasant communication task.

Literature on bad news communication suggests that the (most) relevant culture phenomenon for bad news communication is the varying extent of concerns for challenging others' face [46]. Face is argued as "one of the most important yet under-studied concepts that could help clarify Asian-Western differences in organizational behavior" [42, p.523]. To increase potential cultural differences in the perception of and response to the task of delivering bad news, we did a China vs. non-China comparison to test our hypotheses.

As to task perception, our manipulation successfully elicited different face challenging perceptions between the two tasks (i.e., communicating good news vs. bad news). However, contrary to our expectations, there was no cultural difference in senders' face challenging perception. A deeper look into the related literature helps shed some light on this unexpected result. Existing research on face concerns between Chinese and non-Chinese cultures suggests that individuals in both cultures have an overarching drive to present themselves positively to others [42]. However, differences exist in the priority of individual vs. collective goals [57]. It has been argued that Chinese employees' face challenging concerns are woven into desires to achieve and foster harmony within the work environment including putting collective goals ahead of individual goals [42, 58]. Hence, cultural differences in the face challenging perception would have been elicited, should individuals' unsatisfying performance were linked to poor collective outcomes in the scenario [44]. That is, Chinese participants are likely to perceive delivering bad news regarding hurting collective goals to be more face challenging than non-Chinese participants.

The findings that individuals' preferences for rehearsability and less natural symbol sets increase with the extent to which the task is perceived to be face challenging to receivers are consistent with existing literature on bad news communication [e.g., 39]. Rehearsability has been well studied and well-promoted as an "additive capability" [59] resulting in improved conveyance process (i.e., message transmission) [11]. In the context of delivering bad news, senders who are concerned that the message they are charged with communicating may be face challenging for receivers prefer media features that allow them to rehearse the message to potentially find that "sweet spot" of effectively communicating the message and dampen the impact on the receiver's self-presentation and their relationship. Also, it is important to note that carefully wording a message in recognition of face challenging potential to the receiver does not necessarily mean that the message will be distorted [60].

As to symbol sets, our study found that when senders are concerned about receivers' face, they tend to prefer less natural symbol sets to deliver the bad news. Previous research which found individuals' preference for less natural symbol set in bad news communication tends to focus on *senders'* well-being, e.g., a lower sense of personal responsibility, reduced anxiety, and being physically protected from negative responses from receivers [e.g., 12, 13, 38, 39, 60, 61]. Our study focuses on *receivers'* well-being and finds similar results. Literature on self-disclosure suggests that social cues and social presence of others increase individuals' self-awareness and consequently their concerns about maintaining self-presentation and image in front of others, potentially increasing negative responses (e.g., feeling stressed, embarrassed) that receivers may experience upon receiving bad news. In their review on emotion and CMC, Riordan and Kreuz [39] found that one reason for the preference of electronic communication is to soften negative consequences on receivers, as "It hurts more when done in person" (p. 1669).

What we are more interested in is cultural differences in task responses, i.e., media feature preferences for delivering bad news. Our results show that after controlling for individuals' task perceptions (i.e., face challenging perception), cultural differences exist in the preference for rehearsability (but not symbol sets) between Chinese and non-Chinese participants. That is, to deliver bad news, Chinese participants have higher preferences for rehearsability than their peers even when their task perceptions are the same, but there is no cultural difference in the preference for the amount of symbol sets. A deeper understanding of cross-cultural

differences in the communication style helps us understand the (marginally) supported cultural difference in the preference for rehearsability and the not supported cultural difference in the preference for symbol sets.

Literature on the Eastern-Western communication style suggests that one major dimension to understand the cultural difference is high-vs. low- context communication [e.g., 44]. According to Hall [62], “a high-context (HC) communication or message is one in which most of the information is either in the physical context or internalized in the person while very little is in the coded, explicit, transmitted part of the message. A low-context (LC) communication is just the opposite; i.e., the mass of the information is vested in the explicit code” (p. 79). Eastern culture, which is suggested to have a high context communication style, uses more indirect communication and is receiver-oriented (i.e., meaning is in receiver’s interpretation), while Western culture is suggested to have a low context communication style which uses more direct communication and is sender-oriented (i.e., meaning is in the message delivered by the sender). It is necessary to point out that both Eastern and Western cultures use direct as well as indirect communications, but Eastern culture uses significantly more indirect communication than Western culture [e.g., 44, 51, 63], especially when concerned about other’s face [e.g., 64, 65].

The dimension of high- vs. low- context communication is relevant to the concern for other’s face in delivering bad news. According to Goffman [66] and related empirical studies [e.g., 46, 51, 63], the greater tendency to use indirect communication indicates that the high-context communication culture (e.g., China) is more sensitive and more motivated to save others’ faces and preserve interpersonal relationships.

The high- vs. low- context communication style may explain Chinese participants’ higher preference for rehearsability. In Chinese culture, “The attentiveness and sensitivity to others.....result in a relatively greater cognitive elaboration of the other or of the self-in-relation-to-other.” [44, p.231] Hence, the more attentive and sensitive Chinese participants, who are more motivated to accommodate incompatible communication goals (i.e. ask efficacy, interpersonal relationship, and self-presentation) when delivering bad news, may put more effort into anticipating and directing receivers’ interpretations of and responses to the bad news to make sure that the meaning is effectively delivered to receivers and that the communication is conducted in a sensitive and appropriate way. In contrast, non-Chinese participants, for who the more important goal is explicit communication, may mainly focus on getting the message crossed effectively and spend less effort trying to anticipate receivers’ potential interpretations and responses (and hence less effort trying to craft their messages). As a result, our Chinese participants have higher preference for rehearsability when delivering bad news.

The high- vs. low- context communication style may also explain the lack of cultural difference in the preference for symbol sets to deliver bad news. Initially, we suspected that Chinese participants, who are more concerned about challenging receivers’ faces, may prefer less natural symbol sets than their peers as less natural symbol sets may reduce receivers’ concerns about presenting a nice image in front of others and potential negative consequences that the bad news may have on receivers such as feeling embarrassed [e.g., 67]. However, our results show that Chinese and non-Chinese participants do not differ in their preference for symbol sets. The lack of cultural difference may be due to a *counteracting* preference for more natural symbol sets from Chinese participants: research suggests that in high-context communication culture (e.g., China), individuals are more attentive and sensitive to contextual factors such as facial expressions, body languages, and relationships between communication partners [e.g., 68]. Hence, Chinese participants may prefer more natural symbol sets in complementary to text-based messages to carry out their communication task effectively and appropriately, e.g., using facial expressions and eye contacts to show both the urgency of improving performance and their encouragements. That is, Chinese participants, who use more indirect communication and are more receivers-oriented, may want *less* natural symbol sets to reduce receivers’ concerns about their self-presentations and meanwhile *more* natural symbol sets to effectively and appropriately carry out the task of delivering bad news. The simultaneous existence of a preference for less natural symbol sets and a preference for more natural symbol sets among Chinese participants may cancel each other out; the net result is a similar preference for symbol sets between Chinese and non-Chinese participants.

As with others, our study is not without limitation. A major limitation of this study is the use of single item scale. MST has become a dominate theory for understanding media performance in the IS literature. Yet, limited efforts have been expended on developing scales for media features proposed by MST, and empirical studies using MST generally used single item scale to measure media features [e.g., 53]. To expand the use of MST in empirical studies, future research needs to develop more reliable multi-item scales measuring media features proposed by MST.

CONCLUSION

Task-technology fit argues that individuals’ subjective evaluations of fit will drive their technology utilization or adoption. Researchers have recognized that culture may affect individuals’ interpretations of the technology side of task-technology fit, resulting in divergent technology choices. Our study contributes to the existing task-technology fit literature by examining cultural differences in the perceptions of and/or responses to the task of delivering bad news. Our results provide both theoretical and practical implications for paying attention to people’s interpretations of the task and the potential cultural differences in it—when people are adopting or utilizing a technology, they adopt or utilize it for a certain *purpose or need* (i.e., the task at hand).

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APPENDIX

Summary of Policy Capturing Scenarios

Bad News Scenario

You are going to communicate with an employee who has been working for your organization for many years but with whom you have mostly a professional relationship (i.e., you have very little non-work related interactions). The employee is located in the same building and is usually available through all types of media.

The purpose of your communication is 1) to inform the employee that he/she is not doing an adequate job and will therefore not receive an annual bonus, and 2) to explain why your organization made this decision and where the employee needs to improve in the future.

Good News Scenario

You are going to communicate with an employee who has been working for your organization for many years but with whom you have mostly a professional relationship (i.e., you have very little non-work related interactions). The employee is located in the same building and is usually available through all types of media.

The purpose of your communication is 1) to inform the employee that he/her is doing a good job, and is therefore recommended for promotion, and 2) to explain why your organization made this decision, and to let him/her know that you have the confidence in his/her capability for the new job and that you hope he/she will continue to do well.

Net-Mediated Public Opinion Analysis of China's Real Estate

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ABSTRACT

With the development of Internet technology, the analysis of net-mediated public opinion based on text mining, has become increasingly concerned by the academic community in recent years. In this paper, we do research on net-mediated public opinion of China's real estate in the second quarter of 2015 empirically with the association rules, text tendency analysis and other technology of data mining and visualization. On the basis of the demonstration, a basic framework of net-mediated public opinion analysis is constructed. According to the analysis of this paper, the distribution and association of hot topics in this quarter were found, and the overall tendencies of the topics were reviewed, also some relevant policy recommendations were given.

Key words: Net-mediated public opinion, real estate, association rules, text tendency

INTRODUCTION

Public sentiment refers to a series of attitudes arose and held by the public towards social administrators, their political opinions or other objects as the intermediary social events arise and evolve under certain social conditions. It is a complex which includes views, opinion and feelings delivered by most of the people regarding current social phenomenon. Since ancient times, public sentiment has always been an integral part of economic and social development. As the old saying goes, the flooding of public opinion is much more disastrous than that of rivers, which clearly states the significance of public sentiment. With the rapid development of information as a result of technology advancement and with wider access to the Internet, Internet has more and more become a key means to spread and obtain public sentiments. According to the report of We Are Social 'Digital in 2016', due to January 2016, the population of China is 1.379 billion, which is 57% of global population while the internet user of China is 680 million, which is 49% of global internet user. The internet user of China has increased by 5.91% compared to that of the same period of last year. Analysis of public sentiment on the internet has become more and more important in public sentiment analysis.

Food, clothing, housing and transporting are necessities in people's common life. Real estate, which meets the need for housing, is always one of the most important topics in public opinion. Nowadays, with the development of the domestic economic and the improvement of people living standard, real estate industry has played more and more important role in domestic regional economy. In 2015, under the incentive of the New Normal, domestic real estate industry is facing new opportunity and challenge. From April, 2015, the transaction volume started to pick up. Meanwhile, a large number of post 90s also get engaged in the housing transaction, adding new element for the real estate public sentiment analysis at this period of time. When the housing market and transaction volume start to pick up in general, how to maintain the stable development of the housing market so as to safeguard sustained economic growth is not only the policy target of the government officials, it has also captured the attention from the online media and the public.

Recent years, the approaches of Internet text mining and statistical research are growing prestigious in academia. Regarding the text association rules, Hany Mahgoub, Dietmar Rösner (2008)[1] propose text mining technology based on the automatic association rules. Also, they evaluate, compare and contrast various generating algorithm of association rules in common use. Wang Aiping and some other scholars (2010)[2] introduce the classical algorithm of association rule mining –Apriority and classify discuss the association rule mining from several perspectives such as width, depth, partition, sampling and incremental updating. Then they summarize the commons algorithms of association rule mining through querying documents and comparative analysis and prospect the association rule mining. Regarding the text semantic orientation, XuXin (2011) [3]introduces the model and technology of text classification, proposes pattern matching based on the extraction and text classification algorithm, and describes the technical implementation of text semantic orientation. Li Xiaojun (2011) [4]summarizes the basic flow and three methods of text sentiment orientation analysis and proposes the research perspectives of basic problem and implementation method of specific application. Wang Lancheng (2013)[5] designs algorithms of tendency analysis based on text classification, semantic rules pattern and sentiment word based on the study of the text tendency recognition method. He studies the combination of the sentiment ontology construction and the emotional concept selection method based on How Net and subject areas corpus. He uses machine learning methods to analyze online texts for thematic public opinion. Generally, some of the existing research focuses on the certain link in online text or online public sentiment mining and analysis framework, while empirical studies on overall framework analysis is less commonly seen. In particular, the analysis of real estate online public sentiment is rarely seen.

In this paper, we do research on net-mediated public opinion of China's real estate in the second quarter of 2015 empirically

with the association rules, text tendency analysis and other technology of data mining and visualization. The authors first introduce the resources of the public opinion on domestic real estate, summarize and make the screening and sorting rules of the hot topics in the second quarter of 2015, apply association algorithm to analyze the correlation among the topics, review the overall tendencies of the topics, and finally come to a conclusion of the online sentiment on China's real estate.

TEMPORAL AND SPATIAL DISTRIBUTION OF PUBLIC SENTIMENT INFORMATION

With the help of targeted information crawling, this paper has obtained 58,387 pieces of real estate related public sentiment information from 13 major web portal's real estate section or authoritative real estate portals.

The temporal distribution of the information is showed in Figure 1:

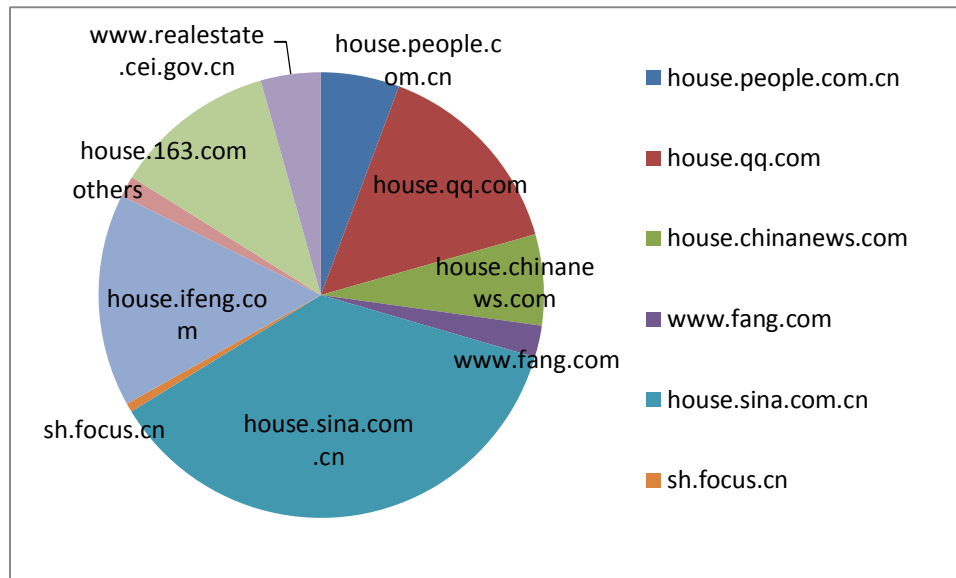


Figure 1: Temporal Distribution of Public Sentiment Information

The obtained public sentiment information was released from April to June, 2015, among which, 28.83% of the information came from April, 31.45% from May, 39.72% from June. This can truly reflect the features of attention paid by the public on the topic of real estate market to certain extent.

CONFIRMATION OF HOT TOPICS OF PUBLIC SENTIMENT

An Overview of Topics of Public Sentiment

Built on the needs of Chinese real estate market's development and online public sentiment analysis, this paper chooses to track the following 11 real estate related topics of great public attention:

Topic 1: Rising housing price.

On March 30th, 2015, the People's Bank of China, Ministry of Housing and Urban-Rural Development of the P.R.C together with China Banking Regulatory Commission jointly released the housing loan policy to adjust housing fund and downpayment. Ministry of Finance and State Administration of Taxation jointly launched the *Announcement on Adjusting Sales Tax of Homes Sold by Individuals*. Stimulated by these policies, second-hand housing market boomed. In May, 2015, the housing price witnessed a 0.45% increase, and it was further expanded to 0.56% in June. Notably, the housing price of different cities demonstrated different patterns in the first half of 2015. Tier-1 cities' housing price increased by 2.53% compared with the same period last year, registering a 5.16% growth. While the housing price in tier-2 cities fell by 0.75%, representing a decrease of 0.35%. As for tier-3 cities, the price declined by another 0.37%, with an accumulative decrease of 1.25%. The apparent housing price changes touched the public sentiment greatly, becoming one of the real estate related hot topics.

Topic 2: Transaction's volume starts to pick up.

In the second quarter of 2015, the People's Bank of China further lower the interest rate and reserve ratio. Meanwhile, the new housing market policy issued on March 30th start to show its effectiveness. The transaction volume started to pick up. The transacted area in May of typical cities eached 31.91 million square meters followed by another increase to 34 million square meter in June. In terms of the performance of individual cities, the transaction volume of different tier cities kept growing. Tier-1 cities grew by 45%, with average monthly transacted area of 750,000 square meters, 18.5% growth and 660,000 square meters for tier-2 cities and 37% growth, 310,000 square meters for tier-3 cities. Driven by the policy, the transaction volume reflects the policy result directly and it can be seen as an indicator for house purchasement by individuals.

Topic 3: New policy on housing fund and down payment.

After the new housing policy issued on March 30th, local governments came up with their policies as well. The adjustment centered around the following 3 areas: 1. Lower the down payment ratio, the minimum loan for housing provident fund to buy the first house was lower to 20% of the housing price, where as the figure for buying second house decreased to 30% of the housing price; 2. Increase the loan commitment for housing provident fund; 3. Loosen the policy on the usage of housing provident fund. These related policies have a direct bearing on the individual's interest.

Topic 4: Business tax reform.

According to the new housing policy issued on March 30th, for individual home buyers, if they have bought the houses for over 2 years, no sales tax will be charged. This policy reduces the pressure of second-house buyer's pressure and facilitates the transaction. This policy reform is closely related to the well-being of the public.

Topic 5: Real estate and stock market.

In the second quarter of this year, China's stock market experienced great fluctuation, highlighting the stable quality of property investment. The much waited housing market regained the attention from investors. After the plunge of A-shares, the total market value evaporation was 21 trillion yuan. Many investors changed their investment strategy, which further leads to the booming housing market. Thus, the "Seesaw Effect" between real estate market and stock market became another heatedly discussed topic by the public.

Topic 6: Real estate developer's capital chain.

Since the second quarter of 2015, many Chinese real estate developers have been confronted with frequent capital crises and the situation is still worsening. Due to over-borrowing, many real estate developers find it difficult to get back the money or second-round financing. As the Internet Finance evolves, the P2P era has come. After gaining the land and related rights, many real estate developers started online financing with the land or the houses as mortgage. This could shorten the loan cycle, trim the financing cost and improve the capital performance.

Topic 7: Lower interest rate.

Under the incentive of the New Normal, a substantial reserve ratio cuts is followed by another round of interest cuts, leading to the booming of housing market transaction. From the demand side, lower interest rate could reduce the mortgage cost and unleash the potential of home buying; on the supply side, lower interest rate could be conducive to the expansion of land investment. The result brought by interest cuts is also another hot topic.

Topic 8: Land market.

After the sluggish land market in the first quarter of 2015, the land market nationwide showcases an overall declining trend since the second quarter. After May, despite the signal of a warmer land market in tier-1 cities, the land market in tier-3 and tier-4 cities remained inactive.

Topic 9: Real estate trust.

In 2015, the Real Estate Trust sector witnessed another round of cash out peak and some of the real estate companies were caught by a shortage of capital. In the second quarter, the property market went up against the odds. Although the housing price was sluggish and the transaction volume decreased, the trust fund went to the real estate sector increased. Against the backdrop the tier-1 city's housing market stabilization, the pick up of Real Estate Trust would be another area of interest.

Topic 10: Shanty town renovation.

In recent years, while the shanty town renovation goes on, local governments come up with a series of guidelines based on the local conditions. Through monetary indemnity, incentive measures, tax and fees reduction and exemption, the relocation of shanty town dwellers moves on smoothly and can contribute to the de-stocking. Shanty town renovation policy's impact on China's real estate market captured much attention from all related parties.

Topic 11: Affordable housing.

In the early 2015, given the result achieved last year, Ministry of Land and Resources together with Ministry of Housing and Urban-Rural Development of the P.R.C jointly released the *Announcement on Optimizing housing and land supply structure for the sound development of Real Estate Market in 2015*. It is proposed that housing supply should be optimized so as to adjust the land use structure and coordinate affordable housing projects. From these measures, one can tell the attitude of the central government to regulate the overheated market and reduce stock. The construction of affordable housing will affect the household's living conditions and it is the key for the sound development of the housing sector, thus, receiving much attention from the public.

Screening of Topics and Distribution Statistics

In order to obtain the online public sentiment information about the popular topics, based on the possible scenarios and various key words combinations, we make the following screening and topic sorting rules as Table 1.

Table 1: Rules for Screening Hot Topics and Sorting Principles

Hot Topics	Rules for Screening and Sorting
Rising housing prices	Public sentiment information with all key words that include “Rising housing prices”
Transaction volume’s pick up	Public sentiment information with all key words that include any word both from “transaction, transaction volume” and “housing price pick up”
New policy on housing fund and down payment	Public sentiment information with all key words that include any word both from “housing fund for down payment” and “loans granted for first house and second house”
Business tax reform	Public sentiment information with all key words that include both “business tax” and any word from the phrase “shift from 5 years exemption to 2 years”
Real estate sector and stock market	Public sentiment information with all key words that include any word from both “capital, capital turnover” and “stock, stock market, security and financial market”
Real estate developer’s capotal chain	Public sentiment information with all key words that include both “developer” and “capital chain”
Lower interest rate	Public sentiment information with all key words that include any word in the phrase of “lower interest rate”
Land market	Public sentiment information with all key words that include any word from “land market, land price” and Public sentiment information with all key words that include any word from both “land block” and “circulation and auction premium”
Real estate trust	Public sentiment information with all key words that include “trust”
Shanty town renovation	Public sentiment information with all key words that include “shanty towns”
Affordable housing	Public sentiment information with all key words that include “affordable housing”

CORRELATION ANALYSIS OF THE PUBLIC SENTIMENT TOPICS

Correlation is the knowledg that reflects the dependency or asociation bewteen one event and the others. The corelation among topics about public sentiment is an important factor that constitutes the overall framework of the public sentiment information. This paper introduces the method of asocciation rules, and apply the algorithm to further analyze the corealtion among real estate related topics. Further analysis and explanation is made for the overall framework of the public sentiment information.

Introduction to the Association Rules

Association rules mining is an important subject in data mining and it has be widely applied and researched in recent years by the relevant community. The major purpose is to sort out the association or corelation among item sets in mass data. Let I be the set of m different projects, I_p as data item (item for short), data item set I as data item set (item set for short).

(1)

(2)

Each hot topic in this analysis constitute a separate data item set and the set of 11 topics forms the overall data item set. As for any nonvoid subset X in the I , if there are k items in the X , then it is called k -item set. For instance, the nonvoid subset X which contains “rising housing price” and “transaction volume pick-up”, there are 2 items, then, it is called 2-item set. Association rule’s transaction T_k is the nonvoid subset of I , the set of item set constitutes the transaction set and it is defined as D .

(3)

(4)

When it comes to online public sentiment analysis for the real estate market, each piece of housing market public sentiment information forms a transaction, and those many public sentiment information forms the transaction set D . If , then implication is called the association rule. Item set X and Y are the antecedent and consequent of that rule respectively. Support, confidence and lift are three major concepts in association rules.

Support is the ratio of the transaction number in X and the transaction number in D . When “rising housing price” and

“transaction volume pick-up” occur at the same time, then make the transaction set as X , then the news that include both “rising housing price” and “transaction volume pick-up” would be the number of transactions of the item set X , the number of total pieces of news is the number of transactions contained in D , and the ratio of these two figure is the support of the item set X . Confidence is conditional probability. The confidence of “rising housing price” and “transaction volume pick-up” is the ratio of number of news pieces which contains both “rising housing price” and “transaction volume pick-up” and the number of news that include “rising housing price”. Lift is the ratio of confidence and successor item set’s support. In general, the higher lift of association rules, the more valuable it is.

In the mining of association rules, when a certain item set’s support is greater than a given minimum support value, then, this item set is called the frequent item set; and when the confidence of the association rules comprised of this frequent item set and its subset is greater than the given minimum confidence value, it is called a strong association rule; In a strong association rule, if its lift is larger than 1, then it is called an effective strong association rule, which is the object worth of closest analysis.

In terms of algorithm implementation, association rule mining algorithm can be divided into two parts: one is to get frequent item sets based on minimum support, that is the frequent item sets generation process; the other is the rule pruning of frequent item sets based on the minimum confidence level so as to produce strong association rules, i.e., the association rules output process. In this paper, we adopt the Apriori algorithm proposed by Agrawal R. et al., which is one of the classical ideas to solve the frequent item sets generation in association rules problem. The essence of this algorithm is derived from the following two monotone propositions: the prerequisite for k -item set X to be a frequent item set is defined as follows: all of the $(k-1)$ -sub item set in the X must be frequent item set; If any of the $(k-1)$ -sub item set in the k - item set X is non-frequent item set, then X must be non-frequent item set. To be more specific, the process to obtain the strong association rule in this paper’s public sentiment is shown as follows:

Based on topic screening rules, match the real estate public sentiment corpus, construct topic transaction sets, is the set that contains the topics in each piece of public sentiment information, and let \min_supp be the minimum support and \min_conf be the minimum confidence;

Go through the 11 topics listed in this paper, i.e., to construct the candidate 1-item set, $k=1$;

Calculate the support of all elements in the transaction set for candidate k -item set, and screen according to the requirement and get the frequent K -item set.

Follow the Apriori’s principle, construct advanced candidate $(k+1)$ -item set from frequent k -item set, among which, K -sub item set of all elements in should be frequent k -item set;

$k=k+1$;

Repeat step 3,4,5 until the number of set items in frequent k -item set in step 3 is ≤ 1 , then end the cycle and get the set for all frequent item sets ;

Conduct rule generation to all the frequent item sets in and calculate the confidence (is the precursor item set for). Conduct pruning according to and output all the qualified results.

Empirical Analysis of Topic Association Rules

By processing the corpus of public sentiment information, based on a support of greater than 0.03 and a confidence greater than 0.6, 31 pieces of association rules were obtained. To demonstrate the result in a more vivid manner, we choose to present it in the following chart. In Figure2, the direction of arrow reflects the direction pointed to by the association rules. The bigger the dot, the higher support it has. And the darker of the dot color, the higher lift it has.

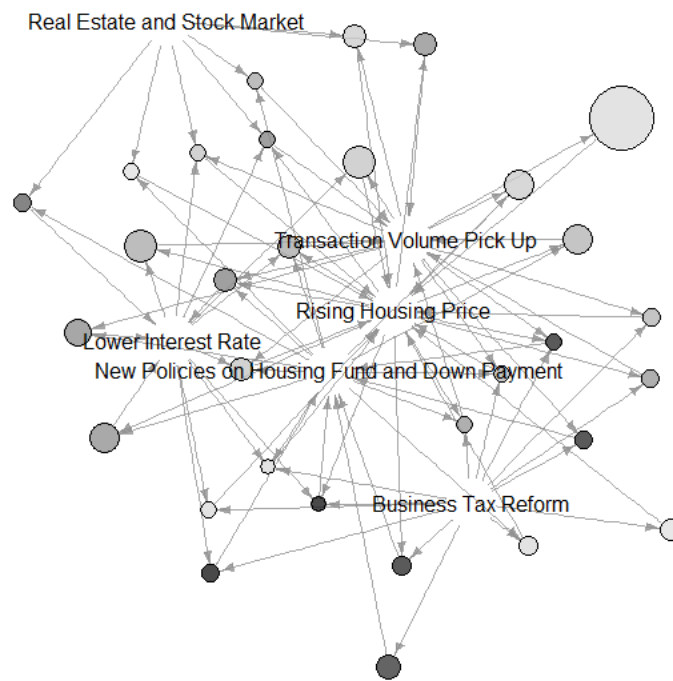


Figure 2: Housing Market Public Sentiment Topic Association Rules

Table 2 :Excerpt of Hot Topics Association Rules

Rule	Support	Confidence	Lift
{ business tax reform, lower interest rate } => { new policies on housing fund and down payment }	0.04506872	0.9229091	2.734542
{ rising housing price, business tax reform, lower interest rate } => { new policies on housing fund and down payment }	0.03018788	0.9061834	2.684984
{ new policies on housing fund and down payment, housing market and stock market } => { lower interest rate }	0.04361260	0.7566235	2.075831
{ rising housing price, Transaction pick-up, new policies on housing fund and down payment } => { lower interest rate }	0.06843769	0.6633391	1.819900
{ rising housing price, housing market and stock market, lower interest rate } => { Transaction pick-up }	0.03849842	0.7475862	1.787971
{ rising housing price, new policies on housing fund and down payment, business tax reform } => { Transaction pick-up }	0.03587030	0.6908345	1.652240
{ Transaction pick-up, new policies on housing fund and down payment, business tax reform } => { rising housing price }	0.03587030	0.8258381	1.460165
{ Transaction pick-up, housing market and stock market, lower interest rate } => { rising housing price }	0.03849842	0.7569832	1.338422

Based on the chart and table, we can find that:

Among popular topics related with real estate market in this quarter, “Rising house prices”, “transaction volume to pick up” are at the center of topics association with many association points to them. Among the 31 rules of association that meet the

confidence requirement, 13 of them point to the topic of “rising house price” and 8 to the topic of “transaction volume pick-up”. This shows that among the 11 popular topics of public sentiment analyzed, it is possible to further discuss the “Rising house prices”, “transaction volume to pick up” while addressing other topics. Therefore, we can further infer that these 2 topics are the core concern of the online public sentiment in this quarter.

“Business tax reform” and “Housing market and stock market” are often the starting points for rules. From Figure 2, we can see that among the generated rules, “Business tax reform” and “Housing market and stock market” are both the starting points for arrows, indicating that these two topics are the lead topics for other topics.

In terms of rules’ lift, most topics starting from “business tax reform” have high degree of lift, indicating that business tax constitutes a major support for the housing market pick-up lately. Relevant authorities should pay close attention to the related discussion about the housing market among the public sentiment information.

TENDENCY ANALYSIS OF PUBLIC SENTIMENT TOPICS

The tendency analysis of the text is an important link in the online public sentiment analysis. By identifying the tendency of public sentiment information towards various topics, it is helpful to form a better understanding of the preferences of the social groups on the related topics, so as to provide evidence for estimating the public sentiment information’s impact on group behaviors. In this paper, the author adopts the adaptive adjustment method for the tendency analysis. It adjusts the emotional words banks according to different topics of the real estate, and adjusts the weight of the emotional words through the adaptive adjustment method so as to obtain the quantitative indicators of tendency about the online public sentiment information of the real estate market. If the indicator is less than 0, it means that the public sentiment information tends to be pessimistic; if the index result is greater than 0, it means that the public sentiment information tends to be optimistic. In addition, the larger the absolute value of the indicator, the greater the pessimism or optimism is in the corresponding tendency.

Introduction of Adaptive Adjustment Method for Tendency Analysis

Emotional word list matching is one of the simple ways to quantify the tendency in the text analysis. When the emotional word list is fairly abundant and accurate, it can be widely used in the recognition of the tendency of some simple online text, such as E-commerce comment or micro blog posts and etc. As professional texts with strong themes, public sentiment news has different tendencies features when compared with everyday language, and the characteristics as summarized as follows:

The public sentiment news corpus is highly professional and many common emotional words in everyday conversation do not occur in the news corpus, which leads to the sparse density of traditional emotional words in news corpus;

There are obvious differences in terms of the content of public sentiment news corpus under different themes. In the various public sentiment texts about the topic, the words expressing positive and negative emotion tendencies are different. Therefore, in the quantitative measurement of public sentiment tendency, the same emotional word may have different inclinations;

In a single subject of public sentiment, different emotional words may carry different tendentious weight, and the weight of the word represent its influence on that subject of public sentiment as well as its own degree of tendency. Whereas the weight contrast among the words in a document without marked tendency features can not be compared in a complete manner. Therefore, the whole corpus needs to be investigated.

Based on the above-mentioned features, this paper reconstructs and adjusts the emotional lexicon according to the content of public sentiment under different subjects and puts forward the adaptive adjustment analysis method. Based on the subjective properties of the text corpus, we classify the tendencies of key words in different subjects for second imposition calculation so as to reflect the differences of different words’ tendency role under different topics of public sentiment. The subjective emotional words used in this method is extracted from texts selected through theme based sampling, and the public sentiment corpus has been tagged, and then adjusted with the Delphi Method.

Table 3: Notes to the Signs

Signs	Meaning
Ω_H	Thematic optimistic lexicon
Ω_D	Thematic pessimistic lexicon
$Hnum_k$	Number of optimistic lexicon occurred in the piece of news
$Dnum_k$	Number of pessimistic lexicon occurred in the piece of news

WH_i	Optimistic weight of the optimistic word
WD_j	Pessimistic weight of the pessimistic word
H_i	Number of the word in the optimistic news
D_i	Number of the word in the pessimistic news
H_{ki}	Number of the optimistic word in the piece of news
D_{ki}	Number of the pessimistic word in the piece of news
HD_k	Tendency of the piece of news
M	Number of the pieces of news

The adaptive adjustment tendency index is calculated as follows:

First, start segmentation of the collected words and get the word frequency matrix;

Based on the frequency of optimistic and pessimistic words, we can decide the attribute of the news. In this paper, it is defined that when , then it is optimistic news; when , then it is pessimistic news.

Adjust the optimistic weight based on the frequency of optimistic words in optimistic and pessimistic news and adjust pessimistic weight based on the frequency of pessimistic words in optimistic and pessimistic news. For those words that don't occur in the news, their weight is 1.

$$WH_i = \frac{H_i}{H_i + D_i}, i \in \Omega_H \quad (5)$$

$$WD_j = \frac{D_j}{D_j + H_j}, j \in \Omega_D \quad (6)$$

The optimistic and pessimistic attribute of the news is recalculated based on the optimistic and pessimistic lexical weights and the formula is shown as follows:

$$HD_k = \sum_{i \in \Omega_H} H_{ki} WH_i - \sum_{j \in \Omega_D} D_{kj} WD_j \quad (7)$$

Calculate, and make sure the current news's orientation about the housing sector, and use it as the online public sentiment of the housing market.

Empirical Analysis for Tendency Analysis of Adaptive Adjustment

Rising housing price

From Figure 3, one can tell that with the stimulus of new housing market policy issued on March 30th, second-hand housing market in China is booming. In the early second quarter, public's attitude towards the rising housing price remains optimistic. Starting from mid May, affected by the closing date of properties with lower price, the public's tendency went down slightly. However, at the end of May and early June, capital inflow into the housing market warmed up the market and the public hold an optimistic attitude towards it.

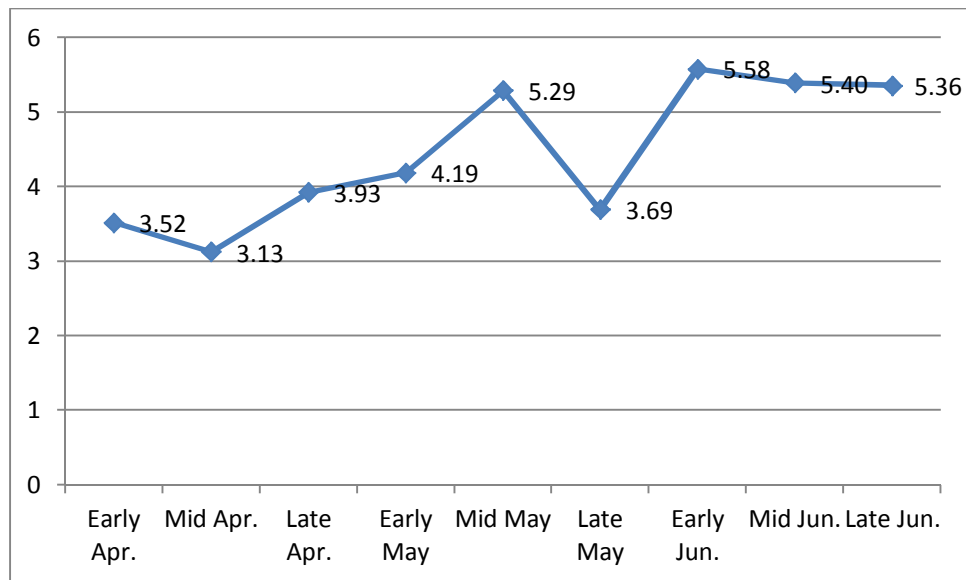


Figure 3: Average Tendency for the Topic of Rising Housing Price

Transaction voume pick-up

In 2015, housing policies changed from curbing demands to stimulating demand. And the government issued a series of stimulus policies at the end of March. As shown in Figure 4, the public have a high degree of optimism about the transaction volume pick-up. Since April, the transaction volume has been growing and the transaction volume of the first 6 months is the same as the second half of 2014.

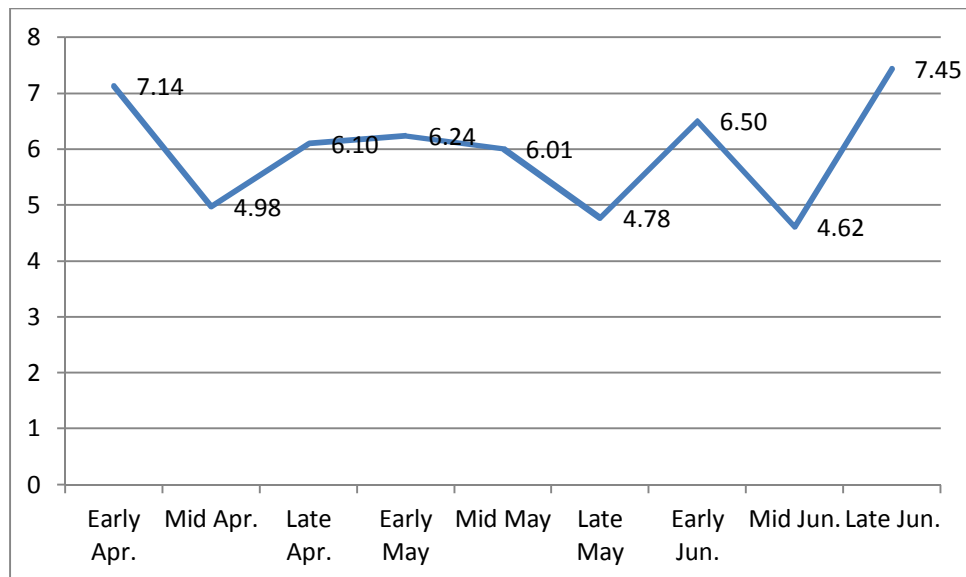


Figure 4 :Average Tendency for the Topic of Transaction Volume pick-up

New policies on housing fund and down payment

As we can see from Figure 5, the public's attitude towards the housing fund policy in Q2 remained quite optimistic. After the launch of new policies released on March 30th, the new housing fund policies have been gradually implemented at all local levels, which greatly eased the pressure of home buyers, further unleashing the potential for home purchasement.

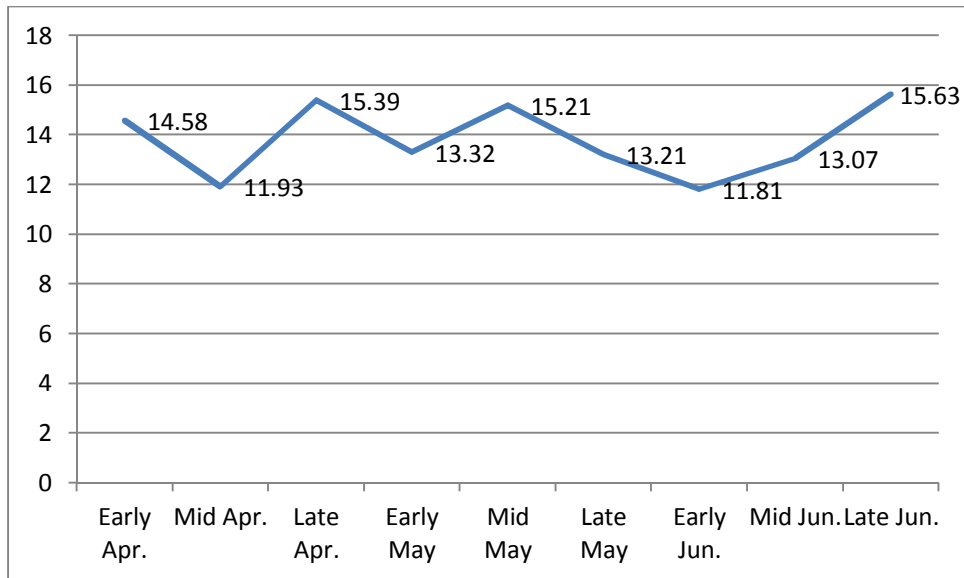


Figure 5 :Average Tendency for the Topic of New policies on Housing Fund and Down Payment

Business tax reform

As shown in Figure 6, the public maintained a positive attitude towards the new tax reform in Q2. The exemption of business tax's five year to two year shift is implemented since March 31st. It is shared by the industry insiders that this policy would stimulate the transaction of second-hand housing markets. Together with the proactive publicity of local governments, the general public have a high level of attention and recognition about the new tax policy.

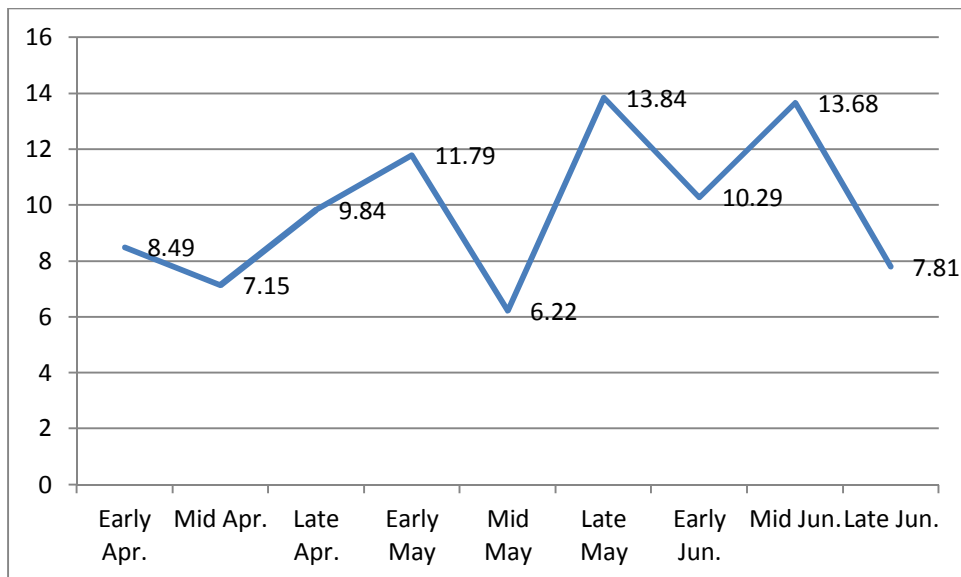


Figure 6 :Average Tendency for the Topic of Business Tax Reform

Housing market and stock market

On March 30th, 2015, series new policies were introduced, including the down payment for the second house buying lowered to 40% and the business tax exemption period shifted from 5 years to 2 years. Coupled with the central bank interest rate and reserve ratio cut policy introduced in succession, real estate sector gradually picked up. On the other hand, since last year, A-shares have been going all the way up, encountered "a bull market caused by reform" in a decade, China ushered in the prosperous period for both stock market and property market. As can be seen from Figure 7, from April to mid-May, the public's attitude towards real estate remains high. Beginning in late May, A-share market continued to strengthen, the real estate market funds may be outflow, and public attitudes towards real estate also went slightly down. In June, A shares plummeted; many investors changed their investment strategy, shifting part of the funds out from the stock market to the property market, promoting the property market to pick up further, and people tend to be more optimistic.

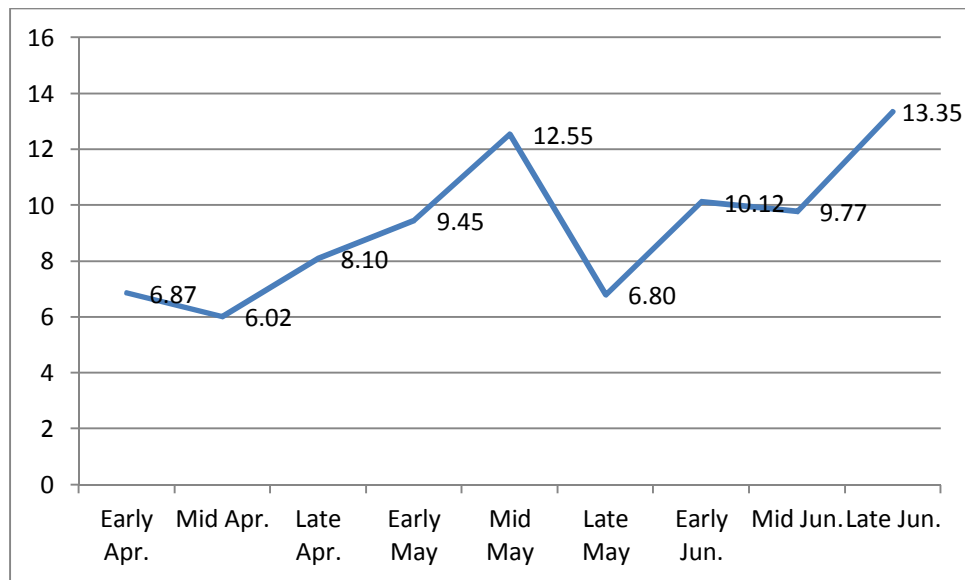


Figure 7 :Average Tendency for the Topic of Housing Market and Stock Market

Real estate developer's capital chain

As shown in Figure 8, in Q1, Real Estate Developer's Capital Chain is tightening. A growing number of companies suffered from capital chain rupture. Therefore, in Q2, public sentiment was quite pessimistic. As more property companies started to control their risks and rolled out capital chain strategies, people's attitude towards the capital chain turned optimistic. However, given the intense economic downward pressure, Real Estate Developer's Capital is still a source of concern. Afterwards, Real Estate capital chain entered the phase of "P2P". The rosy signs in tier-1 and 2 cities boosted the public sentiment.

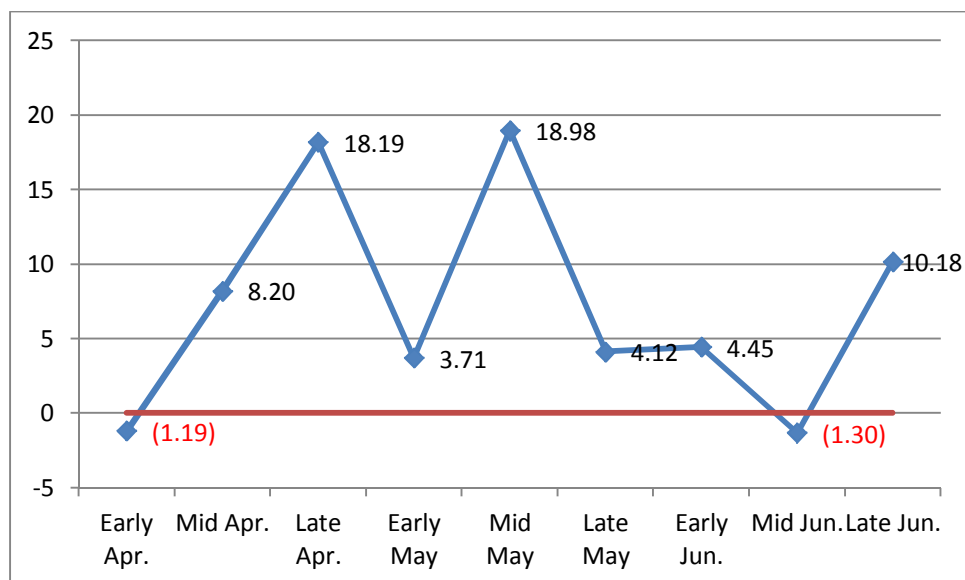


Figure 8 :Average Tendency for the Topic of Real Estate Developer's Capital Chain

Lower interest rate

From Figure 9, we can find the public's attitude experienced slight change but in general it's quite optimistic. In the early Q2, the public were still hesitant about the impact exerted by lower interest rate on the housing market. After the official announcement was made, followed by lowered benchmark lending and deposit rates of RMB in the financial institutions since May 11th, 2015, a series favorable credit policies reduced the cost of home buying, which had a positive impact on the public's attitude towards this topic.

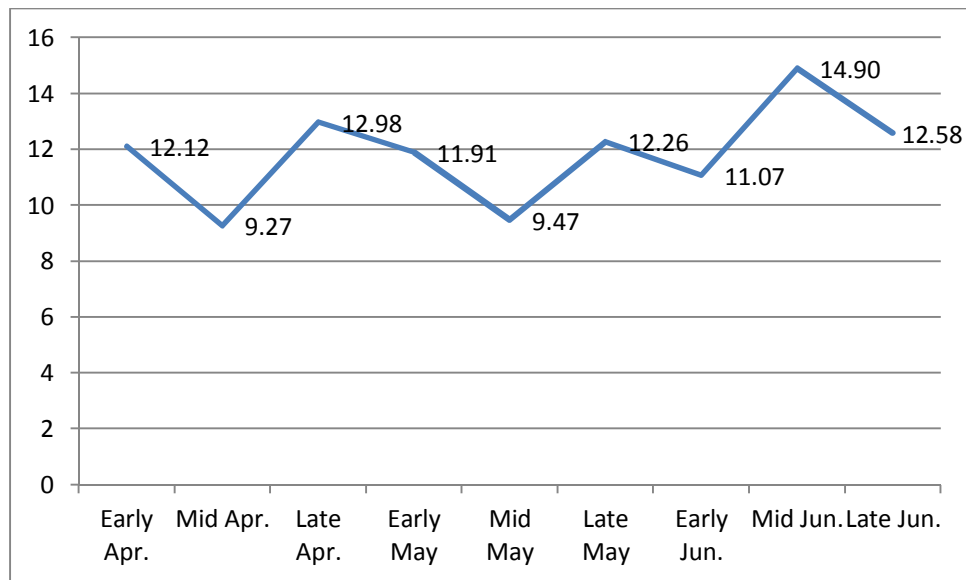


Figure 9 Average Tendency for the Topic of Lower Interest Rate

Land market

From Figure 10, one can tell that in the first half of the Q2, public's attitude towards the land market was quite optimistic. After the new policy issued on March 30th, the housing market transaction started to pick up. As the tier-1 cities' land market continue to boom, the situation in non-tier-1 cities are far from satisfying. The tier-2 cities have been given a cold shoulder and the land market in tier-3 and 4 cities are even more sluggish. The land market nationwide further dropped, thus the level of optimism went down as well. When a new round of interest cuts came into being at the end of Q2, the land market got better and the public sentiment turned to be optimistic gradually.

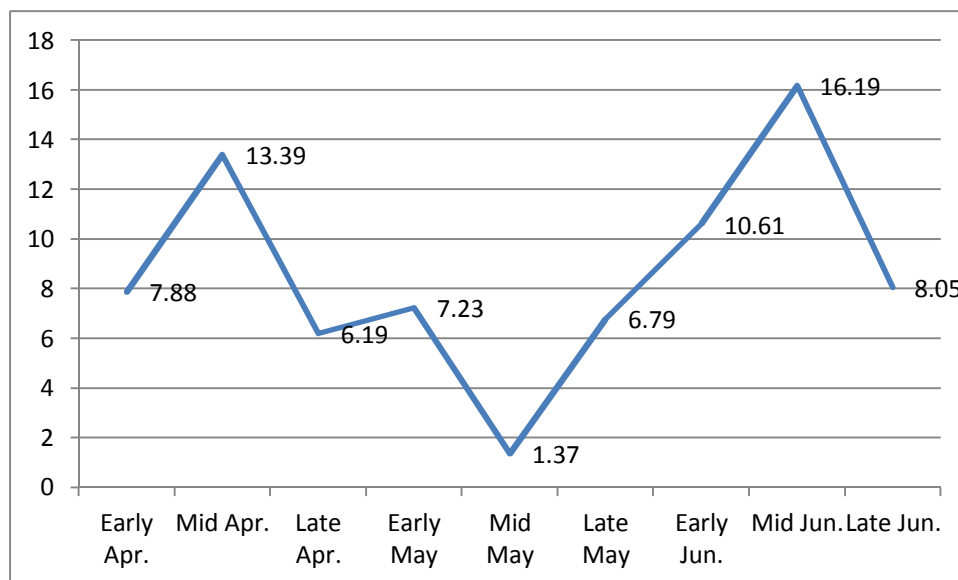


Figure 10: Average Tendency for the Topic of Land Market

Real estate trust

As shown in Figure 11, despite the real estate trust witnessed another round of cash out peak in 2015, given the better performance of A-share in the early Q2, securities and investment trust embraced rapid growth and the public's attitude is quite optimistic. In the late April, as the real estate default popped up one after another, investors got panic and they started to cash out and the public's sentiment also got skeptical about the trust as their attitudes swung. However, the table has turned as the first publicly offered REITs was about to come to the market, together with the growing returns and the expected return rate for real estate trust, the general public's attitude towards this topic was changed.

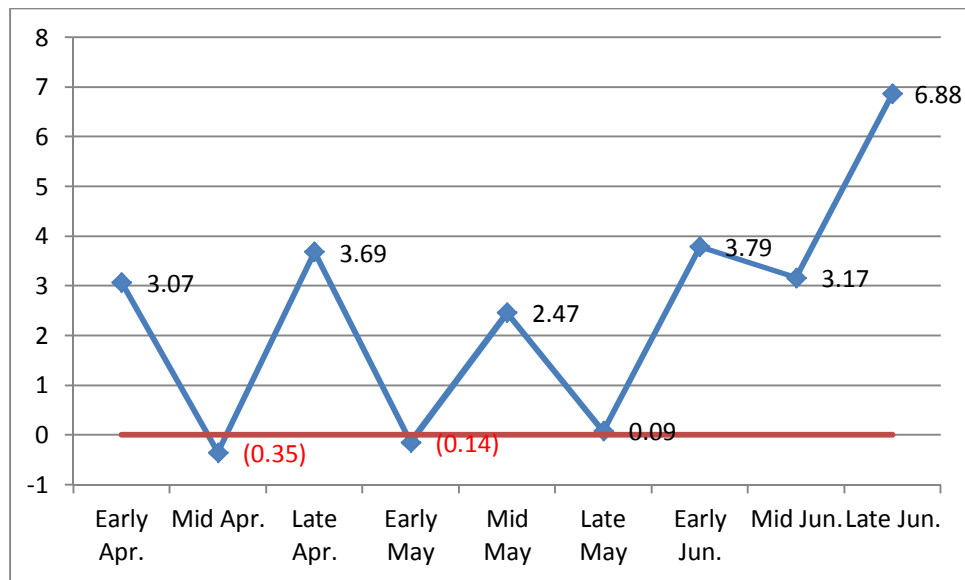


Figure 11 :Average Tendency for the Topic of Real Estate Trust

Shanty town renovation

Figure 12 illustrates that the attitude towards shanty town renovation fluctuated slightly in Q2, but in general, it demonstrated an upward trend. In April, 2015, Premier Li Keqiang made a statement, requesting support for shanty town renovation. Later on, Ministry of Housing and Urban-Rural Development of the P.R.C announced that they will work hard to attain this year's goal, which boosted the public's confidence. In May, the China Development Bank's provision of loans for shanty town renovation exceeded 1 trillion, injecting great support to this plan. In June, the State Council announced that the 18 million shanty town will be renovated in 3 years. It is encouraged that one should use the existing housing in stock and monetary incentives to carry out the renovation and the central government will allocate 10 billion yuan to support this initiative. All of the above mentioned measures keep the public's attitude towards the shanty town renovation upbeat.

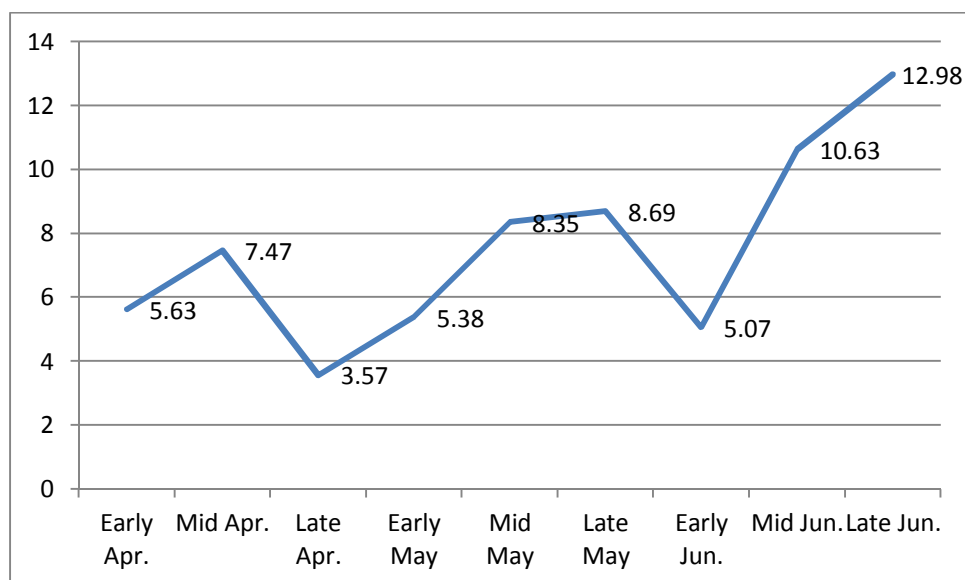


Figure 12 :Average Tendency for the Topic of Shanty Town Renovation

Affordable housing

In the first quarter of 2015, as the scale of loans granted to the housing sector expanded rapidly, the loans provided for affordable housing also grew substantially. Although the affordable housing alleviated the housing problem of low-income families to certain extent, improper management, violation of rules in house allocation, issues in design and planning were found. As we can see from Figure 13, these problems weaken the functions of affordable housing and the attitude towards it fell sharply in Q2. In late June, affordable housing trust fund started, diversifying the financing models for affordable housing. The public sentiment towards this topic went upward slightly.

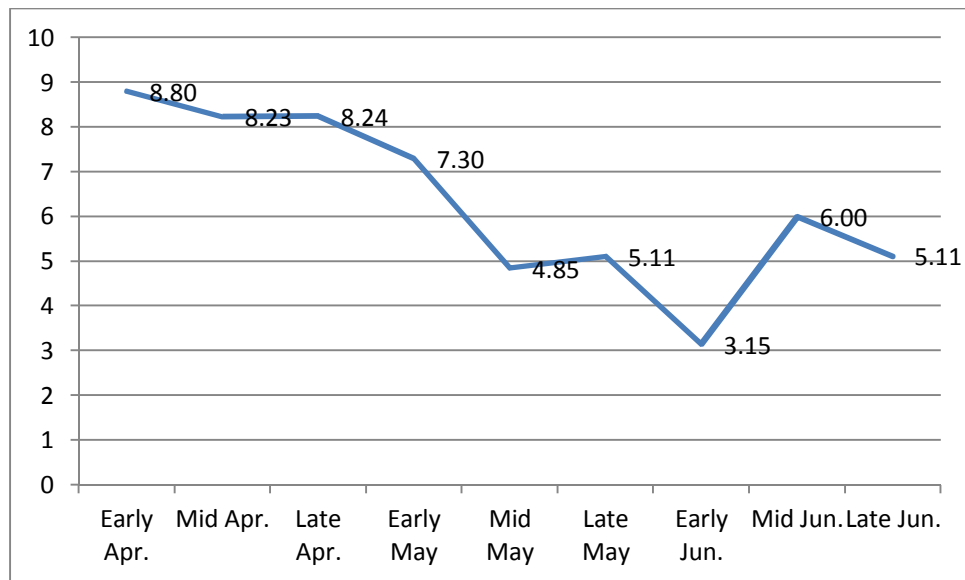


Figure 13 :Average Tendency for the Topic of Affordable Housing

CONCLUSION

This paper chooses several popular topics about public sentiment towards the housing market, including “rising housing price”, “transaction volume start to pick up”, “lower interest rate”, “housing market and stock market”. Together with the online public sentiment corpus from April 2015 to June, 2015, we sorted out the content feature of online public sentiment about housing market in Q2 of 2015 and made an analysis of topics correlation. It also reflects the attention given by the public towards different topics and their attitudes. These can be relevant and helpful for the housing market regulation at present. The following conclusions are found:

Firstly, rising housing prices and the transaction volume pick-up are of the top concern among the online public sentiment for this season’s housing market. And the housing sector starts to stabilize. Based on the popular topics frequency counts, we find that “soaring housing prices” and the “transaction volume pick-up” are of the top 2 concern among the online public sentiment towards the real estate market for Q2 in 2015. Meanwhile, “lower interest rate”, “new policies on housing fund and down payment” also gain much attention from the public as they are related to the housing market policy reform. The attention paid to the warming housing market and favorable house purchase policy shows the potential demand for household in the short term is growing. It also indicates the demand side has contributed to a warming housing market.

Secondly, the six topics are correlated significantly, and business tax reform might further back up the booming housing market. With the help of correlation analysis, this paper finds that in Q2 of 2015, “soaring housing prices” and the “transaction volume pick-up”, “business tax reform”, “lower interest rate”, “housing market and stock market” and “new policies on housing fund and down payment” possess some correlation and further examination of the mutual influence among the public sentiment focus in this season. Despite less attention paid to the “business tax reform” among the public sentiment information, all related association rules have been greatly lifted and demonstrates sound effectiveness. It further reflects that among the public sentiment information in Q2 of 2015, “business tax reform”, “rising housing price” and “transaction volume starts to pick up” play a leading role and they have drawn the public’s attention towards the property market to certain extent.

Thirdly, the overall online public sentiment towards the housing market is optimistic for this season, while some topics’ average degree of tendency fluctuated slightly. Through the tendency analysis of the 11 popular housing market topics, it is found that among the online public sentiment, the average degree of tendency for most topics at different stages have remained an optimistic tune in Q2 of 2015. Among those topics, “soaring housing prices” and the “transaction volume pick-up”, “lower interest rate” and “new policies on housing fund and down payment” maintain a high degree of optimistic tendency while only “real estate developer’s capital chain” and “real estate trust” experience some tendency shift. Thus, based on the analysis result, the overall optimistic online public sentiment towards the housing market in Q2 of 2015, which also reflect that netizens and the media are satisfied with the housing market regulation to some extent and they hold a positive attitude towards the stabilization of the housing market and its sound development.

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What Makes Content Viral Online: A Study of Micro Blogs on Sina Weibo

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ABSTRACT

Social networking sites (SNSs) such as Facebook, Twitter and Sina Weibo have attracted millions of users and it makes social interaction become important and frequent in people's daily life. They enjoy sharing Weibo posts with their friends. However, different posts gain different levels of attention. Why are certain contents on SNSs more viral than others? This question has attracted many researchers. Our research aims to examine what makes online contents viral on Sina Weibo. We find that if a Sina Weibo post is featuring with ease of engagement by users, or visual effect, or new knowledge, then it is more viral than other posts. Otherwise, we concluded several popular kinds of engagement from Sina Weibo: moral encouragement (e.g. good luck from micro-blogs forwarding), material reward (e.g. lucky draw) and topic discussion (e.g. product design; seeking for resonance; emotional appeal). Choosing suitable kind to manage online content can help enterprises operate Weibo marketing much better.

Keywords: Viral Online Content, Social Transmission, Micro Blog, Sina Weibo

INTRODUCTION

With the growth and evolution of Web 2.0 technology, the Internet is able to dramatically facilitate interconnections among users [28], especially on social networking sites (SNSs). People post comments on restaurants, share photos and experiences with others, post forward and praise micro blogs on social networking sites. Their daily life is enriched by sharing behaviors.

The sharing behaviors and social interactions also affect branding strategies of enterprises. This is because social media sites help firms to identify preferences of target consumers, their opinions and perceptions of the brand[1]. A well-known Chinese mobile vendor XiaoMi obtained big success by micro-blog marketing. The micro-blog, known as Weibo, is a Chinese microblogging service similar to Twitter. Large Chinese IT firms such as Sina, Tencent and Sohu provide Weibo services. Among them, Sina Weibo is the most influential in China. On December 19th 2012, XiaoMi posted a post on its official Sina Weibo account. The post encouraged Sina Weibo users to share the "first social shopping on Sina Weibo" with their friends. A Sina Weibo user has a chance of lucky draw to win a free smart phone after forwarding this Weibo post to his/her friends. According to Weiboreach, this Weibo post was forwarded 2.6 million times by the end of December 31th. Nearly 1.5 million users forwarded this Weibo post. In addition, the number of Xiaomi's fans rose to 1.5 million from 0.7million in just 2 days. XiaoMi was the first company to market smart phones on Sina Weibo in 2012. It gained high brand recognition from Weibo marketing.

For Sina Weibo users, social interaction is important and frequent in their daily life. They enjoy sharing Weibo posts with their friends. However, different posts gain different levels of attention. Some posts are forwarded and shared like the growth of virus. They increase their reach exponentially. Some are rarely shared among Sina Weibo users. Some posts about consumer experience receive passionate responses while others obtain sparse followers. Some posts top the ranking list of hot topics while others languish. Today many companies create online advertisements, hoping that they would encourage consumers to generate and share contents about the company. However, this strategy is not always successful[8][34]. The key problem is to understand why some contents are viral while others are not.

Our research investigates which elements affect online content virality from three aspects: the publisher of content, the content itself, and the context of the content. We use Sina Weibo, the most popular social networking site in China, as my research platform to explore the influence factors. Our findings shed light on Weibo marketing strategy for companies which want to market their products and promote their brand on Sina Weibo platform.

The objectives of my research are as follows:

- (1) Explore the characteristics of online content that make micro blogs viral in Sina Weibo.
- (2) Provide suggestions to companies for successful viral marketing on Weibo.

LITERATURE REVIEW

Definition of Viral and Virality

Simmons (2006) described the term viral as "how the content- be it a joke, picture, game or video- gets around" [38]. On one hand, the word "viral" appeared most frequently together with "marketing" and there existed various definitions for viral marketing. On the other hand, researchers considered it as "virality". Without one standard definition of virality there have developed several different opinions. Some researchers assessed that virality referred to the number of people who accessed the given content in a given time interval[21]. Others proposed that virality meant the probability that a piece of message would be

passed along[22]. Otherwise, Guerini (2011) proposed that “virality is a complex phenomenon which can be decomposed into several components: appreciation, spreading, buzz, white and black buzz, raising discussion and controversiality”[21]. However, to start, my research worked with the definition that virality refers to “the number of people who accessed the given content in a given time piece[21]. However, considering that the transmission of micro blogs in Sina Weibo quickly arrive a bottleneck period and the increment of forward gets smaller, we have not set a “given time piece” in my research.

Factors that impact on online content virality

Thus, far, researchers have explored virality of online content in three general groups: the nature of the content itself, the nature of the publisher (or spreader) who spread the content and the context/environment of the content.

The first stream of research focuses on the nature of the content

Some researchers held the opinion that the valence (positive or negative) of the content directly affected the virality[3][11][6][10][32]. Some researchers proposed that whether positive or negative, viral social transmission was in part driven by arousal emotions, such as surprise[16][13][29], excitement[34], interest[23][31][24][28], and humor[34]. In addition, researchers took the motivations to transmit information into consideration, which were classified into two types: egoism[15][18][6][7] and altruism[39][30][12].

Different from previous research on content itself, our research laid more stress on “ease of engagement for users”. Researchers proposed that viral content should encourage ease of use[17]. Research on the influence of brand community commonly used terms such as “engage” or “engagement”[2][36]. Recent research has paid more attention to consumer engagement as it is now regarded as a competitive advantage and a driver of business performance[33][37]. In fact, engagement (sense of participation) played an important role in Weibo marketing. For example, one content that is ease to engage with for users issued by XiaoMi company on Sina Weibo was forwarded 2.6 million times, and the number of Xiaomi’s fans reached to 1.5 million from 0.7million in only 2 days. However, few studies concluded the importance of “ease of engagement”. Our research further demonstrates the importance of ease of engagement in regards to virality and viral marketing.

Based on the above literature review this research will test the following hypotheses:

H1a: Content that is easy to engage with is likely to go viral on Sina Weibo

H1b: While the content is altruistic, the content is likely to go viral.

H1c: While the content is egotistic, the content is likely to go viral.

H1d: While the content is arousing, the content is likely to go viral.

The second stream of research focuses on the nature of the publisher

Previous studies showed that the types, the influence and the gender of the publisher were relevant with the virality of the online content. Some researchers held the opinion that types of publisher had an important impact on virality[19][28][20]. Some researchers supposed that influential users would lead viral topics or marketing[35][9][4]. Some researchers suggested that the gender of the user also affected the viral effect of the content and many of them held the opinion that messages are more likely to be forwarded by male recipients than female recipients[16][4].

As to the content publishers, we continued to study gender and popularity, but changed the types of publisher according to Sina Weibo.

H2a: While the publisher is a male, the content will be more viral than a female.

H2b: While the popularity of the publisher is higher, the content is likely to go viral.

H2c: While the publisher belongs to the few (media, scholar or writers, business people and entertainment stars), the content will be more viral than the publisher who is a common person.

The third stream of research focuses on the context/environment of the content

Gladwell (2006) proposes the power of context in such that the environment (the circumstance and conditions of the places and times in which it occur) strongly influences human behavior[19]. Some researchers see the context as the structure of the network and community[5]. Other researchers propose that seeding an infectious message to disconnected subcultures such as virtual social worlds are much more important than the quantity of seeds[26][27].

In addition, enterprises began to use news-value events to attract media, social communities and consumers’ attention to promote their brand image and sales via the internet more and more in China. Chinese people also attach great importance to special dates such as holidays and memorial dates. In our research, we took all of the aforementioned into consideration.

H3a: Content that is related to a current event is likely to go viral.

H3b: Content that is related to a special date is likely to go viral.

THE CURRENT RESEARCH

We examined what makes online content viral in social networking sites. We studied transmission in three ways. First, I investigated the virality of almost 3000 micro blogs from Sina Weibo (Study 1). We controlled for some factors such as publisher's popularity, publisher's type and publisher's gender, and we examined how ease of engagement for users, altruism, egoism, arousal, current events and special dates used by a micro blog affected the possibility of making it rank the top 100 Weibo list. Second we conducted a series of experiments. I chose some micro blogs that contain factors positively related with virality that Study 1 has verified and created the corresponding micro blogs that excluded these factors. Then we did lab experiments in a college and a company to further verify my hypothesis that these micro blogs with tested factors in Study 1 tended to be transmitted more (Study 2). Third we investigated 11 weeks' top 100 micro blogs, that is, 1100 pieces of micro blogs in total (Study 3). In this study, we focused on the influence of the publisher on virality of Weibo.

Study 1: A Field Study to verify my research framework in Sina Weibo

Our first study investigated what types of micro blogs in Sina Weibo were highly shared. Since Sina Weibo has a massive user base and is comprised of many different types of users (e.g., stars, writers, ordinary people) and a wide range of topics (e.g., amusement, gossip, politics, economics), it becomes an ideal platform for studying content virality. Sina Weibo reports the top 100 micro blogs ranking list in the last week (hot.Weibo.com) and we examined influencing factors which affect whether this micro blog ranked among the top 100 micro blogs list.

Data Collection

Since existing software for collecting data from Twitter is not available in Sina Weibo (the problem of authorization and privacy protection), the first step was to develop appropriate web crawler software to obtain micro blogs automatically from Sina Weibo based on current software and web crawler technology. Sina Weibo, as an open social networking site, offers reliable API and related documents to users. First we applied for an account to use API (open.Weibo.com), and then we called a certain interface when required by the integration of SDK and API offered by Sina Weibo official. The interface accomplished the process of data acquisition and operation and returned the corresponding JSON file. For instance, an interface named "statuses/timeline batch" batches acquired lists of micro blogs of specified users

The top 100 micro blogs ranking list in the past week updated at 0:00 every day. In order to ensure the non-repeatability of data, we collected the top 100 micro blogs every Friday from November 14th (the first Friday), 2014 to January 8th, 2016(hot.Weibo.com), 61 weeks in total. All in all, there were a total of 2200corresponding common micro blogs (not ranking in the weekly top 100 micro blogs list) in Sina Weibo (Weibo.com) from the same publishers who belonged to 1100 hot micro blogs' publishers (two piece of common micro blogs one publisher) and from the same week, that is, 3066 micro blogs in total since some publishers had not posted three micro blogs in the same week.

Data Description

We collected data through a web crawler software based on the API of Sina Weibo. We captured the micro blog content, the time of publishing, the recorded time, the number of times praised, and the number of comments. We also captured the content publisher's information such as gender, verified or not, fans amount and publisher tags. In order to record data better, we made screen-shots of the content and saved the pictures the micro blog used. The above factors are shown as table 1.

Table 1:Data Description

Factor Name	Definition
The micro blog content	The content of the micro blog has two parts: words and pictures (videos). Such as "This is my family photo and we are very happy" with a photo.
The publish time	The date the micro blog is posted.
The recorded time	The date the micro blog is recorded.

The praised times	The number the micro blog is praised. In Sina Weibo, you can praise a micro blog by clicking the sign “thumb”.
The resend times	The number of times the micro blog is forwarded.
Comments times	The number of comments the micro blog obtains.
Publisher’s gender	The gender of the publisher: male or female.
Verified	Whether the publisher get verification from Sina Weibo: Yes or not.
Fans amount	The number of fans of the publisher.
Publisher tags	The tags publisher filled in to describe themselves

Data Coding

We coded the micro blogs on several dimensions. According to The 2015 Report of CNNIC (China Internet Network Information Center), the male netizen: female netizen = 55: 45. The proportion of ages of netizens is as following: Age 10 - 19 is 23%, Age 20-29 is 32%, Age 30-39 is 23%, and Age 40-49 is 13%. So I selected 5 people to help me rate my micro blogs. Age 10-19: 1 person, Age 20-29: 2 people, Age 30-49: 2 people. 3 individuals were male, and 2 individuals were female. They were blind to our hypotheses. They received a five-point Likert scale excel file which contained the content and the publish time of these micro blogs, items they needed coding and a folder which contained corresponding pictures or videos these micro blogs illustrated. They coded micro blogs according to the extent they agree with “this piece of micro blog presented this character” (“1 “means strongly disagree and “5” means strongly agree”).

Before formal rating, we gave these 5 raters a test set of micro blogs and kept giving them feedback on their coding until it was clear that they understood the relevant construct. That is, the interrater reliability between these five raters should be high on all dimensions (all α 's>0.7), indicating that content tends to evoke similar emotions across people. Then we used serial correlation method to analyze interrater reliability between these five raters through SPSS. Results showed that the interrater reliability was very high (α >0.7) which represented that the content of the micro blog evoked same feeling and judgment across ten raters. Then they coded the 3066 pieces of micro blogs. We averaged scores across raters and standardized them (for data processing, see Table2; for sample, micro blogs that rated highly on the different dimensions, see Table3; and for coding instructions, see the Appendix).

Table 2:Data Processing

Variables		Resources of variables
Content Characteristics	Ease of engagement (for users)	Artificial scoring(1point-5point)
	Knowledge	Artificial scoring (1point-5point)
	Public Welfare	Artificial scoring (1point-5point)
	Humor	Artificial scoring (1point-5point)
	Visual Effect	Artificial scoring (1point-5point)

	Surprise	Artificial scoring (1point-5point)
	Self-Promotion	Artificial scoring (1point-5point)
	Positive	Artificial scoring (1point-5point:1-2 negative;4-5 positive; 3 no emotion)
	Search Notices	1-search notices 0-not search notices
Content text/Environment	Current Events	1-current event 0-not current event
	Special Dates	1- special date 0- not special date

Table 3:micro blogs that rated highly on the different dimensions

Primary Predictors
<p><i>Ease of engagement for users</i></p> <ul style="list-style-type: none"> “Samsung posted a micro blog with words “Upload your family photos and @ Samsung to win a free phone”. Every user has the same opportunity to win the prize and the only thing users must do is post a micro blog with their family photo. This micro blog was forwarded more than 100,000 times.”
<p><i>Knowledge</i></p> <ul style="list-style-type: none"> “A fingerprint lock is much safer than coded lock and sliding screen lock. Please learn how to set the fingerprint lock from Samsung. ”
<p><i>Public Welfare</i></p> <ul style="list-style-type: none"> “The number that this micro blog is forwarded, we will give the same amount of money to charity”
<p><i>Humor</i></p> <ul style="list-style-type: none"> “a note from my dad: 'my dear son, I am very happy that tonight you will take your girlfriend back home. I know that something might happen but do not forget to be a responsible man. Safety first.'” with some Durex condoms attached to the note.
<p><i>Surprise</i></p> <ul style="list-style-type: none"> “Changing your laptop to a tablet computer, Lenovo helps your dream come true. Yoga can rotate 360 degrees”
<p><i>Self-promotion</i></p> <ul style="list-style-type: none"> “A group of Chinese people had a trip in UK, they singed a song to praise our motherland- China together in front of the building of UK government”

Positive

- “Write down your dream, and please remember to smile every day, Samsung will help one user’s dreams come true”

Analysis Strategy

In order to research the relationship between the predictor variables and dependent variables –viral, we relied on the following logistic regression specification as (1) which was used in viral analysis by Berger and Milkman (2011).

Virality is the dependent variable that takes value 1 if the micro blog is viral and 0 otherwise. If the micro blog is on Top 100 hot micro blogs ranking list, we assigned it value 1. Otherwise, we assigned it value 0.

Then use SPSS to do multivariate logistic regression analysis, results are shown in table 4:

Table 4: Multivariate logistic regression analysis results

	B	S.E.	Wals	df	Sig.	Exp (B)
Ease of Engage-ment	-.237	.100	5.636	1	.018	.789
Knowledge	.483	.220	4.816	1	.028	1.621
Public Welfare	.473	.274	2.985	1	.084	1.605
Humor	.009	.115	.006	1	.940	1.009
Visual Effect	.276	.098	7.860	1	.005	1.317
Surprise	.155	.107	2.071	1	.150	1.167
Self-promotion	.160	.095	2.805	1	.094	1.173
Positive	.032	.098	.105	1	.746	1.032
Negative	.177	.112	2.490	1	.115	1.193
Search Notices	-.475	.704	.456	1	.500	.622
Current Events	-.067	.224	.090	1	.764	.935
Special Dates	.028	.258	.012	1	.914	1.028
Constant	-.924	.105	76.740	1	.000	.397
Sig. < 0.1, significant at the 10% level Sig. <0.05, significant at the 5% level						

Results and Discussion

According to logistic regression results, we found some conclusions relevant with our research.

We found that ease of engagement is a very important factor. When the topic of Weibo content utilizes ease of engagement for users, the content will be more viral. (H1a is accepted.)

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We found that knowledge is also a very important factor. When the topic of Weibo content contains knowledge, the content will be more viral. (Part of H1b (knowledge) is accepted and part of H1b (public welfare, search notices) is rejected.

H1c is rejected.

We found that visual effects play an important role in viral content. When the Weibo content shows visual effect, the content will be more viral. (Part of H1d (visual effect) is accepted and part of H1d is rejected (surprise and humor).)

H1a (ease of engagement), part of H1b (knowledge) and part of H1d (visual effect) are accepted, other hypotheses are rejected. Research results illustrate that content characteristics (ease of engagement, visual effects and knowledge) are significantly relevant with virality of the micro blog. Part of H1b (public welfare and search notices) is rejected because the micro blogs study 1 used do not contain much information about public welfare and search notices, the same to monetary benefits. H1c is rejected. As to self-promotion, it was significant at the 10% level and we think it was because some Weibo users compelled them not transmit certain official types of micro blogs, such as patriotism among young people. Positive content does not show to be much more viral than negative content, because people in Sina Weibo are also concerned about negative news.

I did not test H2a, H2b and H2c in Study 1.

H3a and H3b are rejected.

Study 2: Lab Experiments- How ease of engagement, knowledge and visual effect affect transmission

Findings of Study 1 have important marketing implications. Online content in Sina Weibo which contains characteristics such as knowledge, visual effects and ease of engagement will be much more viral. Considering these specific characteristics can help enterprises increase their profit if they use SNSs for marketing. It is also useful for enterprises to design their micro blogs content if they want to receive attention and attract customers in SNSs. Findings of Study 1 can also help enterprises to develop their marketing strategy through creating a new topic in Sina Weibo to attract users. As our findings show, topics which incorporate ease of engagement are much more viral. So, companies should focus on reducing the difficulty to engage with the topic discussion.

Experiment 1: Ease of engagement

Participants (N=80) were randomly divided into two groups: Group1 and Group 2. We then designed two sets of micro blogs: Set 1 and Set 2. The two sets of micro blogs have same characteristics except that Set 1 includes the feature: ease of engagement and Set 2 does not have this feature. We gave Set 1 micro blogs to Group 1 and Set 2 to Group 2. After reading about the micro blogs, participants were asked how likely they would be to share it with others (1="not all likely," and 5="extremely likely").

Example of two sets of micro blogs:

Set 1: Contents of micro blogs like "Here are top ten ranking movies of 2015".

Set 2: Contents of micro blogs like "Here are top ten ranking movies of 2015, have you watched some of them and which one did you like best?".

Experiment 2: Knowledge

Participants (N=80) were randomly divided into two groups: Group 1 and Group 2. We then designed two versions of micro blogs: Version 1 and Version 2. We pretested the two versions of micro blogs to ensure only Version 1 of them presented knowledge (rich and useful information). We gave Version 1 micro blogs to Group 1 and Version 2 to Group 2. After reading about the micro blogs, participants were asked how likely they would be to share it with others (1="not all likely," and 5="extremely likely").

Example of two versions of micro blogs:

Version1: "iPhone 7 will come to the market next month".

Version2: "iPhone 7 will come to the market next month, and the difference between iPhone 7 and iPhone 6s are ...".

Experiment 3: Visual Effect

Participants (N=80) were randomly divided into two groups: Group1 and Group 2. We then designed several pairs of sets of micro blogs.

(1)Set1 and Set2: The two sets of micro blogs have same characteristics except that Set 1 is illustrated with pictures or videos and Set 2 is not illustrated with any pictures or videos.

(2)Set3 and Set4: The two sets of micro blogs have same content and they both have visual effect. What the difference between them is one is illustrated with pictures and another one is illustrated with video.

After reading about the micro blogs, participants were asked how likely they would be to share it with others (1="not all likely," and 5="extremely likely").

Results and Discussion

Table5: Results of lab experiments

Version 1 of Questionnaire			Version 2 of Questionnaire		
Q1	3.54	Knowledge-scientific knowledge	Q1	1.92	no
Q2	2.28	no	Q2	2.11	Knowledge-life knowledge
Q3	3.15	Knowledge-life knowledge	Q3	2.08	no
Q4	2.33	no	Q4	3.55	Engagement-topic discussion
Q5	3.64	Engagement-topic discussion	Q5	2.55	no
Q6	2.26	no	Q6	1.92	Engagement-topic discussion
Q7	3.82	Engagement-lucky draw	Q7	1.47	no
Q8	2.31	Pictures, no video	Q8	3.66	Visual effect- Video
Q9	3.72	Visual effect- pictures	Q9	2.24	no
Q10	2.15	no	Q10	3.58	Public welfare
Q11	2.90	Self-promotion-values	Q11	2.26	no
Q12	4.00	Self-promotion- show off	Q12	2.18	no
Q13	1.51	Self-promotion-values	Q13	2.37	no
Q14	1.49	Self-promotion-comparable micro blogs	Q14	1.32	no
Q15	3.77	Engagement-forwarding luck	Q15	2.29	no

Results were showed as above table5. The experimental results reinforced the findings from my archival field study (Study 1), and supported my hypothesized process. First, consistent with my analysis of 3000 pieces of micro blogs in Sina Weibo, micro blogs which where ease of engagement evoked more transmission (Experiment 1). People would be more likely to share and forward a piece of micro blog when it contained knowledge (Experiment 2) and when it included a picture and a video even more (Experiment 3).

Study 3: An Extended Study from Study 1Considering Publisher

We used the eleven weeks' Top 100 hot micro blogs from Study 1, which consists of 1100 pieces of micro blogs as my data set, to study the influence of the publisher from November, 2014 to December, 2015.

Results and Discussion.

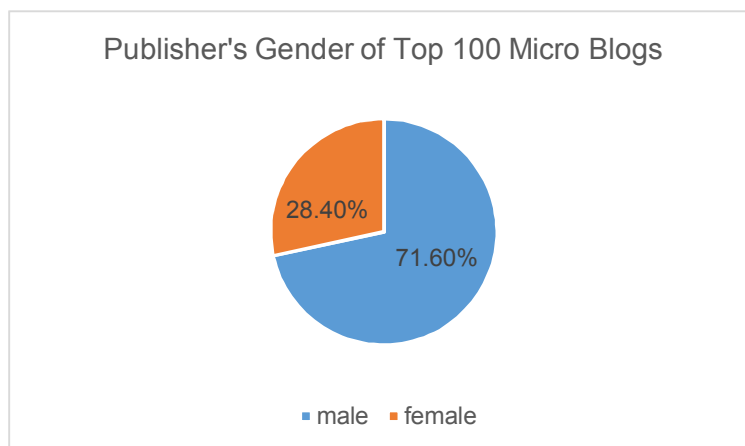
H2a: While the Weibo content publisher is a male, the content will be more viral than a female.

H2b: While the popularity of the publisher is higher, the content will be more viral.

H2c: While the Weibo content publisher belongs to the few (media, scholar or writers, business people and entertainment stars), the content will be more viral than the publisher who is a common person.

Gender:

Among the hot micro blogs data set, 788 pieces of micro blogs, or 71.6%, were posted by males. I suggested that male publishers tend to create and transform much more viral information than female publishers.

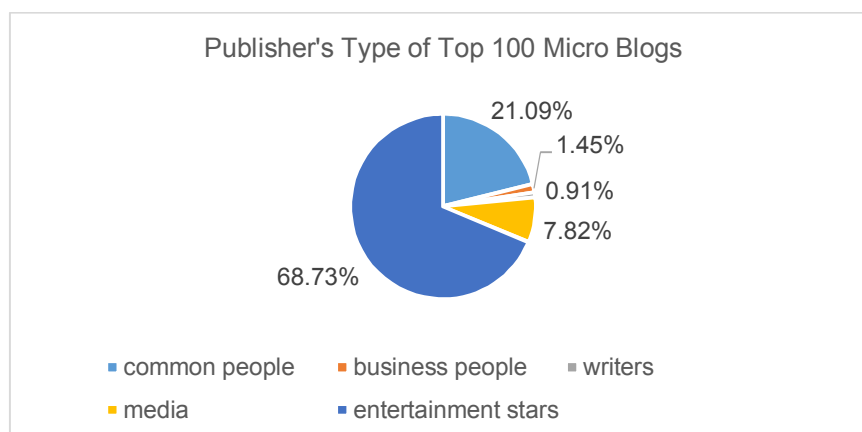


Popularity:

Among the data set, the number of publishers who had less than 10,000 fans was 22, which accounts for 2%; the number of publishers who had between 10,000 and 1 million fans was 160, or 14.5%; the number of publishers who had between 1 million and 10 million was 444, accounting for 40.4%; the number of publishers who had more than 10 million was 474, totaling 43.1%.

Publisher type:

Among the data set, the number of publishers who were common people (including famous grassroots micro bloggers) was 232, which accounts for 21.09%; the number of publishers who were business people was 16, which accounts for 1.45%; the number of publishers who were scholars or writers was 10, which accounts for 0.91%; the number of publishers who were media was 86, which accounts for 7.82%; the number of publishers who were entertainment stars was 756, which accounts for 68.73%.



According to the eleven weeks' Top 100 hot micro blogs analysis, I found H2a, H2b, H2c were all verified to some extent.

LIMITATIONS

This study also has several limitations:

First, measurement of popularity of the Weibo user: we have not found a good way to measure popularity of the Weibo user. Originally we choose fans amount but zombie fans (Malicious registered users or bought by money) are widespread in Sina Weibo. In the future, we will try to use number of fans who have V (verification) offered by Sina to measure popularity.

Second, the data we collect brings biased elements. The data was collected from a specific group and over a specific period-publisher of weekly Top 100 micro blogs and the sample could be bigger other than just 3,000 pieces of micro blogs.

Third, quantitative study: we choose questionnaire to measure qualitative variables from 1 to 5, rather than try to use qualitative study, like text analysis. For instance, we can use text analysis method to distinguish whether the micro blog is positive. In the future research, we will try to solve these problems and test the whole research frame we have proposed in this study.

IMPLICATIONS

These findings have important marketing implications. Online content in Sina Weibo which contains characteristics: knowledge, visual effect and ease of engagement will be much more viral. Considering the specific characteristics can help enterprises increase their profit if they use SNSs to do advertising like Xiaomi. It is also useful for enterprises to design their micro blogs content if they want to get attention and attract customers in SNSs like Durex. Our findings also can help enterprises to develop their marketing strategy like creating a new topic in Sina Weibo to attract users like Samsung. Companies can post a topic relevant with their products and services. As our findings show, topic which is easiness for engagement is much more viral. So companies should reduce the difficulty to engage the topic discussion.

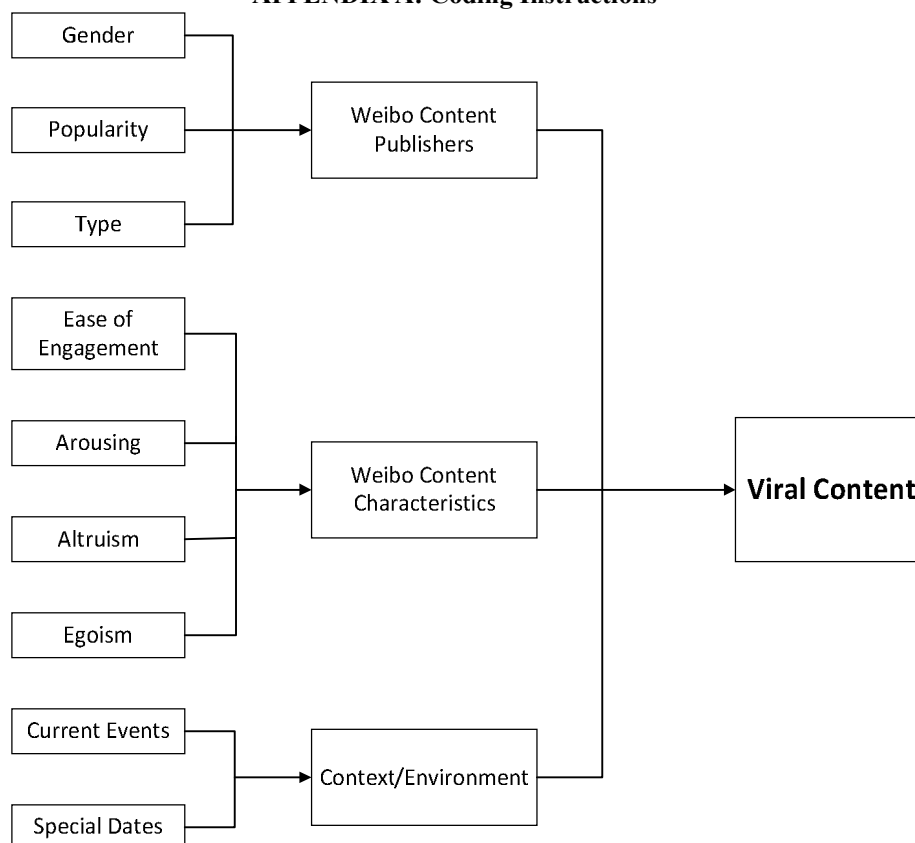
From our research findings, we concluded several popular kinds of engagement from Sina Weibo: moral encouragement (e.g. good luck from micro-blogs forwarding), material reward (e.g. lucky draw) and topic discussion (e.g. product design; seeking for resonance; emotional appeal). Enterprises should choose suitable kind to manage online content.

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APPENDIX A: Coding Instructions



(1) *Gender*: male or female.

(2) *Popularity*: the number of fans.

(3) *Type*: media, scholars or writers, business people, entertainment stars and common people.

(4) *Ease of engagement for users*

Definition: *ease of engagement for users* means that the threshold to engage with the topic a micro blog refers to is low. Ease of engagement contains two meanings: firstly whether this micro blog asks the reader to do something such as forward, share, upload or discuss; second is whether this task is easy to do.

Dobele, Toleman and Beverland (2005) propose that viral content should encourage ease of use. Every Weibo user should be able to participate in the event easily without limitations. For example, a typical topic which one piece of micro blogs from weekly Top 100 hot micro blogs in Sina Weibo refers to is using a phrase to describe the person you love.

According to the long-term observation of famous enterprise Weibo users, many enterprise Weibo accounts like to use the “event driven” method to communicate with their customers and potential customers in Sina Weibo.

(5) *Altruism*

Definition: Altruism means doing something that is helpful for others (knowledge, public welfare, and search notices). Knowledge can be defined as rich and useful information; public welfare refers to doing beneficial things for the public; search notices mean searching for somebody or something.

Previous research shows that altruism is one of the main motivations to transmit information. Several researchers contend that people will share useful information or content for altruistic reasons (Litvin et al, 2011). In my study, I define useful information as knowledge. Considering the characteristics of Sina Weibo, a public social network, it is easy for content with public welfare to become viral. As Sina Weibo has many users, search notices are always quick to be forwarded. Therefore, if a micro blog belongs to the above three kinds, I will define it as altruistic.

(6) *Arousing*

Definition: Arousing refers to calling forth emotions, feelings and responses (humor, visual effect and surprise). Humor refers to that the micro blog makes you laugh immediately or after a serious thought. Visual effect means attractive pictures or videos. Surprise refers to that the micro blog describes something which goes against your expectations.

Previous research shows that viral social transmission is in part driven by arousal (Jonah, 2011; Jonah, 2012). Jonah (2012) proves that content that evokes high-arousal positive (awe) or negative (anger or anxiety) emotions are more viral. Prior research also suggests that content will be more arousing with surprise, humor and other emotions and directly affects the virality of online content (Karen, 2013). I have studied a large amount of popular Weibo posts and found that humor and surprise are the main arousing emotions. My research differentiates itself from prior research as I take visual effects, pictures and videos, into consideration. Visual effects are used to capture people's attention, but prior research hasn't investigated its importance in SNS.

(7) *Egoism*

Definition: Egoism refers to an action that is helpful for oneself (self-promotion, monetary benefits and positive). Self-promotion means doing something which can help build a user's own image such as expressing positive values, presenting merits, and promoting themselves or showing off. Monetary benefits means posting this micro blog in a user's own Weibo could help them to acquire money, free products/services or awards. Positive means that the entire emotional tone of this micro blog is positive such as happy and satisfying.

Prior research suggests that self-enhancement is an important reason to transmit information and positive information is more viral than negative information (Dichter 1966; Gatignon and Robertson, 1986; Jonah and Katherine, 2012). Jonah and Katherine (2011) also propose that people may share information that reflects positively on the sender and prefer to share information that shows and promotes themselves (self-promotion). In addition, many business users in Sina Weibo choose to use monetary benefits to catch people's attention. One example, observed from Sina Weibo, is the forwarding of a lucky draw is very popular. As I discussed in the Introduction, Xiaomi mobile loves to use this method and through it achieves high levels of success. I studied three aspects concerning egoism: self-promotion, monetary benefits and positivity.

(8) *Current Events*

Definition: Current events refers to recent events regarding politics and economics at home or abroad.

(9) *Special dates*: holidays and festivals; memorial days.

APPENDIX B: Micro-blog marketing cases

Xiaomi Case: first social shopping in Sina Weibo (Leijun, 2012)



Durex Case 1: The elder brother of the shoe covers (Durex, 2011)

In June 2011, the heavy rains in Beijing were the hot point. On June 23rd, another heavy rain dropped from the sky. A Sina Weibo user named Di Kong Dao Dan posted a micro blog with words "Heavy rain in Beijing, thanks to these two durex condoms in my bag" and a picture that a pair of shoes with two shoe covers made by durex condoms. This micro blog was forwarded more than 10,000 times in an hour. In fact, Di Kong Dao Dan is a member of Durex Weibo operation team.



Durex Case 2: Pregnant event (Durex, 2011)

On April 12th, a famous grassroots micro blog named Homework posted a micro blog “People will get pregnant if they sleep before 1:00 tonight”. Durex immediately made comments “All right! Leave it to me” and forwarded it. Homework also replied Durex and forwarded Durex’s comments. On the night these three micro blogs were forwarded more than 7,000 times and Durex obtained more than 3,000 fans.

APPENDIX C: The data flowchart of Weibo collection

The data flowchart of Weibo collection is showed as follows:

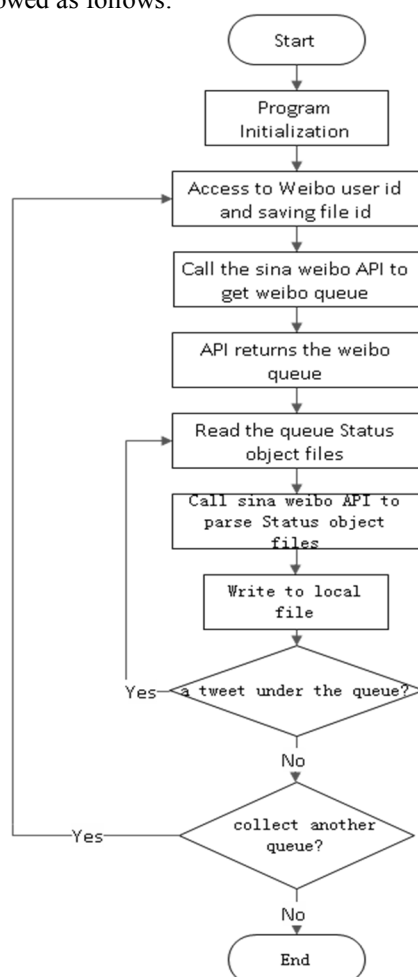


Fig. Web crawler software based on the API of Sina Weibo

Steps were shown as following:

Step 1: I used the software to collect a list of users whose micro blog is in the weekly Top 100 (hot.Weibo.com) every Friday and created two text files. File_1_n: Information included publisher name, gender, verified or not, number of fans and status (e.g. famous presenter or actor). File_2_n: Information included the micro blog content (words and other parts like pictures and videos), the time of publishing, the recorded time, the number of times praised, the number of times resent and the number of comments (n referred to the nth week).

Step 2: I used an online random number generator to generate 11 numbers between 1 to 61, that is, my study randomly chose eleven weeks' micro blogs during this time period, 1100 hot micro blogs totally.

Step 3: According to File_1_k, I used the software to collect each week's corresponding micro blogs, which did not exist on the Top 100 ranking list (k referred to the kth week). That is, File_1_k included the publishers' name who ranked the Top 100 list in week k. The software collected two pieces of micro blogs of the publishers from the File_1_k in the same week k one by one. Information includes gender, verified or not, number of fans, status, micro blog content (words and other parts like picture and video), the time of publishing, the recorded time, the number of times praised, the number of times resent and the number of comments.

The Research on Marketing Efficiency of WeChat Mall Enterprises

Based on DEA Method

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ABSTRACT

As the attention and utilization gradually focus on WeChat marketing advantages, the development of WeChat mall enterprises has received much concern. The characteristics of WeChat malls, such as flexible personalized settings, high sociality and strong closure and so on, have great practical significance to measure and evaluate the marketing efficiency of WeChat mall enterprises. First of all, by constructing a BISP marketing system from the aspects of Brand, Interface, Service and Price, this paper established an input-output system that based on DEA model for evaluating marketing efficiency of WeChat mall enterprises. Secondly, we compared the effective decision making units with the super efficiency DEA model. Finally, we analyzed input redundancy and output deficiency situation. The research shows that the overall marketing efficiency of WeChat mall enterprises is on the low side, and rather big differences are existing among different WeChat mall enterprises. To effectively enhance the marketing efficiency, WeChat mall enterprises should improve marketing investment structure and find suitable marketing schemes according to their own characteristics and advantages. So these enterprises will obtain greater benefits and promote economic development.

Keywords: WeChat mall, data envelopment analysis, super efficiency, marketing efficiency.

INTRODUCTION

Chinese mobile internet market has been booming since 2013. Most of the traditional internet enterprises and computer e-commerce industries are gradually transforming to mobile e-commerce. In recent five years, WeChat has 800 million registered users since it launched in January 21th, 2011 and WeChat Official Accounts have reached to 100 million. According to Tencent's second-quarter results released in August 2015, the combination of WeChat has 600 million monthly active users nowadays. As a social communication trading platform, WeChat uses the strong relationship as core and has a strong social function and the huge active user group, and more and more small companies and individuals, even medium and large enterprises took the WeChat mall as a new distribution channel, at the same time, it brings new hope to these small and medium-sized sellers in Taobao who are experiencing difficulties[30]. However, concerns of consumers have driven increased by emerging concepts such as "acquaintance" marketing and mobile consumption, but they still can't compare with the strength of the e-commerce giants[22]. Based on the fixed input costs, WeChat mall enterprises are urged to find the most effective marketing strategy or combination to obtain the biggest benefit. How to choose the marketing strategies to minimum cost and maximize profit for online mall enterprises? We consider that as WeChat mall enterprises (the seller), how to choose reasonable marketing strategy to improve sales is a question that necessary but difficult to achieve and it is the key to promote WeChat e-commerce development rapidly.

In WeChat malls operation process, there are many influential factors that involved in all aspects of the WeChat mall enterprises' marketing and even included intangible indicators, such as satisfaction. Regression and correlation model of the general effect may not effective enough. At the same time, a large number of studies have found that the efficiency frontier is quite robust in DEA model[26], it has become a hot topic that using DEA method to evaluate and analysis enterprises' marketing efficiency in the field of efficiency evaluation in recent years[4][12][21][29][31]. So the enterprises' marketing strategy choice problem compare to typical performance evaluation, building the marketing efficiency of input and output index system based on the DEA model to evaluate WeChat mall enterprises marketing efficiency, which has certain research

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value and strong practical significance. At the same time, to avoid the traditional DEA model errors that can't make further comparison for more effective decision making units simultaneously, this context further compares the effective decision making units by using the super efficiency model. By analyzing input redundancy and output deficiency situation, we make the enterprises understand the improvement direction, which will help to choose a more effective marketing strategy.

LITERATURE REVIEW

This study contributes to the current literature of performance and efficiency evaluation with DEA method in the following ways. Since WeChat mall opened in March 2014, the attention has increased from all walks of life in recent years. The presence of WeChat malls makes WeChat from a instant messaging application turn into another media follow microblog quickly, it has become an excellent marketing tool for transforming users, enhancing users' viscosity, triggering users' behavior, maintaining good relationship with users and promoting the brand value[33]. It has been more related researches about WeChat malls, including the functions, characteristics, advantages, development and problems and even the research as new marketing mode[11][22][30], but few existing studies have explored marketing efficiency of WeChat mall enterprises as a whole. In addition, some studies have been conducted to explore and improve the problems based on the analysis of the current situation of network marketing[15][32]. According to the research, most studies considered the problems from the perspective of marketing strategy aim for each strategy (such as, price strategy, brand strategy) of the corresponding model to seek for the optimal solution under the strategy[16][17][23]. Some studies also researched the problems from the perspective of competition between different sellers, by introducing the game theory model, studied the channel strategy selection problems[9][13][14], but the optimal solution is only derived by theories, a mall seller in reality need to consider increasing the attraction of the commodity information, is it through the lower price or put more efforts? Or through money for using malls promotional products to promote, or strengthen the service quality of network customer service to attract repeat customers? The sellers don't need an evaluation tool to evaluate various options that compare with other sellers are more relative effective instead of complex models. Therefore, based on existing research evaluate WeChat mall enterprises marketing efficiency, this context provides a marketing efficiency evaluation method that based on relative efficiency, so the sellers can improve marketing strategies that make the right investment decisions.

At present, except the DEA method, there are some other methods about effectiveness of evaluation, such as Analytic Hierarchy Process (AHP)[10], Fuzzy Comprehensive Evaluation (FCE)[28], Principal Component Analysis (PCA)[24] and Artificial Neural Network (ANN)[25]. However, Analytic Hierarchy Process has less quantitative data and more qualitative elements, and it is difficult to convince when index statistics are too much to determine the weight, and the data statistical magnitude is heavy. Fuzzy Comprehensive Evaluation evaluates based on the subjective information, the subjectivity is stronger to determine the index weight vector. Artificial Neural Network overcomes the defects of the subjective given for index weight, the evaluation results are more accurate compared with the Fuzzy Comprehensive Evaluation, but it needs bigger sample data (the local minimization problem) and it has slower speed of network convergence, sometimes it even affects the evaluation efficiency. In addition, Principal Component Analysis to evaluate ranks comprehensive based on principal component scores, not from the perspective of resources input and efficiency output to evaluate relative effectiveness. These methods are limited to a single output, by contrast, the DEA method can deal with multiple inputs and multiple outputs, and especially multiple outputs capacity has an absolute advantage. What's more, DEA method not only can judge whether the correspondent decision making units are on the efficient production frontier or not by using linear programming, but also can obtain useful management information. It is a method not only to evaluate the relative effectiveness, but also to guide and improve weak validity or inefficiency, so it can provide information in production and management for organizer and managers. As a result, it is superior and more widely useful than other methods (including statistical method). So this context evaluated marketing efficiency of WeChat mall enterprises by building a DEA-based input and output index system on the existing research results, and further compared the effective decision making units with the super efficiency model. Finally we analyzed input redundancy and output deficiency, to improve the method and marketing efficiency.

DEA EVALUATION MODEL

In 1978, Data Envelopment Analysis (DEA) method was put forward by the famous operations researcher A.Charnes, W.W.Cooper and E.Rhodes. DEA method is a multi-objective decision method based on the concept of relative efficiency and a method of combined quantitative and qualitative methods that consider the effect of qualitative factors which quantitative model unable to determine, even it can seek for the optimal index weight distribution for each evaluation objects[7][19][20]. The model adapts different analytic requirements under various situations, including the CCR model, BCC model and SBM model, etc.

The DEA model can be regarded as a method of dealing with multi-objective decision problem that has multiple inputs (outputs as small as possible) and multiple outputs (input as larger as possible)[7][19][20]. It is certificated that DEA validity is equal to pareto that efficient solution of correlative multi-objective programming problem (or non dominated solution). Data envelopment analysis (DEA) can be seen as a kind of new method for statistical analysis. It estimated production frontier surface effectively according to a set of input-output observations[1][2]. Estimating the efficient production frontier in economics and econometrics usually use statistical regression and other statistical methods, these methods to estimate the production function show Inefficiency function instead of the actual frontier, because these estimations get results by confusing effective decision unit with the effective decision units[3][18]. This article will use the CCR model and super efficiency DEA model, to measure and evaluate WeChat mall enterprises marketing efficiency, the form of specific mathematical model as shown below:

The CCR model mathematical form as follows:

$$\begin{aligned} \min \theta &= V_{D_1} \\ s.t. \left\{ \begin{array}{l} \sum_{j=1}^n X_j \lambda_j + s^- = \theta X_0 \\ \sum_{j=1}^n Y_j \lambda_j + s^+ = Y_0 \\ \lambda_j \geq 0, j = 1, 2, \dots, n, s^+ \geq 0, s^- \geq 0 \end{array} \right. \end{aligned} \quad (1)$$

The super efficiency DEA model mathematical form as follows:

$$\begin{aligned} \min [\theta - \varepsilon (\sum_{i=1}^s s_i^- + \sum_{r=1}^s s_r^+)] \\ s.t. \left\{ \begin{array}{l} \sum_{j=1}^n X_{ij} \lambda_j + s_i^- \leq \theta X_0 \\ \sum_{j=1}^n Y_{rj} \lambda_j - s_r^+ = Y_0 \\ \lambda_j \geq 0, j = 1, 2, \dots, n, s_r^- \geq 0 \end{array} \right. \end{aligned} \quad (2)$$

CCR model is a kind of ideal efficiency research methods that mainly used to research the relative efficiency of decision making units with multiple inputs and multiple outputs and can also study decision making unit scale and technical efficiency. To consider it from production function perspective, this model is used to study with multiple inputs, especially with multiple

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outputs "manufacturing" and as the "scale" and "technical efficiency" of the ideal and effective method[5][6]. And super efficiency DEA model is based on the CCR model to determine more accurate comprehensive efficiency value of DEA[8]. As choice of WeChat malls under the same conditions is limited, so the context applies the super efficiency DEA to calculate the effective decision making units' related efficiency value, in order to solve the problem that decision making units is less.

For WeChat mall enterprises, the economic meaning of DEA efficiency: when $\theta = 1$, $s^+ = 0$, $s^- = 0$, then the WeChat mall enterprises have DEA effective. Namely in the case of the current input, the output obtained relative optimal among n DMU; When $\theta = 1$, $s^+ \neq 0$ or $s^- \neq 0$, then the WeChat mall enterprises has weak DEA effective, means that to adjust one or more input index of the enterprises, the DEA relative efficiency still keeps relative optimal; When $\theta < 1$, the WeChat mall enterprises show that DEA is invalid. Namely the WeChat mall neither reached technology effectively nor reached in scale, which need to increase or decrease input indexes by slack variable to reach the relative optimal.

RESEARCH METHODOLOGY

Selection of DMU

WeChat mall is an e-commerce system researched and developed based on WeChat, and it is also a shopping system that is the integration of a traditional internet, mobile e-commerce, WeChat, EasyChat. As a new trading platform compared with the traditional marketing, WeChat malls have many different choices for users in various respects about marketing strategy and cannot use traditional 4C (customer, cost, convenience, and communication) model to evaluate, also the study of network marketing tools haven't known as the standard model. Therefore, by reading a lot of literature and expert interviews and so on, understanding and analyzing present situation of WeChat mall enterprises marketing strategy, the WeChat malls' marketing strategies are summarized as interface strategy, price strategy, brand strategy, channel strategy, customer service strategy, product strategy and promotion strategy and so on. This context integrates the current existing marketing theory, such as 4C, 4P (Product, Price, Place and Promotion), 4I (Interesting, Interests, Interaction and Individuality) and 4R (Relationship, Relevancy, Reward and Reaction)[27], according to the consumer experience perspective, BISP marketing system is constructed. As shown in figure 1:

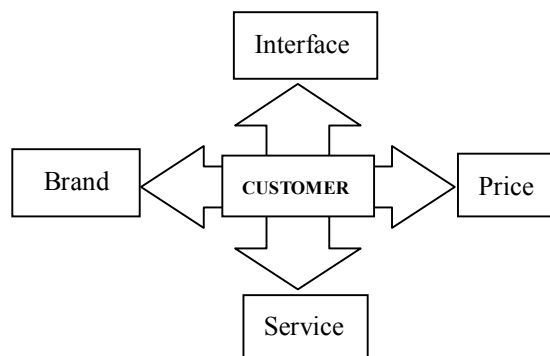


Figure 1. BISP marketing system

Evaluation Index System and Evaluation Standard

Evaluation Index System

Interface strategy. Most mobile e-commerce are directly transplanted from computer terminal, such as Jingdong, Dangdang and some other famous e-commerce companies. It's goods, store, trade process and service tools are all done by electric business platform independently, enterprises can accomplish all commodity exhibition and trading via their cellphone, and don't need to depend on any third-party platform basically. However, WeChat malls just provide user information for enterprises, trading systems and service tools are all depend on third-party platform, and need to set up on the third-party platform. Users can see the web page which has the function of browsing that turned the original chat tools. At the same time, the page content is the medium of communication for businesses and customers. To some extent it works more than physical, a beautiful virtual store

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that can express goods information well is the key to success for WeChat mall enterprises.

There are many indicators that can measure the input of WeChat mall enterprises on interface strategy, such as, information services, platform construction, page design and maintenance of product information. The use of the third-party platform for WeChat malls, makes it possible for personalized settings and operations. And it not only provides more opportunities for the third-party service providers, but also provides more choices for consumers.

Price strategy. In the era of information explosion, consumers can know all prices of the same product from different businesses through a variety of ways, so the network marketing strategy becomes more and more important. Price strategy is a direct contest between the cost and price to guide consumers to make a choice through a lower price is a wise measurement. In addition, the competition is very fierce, the price which the businesses proposed should be modified in time, and even they develop automatic price modification system, to reduce the cost. Merchant adjusts the price according to changes in market supply and demand situation and the price is showed by the competition of businesses. Therefore, the price of the mall enterprises in terms of price strategy inputs can be mainly to markdown amplitude and price adjustment frequency to represent.

Brand strategy. In the era of rapid network development, the brand has become an important tool for the company to win the market. Brand is an invisible belief, it includes the name of the brand, packaging, brand story, reputation and style and so on. Brand is also different from customers' experience by using company's products and different practical experience of themselves. It is the invisible property of the enterprises resource and it has a certainly personality and exclusive. Brand owners can constantly gain profits by virtue of the brand, brand is unique after registering or applying for a patent, and once the purchaser recognized, it will quickly form a brand trust, deepen its specificity. Therefore, this article measures brand strategy input of the mall enterprises is divided into brand name, visual signs, brand commitment and brand personality.

Customer service strategy. Economy is following the changes of the times to change and transform. The economy that based on industrial transform into the economy that based on the center of network, the users' experience has shown more and more important economic value. Customer service has become one of the most important and commonly core measures and profit methods for many companies. In the era of e-commerce, the buyer's market has occupied a superior identity in the whole market. Processing of consume and special needs has changed gradually, the demand and shopping ideas also have shown a new trend. Customer service as a marketing strategy has played a important role to understand and meet customer needs, improve customer experience and integrity, achieve product differentiation, enhance product quality, develop new market opportunities, coordinate the common interests between customer and company, and enhance the company competitive power and so on.

The idea of network customer service strategy is: using online customer service tool FAQ page to provide related products, companies information; using email for online businesses and consumers to exchange and interact; electronic customer relationship management also has been used in some large enterprises, it will guide customers into marketing management and integrate into the group of companies. Interacting with customers to understand customers' needs and timely solve customers' demands. This idea is not unilateral, but forms a closed loop with four aspects and influences each other. As shown in figure 2:

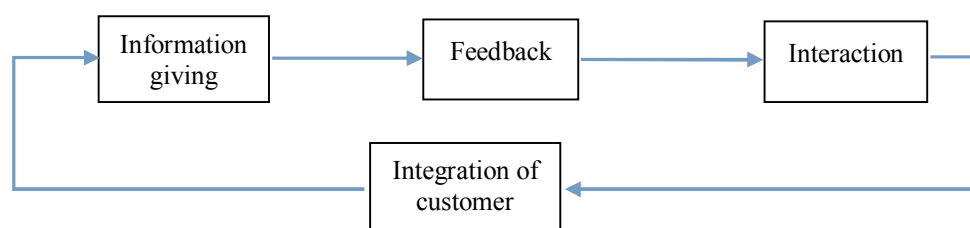


Figure 2. Network customer service strategy

Therefore, the measure of customer service strategy in the mall enterprises mainly divided into FAQ page details, community interaction, customer service system and customer resource integration.

Output variable quantities are mainly composed of browse, collection, concern and purchase and other consumer behavior data, for example, sold items in the following 3 months. Therefore, sales volume, the counts of that have been browsed and collected have become the main output variables. Combined with the characteristics of DEA method, the enterprises' marketing strategy choice problems compare with typical multiple inputs and multiple outputs performance evaluation to evaluate WeChat mall enterprises marketing efficiency and analyzing methods of improvement.

Summary above analysis that based on WeChat mall enterprises marketing strategy to determine the marketing strategy that used commonly, and we found the measure of mall enterprises input standards in each strategy, as specified in Table 1 below:

Table 1. WeChat mall enterprises marketing efficiency evaluation index system

Index	Category	Specific indicators
Input index	Interface strategy	page design
		product information
	Price strategy	markdown amplitude
		price adjustment frequency
	Brand strategy	brand name
		visual signs
		brand commitment
		brand personality
	Service strategy (customer)	FAQ page details
		community interaction
		customer service system
Output index	Sales volume	
	Number of collections	
	Number of good comments	

Index Evaluation Standard

Through analyzing indicators of marketing strategy, we extracted its second class indicators, and through the expert scoring (except price strategy), then getting the weight of corresponding indicators, to establish a set of indicators evaluation criteria.

Price strategy mainly depends on markdown amplitude, calculation method is to firstly calculate commodity prices from different WeChat malls, sales price is taken directly from the product page. When merchant provides discount among the quantity of goods, we use discount divided the quantity of the goods, and then minus the real logistics costs. If there is a different logistics price, we use the simple average method. For example, mask price of one merchant is 699 yuan, surface mail for 5 yuan, expressage for 10 yuan, expressage with long distance for 15 yuan, the finally commodity price is 709 yuan ($699 + (5+10+15)/3=709$), In the end, using the highest price minus the price of calculation to obtain markdown amplitude.

Two indicators of interface strategy is the degree of rich in content and the degree of beautiful page to synthesize the evaluation, as shown in Table 2:

Table 2. Interface strategy rules in details

First class indicator	Second class indicator	Weight	Detailed grading rules
the degree of rich in content	whether integrate basic information or not	0.1	Not integrate for 0 point, integrate for 1 point
	the degree of rich in character	0.2	Less text description for 0 point, more description for 1 point
	the degree of rich in picture information	0.2	Less picture information for 0 point, the more for 2 points, general for 1 point
the degree of beautiful page	the overall consistency	0.3	Mainly inspect color,background and the location of function module and so on
	the degree of beautiful picture	0.2	Picture has the phenomenon that there is an obvious deformation, color is not harmonious, not clear, even theft online picture, for 0 point.picture is clear and nice for 2 points, general for 1 point

The measure indicators of brand strategy contain the brand name, visual signs, brand commitment and brand personality. The evaluation scale as shown in Table 3:

Table 3. Brand strategy rules in details

First class indicator	Second class indicator	Weight	Detailed grading rules
Brand name	Principle for easy to read and remember	0.1	Easy to read and remember for 1 point, otherwise for 0 point
	Principle for enlightenment and imagination	0.1	Enlightenment and imagination for 1 point, otherwise for 0 point
	Principle for strong applicability	0.2	Adapt to the market environment well for 2 points, not applicability for 0 point, general for 1 point
Visual signs	Whether to form more specific, perceptible image memory for consumers or not	0.2	Mark and bright, form knowledge memory for 2 points, not form bright image memory for 0 point, general for 1 point
Brand commitment	Whether to let consumers have feelings on products or not	0.1	Have their own brand promise,produce feelings for 1 point, otherwise for 0 point
Brand personality	Whether to form their own brand style or not	0.3	Mainly inspect the degree of the brand trust for consumers

The measure indicators of customer service strategy contain FAQ page details, community interaction, customer service system and other indicators. The evaluation scale as shown in Table 4:

Table 4. Customer service strategy rules in details

First class indicator	Second class indicator	Weight	Detailed grading rules
FAQ page details	Whether company information is clear or not	0.1	Detailed introduction for 1 point, otherwise for 0 point
	Whether product information is enrich and authority or not	0.2	Product introduction is rich and persuasive for 2 points, no introduction for 0 point, general for 1 point
Community interaction	Whether active and positive about content	0.2	Active community interaction and high response rates to post for 2 points, inactivity for 0 point, general for 1 point
	Whether community management orderly or not	0.1	Community management orderly and posting abide by the rules for 1 point, otherwise for 0 point
Customer service system	The speed of response to consumers	0.1	Response quickly for 1 point, slowly for 0 point
	The attitude to solve the problem	0.1	Good service attitude for 1 point, bad attitude for 0 point
	Competence in solving problems	0.2	Be promptly and efficiently solve the problem of consumers for 1 point, otherwise for 0 point

Data Collection

There are massive open data sources on the open media platform, and the public satisfaction estimate which is developed by third party companies are emerging in an endless stream, and for the closed WeChat, we can't do anything about it at present[30]. The problem is that it has more difficult in WeChat than microblog and other media platform to evaluate marketing efficiency because of underdevelopment of the data source. Therefore, the data are collected by manual operation that focused on the designated WeChat malls and collected the relevant indicators of the malls every month. WeChat malls sprung up in early 2014, it had rapid development in the 2 years, but the development is uneven in all walks of life, and WeChat malls quantity are limited that has output data, so WeChat malls can not classify to analysis by industry or other standard. We searched WeChat malls through the search function, the first ten WeChat malls that has output data are selected as the analytical samples, it is also a certain representativeness. It includes Karin Christian official mall, Jingdong shopping mall, Gome online mall, Choiskycen official mall, Zhang Shi mall, VANCL official mall, Three squirrels official mall, Suning mall, Hot mom school mall and Haier mall. With these ten WeChat malls as the research object, through the ten WeChat mall enterprises marketing efficiency evaluation results, we analyzed the existing problems and putted forward countermeasures and suggestions. Collected and concluded the data of the ten WeChat mall enterprises and got the list of the original data as shown in Table 5.

Table 5. The original data in WeChat mall

Mark	Name of enterprises	Order record	Number of good comment	Number of been collected	Original price (yuan)	Adjusted price (yuan)	Price adjustment frequency
A	Karin Christian official mall	5305	2457	3301	398	119	4 (↓)
B	Jingdong shopping mall	56875	41252	8900	299	129	4 (↓)

C	Gome online mall	5327	4918	87	319	165	4 (↓)
D	Choiskycn official mall	1608	17	5	234	195	2 (↓)
E	Zhang Shi mall	2	1	1	299	194	2 (↓)
F	VANCL official mall	304	240	57	249	168	2 (↓)
G	Three squirrels official mall	1209	29	1	190	99	4 (↓)
H	Suning mall	25789	8812	880	224	159	4 (↓)
I	Hot mom school mall	1348	477	73	219	119	2 (↓)
J	Haier mall	409	330	52	159	139	1 (↓)

The input and output data of the decision making unit are obtained as shown in Table 6 after disposal data. The data concluding sum of the degree of rich in content and the degree of beautiful page, sum of the degree for brand and sum of customer service satisfaction and so on are obtained according to investment strategy of the standard rules, using Likert table, and making the questionnaire that is graded by consumers, finally to calculate the weighted average.

Table 6. Input/output data of Decision making unit

DMU	y ₁	y ₂	y ₃	x ₁	x ₂	x ₃	x ₄	x ₅
A	5305	2457	3301	279	4	5	6	5
B	56875	41252	8900	170	4	6	8	6
C	5327	4918	87	154	4	3	7	1
D	1608	17	5	39	2	4	6	4
E	2	1	1	105	2	3	6	5
F	304	240	57	81	2	1	4	1
G	1209	29	1	91	4	4	8	4
H	25789	8812	880	65	4	5	8	1
I	1348	477	73	100	2	3	4	5
J	409	330	52	20	1	5	8	1

The output variables are:

Y₁ is the total sales volume;

Y₂ is number of good comments;

Y₃ is collected number.

The input variables are:

X₁ is markdown amplitude;

X₂ is price adjustment frequency nearly 6 months ;

X₃ is sum of the degree of rich in content and the degree of beautiful page;

X₄ is sum of the degree for brand;

X₅ is sum of customer service satisfaction.

Results and Analysis

According to the original data of evaluation objects, we used deap2.1 software computing DEA efficiency for evaluating objects. To effective decision unit in the traditional DEA models, we used the ems1.3 software to future calculate super efficiency values of evaluation objects, then to determine the relative ranking position. Calculated results are shown in Table 7:

Table 7. DEA validity evaluation results

DMU	Comprehensive efficiency	Pure technical efficiency	Scale efficiency	Returns to scale	Conclusion	Comprehensive super efficiency	Rating
A	0.495	0.911	0.543	irs	Invalid DEA	0.495	4
B	1	1	1	-	Valid DEA	5.809	1
C	0.627	1	0.627	irs	Invalid DEA	0.627	3
D	0.109	1	0.109	irs	Invalid DEA	0.109	5
E	0	0.857	0	irs	Invalid DEA	0	10
F	0.038	1	0.038	irs	Invalid DEA	0.038	8
G	0.038	0.648	0.059	irs	Invalid DEA	0.038	9
H	1	1	1	-	Valid DEA	2.721	2
I	0.047	1	0.047	irs	Invalid DEA	0.047	7
J	0.068	1	0.068	irs	Invalid DEA	0.068	6
\bar{X}	0.342	0.942	0.349				
SD	0.469	0.115	0.407				
Max	1	1	1				
Min	0	0.648	0				

Note: The comprehensive efficiency refers to the technical efficiency not considering the returns to scale ; Pure technical efficiency is the technical efficiency considering the returns to scale; Scale efficiency has consider the returns to scale and comprehensive efficiency value(EC) = pure technical efficiency value (PE)* scale efficiency value(SE). Among them, the comprehensive super efficiency value of decision making units F and G are 0.0384 and 0.0382. The result is consistent with retaining 3 decimal places, so the decision making unit F is still ranked in the front.

The results of DEA validity evaluation are included in Table 7, it showed that only Jingdong Mall and Suning mall input efficiency value reached to 1, it indicated that the choice of marketing strategy input in the two malls is valid, and the other eight malls investment efficiency can't meet the frontier, are in an invalid state. The average value of the relative efficiency is only 0.342, which shows that the marketing strategy efficiency of WeChat malls are generally low. Choiskycn official mall, Zhang Shi mall, VANCL official mall, Three squirrels official mall, Hot mom school mall and Haier mall have below the average value, standard deviation is 0.469, it indicates that investment efficiency of WeChat mall marketing strategy has great differences. From the results of super efficiency data analysis show that relatively speaking, Jingdong mall and Suning mall are identified for effective decision making units in the traditional DEA model, super efficiency values of Jingdong mall is 5.809, however, super efficiency values of Suning mall is 2.721. They have reached the optimum, but the marketing efficiency of Jingdong mall is more efficient than suning mall. However, Jingdong mall, Suning mall and Haier mall all with strong brand effect, has appeared big differences, why? For WeChat malls, the brand is not the only magic weapon in marketing, interface strategy, price strategy and customer service strategy also need to reach a certain proportion of investment to get the final profit.

The comprehensive efficiency is decomposed into pure technical efficiency and scale efficiency, and we can find the reasons for inefficiency by comparing the pure technical efficiency and scale efficiency of decision making units. Pure technical

efficiency is the efficiency of the system and management level, scale efficiency can be explained that whether WeChat mall is suitable for the current scale of investment or not. Table 7 shows that the average of pure technical efficiency is 0.942 and the standard deviation is 0.115. It shows that the majority of WeChat malls' system and management efficiency level are generally high, and it is not the cause of decision making units' inefficiency. Among them, there are seven WeChat malls that the pure technical efficiency value is 1 and the lowest pure technical efficiency value is Three Squirrels official mall. It also indicated that Three squirrels official mall needs to be strengthened in system and management level. The average of scale efficiency is 0.349 and the standard deviation is 0.407. It shows that there are invalid investment scales in WeChat malls, and there is a big difference in scale efficiency among these malls. In WeChat malls that comprehensive efficiency value is less than 1, the pure technical efficiency value of Gome online mall, Choiskycn official mall, VANCL official mall, Hot mom school mall and Haier mall is equal to 1, in other words, the reasons that the five WeChat malls hadn't reach fully effective mainly are marketing investment scale inefficiency. The scale of rewards shows that WeChat malls that hadn't fully met the efficiency are in stage of the increasing scale of rewards. So we improve the marketing investment scale and investment structure in WeChat malls, to improve WeChat malls marketing investment efficiency. Obviously, compared with Jingdong mall and Suning mall, Haier mall also have a strong brand effect but fall behind caused by its marketing size. And the emerging brand WeChat malls such as Three squirrel official mall and Choiskycn official mall won the favor of consumers with the reasonable investment in marketing strategy.

Compared to ten WeChat malls with input redundancy and output deficiency, the results shown in Table 8:

Table 8. The input redundancy and output deficiency in WeChat mall

DMU	Output deficiency			Input redundancy				
	S_1^-	S_2^-	S_3^-	S_1^+	S_2^+	S_3^+	S_4^+	S_5^+
A	15789.87	12843.32	0	74.92	0.49	0.25	0	0.25
B	0	0	0	0	0	0	0	0
C	5729.62	0	653.91	67.3	1.05	0	1.46	0
D	0	679.01	96.62	0	0	0.16	0.22	0.35
E	4.39	3.64	0	0	0	0	0	0
F	60.26	24.2	0	2.02	0.05	0	0.1	0
G	0	737.72	153.04	0	0.04	0	0.09	0.04
H	0	0	0	0	0	0	0	0
I	0	500.72	137.94	0.71	0	0	0	0.09
J	45.98	0	19.2	0	0.04	0.29	0.48	0.02

From the Table 8 can be seen, most of WeChat malls have the status of input redundancy and output deficiency. In price investment strategy, six WeChat malls that haven't fully achieved effective are redundant, especially Karin Christian official mall, Gome online mall and VANCL official mall; In page investment strategy, Karin Christian official mall, Choiskycn official mall and Haier official mall have input redundancy; In brand investment strategy, Gome online mall, Choiskycn official mall, VANCL official mall, Three squirrels official mall and Haier mall have redundancy in some degree; In customer service investment strategy, Karin Christian official mall, Choiskycn official mall, Three squirrels official mall, Haier mall and Hot mom school mall also have input redundancy. To summary, WeChat malls marketing investment elements are not so fully utilized that caused lower comprehensive marketing efficiency, marketing investment structure needs to be improved.

According to the data, we can also find that the marketing investment of most WeChat malls has output deficiency problems and needs to be further improved. Karin Christian official mall, Gome online mall and VANCL official mall should be adjusted in price strategy. Haier mall, Karin Christian official mall and Choiskycn official mall have redundant in interface strategy, it

should be adjusted investment proportion. And Haier mall, Gome online mall, Karin Christian official mall, VANCL official mall and Three squirrels official mall also need to adjust in customer service strategy, to achieve the optimal investment proportion. Among them, Haier mall and Gome online mall also need to fully use its brand strength, adjusting the structure of marketing investment, to improve output deficiency problem. Anyway, according to the empirical results, the proportion of investment of Jingdong mall and Suning mall is optimal in the price strategy, interface strategy, brand strategy and customer service strategy, and they also have obtained the certain marketing results. The other eight malls are required to improve the investment proportion in their marketing strategies according to the obtained slack variables, to improve marketing efficiency and enhance the mall sales.

CONCLUSIONS AND FUTURE WORK

This study contributes to both theory and practice. It is the very first time that DEA method is used to evaluate marketing efficiency in WeChat. All of first, we obtained the corresponding evaluation index system through the analysis of various marketing strategies of WeChat malls. We took interface strategy (page design, product information), Price strategy (markdown amplitude, price adjustment frequency), Brand strategy (brand name, visual signs, brand commitment, brand personality), Service strategy (FAQ page details, community interaction, customer service system) as input indexes, and output indexes include sales volume, number of been collected and number of good comment. By building an input-output system based on DEA model, we provide the theoretical framework to evaluate marketing efficiency of WeChat mall enterprises. Secondly we offer super efficiency model to make further comparison of the effective decision unit, and input redundancy and output deficiency were analyzed to find out the reasons restricting WeChat mall enterprises' marketing efficiency. Finally, we got the following conclusions and recommendation.

According to the final data results, our study shows that there are two WeChat mall enterprises achieved fully DEA effective, the average of comprehensive efficiency is only 0.342, which shows that the marketing strategy efficiency of WeChat malls is generally low. Standard deviation is 0.469, it shows that there are great differences in investment efficiency of WeChat malls marketing strategy. According to the comprehensive efficiency evaluation results, marketing efficiency of WeChat malls is low and the actual reason is the scale efficiency, in other words, low scale efficiency is the main factor to restrict WeChat mall enterprises marketing efficiency. The situation analysis of scale of rewards shows that WeChat mall enterprises are almost in increasing scale of revenue stage, which is correspond with the characteristics of WeChat malls, such as flexible personalized settings, high sociality and strong closure. According to above conclusions, to effectively enhance the marketing efficiency, the WeChat mall enterprises should improve marketing investment structure and find suitable marketing schemes according to their own characteristics and advantages. As a result, these enterprises will obtain greater benefits and promote economic development.

As with any study, there are several limitations that present opportunities for future research. Although our sample of ten WeChat malls is sufficiently diverse to support our results, future studies could sample a larger set of WeChat malls in order to confirm that our results hold. Second, any theories and methods are constantly developing and perfecting, so are the methods here that proposed in this paper. The indicators of our study in the evaluation system are limited to only four strategies, because some cognition limitations may cause the deviation of evaluation results. In addition, are the models effective for any network platform for evaluating marketing strategy? These problems need to do further exploration and study.

ACKNOWLEDGMENT

This work described in this paper was partially supported by National Science Foundation of China(Grant No.71303204), and was also supported by the Excellent Youth Scholars of Education Department of Hunan Province(Grant No. 13B118).

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Incentives, Positive Emotions and SWOM Intention: Moderating Roles of Allocation Type and Emotion Regulation

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ABSTRACT

With the increasing popularity of social networking sites (SNS), companies are adopting monetary incentives to generate eWOM on SNS (SWOM). Drawing on emotion and equity theories, this study explores effects of perceived magnitude of monetary incentives and emotions on consumer SWOM intention. In addition, this study investigates the moderating effects of allocation types of rewards (positive inequity and negative inequity) and emotion regulation (reappraisal and suppression emotion regulation) on these relationships. An online situational experiment was conducted and yielded valid responses from 193 WeChat users in China. With the preliminary data, we tested the direct, mediation, and moderation effects using SmartPLS 3.0. The empirical results show that (1) perceived monetary incentives have a positive effect on SWOM intention; (2) positive emotions of senders mediates the relationship between incentives and SWOM intention; (3) negative-inequity incentives negatively moderates the relationship between incentives and positive emotion, while the moderating effect of positive-inequity incentives is insignificant on the relationship between incentives and positive emotion; (4) reappraisal emotion regulation strengthens the effect of positive emotion on SWOM intention, whereas the moderating effect of suppression emotion regulation between positive emotion and SWOM intention is not statistically significant.

Keywords: Incentives, electronic Word-of-Mouth (eWOM); equity theory; emotion theory; positive inequity; negative inequity; emotion regulation; SWOM intention; social networking sites.

INTRODUCTION

Electronic Word-of-Mouth (eWOM) has emerged to play an important role in the consumer decision making [1] because it can impact both receiver attitude [2] and behavior [3]. The increasing popularity of social network sites (SNS) has attracted consumers collecting product information and sharing their consumption experiences with friends [4]. For example, according to Nielsen's Global Trust in Advertising Survey (2015), 83% of consumers trust the recommendations of friends and families [5]. Given the importance of recommendation from friends and acquaintances, companies provide incentives for promoting consumer to transmit eWOM on SNS (hereafter referred to as SWOM). Recent research point out that SWOM, a driver of consumer behavior and Internet platforms, is the future of customer relationship management [6].

Although existing research on eWOM find that monetary incentives increase the likelihood of online recommendations [7-11], other studies suggest that monetary incentive may cause a negative customer experience and negatively influence eWOM [12, 13]. For example, the referral probability is lower when receiver's incentive is higher than sender's [14]. Lazarus, R. S. and Folkman, S. [15] indicate that the appraisal of external event leads to the experience of positive or negative emotion which elicits cognitive and behavioral efforts. Therefore, the appraisal of monetary incentive event which brings positive emotions will lead to increased eWOM, otherwise it will lead to negative consequents. Departing from the existing paradigm of SWOM, this study strives to further explore the effect of incentives on SWOM intention.

In essence, emotion can powerfully, predictably, and pervasively influence decision making [16]. In the disciplines of marketing and information systems, prior scientific efforts have proven that emotion influences customer's perceived review helpfulness which in turn influences review credibility [17] and customer purchasing behaviors [18]. Although past work has important theoretical and practical implications, extant studies have yet to distinguish the roles of emotion and emotion regulation in the relationship between incentives size and SWOM intention. As such, this research attempts to fill the knowledge gap. Drawing on emotion theory and equity theory, this study is one of the early attempts investigating the connection between perceived incentive size, emotion, and SWOM intention. In particular, we endeavor to investigate the mediating effect of emotion on the relationship between perceived incentive size and SWOM intention. In addition, we estimate the moderating effects of allocation type of rewards and emotion regulation on these relationships. To test the proposed hypotheses, we design a situational experiment using data from WeChat, the most popular online social site in China. This study aims to offer four theoretical contributions. First, we prove that perceived reward size has a positive effect on incentivized SWOM intention. Second, prior research show that emotion plays a critical role in online activities [19, 20], but there is still a paucity of the consequences of emotion in stimulated SWOM. This study deepens the understanding of the mediating role of positive emotion between perceived incentive size and SWOM intention. Third, the rewards allocation disparity between senders and receivers affects senders' recommendation intention, and the inequity leads to different consequences compared with equity [14]. In the SNS paradigm, our study shows the allocation of reward has insignificant difference on SWOM intention, but it influences emotion and the relationship between perceived incentives size and positive emotion for senders. Last but not least, although prior studies find the direct effect of emotion regulation on negative SWOM intention [21], we further provide a piece of empirical evidence that emotion regulation moderates positive emotion and SWOM intention. Practically, our research findings shall benefit e-commerce participants designing effective incentive

mechanism to acquire more customers in the emerging context of social commerce.

THEORETICAL FOUNDATION AND RESEARCH MODEL

Figure 1 depicts our research model. This proposed model is an integration of emotion theory and equity theory in incentivized SWOM. In previous studies of stimulated WOM, the amount of monetary incentives is positively related to referral likelihood. Past work has emphasized that positive and negative emotions have important roles in decision making and consumer response [16, 22]. In marketing, for instance, Meloy *et al.* (2006) indicate that financial incentives can elevate mood [23] and worsen task performance. As such, we argue that positive emotion mediates the relationship between the amount of perceived incentives and SWOM intention. Equity theory has been used to explain the decision-making activity of e-referrals when rewards are allocated to two parties of communications [14]. This study conjectures that the allocation type of rewards may influence the effect of perceived incentives size on positive emotion. Prior studies have suggested that emotion regulation impacts SWOM [21], so we argue that emotion regulation, as individual difference, moderates the connection between positive emotion and SWOM intention.

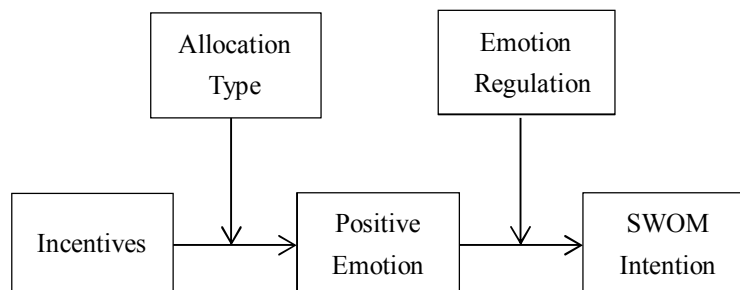


Figure 1: Proposed Research Model

Incentives and SWOM Intention

Prior research have suggested that referral reward program is a kind of business strategy which aims to increase online recommendations of products and service to potential customers [8]. Recommendations can be affected by a variety of factors including the reward type [13], the amount of reward [10, 11], and the way of distribution [11, 14]. Compared with intangible rewards, recommended ratio is higher when providing tangible rewards [10]. Various companies have recently introduced monetary rewards to incentivize existing customers to make recommendations through referral programs. Previous research indicates that the amount of monetary rewards affects the consumer's referral likelihood, improves their positive WOM spread, and changes their brand attitude [10, 11, 24]. The literature also points out that the effect of monetary incentives on online recommendations is equal to the effect of simplistic incentives when the money is sufficiently large and is better than symbolic incentives when both communities are rewarded [11]. We infer that incentives may improve the intention of SWOM sender. Thus, we propose the following hypothesis:

Hypothesis 1: Perceived incentives is positively associated with SWOM intention.

Positive Emotion

Emotion refers to “a mental state of readiness that arises from cognitive appraisals of events or thoughts” [25]. From philosophy of emotions [26] to consumer behavior [25], there is an increasing quest to estimate the effect of emotion on customer attitudes and behaviors [16]. For the antecedents and consequences of consumers' positive affection, Meloy *et al.* [23] argue that monetary incentives can elevate positive affect and that the positive affect influences task performance. In the SWOM context, we surmise that incentives are positively associated with senders' emotion in SNS. Prior studies suggest the importance of emotion on customer behavior [27-29] and emphasize the role of emotion in online activities, such as users eWOM behavior [30, 31]. In online settings, emotional content has a significant effect on users' perceived helpfulness [20] and sharing behaviors [32]. Recently, researchers have found that positive emotions predict behavior based on cognitive appraisal [22]. For example, several studies point out that discrete emotions, such as gratitude and pride which are caused by different appraisal [33, 34], have unique effects on customer behaviors [35]. Thus, we propose the following hypothesis:

Hypothesis 2: Positive emotion mediates the relationship between perceived incentives and SWOM intention.

Allocation Type of Incentives

In this study, allocation type of rewards includes equity and inequity. Equity exists when both the sender and the receiver receive the same financial incentives from firms. Positive inequity is present when the amount of senders' rewards is greater than receivers', whereas negative inequity is present when the receivers obtain a higher level of rewards than senders [14]. Equity theory, the major psychological model of fairness in social exchange, is instrumental to help explain the decision making of two parties [14]. Equity theory indicates that individuals justify the equity based on what they give and receive during the decision making [36]. Prior research has suggested that inequity distress could bring negative emotions and cause participants to behave differently compared with the equity [14, 37, 38]. In the situation of unequal financial incentive offering e-referral, Wirtz [39] demonstrates that the senders are concerned that the receiver may view the incentivized recommendation

in a negative way and the incentives has a negative impact. Positive inequity rewards may increase recommenders' perceived social costs [13] and evoke customers' guilty [40]. Negative inequity rewards elicit customers' envy [41]. Therefore, inequity elicits customers' negative emotion and negatively influences their positive emotion. Compared to the inequity reward, equity reward significantly decreases perceived social costs [13] and increases customers' positive emotions [40]. Therefore, we infer that both positive inequity and negative inequity may weaken the association between incentives and positive emotion of SWOM senders. Thus, the following hypotheses are proposed:

Hypothesis 3: Negative inequity moderates the effect of incentives on positive emotion such that the effect is weaker when negative inequity is high.

Hypothesis 4: Positive inequity moderates the effect of incentives on positive emotion such that the effect is weaker when positive inequity is high.

Emotion Regulation

Emotion regulation influences which emotions we experience, when and how emotions are expressed [42]. There are two ways of regulating emotions, including manipulating its input (antecedent-focused) and manipulating its output (response-focused). Different emotion regulation strategies cause different people's physiological, behavioral, and emotional responses [43]. In essence, researchers have categorized emotion regulation strategies into reappraisal and suppression [21]. Reappraisal strategy indicates that people reappraise emotion-eliciting situations to regulate emotion, which is an antecedent-focused regulation strategy, while suppression strategy indicates that people inhibit emotion expression to regulate emotion, which is a response-focused emotion regulation [42]. Furthermore, Gross and John indicate that individuals differ in usage of different emotion regulation strategies and reappraisal and suppression play different roles in social activities [44].

The literature also suggests that suppression emotion regulation negatively impacts the expression of negative emotion, such as depression and anxiety [21, 44]. Therefore, suppressors are unlikely to express their feelings to someone else, no matter whether they experience negative or positive emotions [42, 44, 45]. By contrast, reappraisal positively influences the positive emotion expression and negatively influences negative emotion expression in users' self-reported measures [42, 44, 45]. Therefore, individuals with reappraisal emotion regulation are more likely to express their positive emotional experiences to others [42, 44, 45]. Reappraiser experiencing more positive emotions is more likely to express voice. Extending the consequence of emotion regulation strategies to SWOM research, reappraisal and suppression determine the customers' intention to engage in SWOM [21]. In this research, we argue that emotion regulation serves as a moderator affecting the relationship between positive emotion and SWOM intention. By comparing two emotion regulation strategies, this study proposes that suppression emotion regulation negatively moderates the effect of positive emotions on SWOM intention and reappraisal emotion regulation positively moderates this relationship. Therefore, following hypotheses are proposed:

Hypothesis 6: Suppression emotion regulation moderates the effect of emotion on SWOM intention such that the effect is weaker when suppression emotion regulation is high.

Hypothesis 7: Reappraisal emotion regulation moderates the effect of emotion on SWOM intention such that the effect is stronger when reappraisal emotion regulation is high.

Control Variables

Not all research have concluded that monetary incentives and emotions have direct or positive impact on WOM behavior, and these inconsistent results are perhaps due part to a lack of control variables in the empirical analyses. While prior experience and frequency of using SNS are also treated as important antecedences to SWOM communication [6], we consider them as a battery of control variables directly or indirectly affecting SWOM intention. In addition, prior research suggest that gender may produce different patterns for positive and negative emotions and that positive emotions are more correlated for women than men [46], so we employ prior experience, frequency of using SNS, and gender as control variables for ruling out alternative explanations in our research model.

RESEARCH METHODOLOGY

In this study, we propose a research model to explore the effects of incentives vis-à-vis SWOM intention. We will test how positive emotion, allocation type of incentives, and individual difference of emotion regulation influence the process of incentivized SWOM communication. To examine this research model, this study uses a controlled online experiment scenario. To be more specific, if greater levels of perceived incentives size are effective to enhance positive emotion, SWOM intention should increase. In addition, emotion mediates the relationship between monetary incentives and SWOM intention. To capture the underlying process, we also conjecture that allocation type of rewards offered to senders and receivers moderates the relationship between incentives and positive emotion and that emotion regulation moderate the relationship between positive emotion and SWOM intention. The detailed procedure of the experiment is described below.

Participants and Design

A total of 210 users (70 participants per group) of WeChat in China were solicited to participate in this study. This study employed a 3 factorial experiment in which we varied the reward allocation of sender and receiver. All participants were told to

imagine that they and their friends would receive monetary incentives from a taxi-hailing company if they shared the referral link to their WeChat circles of friends and their referral friends registered and used it through their shared link. In regard to monetary incentives, we displayed RMB 10 vs. 50, RMB 30 vs. 30, and RMB 50 vs. 10 as three allocation types between sender and receiver. The allocation types represent negative inequity, equity, and positive inequity, respectively. When participants finished browsing the incentives information, they were asked to fill out a follow-up online survey questionnaire including perceived incentive size, degree of positive emotion, suppression and reappraisal emotion regulations, and frequency of using WeChat.

Stimuli Materials

To ensure the intended direction of manipulation in the experiments, the stimulus materials were adapted based on actual reward programs of a taxi-hailing app in China. Taxi is one of the important means of vehicles for citizen's activities, so "difficult to take a taxi" is a social concern [47]. With the advent of Internet, many companies have established a software service platform for reserving a taxi through mobile devices to facilitate the communication between the passengers and the taxi drivers. This emerging service platform has introduced a variety of taxi subsidy schemes such as Uber, Lyft, and DiDi. The innovation of ride sharing services is providing unprecedented competition in the taxi industry [48]. China has 221 cities with a population of over one million, and is a highly profitable market for any taxi company with international awareness [48]. In order to attract more users, various incentive mechanisms have been utilized by these taxi-hailing apps in practice. For example, the regular reward of Uber is to invite a new user such that both the sender and the receiver will obtain RMB 30 (approximately 5 USDs) as the incentive. The rewards allocation of DiDi is RMB 12 for both the sender and the receiver. In addition, ShenZhou provides RMB 30 for the sender and RMB 60 for the receiver. Based on these different reward regulations, this study adopts three ways of incentives for both the sender and the receiver (e.g. RMB 10 vs. RMB 50, RMB 30 vs. RMB 30, and RMB 50 vs. RMB 10) to differentiate the effects of negative inequity, equity, and positive inequity on SWOM intention.

Social media marketing has become an increasingly important marketing communication means [49]. Although the above-mentioned taxi app companies provide a variety of recommended channels, such as WeChat circle of friends, micro-blog, and QQ space, among all the digital marketing tools, WeChat is a unique social media platform with high stickiness. The participants indicated that they use WeChat all the time, and they have to check their WeChat numerous times during a day. In other words, WeChat has been a dominant leader as China's most popular mobile app. According to eMarketing (2016) [50], WeChat has more than 700 million monthly active users, and WeChat news have more influence than news websites and televisions. Every day, WeChat users who use WeChat at more than 10 times occupy 67%; more than half of the users spend their time over an hour, and nearly a fifth of them are on this social media platform at more than 4 hours; and 61.4% of the users view their own circle of friends [50]. Therefore, we use WeChat circle of friends as the grounding experiment scenario.

Measures

For the instrument of constructs in our research model, we adopted items from previous studies in the fields of psychology, marketing, and information system. The eWOM intention is assessed with the three items and a seven-point semantic differential scale ("1" = strongly disagree, "7" = strongly agree) from Wan [51]. Perceived incentives size was measured using one item on 10-point scale ("1" = a very small amount, "10" = a very large amount) from Wirtz *et al.* [39]. Positive emotion was assessed with the use of a seven-item on five-point scale adapted by Mauss *et al.* [52]. The measurement of suppression and reappraisal emotion regulation was adopted with six items on a seven-point scale from Gross and John [44]. Frequency of using SNS was measured with three items on seven-point Likert scale items adopted from [6]. As the measurements were originally written in English, a two-way (English and Chinese) translation process took place to ensure the accuracy and compatibility of the items in the present research.

PRELIMINARY ANALYSIS AND RESULTS

The preliminary analysis conducts a two-step methodology based on Anderson and Gerbing [53]. The first step in the data analysis is to assess the measurement model. In the second step, the hypotheses in structure model are examined. The aim of this approach is to estimate the reliability and validity of the measurement model before assessing the structural relationship of proposed research model. Partial least squares structural equation modeling (PLS-SEM) has been a key multivariate analysis method in IS [54]. PLS shares the same sample size and distribution requirements as ordinary least squares regression. In addition, since PLS-SEM allows for the unrestricted use of single item constructs [55], we use SmartPLS 3.0 to evaluate both the measurement model and the structural model.

Measurement Model

The adequacy of the measurement model was evaluated for reliability, convergent validity, and discriminant validity of the construct measure. Reliability was assessed using composite reliability values in the reflective measure model [56]. Table 1 shows adequate reliability in this measure model because all the values are above 0.7 [53]. A common measure to assess the convergent validity is based on two criteria [57]: (1) all the outer loadings of indicators should be significant and more than 0.708, and (2) using same logic with individual indicators, average variance extracted (AVE) value should exceed 0.500. The results in Table 1 indicate that all the outer loadings exceed the thresholded value of 0.708 on their constructs excluding ser3 (0.437), and all the AVE values range from 0.718 to 0.904, thus satisfying both criteria for convergent validity.

Table 1: Results Summary for Reflective Measurement Models

Latent Variable	Indicators	Loadings	Composite Reliability	Cronbach's Alpha	AVE
Emotion (EMO)	Emo1	0.909	0.973	0.967	0.836
	Emo2	0.932			
	Emo3	0.890			
	Emo4	0.902			
	Emo5	0.938			
	Emo6	0.930			
	Emo7	0.896			
Reappraisal emotion regulation (RER)	Rer1	0.788	0.884	0.814	0.718
	Rer2	0.870			
	Rer3	0.881			
Suppression emotion regulation (SER)	Ser1	0.891	0.895	0.765	0.810
	Ser2	0.909			
SWOM intention (SWI)	Will1	0.961	0.966	0.947	0.904
	Will2	0.961			
	Will3	0.931			

Furthermore, we used two measures to test discriminant validity [56]. One method is that the outing loadings of each indicator on the associated construct should be greater than all of its loadings on any other constructs. Second, the square root of the AVE value of a construct is greater than the correlation between the construct and any other construct. The results of these tests demonstrate that our measurement model meets the rigorous standards expected in IS research. As the measurement model demonstrated adequate validity, the structural model was evaluated next.

Structure Model

Applying SmartPLS 3.0 through the standard bootstrap resampling procedure (1,000 samples) to assess the significance of the paths, the structural research model was tested. To evaluate the proposed hypotheses, the significance of the control variables was examined. The results of the analysis for the hypothesized relationships including the standardized regression weights and level of significance can be found in Table 2. The results suggest that hypotheses 4 and 5 are not supported, whereas hypotheses 1, 3 and 6 are supported. For hypothesis 2, according to Baron and Kenny [58] to establish mediation in a structural equation context, we show that (1) the independent variable (INC) significantly affects the outcome variable (SWI) in the absence of the mediator ($\beta = 0.411$, $p < 0.001$) and (2) the direct effect of the independent variable (INC) on the outcome variable (SWI) decreases upon the addition of the mediator (EMO) ($\beta = 0.218$, $p < 0.01$). The results suggest that the effect of INC on SWI is mediated by EMO and the indirect effect is significant ($\beta = 0.193$, $p < 0.001$). The R^2 values for EMO and SWI were 0.192 and 0.494, respectively.

Table 2: Significance Testing Results of the Structural Model Path Coefficients

Hypothesis	Path	Coefficients (Standardized)	Regression Weight (Standardized)	P-Value	Results
1	INC→SWI	0.411	0.069	0.000	Supported
2	INC→EMO→SWI	0.193	0.044	0.000	Supported
3	INC*NIE→EMO	-0.160	0.069	0.021	Supported
4	INC*PIE→EMO	-0.029	0.081	0.725	Not Supported
5	EMO*SER→SWI	0.022	0.074	0.771	Not Supported
6	EMO*RER→SWI	0.151	0.071	0.033	Supported

CONCLUSION

In the social commerce era, SWOM strategy is an emerging yet crucial area in IS and marketing disciplines. Although it has drawn mounting attention recently, there are still scarce empirical studies. Extending the line of SWOM research, this study has investigated this important research domain and proposed a research model to interpret how incentives affect consumer SWOM intention through senders' positive emotion, allocation type, and emotion regulation. Data collected from WeChat circle of friends has empirically gauged and validated the proposed research model. Our preliminary findings provide a better understanding of the impact of incentives mechanism on SWOM communication as the researchers are in the process of collecting additional data for the final examination.

Acknowledgments

This research was supported by the Social science planning key projects in Fujian Province (Grant No. FJ2015B202) and Special funds for basic scientific research business of Central University (Grant No. 20720161052).

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Can Consumers Detect Deceptive Product Online? An Analysis of Consumers' Anti-deception Mechanisms For Product-related Deceptions

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ABSTRACT

The rapid growth of electronic commerce (e-commerce) has lead to great loss of online customers every year. Among the different kinds of e-Commerce deceptions, product-related deception receives relatively most attention by practitioners but less attention by researchers. This paper aims to address two questions, 1) Can consumers detect product-related deceptions online? 2) How consumers distinguish the product-related deceptions from the good ones? To answer these two questions, an integrative model and a set of hypothesis, describing the relationship among product-related deception practices, consumers' perceptions and purchase behavior will be developed. And then, test the proposed model using Partial Least Squares (PLS) method on the data collected via a scenario experiment and serverly on real customers.

Keywords: product related deception, consumer experience, partial least square, consumer perception, purchase behavior

INTRODUCTION

The rapid growth of electronic commerce (e-commerce) has created fertile ground for online deception and deception. According to the annual report released by the Internet Crime Complaint Center (IC3) in 2015, the IC3 received 288,012 complaints from consumers claiming to have been dedeceived online; the total dollar loss linked to online deception was U.S. \$1071 billion, which represents a 33.1 percent increase over the previous year; and the average individual loss amounted to \$8421 (Internet Crime Complaint Center 2016). In China, which has the biggest e-commerce transaction amount of the world in 2015, online customers complained average individual loss of 5106 yuan in 2015 (Ministry of Commerce of People's Republic of China 2016).

Among the different kinds of e-Commerce deceptions, product-related deception receives relatively most attention by practitioners but less attention by researchers. In fact, product related deceptions, like counterfeited products, deceptionulent transaction records, fictitious price, false description are widely adopted by e-commerce sellers and trapped a big amount of customers. Online transaction deception is clearly an important concern for e-commerce research. Prior studies in offline and online deception have focused on investigating factors contributing to individuals' detection (or non detection) of another party's deliberate attempts to deceive [1][2][3][4][5][6]. Some aspects of product-related deception such as price of commodities, false product comments are also examined. However there is lack of comprehensive understanding of why consumers may actually be deceived by deliberately product-related deceptive practices. This paper aims to address two questions: 1) *Can* consumers detect product-related deceptions online? 2) How consumers distinguish the product-related deceptions from the good ones? To answer these two questions, we will develop an integrative model and a set of hypothesis, describing the relationship among product-related deception practices, consumers' perceptions and purchase behavior. And then, test the proposed model using a Partial Least Squares (PLS) method on the data collected via a web survey. The whole analysis process will be structured as follows:

CONCEPTUAL DEVELOPMENT: THE RESEARCH MODEL AND HYPOTHESES

Basic Theoretical Model

When facing product-related deceptions on the internet, consumers often act on information that is less than complete and far from perfect. As a result, they often perceive some degree of risk or uncertainty in their purchasing intention. Tarpey and Peter [7] provided a valence framework, combining perceived risk and perceived benefit, which assumes consumers make decisions to maximize the net valence resulting from the negative and positive attributes of their decisions. And then, Dan J. Kim , Donald L. Ferrin 和 H. Raghav Rao [8] extend the valence framework by adding trust as a critical variable in electronic commerce, we modify this framework to fit the context of this research which provides a basic theoretical model for our study(See Figure 1). The underlying logic of the framework is that a consumer's intention (INTENTION) is affected by his or her perception of benefit (BENEFIT), risk (RISK), and trust (TRUST) toward the Internet selling entity. The consumer will be more likely to engage in an Internet purchase when perceived risks are low, when perceived benefits are high, and when trust is high (direct effect).

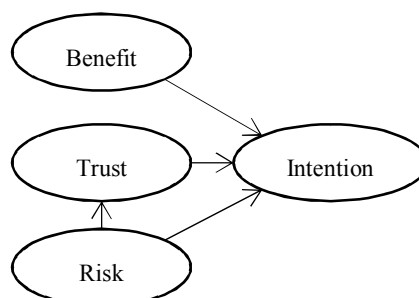


Figure 1: Basic theoretical framework

Purchase intention

Purchase intention is the outcome variable of our study. In this paper, purchase intention refers to the probabilities when consumers detecting product-related deceptions in the condition of purchasing on the Internet. Thus, a consumer's intention to perform (or not to perform) a purchase is the immediate determinant of that consumer's actual behavior.

Perceived risk

A consumer's perceived risk is an important factor for online consumers to detect product-related deceptions, and it is also an obstacle for a consumer to consider whether to make a purchase. In our study, we consider perceived risk as a consumer's perception about the potential negative consequence from the online purchase. Also, various types of risk have been identified, Bhatnagar et al [9], considered that risk is mainly composed of three types: finance risk, product risk and information risk. Product Risk is related to the product itself, for example, a product may be a defective one. Finance risk is uncorrelated to product, but it is related to the opportunity cost and time of e-commerce transaction, for example, at the time of payment, a system error may lead the paid money disappear. Information Risk is relative to security and privacy, for example, the credit card information leaked in a transaction. A consumer's perceived risk has been found to negatively have an impact on the consumer's purchase intention, the higher risk consumers perceive, the less likely consumer make a purchase [10].

Therefore, we proposed that:

Hypothesis 1: A consumer's perceived risk negatively affects a consumer's purchase intention.

Perceived trust

In this paper, we defined the perceived trust as a consumer's perception relevant in conditions of ignorance or uncertainty with respect to the product-related deception. The research of Gefen et al [11], presented that perceived trust is the basis of e-commerce transactions, and it has positive impact on the consumer's transaction intention, it is to say that the higher the consumer's perceived trust, the stronger the transaction intention. Of course, trust is not the only factor of e-commerce transaction behavior, it tends to appear with the perceived risk and they influence each other. Due to the virtual and other characteristics of e-commerce transactions, consumers are bound to have a certain perceived risk when shopping, perceived trust plays a key role in the face of these uncertain risks. Kim's research presented that trust is an important influence factor to reduce perceived risk and promote consumers to take purchase decision, consumers' perceived trust has a more strong effect on purchase intention than the price that consumers perceived on it. That is higher the perceived trust, the lower the perceived risk [12].

Therefore,

Hypothesis 2a: A consumer's perceived trust positively affects a consumer's purchase intention.

Hypothesis 2b: A consumer's perceived trust negatively affects a consumer's perceived risk.

Perceived benefits

In our study, perceived benefit was defined as an extent that a consumer considers that he/she can make a profit from this transaction when he/she is having an online transaction. Margherio's study presented that online transaction benefits consumers more on cost, time, convenience and other aspects than traditional shopping, which has become the significant factor that promote the purchase of consumers [13]. The research of Xiao Liu et al. presented that perceived benefit positively affect consumers' online purchase intention, Consumers perceived the greater benefit, the greater intention of the consumer transaction [14].

Therefore,

Hypothesis 3: A consumer's perceived benefit positively affects a consumer's purchase intention.

Antecedents of perceived risk and trust.

Understanding the antecedents of a consumer's perceived risk and trust can provide government regulator with the normally neglectful insights and tools that they can use to help consumers to detect product-related deceptions. We argue that there are three types of antecedents that influence consumer's perceived risk and trust during the detection of product-related deceptions. These comprise the following:

- Manipulations of product-related deceptions: e.g., deceptions of product comments, deceptions of product info presentation, deceptions of product price, deceptions of product after-sale service, deceptions of product recommendation agent.
- Experience: e.g., internet experience, deception experience.
- Personality: e.g., disposition to trust.

Combining perceived risk and trust antecedents with the theoretical framework above, we propose a consumers' perceived deception mechanisms for product-related deceptions. Fig. 2 presents the proposed research model with hypotheses.

Methods of product-related deceptions

Deception of product comments: In this paper, the deception of product comments refers to the manipulation of comments about products and services by online stores, for example, the website automatically filters out consumer reviews without consumers' permission, or the online store pose as prior consumers and write positive review about products. The research of Ong et al. showed that in the e-commerce transactions, consumers' perception of false reviews will affect the consumer's consumer behavior [15]. Under the circumstance of product information deception, the author believed that once consumers perceive the existence of the deceptions, their perceived trust in product will decline, perceived risk will rise. Based on these, we proposed that:

Hypothesis 4a: Deception of product comments positively affect consumer's perceived risk.

Hypothesis 4b: Deception of product comments negatively affect consumer's perceived trust.

Deception of product info presentation: The deception of product info presentation refers to the manipulation of descriptive information about the product, for instance, the websites use flashy animations to distract consumers from processing non-vivid yet more useful and informative textual descriptions. Larose thought that businesses use exaggerated animation and other product information display will affect the consumer's psychological perception, to induce consumers to make irrational judgments [16]. Under the circumstance of product information deception, the author believed that once consumers perceive the existence of product information display deception, their perceived trust on the product will decline, perceived risk will rise.

Based on these, we proposed that:

Hypothesis 5a: Deception of product info presentation positively affect consumer's perceived risk.

Hypothesis 5b: Deception of product info presentation negatively affect consumer's perceived trust.

Deception of product price: Product price deception refers to the manipulation of the product price and display of unclear price, fuzzy price commitment and hidden additional price. Grewal, Monroe and Krishnan et al. studied that the selling price of the product has an impact on consumer perception, and then affect the consumer's behavior intention[17]. Under the circumstance of product information deception, the author believes that once consumers perceive the existence of product price deception, their perceived trust on the product will decline, perceived risk will rise. Based on this, we put forward the hypothesis of this paper:

Hypothesis 6a: Deception of product price positively affect consumer's perceived risk.

Hypothesis 6b: Deception of product price negatively affect consumer's perceived trust.

Deception of product after-sale service: Product after-sale service refers to the corresponding service that consumers should enjoy when shopping on the Internet, such as logistics, goods return, product maintenance and other services. Deception of product after-sale service refers to the consumer in the process of online shopping cannot enjoy the due service. In real life, some businesses through the fuzzy information services and other ways to prevent consumers to enjoy the service, for example, currently seven days no reason to return has been written into law by administration for Industry and Commerce, but some businesses still with various reasons refused to return the consumer. Drew and Bolton's research points out that the quality of service affects the consumer's perception, and then affects the customer's purchase behavior [18]. Under the circumstance of product information deception, the author believes that once consumers perceive the existence of products supporting services

deception, the perceived trust of their products will decline, perceived risk will rise. Based on this, we put forward the hypothesis of this paper:

Hypothesis 7a: Deception of product after-sale service positively affect consumer's perceived risk.

Hypothesis 7b: Deception of product after-sale service negatively affect consumer's perceived trust.

Deception of product recommendation agent: Various types of deception of product recommendation agent have been identified, for example, the online store excludes products that best fit consumers' preferences from the recommendation list, instead promotes products being a distinctive competitive advantage. Senecal's research shows that the recommendation agent will make consumers feel more professional and more likely to be accepted by consumers than other consumers[19]. Taking into account the situation of product information fraud, the author believes that once consumers perceive the existence of product recommendation information fraud, their perceived trust on the product will decline, perceived risk will rise. Based on this, we put forward the hypothesis of this paper:

Hypothesis 8a: Deception of product recommendation agent positively affect consumer's perceived risk.

Hypothesis 8b: Deception of product recommendation agent negatively affect consumer's perceived trust.

Experience

Deception experience: A consumer's deception experience refers to the consumer's degree of acquaintance with the manipulation methods of selling entity, which includes whether to be familiar with the deceptive vendor and procedures. Besides, whether to experience the deception also includes. Experience is a "precondition or prerequisite of trust", because it leads to an understanding of an entity's current actions while trust deals with beliefs about an entity's future actions [20]. Some research has reported that experience reduces a consumer's perceived risk, interface complexity or uncertainty because it simplifies the relationship with a selling party [20,21,22].Based on these above, we proposed that:

Hypothesis 9a: A consumer's deception experience negatively affects perceived risk.

Hypothesis 9b: A consumer's deception experience positively affects perceived trust.

Internet experience: A consumer's Internet experience refers to the experience of acquiring skills or knowledge from practice. According to the characteristics of electronic commerce, this paper will define the Internet experience for consumers as the familiarity extent of e-commerce transactions, after e-commerce transactions, consumers in the purchase process, product information search and other aspects have a certain familiarity. Luhmann's research presents that the shopping experiences can reduce consumers' perceived risk. Experiences can help consumers to familiar with the operation, so that shopping uncertainty, the complexity of showing the page and other factors are greatly reduced [23]. The results of Light study presents that the consumer's familiarity is a prerequisite for trust, compared to products that have not been exposed to, there is a good shopping experience of the product is more likely to allow consumers to trust, and ultimately to achieve a sense of purchase [24]. Gefen's research shows that once consumers was familiar with the purchase process, website and the business, their personal experiences promote the transaction intention [25].Based on these above, we proposed that:

Hypothesis 10a: A consumer's Internet experience negatively affects perceived risk.

Hypothesis 10b: A consumer's Internet experience positively affects perceived trust.

Personality

Consumer disposition to trust refers to a customer's individual traits that lead to expectations about trustworthiness, a consumer-specific antecedent of trust. A consumer's disposition to trust is a general inclination to display faith in humanity and to adopt a trusting stance toward others. Some of the existing research results show that trust has a great impact on consumer trust. McKnight believed that the consumer's trust tendency positively influences consumer trust, that is, the higher the consumer's trust, the more likely he/she is to trust others, vice versa [26].Therefore, we proposed that:

Hypothesis 11: A consumer disposition to trust positively affects perceived trust.

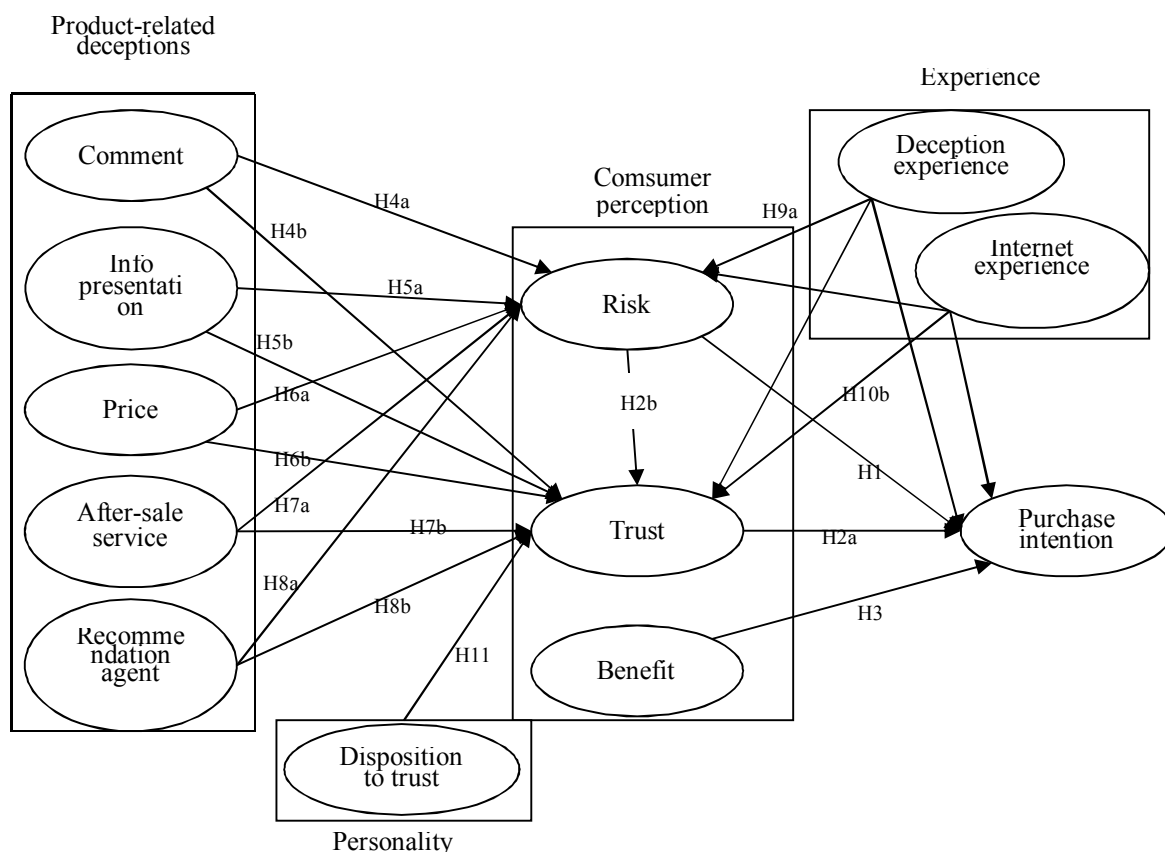


Figure 2: Proposed model and hypothesis

RESEARCH METHODOLOGY AND DATA COLLECTION

To test the research model, we will measure the consumers' perceptions and behaviors by means of questionnaire survey. The research survey was conducted among teachers and undergraduate, because online consumers are generally more educated than are conventional consumers, and data collection in our research indicated that the sample were more sensitive to the deceptive product online.

We published questionnaire surveys via Internet, and received the responses as research data. During the survey, the participants were asked to follow the procedures below: first, they were instructed to visit at least any two B-to-C or C-to-C retailer websites to comparison shop for an item of their being most needed recently. Next, the participants were asked to choose two shops from website for purchasing the products they had chosen in last step, one shop is manipulated by product-related, but the another is not. And then the participants randomly assigned to complete one of two questionnaires: one questionnaire asked questions about the shop from which the participants feel trustful, the another asked the same questions, but about the shop from which the participants feel deceptive. Last, we would verify the websites filled by the participants, to judge whether they detect the deception correctly.

The instruments development for this study was carried out according to the two parts, one part of instruments was adapted from previous research and modified to fit the context of this research, the another part was developed based on the results of a literature review of the topics. All of the constructs were measured by at least three indicators with 5-point Likert scales. We conceptualized and measured product-related deceptions, perceived risk, perceived trust, perceived benefit, and purchase intention as aggregations of different manifestations of deception ways, risk, trust, and intention, respectively, thus the direction of causality is from indicator to construct (i.e., formative). The other constructs were operationalized as reflective indicators.

A total of 285 responses were received. After eliminating incomplete and inappropriate responses, a total of 210 usable responses were included in the sample for construct validation and hypothesis testing.

DATA ANALYSES AND RESULTS

To test the proposed research model, data analyses for both the measurement model and structural model were performed using Partial Least Squares (Smart PLS 3.0) with bootstrapping. We use PLS method for data analyses because it is a powerful tool for assessing both structural model and measurement model with minimal demands on measurement scales, sample size, and residual distributions [27,28,29], also PLS can be used to handle both formative and reflective indicators.

To ensure the appropriateness of the research instrument, we used PLS method to test for content validity, reliability and construct validity.

Reliability: Internal consistency was calculated using Cronbach's alpha, composite reliability, and average variance extracted (AVE) [30]. Table 1 shows that most of Cronbach reliability coefficients are higher than the minimum cutoff score of 0.70 [31] (see Table 1) except for experience's alpha coefficient, but all composite reliability coefficients are greater than 0.7, and all constructs have an AVE of at least 0.5, so it indicates adequate internal consistency.

Table 1: Descriptive statistics and reliability indices for constructs

Constructs	Types of indicators	Cronbach's Alpha	Composite Reliability	AVE
Disposition to trust	Reflective	0.836	0.888	0.667
Internet experience	Reflective	0.831	0.888	0.666
Deception experience	Reflective	0.561	0.772	0.538
Deception of product after-sales services	Formative	NA	NA	NA
Deception of product recommendation agent	Formative	NA	NA	NA
Deception of product info presentation	Formative	NA	NA	NA
Perceived trust	Formative	NA	NA	NA
Perceived benefit	Formative	NA	NA	NA
Deception of product price	Formative	NA	NA	NA
Deception of product comments	Formative	NA	NA	NA
Perceived risk	Formative	NA	NA	NA
Purchase intention	Reflective	0.84	0.904	0.758

Note: NA-Does not apply for the formative measures.

Construct Validity: We examined construct validity by assessing discriminant validity. According to Fornell and Larcker (1981), constructs have adequate discriminant validity if the square root of the AVE for a construct is higher than the variance shared between the construct and other constructs in the model [30]. As we can see in Table 2, in all cases the correlations between each pair of constructs were lower than the square root of the AVE for the particular construct. Consequently, these results as well as the factor analyses confirm that all the constructs were empirically distinct.

Table 2: Discriminant validity indices

	After-sale service	BENEFIT	Comments	Deception experience	Disposition to trust	Info presentation	Internet experience	Price	Purchase intention	RISK	Recommendation agent	TRUST
After-sale service	NA											
BENEFIT	-0.36	NA										
Comments	0.451	-0.06	NA									
Deception experience	-0.47	0.24	-0.28	0.73								
Disposition to trust	-0.311	0.21	-0.17	0.21	0.82							
Info presentation	0.048	0.11	0.33	0.11	0.16	NA						
Internet experience	-0.572	0.41	-0.25	0.57	0.39	0.10	0.81					
Price	0.663	-0.58	0.37	-0.32	-0.36	0.07	-0.50	NA				
Purchase intention	-0.594	0.54	-0.35	0.43	0.33	-0.02	0.47	-0.73	0.87			
RISK	0.451	-0.09	0.44	-0.28	-0.02	0.24	-0.14	0.38	-0.43	NA		
Recommendation agent	0.62	-0.40	0.36	-0.37	-0.36	-0.03	-0.52	0.67	-0.60	0.26	NA	
TRUST	-0.71	0.47	-0.42	0.36	0.37	-0.11	0.46	-0.74	0.75	-0.47	-0.62	NA

Note: NA-Does not apply for the formative measures.

Testing the Structural Model: The assessment of the structural model includes estimating path coefficients and *T* statistics. Fig.3 shows the results of assessment and hypothesis testing. As shown in the figure, three hypothesized paths from the consumer perceptions (risk, trust, benefit) to purchase intention were significant at *T* statistics > 2, thus validating H1, H2, H3a, and also risk had a strong negative effect on trust and significant, validating H3b. Interestingly, among the two hypothesized paths from the experience to consumer perceptions and purchase intention: for one thing, deception experience had a positive

effect on purchase intention, but a strong negative effect on risk, and both were significant, but to trust was not significant, validating H9b. For another, internet experience had a strong positive effect on risk and was significant, but to trust and purchase intention were not significant, not supporting to H10b. The hypothesized path from personality (disposition to trust) to trust was significant, supporting H11. Among the hypothesized paths from product-related deceptions to consumer perceptions: on one hand, deception of product comments, deception of product price, deception of product after-sale service had strong negative effects on risk at T statistics > 2 . These findings support H4a, H6a, H7a, but the hypothesized paths from deception of product info presentation, deception of product recommendation agent to consumer perceptions were not significant, not supporting H5a, H8a. On the another, deception of product price, deception of product after-sale service had strong positive effects on trust at T statistics > 2 , validating H6b, H7b, the other hypothesized from product-related deceptions to consumer perceptions were not significant.

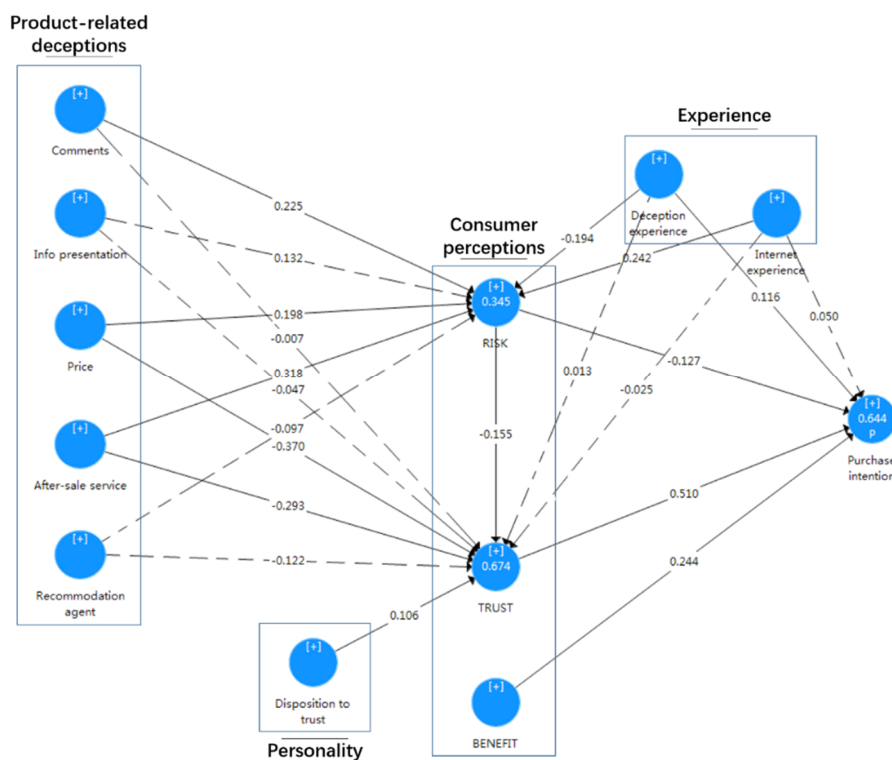


Figure 3: Results of structural model

DISCUSSION AND CONCLUSION

Research findings

According to the proposed model, a consumer's perceived risk has a significant negative impact on purchase intention, but perceived benefits and perceived trust are positively correlated with transaction intention. And the higher the perceived risk, the greater the perceived trust low. Consumers' personal experience can not directly affect the consumers' intention to trade, but through the impact of perceived risk and perceived trust and indirectly affect the purchase intention. These findings exactly verify the classical model.

Deception of product comments, deception of product price, deception of product after-sale service have strong negative effects on risk, and deception of product price, deception of product after-sale service had strong positive effects on trust, suggesting that consumers consider a relatively wide variety of perceptions and observations when developing their trust and risk in a website and vendor, so these findings provide government regulator with the normally insights and tools that they can use to help consumers to build consumer trust and manage the perceived risks during the detection of product-related deceptions.

One interesting finding is that the presence of deception of product info presentation and deception of product recommendation agent did not influence consumer's trust and risk. These findings indicated that a consumer easily ignore product info presentation and recommendation agent during the detection of deceptions. So in our future study, we would center on the enhancement of government regulators' education strategy, to increase consumer's risk and control the trust when facing the product-related deceptions.

Surprisingly, the deception experience and Internet experience had strong direct influence on consumers' perceived risk as expected, however, neither of them have significant direct effect on consumers' perceived trust.

Finally, we found that our personality-oriented antecedent, a consumer's disposition to trust, had a significant effect on a consumer trust. This is consistent with previous studies on the relationship between trust and consumer disposition to trust.

Research limitations and prospects

This article explores the impact of fraud and consumer's personal characteristics on consumers' perceived risks, interests and trusts in e-commerce product information fraud by using empirical research. Commerce trading platform for the corresponding recommendations. But in the whole study, there are still many deficiencies, mainly in the following areas:

This article put the product of information fraud of e-commerce fraud as the object of study. There are many categories in e-commerce deception, each type of fraud may affect the perception of consumers is different. Therefore, consumer perception of e-business fraud is only a case study, which can not explain the general situation of consumer perception in e-commerce fraud.

As for research model, this paper put the product of information fraud and consumer personal characteristics as the consumer perceived pre-influencing factors which study the impact of pre-factors on consumer perception. There are other factors exist in the real life.

The questionnaires on the issue and recovery: although some teachers and social workers take participated in this project, but college students become the main object of this survey, the proportion of the object is not very reasonable, so we should pay more attention to Research on the proportion of the object on future research.

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Exploring The Role of Consumers' Trust in The Online Financial Products Sales Platforms Using The Commitment–Trust Theory

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ABSTRACT

Recent years, Internet Finance pops into our field of vision and plays a quite essential role in our daily life; besides, it seems to change our ordinary financial management concept in a subtle way. In order to provide convenient for consumers, many third-party platforms emerge as required simultaneously which are widely used to satisfy both investors and sellers. Therefore, it is undeniable that the success of Internet Finance's practical meaning heavily depends on its users' continuous support. More specifically, the "continuous support" comes from customers' favorable comments and trust. However, the topic about internet financial sales platforms has not been completely studied in former researches. According to this, the highly practicability and significant utility of this topic indicate the importance of the present study.

Based on the commitment-trust theory and Meyer and Allen's three-component model of commitment, this paper focus on constructing a researching model which incorporates contexts specific antecedent. Moreover, Perceived benefit, products diversity, quality of alternatives perform well as antecedents of commitment. Using Meyer and Allen's three-component model of commitment as a proxy for formal control, this study finds out that elements characterized such as platform assurance, products recommendation and government regulation are positively related to the trust raised by users and even the third-parties. And vice versa, trust and commitment positively affect relational outcomes that we theorize would contribute to outsourcing success as well. Both researches and their practical implications of the results are to be discussed. The results of this research provide theoretical implications for future research and practical implications for the success of internet financial products sales platforms.

Keywords- Trust–commitment Theory; internet financial sales platforms; trust

INTRODUCTION

Since the birth of the Internet, it keeps growing with a sustained step. The Internet has become an essential business platform for trading, distributing and selling products among organizations, corporations and even individual consumers (Brian et al. 2003). With the development of the Internet, Internet sales platforms have been built for online transaction for sake of technology progress and online transactions. Recently, a lot of financial products have been sold through the Internet. However, comparing to the total Internet users, the percentage of Internet financial sales platform is rather insignificant. Majority users believe that online transaction has potential risks, doubt the security of internet financial sales platforms and just use them occasionally. Notwithstanding, commitment and trust are growing in importance as a topic of study and their influence on Internet financial sales platforms is increasing.

Commitment research has shown that users' commitment and to continuous use those platforms is critical to supporters in the Internet context (Li et al. 2006). Because the Internet context is a condition that totally voluntarily used rather than compulsively (Gefen et al. 2003), and it is easy to switch one Web site to another without any cost (Brynjolfsson & Smith, 2000). Based on the above words, in order to catch users' attention to continuous investment, this paper firstly applies the commitment-trust theory in the context of internet financial sales platforms.

Trust is considered essential in exchange relations as it is a key element of social capital (Mayer et al. 1995). Recently, the focus has shifted to evaluating trust in the field of Internet finance. Trust is crucial in all kinds of transactional relationships, especially those containing transaction risk, such as online transactions (Reichheld and Scheffer 2000, Moorman et al. 1993, Morgan and Hunt 1994). If Internet financial sales platform can't build firm trust with its consumers, then their marketing activities on the web will have no condition to be carried out smoothly (Changsu et al. 2010; Sirkka et al. 2000; Hee-Woong et al. 2012).

However, only few scholars have studied the factors that influence continuous use based on the commitment–trust theory and almost all scholars studied commitment or trust in e-commerce context, letting alone conduct researches based on Internet financial sales platforms. In order to fill this void, we attempt to adopt the commitment–trust theory to explain consumers' continuous use in Internet financial sales platforms.

The rest of the paper is organized as follows. Firstly, we review the literature on the Internet financial sales platforms and the commitment–trust theory which are followed by the research model and hypotheses, research methods, data collection as well as

statistical analysis. The results are presented, followed by a series of discussion of finding. The paper concludes the limits and imperfection of this study and prospects a further direction.

BACKGROUND

Internet financial sales platform

Along with the rapid development of Internet finance, Internet financial sales platforms emerge with a certain purpose which aims to facilitate the consumers' online transaction. Third parties became the most vital channel for earn end-users' confidence and to participate easily in online activities (Paula et al. 2003; Jari and Heikki 2007). Internet financial sales platforms are different from traditional financial sales platforms and consumers cannot contact with agents face-to-face by the old one. So the credit problem becomes the greatest barrier preventing consumers from Internet financial sales platforms. Though merchants engaged in online business claim that the internet financial sales platform is a safe platform, a bunch of consumers still worry about its safety. There is no denying that merchants and third parties mainly consider security of Internet financial sales platforms from one single dimension, but the factors which affect consumers' trust can be multi-faced. In this paper, we will study consumers' trust in Internet financial sales platforms from both technologies and network percepts.

Commitment-trust Theory

Morgan and Hunt concluded that trust and commitment played a mediator in the process of development and performance of the role. When both trust and commitment "is not just one or the other" are present, high efficiency, productivity and effectiveness of the relationship between the results can be produced. They pointed out that commitment and trust from both, the economic value of the shares of the necessary communication and opportunistic behavior directly affected the force of Trust (the Trust as well as through indirect effects of commitments). Although the commitment and trust are very desirable "qualitative results" itself as an integral part of the development process, Morgan and Hunt made five other qualitative results and inferred that these achievements promoted success. "Acquiescence" and "tendency to leave", flows directly from the commitments. "Functional Conflict" and "uncertainty" is the direct result of the trust. The "cooperation" from both the commitment and trust for the immediate emerged.

Trust and commitment have been key factors found under the management of IT outsourcing background. Under such contacts, the two organizations exchange the results of cooperation involving intangible assets ambiguous compared to the results in exchange for common services tangible assets definable.

Morgan and Hunt's trust, commitment is consistent with the theory, we infer the existence of trust and commitment is central to the success of IT outsourcing. In particular, we include two management issues and put forward a formal contract to promote the development of relations of governance and IT outsourcing arrangements. More particularly, the present study sees the service level agreement as a commitment of the relationship of trust and key attributes of a formal contract in a direction and concluded, developed and improved SLA provisions can facilitate the exchange of confidence-S and IT outsourcing business commitments. We also note that the complementarity between formal contracts and relational governance is reciprocal; that is, the relationship of trust and commitment of governance can be improved further to support larger SLA relations contacts.

Commitment is generally referred to as a continued desire to sustain a relationship (Morgan & Hunt, 1994). Meyer and Herscovitch (2001) defined commitment as 'a force that binds an individual to a course of action of relevance to one or more targets'. They also indicated that it is experienced by an individual as a mindset, 'a frame of mind or psychological state that compels an individual toward a course of action' (Meyer & Herscovitch 2001). Commitment plays a direct impact on the system vendor commitment and indirectly affects attitudes and intentions procurement network an important role. In P2P, lending commitment is combined with the lender Investment Behavior force. Thus, the concept of commitment can capture forces to promote a wider range of personal opinions and online continuous operation.

In the field of social psychology, trust has been defined as a state of mind, including intends to be expected based on other positive intention or conduct vulnerability. (Rousseau et al., 1998). Lewis and Weigert (1985) contended that trust, from a sociological perspective, should be defined as a property of collective points, and not of isolated personals (Ardion et al. 2010, Roger and James 1995; Blanca 2011, Luhmann 1979, Vishal 2012). In the context of consumer trust in e-commerce, McKnight et al. (2002) defined trust as 'one believes in, and is willing to depend on', another party (Chechen et al. 2011). An important aspect of this definition is the notion of trust as a belief, a sentiment, or an expectation about an exchange partner (Shankar 1994) Lack of organization as counterparties trust often cause people do not want to engage in online transactions. (Donna and Thomas 1999). Similarly, if consumers do not fully trust the Internet financial marketing platforms, they would not use their own financial products.

RESEARCH MODEL AND HYPOTHESES

According to the literature review, research model construction includes nine variables. Figure 1 summarizes our research model. The dependent variable is the behavior of investors who are willing to continue to invest in Internet banking platform sales. Using behavioral willingness in the Figur1.

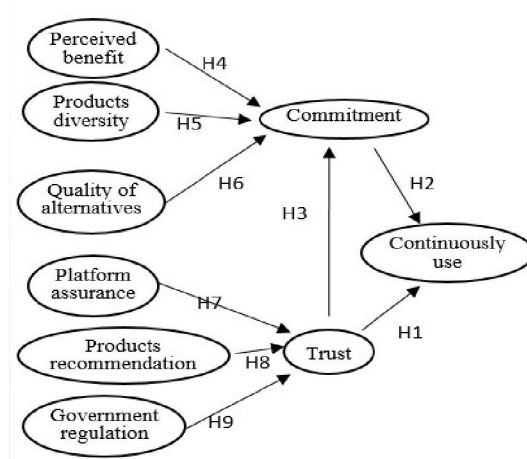


Figure 1. Research model.

A.Trust

Trust is a cornerstone in terms of constructing a longterm business relationship and partnership. Trust refers to the depth and assurance of feelings based on inconclusive evidence (Giffin, 1967; Doney and Cannon, 1997; McKnight and Chervany, 2002). Value trust necessary conditions of uncertainty and risk disclosure. (Moorman et al., 1993). ct the scope and depth of consumer relationships with vendors. McKnight et al. (2002) pointed out that When you established trust in the site, they tended to continue to participate with content providers and trade. Eastlick et al. (2006) conducted empirical study and found out that trust was an important antecedent for individuals to maintain continuous and valuable relationships with e-tailers. Commerce Net's report suggests that trust is the third of 10 top barriers and inhibitors to e-commerce (Brian et al. 2003). If the Internet can not finance sales platform to build trust with consumers on the network marketing activities are not carried out smoothly (Changsu et al. 2010; Sirkka et al. 2000; Hee-Woong et al. 2012). In the third-party platform, information asymmetry is magnified because almost faceless in the investment process in the network environment, near anonymity. To address this uncertainty, according to the situation and handle party, trust evaluation is necessary and the following assumptions may be true:

H1.trust is positively associated with willingness to continue investing in the third party platforms.

B.Commitment

Commitment, symbolizing the implicit or explicit assurance of service providers, refers to a willingness to develop and maintain a positive exchange relationship (Dwyer et al., 1987). Chen et al. (2013) concluded that the commitment exerted a large positive effect on the behavior of content creation on the social networking site. The thirdparty platform promises to continue the use of incentives and benefits associated with the identification of investors. Previous studies have found a positive effect on behavior intention of commitment (e.g. De Ruyter et al. 2001). Commitment plays a direct impact on the system vendor commitment and indirectly affects attitudes and intentions procurement network an important role. Thus, the following hypothesis can be established:

H2.Commitment is positively associated with willingness to continue investing in the third party platforms.

There are also some relationships between trust and commitment. Morgan and Hunt theorized that trust and commitment played key mediating roles in the process of relationship development and performance. Aiken and Boush (2006) examined the trust in e-commerce and found that third-party was a wise way to develop trust. In addition to this, trust could promote building relationship commitment (Li et al. 2006). When both trust and commitment "not just one or the other" are present, efficiency, productivity, and effectiveness of relational outcomes can be produced. Thus, the following hypotheses can be established:

H3.trust is positively associated with an investor's commitment.

C.Factors

Perceived interests of consumers related to the degree of belief that he or she will become the best online transaction with a certain website (Paula et al. 2003). More and more people make financial transactions through Internet sales platforms, as the provision of products in the store on the Internet provides people with a lower price compared with the store. More importantly, consumers can scan products from different platforms in a short time which they think are cheaper. Consumers can get more profits through Internet sales platforms for funds to buy financial products. Dan et al demonstrated that the perceived interests of consumers positive impacted consumer purchase intentions. Lee proved that the perceived benefits had a positive impact on the attitudes and planned to use online banking online banking. If a third-party platform rewrite greater benefits, equity investors will get more from it, it seems to be a signal to potential investors trying to assess the unobservable characteristics of the enterprise issued by

interpreting entrepreneurs, but also to characterize possible indicators company properties (Connelly et al., 2011). Thus, the following hypotheses can be established:

H4. Perceived benefit is positively associated with an investor's commitment.

According to Knudsen and Eriksen (2000), capacity constraints diverse commitment, their findings suggest that in order to select the physical assets and technology, the commitment promotes the product line diversity. In a study comparing the financial performance of the Diversifying Top 50 Companies for Diversity to a matched sample. They found that the evidence suggests that the diversification of the company to outperform the average firm commitment counterparts (Stanley F. Slater, 2008). Thus, the following hypotheses can be established: H5. Products diversity is positively associated with an investor's commitment.

Mass attenuation quality alternatives to service, value, satisfaction and use of online banking customers the ultimate intention views (Shi, 2008). This is similar to the Internet financial marketing platform. Thus, the following hypothesis can be established:

H6. Quality of alternatives is positively associated with an investor's commitment.

Web sites ensure that the platform means a protective structure or beliefs technical safeguards to ensure that online transactions can be conducted in a safe premise (McKnight et al. 2002). As an intermediary, inspection and monitoring of third party platforms to engage participants appease enforcements in the case of opportunistic behavior, privacy and security of data and transaction care (Wang et al. 2014). Platform will help ensure a high level of users' confidence and overcome the fear of those operating the Internet. A trusted third party can be more willing to give up personal information in a reliable road construction site, and interact with your site (Durkan et al., 2003; McKnight et al., 2002). Thus, the following hypotheses can be established:

H7. Platform assurance is positively associated with an investor's trust.

In many seminars, we clearly show 3R principles of social consumer will completely change the global sales: ratings, comments and suggestions (Social Media Link, 2015). It shows that the problem of recommendations is also the problem of recommendations with trust relations. (Deng et al., 2014) Users receive recommendations for items rated highly by people in their web of trust (Patricia, 2011). Thus, the following hypotheses can be established:

H8. Products recommendation is positively associated with an investor's trust.

Tyler and colleagues have been found to trust the government's instruction led authoritative generally accepted. The study also showed that confidence in the government actively supported the forecast regionalization policy. Government regulation can help standards establish under the financial regulation of Internet sales platforms. Trust in Government can increase a person's willingness to support a government undertaking risky activities, such as encouraging investment in the Internet financial marketing platform. Thus, the following hypotheses can be established:

H9. Government regulation is positively associated with an investor's trust.

RESEARCH MEASUREMENT

Measurement Development

All measurement items were adapted from previous literature, with minor modifications in wording to make them relevant in the context of internet financial sales platforms. The measurement items were formulated by a five-point.

Likert scale, ranging from 1 "strongly disagree" to 5 "strongly agree". Before posting formal survey, the survey was examined by bachelor's degree students (n=20) in a MIS program who have experience of internet financial sales platform to reduce possible ambiguity in the questions. Respondents were asked about any problems they may have encountered in the survey. Comments and suggestions on the items' contents were solicited.

Survey Procedure

This research takes China as the site of the empirical investigation because the supporting infrastructure required for internet financial sales platforms developments have been put in place. China has aggressively pursued the development of IT and has created a rapidly growing IT infrastructure. According to CNNIC's report, up to December, 2015, the number of net citizens who have invested in internet financial platforms in China has reached 90.26 million, increasing by 11.77 million compared to the end of 2014. A Total of 352 questionnaires were distributed in the formal survey between March, 2016 and June, 2016. The questionnaires were distributed through E-mails, personal visits to people who are working in diverse industries and social institutions, including schools, universities, offices and companies that were drawn at random in China. Altogether, 304 questionnaires were collected. After reviewing, 30 questionnaires were eliminated due to invalid answers, leaving 274 questionnaires for the empirical analysis. Our sample comprised 51.97% male and 48.03% female respondents. The respondents are relatively young and generally well educated.

DATA ANALYSIS AND RESULTS

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Measurement Development

Both of validity and reliability were determined to evaluate the measurement model. Hair et al. (1998) indicates that Cronbach's α value of 0.7 is the minimum acceptable value for reliability. The α value of each construct is over 0.7, which represents good reliability. Content validity and construct validity are often used to measure validity. The variables in this study were derived from existing literature, thus exhibiting strong content validity. Construct validity was examined by investigating discriminant validity and convergent validity. The convergent validity of the scales was verified by using the criteria suggested by Fornell and Larcker (1981). All the factor loadings for all items exceed the acceptable level of 0.6, and all factor loadings are significantly related, via t-tests at $p < 0.001$, to their respective constructs, the composite reliability of the constructs ranged from 0.82 to 0.91, and thus all exceeded the generally accepted value of 0.70. In addition, the AVE ranged from 0.54 to 0.76. Hence, all three conditions for convergent validity were met. Discriminant validity was examined using criteria suggested by Fornell and Larcker (1981). The shared variance between each pair of constructs was less than the average variances extracted, providing evidence of discriminant validity.

TABLE I. CONSTRUCT RELIABILITY AND CONVERGENT VALIDITY

Constructs	Items	Factor			
		loading	CR	AVE	Cronbach's α
Perceived benefit	beni1	0.815	0.849	0.652	0.875
	beni2	0.742			
	beni3	0.861			
Products diversity	prod1	0.884	0.896	0.742	0.898
	prod2	0.843			
	prod3	0.857			
Quality of alternatives	qua1	0.889	0.906	0.764	0.894
	qua2	0.822			
	qua3	0.908			
Platform assurance	perc1	0.787	0.881	0.652	0.872
	perc2	0.687			
	perc3	0.858			
	perc4	0.884			
Products recommendation	rec1	0.844	0.880	0.710	0.896
	rec2	0.783			
	rec3	0.897			
Government regulation	gove1	0.908	0.900	0.750	0.860
	gove2	0.757			
	gove3	0.924			
Commitment	com1	0.868	0.896	0.741	0.856
	com2	0.799			
	com3	0.912			
Trust	trus1	0.814	0.841	0.639	0.840
	trus2	0.700			
	trus3	0.875			
Continuously use	use1	0.683	0.824	0.541	0.873
	use2	0.632			
	use3	0.798			
	use4	0.814			

Test of Structural Model

To assess how well the model represents the data, this research employed AMOS 6.0 to evaluate “goodness of fit” index. $\chi^2/df=1.53$, RMSEA=0.04, GFI=0.90, AGFI=0.91, CFI=0.91, NFI=0.89 and IFI=0.90 are all within the commonly accepted thresholds suggested in the literature. The fit indexes indicate that the model provides a reasonably good fit.

Hypothesis Testing

The result shows that hypothesis 1 to 7 is fit well but hypothesis 8 and hypothesis 9 is inconsistent with the paper. It will be discussed in detail in the next part.

DISCUSSIONS AND IMPLICATIONS

Discussion

According to the result of our research, the effect of perceived benefit products diversity and quality of alternatives ($\beta_{\text{perceived benefit}}=0.304$, $t=3.175$, $p<0.001$; $\beta_{\text{products diversity}}=0.313$, $t=3.496$, $p<0.001$; $\beta_{\text{quality of alternatives}}=0.311$, $t=3.676$, $p<0.001$) are significant to commitment. Meanwhile platform assurance ($\beta_{\text{platform assurance}}=0.393$, $t=4.678$, $p<0.001$) also have significant effect on consumers' trust.

These findings are consistent with our expectation basically. In many prior researches, perceived benefit, products diversity and quality of alternatives have been found having positive effects on commitment. Users still show strong relationships with trust towards platforms. This finding indicates that people pay attention to the structural assurance during online lending process. Our results support all these findings.

However, products recommendation and government regulation ($\beta_{\text{products recommendation}}=0.304$, $t=3.175$, $p=0.214$; $\beta_{\text{government regulation}}=0.313$, $t=3.496$, $p=0.233$) are not considered determining factors of platform trust.

The possible explanation for the result may be that internet financial products sales platforms only have a short history in China. People who adopt online purchasing are not sufficient enough to perceive users the reach of critical mass. And the platforms are not widely accepted in China. Some people prefer traditional banking lending process since there are fewer risks and more guarantees. On the other hand, financial products sales are sometimes thought to be unreliable because online financial products sales markets are in the phase of development and lack specific laws to monitor the running of it. As a result, these two factors may still not enough to produce trust towards financial products sales platforms.

Implications

From a theoretical perspective, although commitment – trust theories have been widely used to explain continuous technology use, current studies have shown few attention on its applications in the third-party platform. Our research fills this knowledge gap. We advance these theories by applying commitment-trust research model in a third-party platform context. This is the first study that empirically tests the investors' continuous use in the third-party platform. Our research applied commitment-trust model expands the understanding of the model's robustness in explaining continuous use. For instance, we find that trust on third-party plays an important role in influencing investors continuous investment in third-party platform.

From a practical perspective, the findings of this study will help third-party platforms stimulate investors' willingness to continue investing by increasing their commitment and trust. In order to increase investment, thirdparty platforms could offer more rewards and easy the use. Meanwhile, both platform designers and company managers can also obtain benefits by applying our model in the practical context. From the perspective of platform designers, they can increase their platform commitment by paying more attention on platform securities.

DISCUSSIONS AND IMPLICATIONS

Despite the importance of the present findings, this paper has several limitations which should be solved in future study. First of all, the research model of this paper does not examining the relationship between willingness and actual behaviors. By not examining the actual behavior of continuous investment in a third-party platform, the potential effect remains unclear. Therefore, measuring actual behavior to continuously invest in third-party platforms may reveal interesting findings. Second, our empirical study is confined to a Chinese sample. It could be prolific to test whether the findings hold in other countries. Differences between cultural and technological should be considered. A further extension of this paper could be to compare the continuous investment in third-party platforms in different countries. Furthermore, our paper only focuses on the simple intermediary of thirdparty platforms. Future researches can examine the research model in other types of third-party platforms.

ACKNOWLEDGMENT

This work has been supported by the National Natural Science Foundation of China (Project No. 71502145).

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Review on The Research of Online Reviews' Perceived Credibility

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ABSTRACT

Online review has become one of the most important references for modern consumers to purchase products or service. Based on combing the related literature on credibility of internet public opinions, this paper gives a summary of influence factors of perceived credibility of online reviews through three aspects: the credibility of source, the credibility of channel and the credibility of information. From the angle of online reviews information structure characteristics (including additional reviews vs. one-time reviews), this paper aims to discuss which one has higher perceived credibility, and information quality adjust the differences in perceived credibility.

Keywords: including additional online review, perceived credibility, effect of online reviews

INTRODUCTION

The integration of the Internet and information technology has profoundly changed the way in which people share their experiences of shopping, publish and exchange information about products or services [1]. The online word of mouth which users published through the community / forum, social networking sites, blogs / micro-blog and other Internet platforms has become a very valuable source of information for consumers in the purchase decision [2]. The online review, a special form of spreading online word of mouth that the potential or actual consumers posted positive or negative views about products, services and sellers through online shopping websites or third party comments websites [3], plays an important role in eliminating uncertainty of consumers' cognition and aiding them make effective decision [4]. The online reviews are the information, provided by consumers who have purchased and experienced the product or service, overcoming the shortcomings of the untrusted marketing information from sellers [5]. According to the CNNIC survey, 71.1% of online shopping users believe that the most important factor affecting online shopping consumer decision-making are the online reviews [6]. Consumers do some search to get online reviews to reduce the time of making purchase decision and reduce the risk of purchase [7].

At present, there is the lack of information audit link to release online reviews [8]. Reviewers will likely transfer false or inaccurate information to the consumer [9]. To a certain extent, it disturbs consumers to distinguish comments' credibility. Online reviews no longer have the characteristics of traditional word of mouth which have the high credibility. Compared to the traditional word of mouth, consumers in the search for online reviews will consider the credibility of the information from more aspects, and will only adopt the online comments they trusted [10].

The credibility of online reviews has been the concern of many scholars. Previous studies about the perceived credibility of online reviews are basically assume that reviews come from different critics, fewer study has involved additional reviews. In the real reputation systems, the reviewers can post the reviews about the same product twice. For example, Taobao.com, which officially launched additional review mechanism in April 2012, the buyer can take effect in the Taobao's reputation systems within three months after the additional comments, the seller can explain the content of the additional comments, and the content of the additional comments shall not modify, thus more real reflect consumer post-purchase experience.

From the angle of online reviews information structure characteristics (including additional reviews vs. one-time reviews), this paper aims to discuss which one has higher perceived credibility. Can information quality adjust the differences in perceived credibility? This article will revolve around the above problems.

LITERATURE REVIEW

Perceived Credibility of Online Reviews

Credibility refers to the degree of judgment from receiver to communicator, and it may affect the receiver's perception, attitude and behavior [11]. Perceived credibility of online reviews, refers to the user perceiving the degree of authenticity, reliability, integrity and usability from comment review information in the network environment, especially in the current users' active participation and interoperability of Web environment [12]. Credibility is one of the important pre-variables that affect the quality of online reviews [13]. Online reviews with high credibility will have a positive impact for users on accepting the comments and making purchase decisions [14].

At home and abroad, the researches on the credibility are divided into three perspectives: the credibility of source, the credibility of channel and the credibility of information [15]. This paper is concerned with the credibility of online reviews, and discusses the impact of online reviews information structure on its credibility.

From the angle of the source, the credibility of source is the judgment on the credibility of the source from information receiver, and it has nothing to do with the information itself. The audience will be more likely to directly accept the recommended

points of view, when the communicators of high reliability transfer information [16]. The research on the credibility of source mainly includes two aspects: the specialty and credibility [17]. At the same time, the social relationship between the information receiver and the source will affect the judgment of the credibility of source [18]. In the online trading market, online reviews are often released by anonymous reviewers, and releasers and the receivers are in a weak relationship state and the network interpersonal trust could be low [19]. Consumers cannot determine the real identity of the publishers and the real motives of releasing online reviews [20]. In reality, it exists that the enterprise or the seller contacts friends and even hires online water army to add positive comments in order to improve the word of mouth and sales, so that it is difficult for consumers to confirm the source credibility of online review information. Therefore, the more detailed personal information disclosure, the stronger perception of the relationship between reviewers, the more reliable reviewers are^[21]. According to the theory of Persuasion Communication effect, the acceptance of the information will not be affected by the source, when the audience can separate the source and content of the information [16].

From the angle of the channel, communication of the traditional word of mouth does not require external channels, and online reviews need to rely on the forums, blogs / micro-blogs, third party reviews sites and other Internet platform as a channel for dissemination. Therefore, dependence of consumers on the information dissemination platform and the platform's own characteristics will affect the attitude of consumers on the platform [19]. Users will assess the credibility of the site based on its interface design firstly. If the web page is carefully designed, and provides a reliable interface for the user, it will enhance the users' perception of trust on the platform and push users continue using the platform [22]. Online review platform is divided into marketing platform and third party platform [23]. As for some comments posted on marketing platform, consumers will doubt these with selling intention, and that the platform will manipulate the reviewers to publish information that does not conform to the actual product to reduce the persuasion of the comments [24]. Lee & Youn analysis review platform and comment the potency of interaction. They think, when the comment information is positive, the platform type will affect consumers' perceived credibility of product reviews; when the review is negative, the platform type has no effect on perceived credibility [25].

From the angle of the information, online reviews are divided into two categories: properties evaluation and simply recommended reviews [26]. Properties evaluation reviews refers to the product specific attributes, performance based on objective information; simply recommended reviews mainly include more subjective emotional factors which based on consumers' subjective feeling. Compared to the simply recommended reviews, most of properties evaluation reviews are based on the product specific facts, which can help consumers form a clear cognition of product. Consumers will tend to think that it has higher credibility and stronger persuasion. At the same time, the direction of eWOM can also affect perceived credibility. However, the academia does not give a consistent conclusion to the question that which positive or negative online reviews has more influential. When the online reviews of the product are all positive, consumers are likely to think that sellers may manipulate the information intentionally, removing negative online reviews and only providing positive reviews; when there are both positive and negative reviews, it will weaken consumer's suspicions. Therefore, compared to only contains positive online reviews, the combination of positive and negative of the online reviews have higher credibility.

Summarized through the related literature about the perceived credibility of online review, we found that the studies are mostly assumed that reviews come from different reviewers, which do not consider that one reviewers can evaluate twice about the same products. In view of this, this article attempts to use the experimental situation method to improve the research in the field.

Online Reviews' Information Quality

Information objectivity, timeliness, understandability and sufficiency are the factors that affect the quality of information [27]. Based on Lee [28], online review information quality can be divided into high quality and low quality. High quality reviews contains more detailed properties, such as product appearance, function or descriptive information related to the experience, and provide a strong argument. However, low quality information is the low correlation with product evaluation and contains only simple recommendation or statement of information. In view of this, we believe that high quality comment refers to the objective, detailed description of the product attributes, and the information of the products with high correlation; low quality comment refers to the reviewers' subjective, emotional description of the product, and the description of the product attribute is fuzzy, low correlation with product information.

In the marketing field, argument that the information contained to persuade represents the quality of information. The objective, easier to be understood online information convince stronger persuasion than subjective, emotional information [29]. Reviewers describe more detailed experience of products, adopt the combination of pictures and words expression, the reviews are more convincing, and higher information quality, more easily accepted by consumers. Based on the elaboration likelihood model, Sussman & Siegal build the information adoption model, which explain the relationship between information quality and information usefulness, thus influence consumers' adoption of information and decision-making process [30]. Cheung et al. applied the adoption model into the eWOM dissemination and communication situation, think that eWOM information quality and usefulness are related, and the quality of eWOM understandability and relevance has significant effects on perceived usefulness [31].

In conclusion, this paper puts forward the following assumptions:

H1: When the first review is positive, if positive additional reviews is low quality, the difference of perceived credibility between including additional online reviews and one-off online review was not significant.

H2: When the first review is positive, if positive additional reviews is high quality, the difference of perceived credibility between including additional online reviews and one-off online review was significant.

H3: When the first review is negative, no matter the quality of negative additional comments, the difference of perceived credibility between including additional online reviews and one-off online review was significant.

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Understanding Trust Transference Among Social Network Friends In Social Commerce

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ABSTRACT

This study aims to examine the trust transference among social network friends in social commerce through a randomised experimental design. A total of 558 respondents participated in the experimental study. The findings of this study suggest that trust propagates from one to another in a transitive network path structure (i.e. between a direct-friend relationship, to one of friend-of-friend, friend-of-friend-of-friend or virtual friend relationship) in the social commerce context. Trust is also positively transfers between strong-tie friends when it is examined in the context of message framing with positive and negative attributes.

Keywords: Trust transference, social commerce, social ties, message framing.

INTRODUCTION

The growth of e-commerce has shifted onto online social network (OSN) platforms (e.g. Facebook), which provide a more interactive environment for e-commerce retailers as compared to a traditional e-commerce setting that has no interaction with OSN platforms [15] [13] in the last six years. Many e-retailers have attempted to take advantage of the economic potential and interactive features of OSN websites to fully exploit their social commerce capability. However, making a decision to trust a social commerce retailer is generally more complex than for an offline bricks and mortar physical store [22] as well as for a traditional e-commerce retailer. This is because more than one party (e.g. social commerce retailer and social commerce provider) is involved in any social commerce transaction. Concerns such as social commerce providers (e.g. Facebook) disclosing too much and/or abusing their users' personal information, the accuracy of the content featured on social commerce websites [29], and user vulnerability to social security attacks [7] have also escalated the question on how one perceives trust within the social commerce environment. This suggests that trust is a crucial factor in the success of social commerce.

In the literature, there are three major streams of trust (psychology, sociology and technology) derived from relational theory [2] and trust transference theory [25]. For example, trust from a psychology perceptive focuses on individual's interpersonal trust [16]. Social trust focuses on social relationships from other group members in a social group [23] either in a transitive network path structure or composability network path structure. The technological elements within the e-commerce and social commerce contexts play an important role in institutional or system aspect of trust [23]. Trust is relational, propagative [23] and transferable [6] [18] in both offline and online settings. This is because the frequency of an individual's interactions with another party strengthens the relationship between these two parties and trust evolves based on their experiences [23]. Past research suggests that the basis of online trust starts from offline relational trust (offline trust) [27]. Many Information Systems (IS) researchers adapt trust characteristics from the offline environment into the social commerce context [6] [13] [28]. In addition, the message presentation from different social ties plays an important role to influence another party especially in the social commerce setting when one party has very little knowledge on the online retailer that they want to purchase from [28].

A number of research (i.e. [18], [12], [8]) suggests that trust transference between members of the network in the social commerce context plays an important role in predicting consumer behaviour intention. For example, Ng [18] and Gefen et al. [8] have extended the relational and trust transference theories from Bourdieu [2], Kim [12] and Stewart [25] respectively to investigate how trust is transferred from one member of the network to another via recommendations. However, the studies by Gefen et al. [8] and Nielsen [19] did not take into account tie-strengths (strong-tie and weak-tie) and the different social trust chains (also known as social distances) between members of the network when examining trust transference between members of the network. For instance, how trust transfers transitively via the OSN path structures was not investigated. Additionally, the importance of social trust chains (social distance between friends) on different types of message presentations (such as combinations of aligned and contradicted messages) was not taken into consideration in the previous studies. To address this research gap, this study aims to examine the trust transference on different types of the tie-strengths (strong-tie [direct friend] and weak-tie [friend-of-friend, friend-of-friend-of-friend, virtual friend]), and the different social trust chains via different message presentations (message framings) through a randomised experimental design [3]. The social trust chains included in this research study are: direct friend, friend-of-friend, friend-of-friend-of-friend and virtual friend. The different message framings are: aligned and contradicted positive and negative messages.

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Social ties

A social tie is defined as "the set of social interactions between two or more individuals" [25, p.338]. Previous studies have found that social ties, especially the aspect of different types of tie strengths (strong and weak ties), are important in the consumer decision-making process [28], particularly in the social commerce context. Specifically, the closeness of the relationship

between one another (social distance) plays an important part in influencing one's decision-making. This is because different types of social ties have different impacts on purchasing decision [28]. For example, strong ties exert more influence over a recommendation receiver's decision-making than weak ties [4] [21]. Consumers also generally perceive strong ties to be more influential than weak ties in their decision-making processes [4], and they are more likely to share all types of information with their strong-tie contacts.

Past literature has also indicated that a strong-tie is not limited to only being influential; information that is derived from strong-tie friends is perceived to carry less risk [21]. In other words, information from strong-tie relationships is likely to have a higher economic value, is more credible, and considered more useful than that from weak-tie acquaintances [28]. Therefore, based on the stated arguments, consumers can more easily evaluate the quality of products and place their trust on them if their strong-tie friends are the ones who provide the information about these products. In contrast, if weak-tie friends were to provide product reviews, consumers may deem the reviews as risky, less credible, and less useful. In this regard, when the social distance between two parties increases in a social trust chain, such as from a direct friend relationship to one of the virtual friend, friend-of-friend or friend-of-friend-of-friend, then trust between the two parties would be weaker. Hence, the following hypothesis is proposed:

H1. Social distance is negatively related to the level of trust in the social commerce environment.

Message framing

Message framing refers to the presentation of a message [24]. The way a message is framed can have a significant effect on the result of its communication. For example, Prospect Theory [11] explains that when a message is presented in two different ways (i.e. with positive versus negative attribute labels, or the benefits of gain versus loss of a product), the message can change an individual's perspective, preferences and actions.

Besides message framing, persuasive messages derived from social ties are more likely to influence consumer decision-making [19]. For example, if a consumer were to plan a visit to another city and needed to book a hotel, he or she, being not familiar with the destination, would likely ponder to make a decision on where to stay. Frequent internet and OSN users would do a search on the Internet and/or seek advice from their social network friends [18] [28]. What all these information-seeking strategies have in common is that people often seek the advice of others (i.e. social ties), which are either positively or negatively framed as part of their decision-making [28].

Past research results have shown that the framing effect to be rather mixed and contradictory. Smith [24] suggests that positive-framed messages are superior to negative-framed messages. This is supported by Jaworski and MacInnis [10] and Muehling [17], who put forward that positive-framed messages generally result in a positive-effect reaction.

In this study, the positive and negative messages are framed into match and mismatched messages, with the expectations that such attributes may encourage an individual to follow advice from their social ties. The matched (or aligned message) refers to messages derived from a recommender which are aligned with the feedback from other consumers who have consumed and experienced the products or services on the social commerce retailer website (such as TripAdvisor). Mismatched (or contradicted message) refers to the messages derived from a recommender which are not aligned with the feedback from other consumers who have had consumed and experienced the products or services on the social commerce retailer website. As such, recommenders can articulate their personal perception or consumption-related advice, which is either matched with or mismatched with the feedback from other consumers in the virtual platform.

Based on the message framing arguments, it can be posited that individuals often seek the advice of others (social ties) as part of their decision-making, and the advice by recommenders can be positively or negatively framed. In addition, there may be differences on the framed messages when positively (matched) framed messages are derived from closer social ties in the social commerce context. As noted earlier, this is because strong-tie friends are not only more influential, the messages derived from them are also perceived to have higher economic value, more credibility and more useful than that from weak-tie friends [21] [28]. In this regard, the level of trust between strong-tie relationships is greater than weak-tie acquaintances. Together with the message framing, the motives for an individual to engage in a positively framed (matched) message may differ from the motives of other types of framed message. Thus, both strong-tie and positively framed (matched) message can potentially influence the purchase decisions of individuals. Hence, the following hypothesis is proposed:

H2. A positively framed message (matched) has a stronger impact than any other types of framed messages within the same strength of tie between individuals.

H2a. A positively framed message (matched) has a stronger impact than a negatively framed message (matched) within the same strength of tie between individuals.

H2b. A positively framed message (matched) has a stronger impact than a positively framed message (mismatched) within the same strength of tie between individuals.

H2c. A positively framed message (matched) has a stronger impact than a negatively framed message (mismatched) within the same strength of tie between individuals.

Social ties and message framing towards willing to follow advice from social friends

In addition, following a similar conceptual idea from Roger [21], this research conceptualises that messages derived from a strong-tie social friend and which are aligned with the source of other consumers' feedback are likely to be perceived to carry less risk. Aligned messages that are derived from a strong-tie may promote an individual's willingness to follow their advice. On the other hand, contradicted messages may be perceived to carry a higher risk and such messages may demotivate an individual's willingness to follow advice from their social friends. To further explore such message framing activities on decision-making in the social commerce context, this study expects that messages (either aligned or contradicted) provided by a strong-tie are more likely to be viewed as informative, and such messages increase the individual's willingness to follow advice within the same framing. Thus, this research study proposes the following hypothesis:

H3. Strong-tie has a greater impact to intending to follow advice within the same framing.

H3a. Strong-tie has a greater impact to intending to follow advice that is positively (matched) framed than a weak-tie.

H3b. Strong-tie has a greater impact to intending to follow advice that is negatively (matched) framed than a weak-tie.

H3c. Strong-tie has a greater impact to intending to follow advice that is positively (mismatched) framed than a weak-tie.

H3d. Strong-tie has a greater impact to intending to follow advice that is negatively (mismatched) framed than a weak-tie.

RESEARCH METHODOLOGY

This study obtained approval from the university's Human Research Ethics Committee. The target sample for this study was undergraduate students (18 to 24 years old) from universities in Malaysia. The use of students as a generalizable sample for research projects has been supported by previous research [5] [8] [22]. Therefore, the use of undergraduate students as respondents in this study is appropriate as they are representative of active internet and social media users [20]. Since internet users and online shoppers are usually young [8], educated, current college and university students [14], and undergraduate students (18 to 24 years old) were chosen as sample in this study. According to a recent study by Arbitron and Edison Research [1], 86 percent of people aged 18 to 24 participate in OSNs and more than half of the active OSN users between the age of 18 and 24 participate in social commerce. A number of studies in OSN and social commerce have used undergraduate students as their sample due to their appropriateness to the context studies [5] [8] [22]. The demographic details of participants in this study are shown in Table 1.

Table 1: Demographic characteristic and TripAdvisor experiences of the respondents

Measure	Item	Total, n=558	Percentage, %
Gender	Male	335	60.0
	Female	223	40.0
Have you visited TripAdvisor (www.tripadvisor.com.my) before?	Yes	181	67.6
	No	377	32.4
How long have you been using TripAdvisor? *	Less than 6 months	96	53.0
	6 to < 12 months	31	17.1
	1 to < 2 years	34	18.9
	2 to < 3 years	12	6.6
	3 to < 4 years	8	4.4

* Note: The total number is 181 instead of 558.

Before the experiment session, the respondents were briefed on the research objectives, the experimental tasks and precautions. Respondent was voluntary and prior consent was obtained. All respondents were assured of anonymity. During the experiment session, the respondents were required to provide their demographic information before they were introduced to the TripAdvisor website. A Solomon four-group experimental design [26] that involved two experimental and two control groups (refer to Table 2) was adopted in this research to examine the 4x4 factorial design (i.e. four social relations with four types of recommendation) of this study. The framing of these four different recommendations are shown in Table 3. The four different types of recommendations were formed using opinion keywords extracted from genuine reviewers who shared their accommodation renting experiences on the TripAdvisor website. Made-up recommendations refer to the fictional recommendations used in the

experiment treatment. Extracted positive and negative opinion keywords from the genuine TripAdvisor recommendations were used to draw up the made-up fictional recommendations. There were a total of four types of different recommendations that this study used to measure the impact of trust transference: two matched (aligned) and two mismatched (contradicted) scenarios. Extracted positive or negative opinion keywords from the TripAdvisor website were used to form the made-up recommendations in the matched scenarios, whereas extracted positive or negative opinion keywords were manipulated for the mismatched scenarios. As such, 16 treatment conditions were formed.

The 16 different treatment conditions were included in the respective Group 1 and Group 3 experimental groups. The treatment condition is represented as X_n in Table 2. The control groups are: Group 2 – the control group with pretest and posttest observations; and Group 4 – the control group with posttest observation only. Respondents were randomly assigned to one of the four different groups between Group 1 and Group 4. In order not to exhaust the respondents during the data collection process [9], between-subjects design was employed as part of this experimental study strategy, i.e. each respondent participated only in one treatment during this study.

Respondents that have been randomly assigned into Group 1 will receive two sets of questionnaire (one for pretest and another for posttest observations) with a treatment condition (scenario with tasks to review and book a hotel room). Each respondent in Group 1 received a scenario that required the respondent to navigate the TripAdvisor website and book a hotel room respectively after they have completed the pretest questionnaire. Once they complete the tasks in the scenario, respondent will received the posttest questionnaire. Unlike Group 1 respondents, those respondents who were randomly assigned to Group 3 received the scenario and perform the required tasks. Following this, they only need to respond to only posttest questionnaire. Control groups respondents only received the questionnaire.

Table 2: Number of respondents corresponding to Solomon four-group design

Pretest	Treatment	Posttest	Group	Sample size, n
O_1	X_n	O_2	1	268
O_3		O_4	2	17
	X_n	O_5	3	256
		O_6	4	17
Total				558
Note: X = treatment; n = number of treatment, where $n = 1 \dots 16$; Group 1 = experimental group with pretest and posttest observations; Group 2 = control group with pretest and posttest observations; Group 3 = experimental group with posttest only observation; Group 4 = control group with posttest only observation.				

Table 3: Four types of message framings

Made-up recommendation, M	Recommendations from TripAdvisor website, W	
	Positive-framed, $W+$	Negative-framed, $W-$
Positive-framed, $(M+)$	Made-up recommendation matched with the web positive opinion keyword $(M+, W+)$	The negative opinion keyword from TripAdvisor is manipulated and becomes positive $(M+, W-)$
Negative-framed, $(M-)$	The positive opinion keyword from the TripAdvisor is manipulated and becomes negative $(M-, W+)$	Made-up recommendation matched with the web negative keyword $(M-, W-)$

Note: + sign = positive recommendation; – sign = negative recommendation.

RESULTS

After the initial scrutiny for the data, 558 samples (refer to Table 2) were retained and no sign of pretest sensitisation was found in all the treatments via the Braver and Braver's [3] meta-analytic approach. With this, this study further examines the results with mean scores, standard deviations, effect size and variance via hypotheses testing.

Cases with only posttest observation were used to evaluate the social distances relating to the level of trust in the social commerce context. This is because such evaluation gives a better understanding on how trust transfers when the participant's online social friends introduce the participant to navigate a social commerce website (in this case TripAdvisor) and their decision-making process – to follow the recommendation from their social friends.

A one-way between-groups analysis of variance (ANOVA) was used to explore the social distances relating to the level of trust in the social commerce context. The results showed that there was a statistically significant difference at $p < .001$ in the trust level scores for the four levels of social relations: $F(3, 264) = 46.776$, with $\bar{x} = 4.970$, $S.D = 1.000$ for direct friend relationship, $\bar{x} = 3.689$, $S.D = .939$ for friend-of-friend, $\bar{x} = 2.927$, $S.D = 1.411$ for friend-of-friend-of-friend, and $\bar{x} = 2.754$, $S.D = 1.398$ for virtual friend. The effect size was .347. This indicated that the actual difference in mean scores between the social relation

groups was high. Therefore, there was significant difference among the mean scores of trust level over the four levels of social relations. Hence, there is an evidence to support H1.

Two-way ANOVA tests were used to compare the matched and mismatched message framings within the same strength of tie between individuals. There was a statistically significant main effect for the level of social relations at $p < .001$ across the four scenarios. Overall, the results showed that there was no significant interaction between the effects of message framings and the levels of social relations. The results only showed a significant main effect for social relations in all the sub-hypotheses of H2. Given this, H2a, H2b and H2c are only partially supported.

A one-way between-groups analysis of variance was conducted to explore the impact of social tie within a message framing on the level of trust. Participants were divided into two groups according to their social tie (Strong-tie: direct friend; Weak-tie: friend-of-friend, friend-of-friend-of-friend, and virtual friend). ANOVA results showed that there was a statistically significant difference at the $p < .05$ level in following positively matched advice (scenario 1) for the two social tie groups (strong-tie versus weak-tie): $F(1, 64) = 44.248$. The mean score for strong-tie ($\bar{x} = 4.891$, $S.D = .949$) was significantly different from that of weak-tie ($\bar{x} = 2.980$, $S.D = 1.301$). Effect size = .314 indicated that the actual difference in mean scores between strong-tie and weak-tie was big. Therefore, H3a is supported. Similarly, the results of scenario 2 (negatively matched advice), scenario 3 (positively mismatched advice) and scenario 4 (negatively mismatched advice) also showed that there is a statistically significant difference at the $p < .05$ level for the two social tie groups: $F(1, 64) = 36.512$, $F(1, 65) = 30.982$, $F(1, 66) = 63.306$, respectively. Therefore, H3b, H3c and H3d are supported.

DISCUSSIONS AND CONCLUSION

The primary goal of this study is to explore trust transference among social network friends in the context of social commerce through a randomised experimental design. This study shows that trust can be transferred in a transitive network path structure in the social commerce context. Immediate social friend relationships play a stronger role in influencing an individual's decision-making. This finding supports existing thought, but the strength of its impact is more fully elucidated when it is examined in the context of message framing. The findings of this study highlights that regardless whether a web posting is positive or negative, the effect is about the same, i.e. there is no difference in the strength of influence toward an individual's decision-making process. However, when the tie-strength is tied with recommendation, there is a strong swing towards strong-tie recommendation.

The empirical evidence of this study confirms the existing understanding that individuals are more likely to pay attention to their social relations (especially strong-tie friend) when they give advice and recommend a product or service. The results of this study further highlight that this effect is particularly pronounced in cases where there is a negatively framed advice from a strong-tie that contradicts the feedback from TripAdvisor's consumer comment, in that the former strongly changes an individual's belief towards a retailer. For a practical aspect, this study provides a new insight for social commerce retailer as individuals in the social commerce setting still believe in their close friends whom they perceive as trustworthy in recommending products and services. This suggests that viral marketing may not be as effective as it seems to be in the social commerce context. For social commerce retailers to take advantage of the social commerce platform, they would need to focus on improving their referral mechanism, such as providing incentives to encourage consumers to share their purchase and/or product/service experiences with their strong-tie friends.

This study has two limitations. First, the current study of trust transference focuses on one social commerce retailer (TripAdvisor) that specializes in hotel room booking and recommendations of places of attraction. Future research study could consider comparing other similar room booking settings (such as Airbnb.com and Homestay.com), where the effects of recommendation and social ties may differ. Second, the current sample examined on transitivity network path structure within a single social trust chain but was limited to only one network path. In future research, trust transference may consider comparing different composability network path structures (i.e. more than one social trust chain), where the effects of trust transference may differ.

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Understanding College Student' Acceptance Of Online Credit Offering Services In China

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ABSTRACT

With the rapid economic growth in China, peoples' consumption behavior is constantly changing. The online credit offering service is playing a more and more important role in China. In this paper, we aim to understand college students' acceptance of online credit offering services in China. A research model based on technology acceptance model (TAM) with six research hypotheses is proposed. And an empirical study with 239 subjects was conducted to test this model. According to the results, 4 of 6 hypotheses were supported. The results indicated that both perceived usefulness and subjective norm directly affected college students' behavior intention to use online credit offering services significantly.

Keywords: Online credit offering service, TAM, Perceived risk, Subjective norms.

INTRODUCTION

Today, purchasing goods by online consumer credit offering services is getting more and more popular in China. According to the annual report 2016 from Alibaba, more than 60 million payments for purchases on Alibaba's November 11 Shopping Day in 2016 were made through the online personal line of credit (Ant Huabei) available on Alibaba's Alipay, representing 8.5 percent of the total payments Alipay processed on the day. Peoples' attitude towards money is changed by credit card usage that is becoming increasingly widespread in many countries [7] [16]. When it comes to buying a property, people often want to choose mortgage payment by installments. The advance in Internet technology is of help to increase the usage of online credit offering services as the Internet provides users with a convenient channel to shop for goods. Internet financial agencies (e.g., Alipay, Wepay[11] in China) offer users short-term loans to help them cover urgent cash needs for online shopping. This is a typical example of online consumer credit offering services. It is becoming a common consumption way in peoples' daily life in China [3]. Along with the growing credit market in China, users are able to consume first and pay later by taking advantage of online loan services provided by Internet financial agencies. Palan, Morrow, Trapp, and Blackburn [19] also indicated online consumer credit offering services could help consumers solve the problem of urgent online consumption.

With the development of market economy and the improvement of social consumption level in China, college students have a different consumption psychology and consumption behavior with other social groups. Their consumption patterns are largely affected by the market economy, which prevents them from setting up correct outlook on life and the world outlook to a certain extent. College students as a special social group, their consumption situation is getting more and more widely attention. More and more post-1990 college students are dressed in Nike, using iPhones and eating KFC [17]. Such bold theme of high consumption has become more and more popular among college students. The consumption pattern reflects their life attitude and value orientation, which in turn affects college students' ideological and moral construction and education of the school management. Therefore, we would like to investigate college students' acceptance of online consumer credit offering services in China.

This paper aims to study potential factors' that affect college students' acceptance of online consumer credit offering services in China. To address this, a research with six research hypotheses is proposed. And the research model was empirically tested with 234 college students in China. The remainder of this paper is organized as follows. Section 2 reviews the related literature. The research model and hypotheses are presented in Section 3. The empirical study is presented in Section 4. Section 5 discusses the findings of this research. We conclude this research in Section 6.

LITERATURE REVIEW

The related literature is discussed in this section.

Extended Technology Acceptance Model

TAM is widely acknowledged as one of the most robust and influential models for explaining user acceptance behaviour. It has been revised to incorporate additional variables in specific contexts, such as the Internet [23], WWW[18], and so on. Numerous extended variables with specific contexts have been added to TAM (e.g., perceived enjoyment[24] in using the Internet, trust[13] in using mobile information services). These studies with extended beliefs were proposed to improve the understanding of user acceptance behaviour for specific contexts, and better explanations were enabled as a result.

Perceived Usefulness and Perceived Ease of Use

Davis defines the perceived usefulness as the degree to which work performance can be improved by using a specific system [5]. In the context of this research on college students' acceptance of online credit consumption service, perceived usefulness is defined as the degree to which the college students believe that the online credit consumption service would enhance his/her performance of the online consumption activities. The perceived ease of use is defined as the degree to which an individual

believes that using a specific system would be free of effort [6]. In our research context, the perceived ease of use refers to the degree to which consumers believe that online credit offering services would be free of effort.

Perceived Risk and Subjective Norms

Perceived risk is commonly thought of as felt uncertainty regarding possible negative consequences of using a product or service [8]. Since consumers prefer to avoid a loss in the process of purchasing rather than purely pursue the benefit maximization, perceived risk showed very strong explanatory power to consumer behaviour and showed strong applicability in the various research fields. Subjective norm refers to the individual feeling to the pressure of social conventions and outside groups as to whether to perform a particular behaviour [9]. Ajzen and Fishbein [1] found that subjective norm had a positive effect on customers' attitude towards use new technology.

RESEARCH MODEL AND HYPOTHESES

Research Model

On the basis of the previous studies, we proposed a research model as illustrated in Fig. 1. The research model shows that there are five factors which affect users' attitude to use online credit offering services. In addition to perceived usefulness and perceived ease of use from TAM, the model includes influence related elements as additional factors to study consumers' acceptance of online credit offering services.

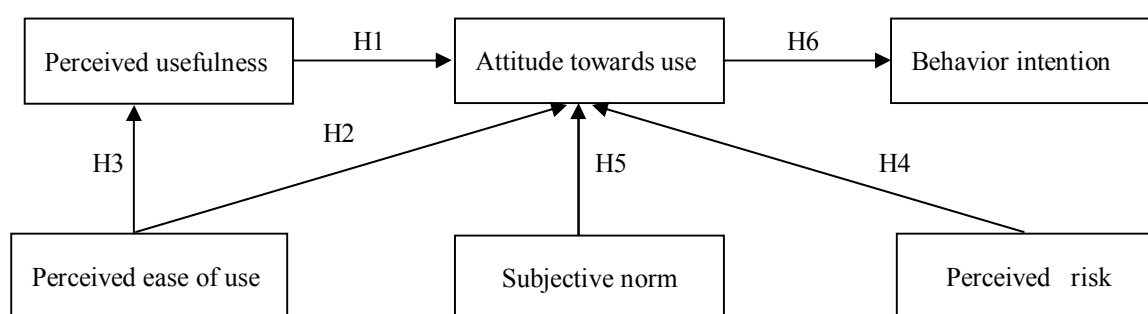


Figure 1: The research model

Research Hypotheses

TAM has been widely used in the technologies diffusion research. In this study, perceived usefulness is defined as the degree to which college students believe that online credit offering services would enhance his/her quality of life, and perceived ease of use refers to the degree to which college students believe that choosing online credit offering services would be free of effort. The TAM posits that perceived ease of use and perceived usefulness have a direct effect on the attitude toward the use of a technology, and perceived ease of use has a positive effect on perceived usefulness[8][12]. Therefore, the following three hypotheses are proposed.

H1: Perceived usefulness of online credit offering services has a positive effect on college students' attitude towards using online credit offering services.

H2: Perceived ease of use of online credit offering services has a positive effect on attitude towards using online credit offering services.

H3: Perceived ease of use of online credit offering services has a positive effect on perceived usefulness of online credit offering services.

On the basis of previous literature [20] [21], we believe perceived risk is a significant determinant of attitude towards using online credit offering services. Featherman and Pavlou[8] defined perceived risk as a key driver of long-term relationship between consumers and suppliers. In recent years, domestic credit card fraud occurred frequently, consumers tend to possess the hesitation attitude of choosing credit card for the reasons of financial risk. On the other hand, choosing online credit offering services is often associated with a relatively high loss potential which related to privacy, such as the personal data, the transaction itself and so on. Thus, we proposed the following hypothesis:

H4: Perceived risk has a negative effect on attitude towards using online credit offering services.

With the rapid development of social economy, some special consumption phenomena strengthen college students' consumption desires. College students may choose to use online credit offering services actively or passively under social influence from others. The effect of social factors influence cannot be ignored. According to theory of reasoned action [9], the specific behaviour of the individual depends on behaviour intention which under the influence of individual behavioural attitude and subjective norms. Moreover, Venkatesh, Morris and Davis[25] found that subjective norms affect the use of information technology significantly. Therefore, we proposed the following hypothesis:

H5: Subjective norm has a positive effect on college students' attitude towards using online credit offering services.

Based on the previous literature, behaviour intention is another main dependent variable in technology diffusion research [6], which defined as an individual willingness to use a technology. According to the TAM, the key mediator of the influence of other variables on behaviour intention is a person's attitude towards using a technology [5]. It is defined as the degree to which users believe a technology is positively or negatively valued by an individual. In our research, we want to further confirm the influence of users' attitudes on users' behaviour intention in the context of online credit consumption service with college students. Therefore, the following hypothesis is proposed:

H6: The attitude towards online credit offering services has a positive effect on the behaviour intention to online credit offering services.

AN EMPIRICAL STUDY

Empirical data was collected by conducting a survey. The survey was distributed in term of questionnaire individually from March 10 2016 to June 5 2016, all the samples were randomly selected from the surrounding universities in the biggest city in the central China. To ensure that the measured beliefs were based on direct behavioural experience with the object, only responses from those who had previously used the online credit consumption service were included in our analysis, we chose the object mainly concentrated in some of the students who seem to live a good life, such as well dressed, or with a brand-name mobile phone. As a result, 256 completed questionnaires were collected from the college students, the questionnaire is mainly collected by means of giving away randomly offline and smaller part of electronic questionnaires, among which 239 responses (93.36%) were valid questionnaires. The first part of the questionnaire was about the demographic questions. Among all the participants, 52.3% of them are female and 47.7% of them are male. They are relatively young and 97.1% of them have bachelor degrees at least. Most of them (88.2%) thought they were aware of online credit offering services, 57.2% of them were familiar with online credit offering services.

The second part of the questionnaire was set to test the hypotheses proposed above. The validated instrument measure in previous research was used as the foundation to create the instrument for this study. As a result, 17 measurement items (see Appendix 1) were included in this part of the questionnaire. A five point Likert scale, with 1 being the negative end of the scale (strongly disagree) and 5 being the positive end of the scale (strongly agree), was used to examine participants' responses to all items in this part. For the purposes of testing the research hypotheses, data were analysed using the structural equation model (SEM) [2].

Measurement Model

In this study, we examined goodness-of-fit of the measurement model by using six widely-used fit indexes: the chi-square/degrees of freedom (χ^2/df), the goodness-of-fit index (GFI), the adjusted goodness-of-fit index (AGFI), the comparative fit index (CFI), the norm fit index (NFI), and the root mean square error of approximation (RMSEA). The fitness measures are shown in Table 1. Table 1 shows that all the fitness measures are within acceptable range except for the GFI and RMSEA. In practice, GFI values above 0.8 are considered to indicate a good fit. Meanwhile, RMSEA is also acceptable when it is less than 0.08 [14]. Consequently, all the fitness measures are within acceptable range. Therefore, we consider the measurement model is acceptable, and the measures indicate that the model fit the data.

Table 1: Fit indices for the measurement model

Measures	Recommended criteria	Measurement model
Chi-square/df.	< 3.0	2.014
GFI	> 0.9	0.891
AGFI	> 0.8	0.856
NFI	> 0.9	0.915
CFI	> 0.9	0.955
RMSEA	< 0.05	0.065

Table 2 shows the composite reliability and average variance extracted. All the reliabilities exceed the threshold value of 0.7. Meanwhile, the average variances extracted for all constructs exceed the benchmark of 0.5. As the four values of reliability are above the recommended values, the scales for measuring these constructs are deemed to exhibit satisfactory convergence reliability.

Table 2: Construct reliability

Construct	Factor Loading	Composite Reliability	AVE
PU	0.74-0.83	0.84	0.64
PEOU	0.77-0.89	0.91	0.71
ATT	0.84-0.93	0.90	0.76
BI	0.78-0.85	0.86	0.67
PR	0.86-0.91	0.91	0.78

SN	0.70-0.90	0.85	0.65
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Furthermore, the variances extracted by the constructs are more than the squared correlations among variables. The fact reveals that constructs are empirically distinct. As the convergent and discriminant validity measures are quite well, the test of the measurement model is satisfactory.

Test of Structural Model

The structural model was tested using Amos 21.0. The results of the structural model are shown in Fig. 2.

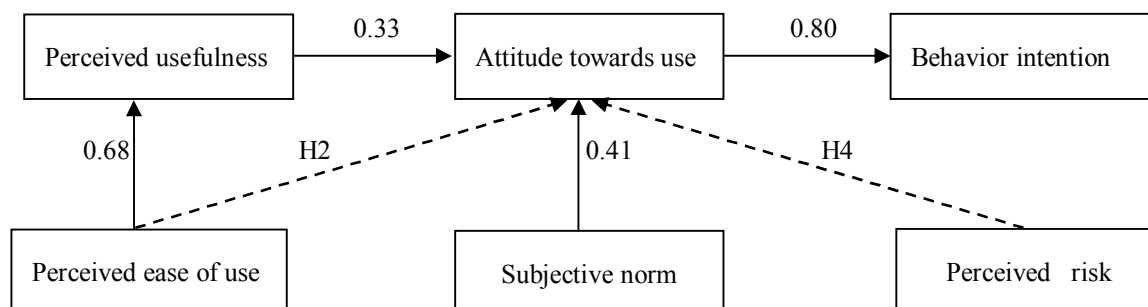


Figure 2: Results of structural modeling analysis

And Table 3 shows regression weights. It provides a measure of how well future outcomes are likely to be predicted by the model, the amount of variability of a given construct. In our analysis, the path coefficient from attitude towards to behaviour intention is statistically significant, and the positive effect is relatively strong, as shown by the path coefficient of 0.80 ($P < 0.001$). Besides, perceived usefulness affects perceived ease of use and attitude towards use strongly, and the path coefficient is respectively as 0.68 ($P < 0.001$) and 0.33 ($P < 0.001$). In addition, path coefficient from subjective norm to attitude towards is statistically significant, and the path coefficients are 0.41 ($P < 0.001$). Meanwhile, perceived risk has a negative influence on attitude towards and perceived ease of use has a positive influence on attitude towards, both of which are not significant (showed as dotted lines in Fig 2). Thus, H1, H3, H5 and H6 were supported. Hypotheses H2 and H4 were not supported.

Table 3: Regression Weights

	Estimate	S.E	C.R	P
EOU ← -- -PU	0.682	0.071	9.081	***
ATT ← -- -PU	0.332	0.099	5.232	***
ATT ← -- -EOU	0.139	0.086	-0.295	0.768
ATT ← -- -SN	0.412	0.100	3.507	***
ATT ← -- -PR	-0.017	0.053	1.789	0.074
PU ← ATT	0.802	0.072	10.630	***

DISCUSSION

According to the results, two hypotheses were not supported. Firstly, perceived ease of use does not positively affect student's attitude towards use online credit offering services. In the previous studies [10], perceived ease of use was found to have a positive impact on customer's attitude. The possible explanation might be that some of the college students thought that it was interesting to consume first and pay later. In this case, they can quickly and easily learn how to use this new information service. On the other hand, most online credit offering service vendors have made the interfaces of the services very easy to use. Thus the significant effect of perceived ease of use to behaviour intention to use online credit offering services might decrease. Previous studies found that perceived risk affected customer attitude significantly [15][22]. However, this hypothesis was not supported in our study. A possible explanation is that many college students have a strong desire for consumption and a high degree of sensitivity to consume trends and fashion trends, among of which some students may temporarily ignore the potential risk of online credit offering services so as to satisfy their high quality life. In addition, the number of students that use online credit offering services is less than those that are inclined to small loans credit consumption. This may indicate that, the ability and willingness of these students to bear the risk is weak. Therefore, perceived risk may not have a significant impact on college students' attitude towards online credit offering services. Furthermore, the behaviour intention of using online credit offering services was positively and significantly impacted by perceived usefulness and subjective norm. Most respondents thought that online credit offering services were useful in their daily life. What's more, attitude towards online credit offering services directly affect the behaviour intention to use online credit offering services. And users' attitude to online credit offering services indicates users' likeness to use online credit offering services. This finding confirmed the previous findings [4] that attitude is the mainly factor for people to accept a new technology.

CONCLUSION

With the rapid economic growth in China, private consumption expenditure has increased rapidly in the past few years. It is believed that online credit offering services are becoming popular among Chinese college students. Thus, the reasons why college

students choose online credit offering services should be considered by the practitioners. This study explored potential factors which affect college student's behaviour intention to use online credit offering services. Six research hypotheses were proposed in the study. Four research hypotheses were positively significant supported, while two research hypotheses were rejected in this study. The result indicated that both perceived usefulness and subjective norm have positive effects on college student's attitude to use online credit offering services. And the effect of perceived usefulness is stronger than that of subjective norms. Besides, attitude towards the process of choosing online credit offering services has a strong effect on customers' behaviour intention.

This study has some limitations. Firstly, the participants of our study are mainly students in one province in China, they can represent customers of online credit offering services to some extent, and they cannot reflect the whole population of college students in China. Furthermore, in addition to the factors in our structural model, there may be some other factors affecting college student's behaviour intention to use online credit offering services, such as personal characteristics, perceived playfulness. Thus, future studies can further investigate how behaviour of using online credit offering services is influenced by these factors. In addition, some mediating factors (e.g., gender and age) may provide fresh insights and offer new directions for future research.

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APPENDIX

<p>Behaviour Intention(Fred D. Davis, 1989)(Park, 2009)</p> <p>I am likely to use online credit offering servicesin my daily life.</p> <p>I am willing to use online credit offering services in the near future.</p> <p>I am likely to recommend use online credit offering services to my friends and family</p>
<p>Attitude towards(Fred D. Davis, 1989)(Park, 2009)</p> <p>Using online credit offering services is interesting.</p> <p>Using online credit offering services is wise.</p> <p>I am support of using online credit offering services.</p>
<p>Perceived Usefulness (Fred D. Davis, 1989)(Park, 2009)</p> <p>Using online credit offering services can enjoy the service of consume first and pay later.</p> <p>Using online credit offering services can enjoy a variety of preferential activities.</p> <p>Using online credit offering services can improve the performance of consumption activities</p>
<p>Perceived ease of use(Fred D. Davis, 1989)(Park, 2009)</p> <p>It is easy for me to learn how to use online credit offering services.</p> <p>Using online credit offering service won't cost me a lot of energy.</p> <p>The step of using online credit offering services is simple for me</p> <p>In general, online credit offering services is convenient.</p>
<p>Perceived risk (Jan et al., 2012; H.-H. Teo et al., 2003)</p> <p>Worrying about personal information will be leak or sold.</p> <p>Worrying about unnecessary losses due to improper use.</p> <p>Worrying about the transaction data will be leak or sold.</p>
<p>Subjective norm (Fred D Davis, 1989; Jan et al., 2012; Park, 2009)</p> <p>People who have a great influence on me (such as the teacher, boss and so on) would recommend using online credit offering services.</p> <p>People who are important to me (such as family, boy/girlfriend and so on) would agree with me to use online credit offering services.</p> <p>The group where I lived would think online credit offering services is a good idea.</p>

Exploring the Impact of Different Sources Credibility on App Downloading Behavior: An ELM Perspective

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ABSTRACT

With the increasing of using smart phone, people began to use “App” in their daily life. While they need to download a specific type of App, the developer of the App will provide them an introductory page which describes the functionality of the App and contains statistical data. Besides, function of “your friend who has downloaded this App” is introduced to smart phone users. Therefore, many peripheral cues are listed in the page nowadays to persuade people to download. The purpose of this study is to understand whether peripheral cues in the introductory page can persuade people to download this App. In our study, we used ELM-based theory to explain the behavior of persuading.

The expected contribution of this study is to understand three peripheral cues would influence App credibility which influence attitude toward downloading. This study will provide advices to App developers to promote their strategies of business.

Keywords: App, Source credibility, Elaboration likelihood model, Mobile, Download.

INTRODUCTION

Nowadays, there're a lot of people using the mobile devices, such as smart phone, tablet, android wear and so on. Those devices make our life more convenient, and we can't live without it. According to the report of Statista, the number of smart phones sold to end user globally has been increasing. The number of smart phones sold globally is 967.78 million units. That means that about 20% people in the world have a smart phone. You can image that the market of mobile devices and its applications will keep thriving for many years. Smart phones must run the applications on a platform. The most common platforms are Android (Google) and iOS (Apple). We generally call the applications that run on mobile OS as “App” that can be downloaded in Apple Store and Google Play. While many Apps are free, developers of many other Apps charge users certain amount of money for downloading and using their products. “App Annie” which is an analytical website in mobile Apps demonstrates that iOS earns more than Android, whereas number of downloading in Android is higher than iOS.

Since Apps are dramatically increasing, many Apps are available for us. But how can we find the App that fits our demand? In addition to its functionality, all Apps in an App store will show their description, which describes their App's name, corporation/author's name, App's short description, and other statistics from App store, such as how many people have downloaded, how these people score this App, and leaving comments of the App. Many Apps have not been downloaded at all. Developers try their best to enrich the description provided in App store to persuade users to download their App. Besides dull description, we are more curious about other information provided by introductory page of the App. In fact, Google Play also provides “which of your friends have downloaded this as well” function to facilitate users to make a decision. Therefore, App downloading behavior can be viewed as a persuading process that App developers and App store try to make users believe that specific App is useful and worth to download.

However, past studies based on TRA or TPB theories to understand the App downloading behavior. We would like to argue that, to better understand such a process, persuading theories should be adopted, instead of TRA-based theories. Besides TRA-based theories, a theory called “Elaboration Likelihood Model” can be also used in forming attitude. ELM is much suitable for explaining the process of persuading message recipients because people are processing message according to their involvement.

We choose some Apps from various sources, such as BBS, blog, SNS, etc. Later, we may look at the App's short description and information provided by the App's developer. But there is a lot of information put on the App's introductory page. There is lots of information listing on here. Which part of the page will we see, and which won't? And which part of the page will affect us to download this App finally? According to the content provided by Google Play, there are number of installation/rating. But we don't use ratings in this study, because it looks like sampling. Not all users leave rating, and every App has similar rating symbol. Therefore, we discard rating stars and number of rating. Besides, system will hint you your friend has downloaded and even left a comment. You will see a name of corporation/author under App's name. We also want to know the difference payment method of the App. Also, expertise or previous experience may have difference between behaviors of downloading.

Therefore, the purposes of this study are indicated as below:

- (1) In order to understanding whether peripheral cues affect individual's attitude.
- (2) In order to understanding whether motivation to process information (free/paid) and ability to process information (expertise)

affect the impact of peripheral cues on attitudes.

LITERATURE REVIEW

Elaboration Likelihood Model (ELM)

Elaboration Likelihood Model (ELM) was proposed by Petty and Cacioppo (1986). This is an important theory about how message recipient will process. And ELM is a dual processing theory, it processes a message within two methods. It is usually applied in marketing or social psychology. ELM explains individual's attitude change and the process of persuasive communication. It can be classified by two "routes" (Figure 2-1). One is central route, the other is peripheral route. A route is a method used by message recipient to process, and the difference between two routes is the amount of thoughtful information processing as well as individual's elaboration degree (Petty and Cacioppo, 1986; Petty, et al., 1981).

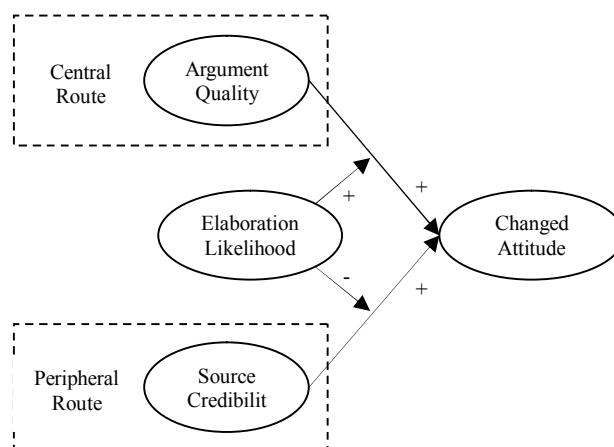


Figure 1: Elaboration likelihood model from Bhattacharjee (2006)

The person in central route tends to think carefully about issue-relevant arguments and the merits of information in a message to form their own opinion. In contrast, the person in peripheral route tends to use simple cues to evaluate to form their own opinion without cognitive thinking or scrutiny of the merits (Bhattacharjee and Sanford, 2006). In prior ELM research, the construct of argument quality represented the central route, whereas source credibility represented the peripheral route (Bhattacharjee and Sanford, 2006; Sussman and Siegal, 2003).

Argument quality means that the messages which are embedded with strong and persuasive arguments. If a person is in high elaboration likelihood, meaning that he/she has greater ability or motivation to elaborate the message. Further, he tends to choose central route to elaborate the message. As a result, argument quality will be more persuasive than peripheral cue in high elaboration.

On the other hand, source credibility means that the source of the message which is perceived to be believable, credible, and trustworthy. A person who is in low elaboration likelihood tends to use peripheral cues due to lack of the ability or motivation to scrutinize message to form their own attitude. That is, people in low elaboration will depend on peripheral cues. For example, an acquaintance endorses this message to ensure it is correct. Then people will depend on that cues to make a decision.

ELM originates from social psychology. It has been applied to many disciplines. For instance, Choi and Rifon (2002) figure out the relationship between web advertising credibility and consumer's attitude toward banner ads. Bhattacharjee and Sanford (2006) figure out that when IT is introducing into the organization, some people will refuse to accept, the executives of the organization must do some solutions such as providing some persuasive message to IT users to persuade them to accept. In the context of Electronic Health Record (EHR), Angst and Agarwal (2009) conduct a study for EHR users who have privacy concerns. In order to persuade them into using EHR, it has to send a persuasive message to the users.

RESEARCH FRAMEWORK AND HYPOTHESIS

Extending from Bhattacharjee and Sanford's model, we proposed a research model to figure out different factors in Google Play influencing App's credibility. Based on our research model, there are two types of information in message emerging. One is argument quality of message, the other is peripheral cue of message. And these two factors are read by message recipients to form an attitude to decide whether downloading the App. In the process, there are some Elaboration Likelihood factors intervening. In next section, we will figure out the relationships between variables. Figure 2 is the research model of this study.

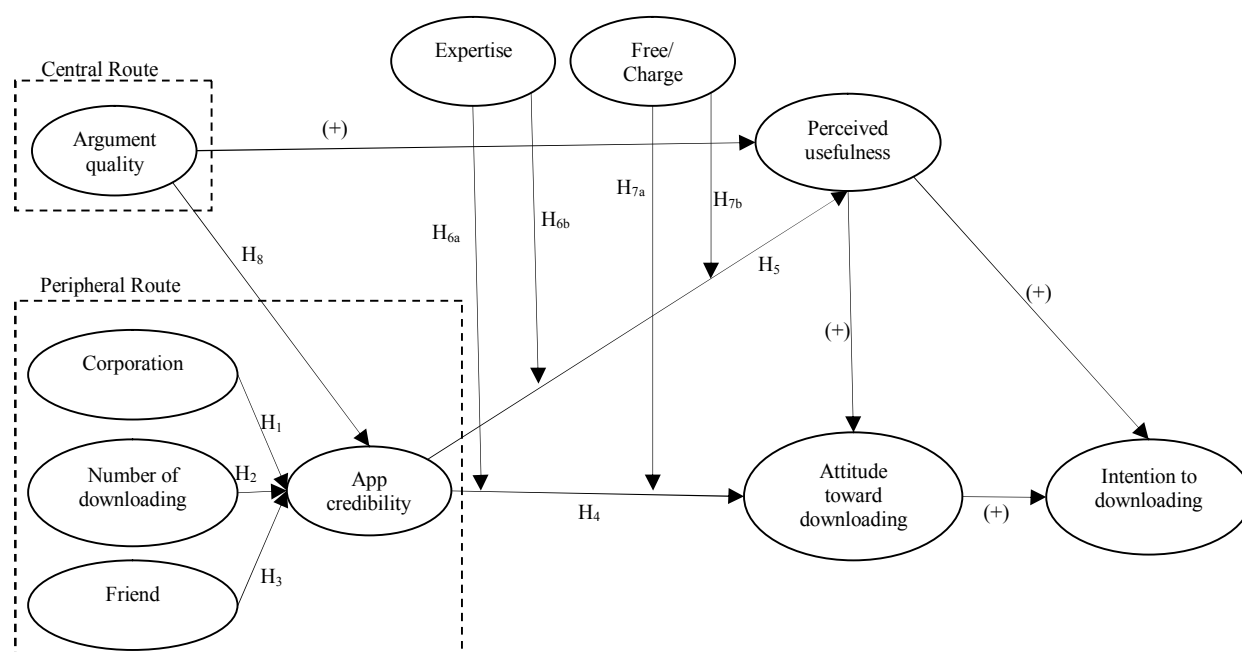


Figure 2: Research Model

Peripheral Route

Ohanian (1990) said, source credibility is a term commonly used to imply a communicator's positive characteristics that affect the receiver's acceptance of a message. Hovland and his associates (1953) analyzed the factors leading to the perceived credibility of the communicator and concluded that two factors - expertise and trustworthiness-underscore the concept of source credibility. From this study, many researchers are dedicated in the study of source credibility. Another popular study in source credibility is proposed by Ohanian (1990). He integrated Hovland's source-credibility model and McGuire's attractiveness model to propose three dimensions of source credibility. Ohanian suggested that source credibility could be classified into: (1) Attractiveness (2) Trustworthiness (3) Expertise. Source credibility in Elaboration Likelihood Model is determined by these three factors. There are three major information sources in Google play: developers, crowd, and friend. Individuals rely on those characteristics to determine whether the App is credible. Source credibility in mobile Apps should be replaced by App's credibility because individual is credible to the App instead of source of the App.

App is created by developers, developers might be a corporation or an individual. No matter what they are, they must have influence to affect the credibility of consumers (Goldberg and Hartwick, 1990; Goldsmith, et al., 2000; Lafferty and Goldsmith, 1999). Customers may infer higher quality and/or value when a service firm has a good reputation and thus, satisfaction should be positively associated with customer-based reputation (Oliver and DeSarbo, 1988). To maintain their reputation, famous developers or companies in general develop high quality software. That means while a corporation can deliver a good product to customers, customers will satisfy with good products and further form credibility of the corporation. As corporation is more credible than ever, its reputation will increase due to WOM. In general, a famous or capable corporation forms higher credibility than obscure or incapable corporation. As a result, a corporation has its expertise or domain knowledge to manufacture their products to make a difference between companies and let customers be loyal. In order to defend reputation of corporation, they will try their best to provide the most valuable product to consumers. Consequently, reputation of corporation seems to be more valuable to consumers. To sum up, reputation of corporation is replaced three dimensions (Expertise · Attractiveness · Trustworthiness) of source credibility. Corporations use their expertise to improve products. Furthermore, attracting consumers to make them trust products provided by its corporation. Therefore, we proposed the following hypothesis:

H1: Reputation of corporation positively affects App credibility.

Another important influence of App credibility is number of downloading in mobile Apps. Number of downloading is defined as "how much people have downloaded this App before". Imaging that if there are a lot of people have downloaded this App, we will be surprised since we ponder why so many people decide to download. Is this App so good that everyone wants to download? Actually, this situation seems to be attractive to you to think how good this App is. Also, the concept of number of downloading is similar to influence of majority. Some studies indicated that individual will agree that majority opinion is correct (Chaiken and Maheswaran, 1994; Giffin, 1967). When this App has downloaded by a lot of users, their perceived risk of buying this product will be declined. To sum up, number of downloading is replaced two dimensions (Attractiveness · Trustworthiness) of source credibility. While number of downloading is very high, we will be curious about this number. Many people have downloaded, the uncertainty will be lower. While the uncertainty is lower, we will further trust this product. As a result, we proposed the

following hypothesis:

H2: Number of downloading positively affects App's credibility.

Friendship is always viewed as an important influential factor to mankind. According to Brooks (1957), friends and acquaintances-those people to whom consumers talked every day-were the most influential sources in terms of opinions and subsequent behaviors, and interpersonal contacts provided the most effective form of Word-of-mouth. DeSarbo and Harshman (1985) also had similar concept to agree that friend and family were perceived to be more trustworthy than salespeople. Zimbardo (1960) demonstrated that if the communicator was the best friend of the recipient, the recipient would induce the greatest opinion change. Fisher, et al. (1979) suggested that from job applicant's point of view, it might mean that friends or favorite professors are credible source of information. Furthermore, friend can be regarded as implication of trustworthiness. Upon being conscious of appearance of friend on page of downloading, we have more confidence to download this App due to friend has downloaded. To sum up, friend is replaced three dimensions (Attractiveness、Trustworthiness) of source credibility. When we notice our friends have downloaded this App, it is more attractive than other Apps. Further, we will trust this App more than other Apps due to friends. Therefore, we proposed the following hypothesis:

H3: Friend positively affects App's credibility.

Downloading an App is like a behavior of IT acceptance. According to Bhattacharjee and Sanford (2006), they proposed a model which combined TAM and ELM to be used in understanding influence process for IT acceptance. Most prior ELM researches focused on attitude as the dependent variable of interest (Lord, et al., 1995; Petty, et al., 1981). Peripheral cues such as App credibility are likely to influence attitude because such cues appeal to human affection rather than their rational judgment. These expectations lead us to propose:

H4: App credibility positively affects attitude toward downloading.

Besides, App credibility may sometimes directly influence users' perceived usefulness of downloading the App, particularly high App credibility's appearance. In this instance, potential users may substitute their own effortful thinking process with peripheral cues and employ a less effortful peripheral-route decision process to assess the potential usefulness of IT acceptance. Hence, we hypothesize:

H5: App credibility positively affects perceived usefulness.

ELM also posits that the effects of argument quality and App credibility are moderated by potential users' motivation and ability to elaborate on informational messages (Petty and Cacioppo, 1986).

Drawing on prior ELM research, we operationalize the motivation dimension of elaboration as "Free/Paid". "Free/Paid" is defined as the App is "free or paid". Ability is replaces with user's expertise in Bhattacharjee's study, which is defined as the individual's knowledge or previous experience in using mobile App in general. Users who perceive the same App as being less relevant to their problem or daily life are less motivated to engage in extensive elaboration, and may instead rely on peripheral cues such as App credibility for shaping their personal attitudes and usefulness perceptions of downloading the App. Hence, we proposed:

H6a: App credibility will have less impact on attitude toward downloading while the App is paid.

H6b: App credibility will have less impact on perceived usefulness while the App is paid.

User who is superior mobile App expertise obviates their need to examine peripheral cues, since they can form more accurate perceptions by critically examining the message content. In contrast, novice or less expert users are forced to rely on peripheral cues such as App credibility, rather than embedded message arguments, in framing their attitude and perceived usefulness perceptions. Hence, we propose:

H7a: App credibility will have less impact on attitude toward downloading while individual has expertise on mobile App.

H7b: App credibility will have less impact on perceived usefulness while individual has expertise on mobile App.

Besides, we considered that a description is more detailed, the products would be more trustworthy than others. Daft and Lengel (1983) proposed information richness theory. That describes the organization can improve our equivocality and uncertainty by using rich and abundant information. While uncertainty is getting lower, our trust in this product can be higher than ever. As information provided by developers is richer, it tells us how well this product is. As a result, we form an attitude which is credible toward this product. Conversely, our confidence will be lower if the information provided by developers is not abundant enough to tell us how well it is. Hence, we propose:

H8: Argument quality positively affects App credibility.

RESEARCH METHOD

In order to understand the different effects of reputation of corporation, number of downloading and friend on user's attitude toward downloading the App, we adopts online experimental methodology. We design several contexts to measure the relationship between three factors including reputation of corporation, number of downloading and friend and App credibility. Besides, we will investigate that how expertise of subjects and the App which is paid/free affect the relationships between three aforementioned factors and attitude toward downloading.

CONCLUSION

The main purpose of this study is to understand the impact of different sources credibility on downloading. Multiple sources are reputation of corporation, number of downloading and friend. These three sources will influence App credibility and further influence attitude toward downloading. Besides, we want to investigate the moderating effects on the relationship between App credibility and attitude toward downloading.

The results are expected to provide the following contributions for the academia. Many TRA-based theories instead of ELM are used to understand IT accepting behavior especially Apps. This study applied ELM to explain the persuasive effect in App field.

For practitioners, this study will provides advices to App developers to promote their strategies of business. App developers should take these factors we proposed into account.

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Institutional Pressures, Top Management and M-commerce Adoption in Organizations: an Empirical Study of SMEs in China

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ABSTRACT

Based on the institutional theory, this paper intends to clarify the relationship of institutional pressures, top management and m-commerce adoption intention in organizations. Using the data from 204 small and medium-sized enterprises in China, we examined the effect of mimetic, coercive and normative pressures on top management support and M-commerce adoption intention. The empirical result shows that: top management support and three types of institutional pressures could positively act on the adoption intention of M-commerce in organizations; top management support partly mediates the influence of two institutional pressures (coercive pressures and normative pressures) on the adoption intention of m-commerce. Implications of these findings for research and practice are discussed.

Keywords: Institutional Pressures, M-commerce Adoption, SMEs, China

INTRODUCTION

With the spread of smart phones, mobile phone has become an indispensable part of our life and work. By June 2016, the number of mobile internet users in China has reached 656 million which accounted for 92.5% of the total internet user population (CNNIC, 2016). The quick growth of mobile phone users has provided a solid user base for m-commerce usage of firms. The shift of internet users from PC to mobile phones would prompt more companies in China to use mobile technologies. Mobile internet and smart phones provide an important channel for marketing and selling. In comparison with the rapid uptake of mobile users at individual level, the adoption of mobile commerce in firms of China has lagged behind. According to the survey report of Enterprises' Mobile Informatization Status in China during 2013-2014, 82.7% of 350 firms surveyed in China had no specific mobile strategies in the next three years, and most firms were still in the wait-and-see stage (Mobile Information Center, 2014). Among companies with the experience in e-marketing in China, only one third firms had carried out marketing activities via mobile internet (CNNIC, 2016).

Many research have been made on m-commerce adoption issue from the perspective of consumers at the individual level, but minimal research have been done on the adoption of m-commerce in firms at the organizational level (Li & McQueen, 2008; Swilley et al., 2012; Picoto, 2014), especially in the context of China. Although many studies have been done on e-commerce adoption in firms, there are many differences between e-commerce and m-commerce. M-commerce is not only a subset or extension of e-commerce but also means a different business way for firms (Alfahl et al., 2012). Compared to e-commerce, mobile technologies have broken through the limitation of time and place to access to information, communication, and services (Mallat, 2009). Mobile internet can bring unique value by ubiquity, portability, convenience, identification, personalization, localization, and instant connectivity (Clarke III, 2001; Picoto et al., 2014). The value of m-commerce includes the impact on marketing and sales, internal operation, and procurement (Picoto et al., 2014). M-commerce applications can significantly benefit small and medium-sized enterprises without requiring significant modifications to processes or major investments (Gebauer and Shaw, 2004; Balocco et al., 2009). Thus, m-commerce applications seem to be particularly suitable for SMEs (Chuang et al., 2007). As more and more SMEs in China start using mobile technologies, it is crucial for researchers and practitioners to better understand which factors determine firm's adoption intention of m-commerce.

The role of institutional pressures in affecting firms' adoption of innovations is broadly studied, but few research has been done within the context of the new m-commerce technologies. Due to the importance of the m-commerce and the lack of research about firm's adoption of m-commerce in China context, this study studies how institutional pressures motivate the top management and the firms to adopt m-commerce based on institutional theory, and how such effects are mediated by top management with data collected from small and medium-sized firms in China. A model is developed and tested by the partial least squares and structural equation model method.

The paper is organized as follows. Section 2 presents the literature review focusing on m-commerce adoption at organizational level and the institutional theory. Section 3 introduces the research model and hypotheses. Section 4 explains the research method and data collection. Section 5 presents the empirical results. Conclusions including the contributions, limitations and discussions of this research are provided finally.

LITERATURE REVIEW

M-commerce Adoption at Organizational Level

The most widely used theories of IT innovation adoption in firms are the Technology-Organization-Environment (T-O-E) framework proposed by Tornatzky & Fleisher (1990) and the innovation diffusion theory (IDT) proposed by Rogers (2003) (Oliveira & Martins, 2011). In prior research on m-commerce adoption at organizational level, most research has applied T-O-E framework or IDT to identify the factors for a firm's adoption of m-commerce (e.g. Picoto et al., 2014). T-O-E

framework identifies three dimensions that influence firm's usage of technological innovation: technological aspects such as technological characteristics, organizational aspects such as firm size and structure, and environmental aspects such as industry and competitors. Specific factors identified within the three dimensions may vary across different studies. IDT proposed five attributes determining innovation's adoption and diffusion process including relative advantage, compatibility, complexity or difficulty to learn, trialability or testability, and observability or observed effects. In fact, these five attributes are usually integrated into the technological dimensions of T-O-E framework in research.

Based on T-O-E framework, Doolin(2008) confirmed technology factors such as relative advantage and compatibility, and organizational factors such as top management support, organizational readiness degree and company information intensity were the significant determinants influencing firm's adoption of m-commerce in New Zealand by multiple case study. Based on T-O-E framework, IDT and resource based review, Picoto et al. (2014) studied usage factors of m-business with data collected from 180 Portuguese organizations and found that relative advantage from technological factors, organizational factors(technology competence, technology integration and managerial obstacles) and environmental factors(competitive pressures, partners pressures and mobile environment) had significant influence on m-business usage. San Martin et al. (2012) complemented the T-O-E framework by adding customer value for the firm and fit between marketing and m-commerce, and found that task-technology fitness, technological competence and customer value for the firm have positive effect on the firm's performance brought by m-commerce technology using a sample of 125 Spanish firms. Chang et al.(2009) identified the critical successful factors of m-commerce adoption in the context of Taiwan from the perspective of system life cycle, and found that the top three important factors for m-commerce adoption were the support capabilities of the IT vendor, TOP management support, and project team capabilities, which could be incorporated into the organizational or technological dimensions of T-O-E framework.

In addition to T-O-E and IDT theory, task-technology fit theory (TTF) proposed by Goodhue and Thompson (1995) has also been applied widely to explain the IT usage behaviors of firms. According to TTF, a better fit between technological characteristics and task requirements will lead to better performance. Mobile technology fits to tasks associated with time-, location- and identity-dependent features (Watson et al., 2002; Liang et al., 2007; Picoto et al., 2014). Liang et al. (2007) proposed a fit-viability framework combined the theory of task-technology fit on the adoption of mobile technology in business. In their model, fit measures the extent to which the capabilities of mobile technology meet the requirement of task by task and technology dimensions, and viability measures the extent to which the organizational environment is ready for the mobile application by economic, IT infrastructure and organization dimensions. Wamuyu & Wamuyu(2011) found that fitness and user acceptance were significant determinants of mobile money transfer services usage in Kenyan micro and small enterprises.

Some research explored the m-commerce adoption factors from the perspective of drivers and barriers. Mallat & Tuunainen(2008) explored merchant adoption of mobile payment systems in the context of Finland, and suggested that increasing sales or reducing the costs were the main adoption drivers while complexity of the systems, unfavorable revenue sharing models, lack of critical mass, and lack of standardization were the barriers to adoption. Rahman(2013) explored the key barriers to m-commerce adoption in developing countries by face to face in-depth interviews, and concluded that lack of literacy, trust and conflict of interest between telecoms and banks were the major barriers to the adoption of m-commerce in Bangladesh. Balocco et al. (2009) explored the adoption barriers of business to employee mobile internet applications through a survey of 646 Italian SMEs in the manufacturing industry, and concluded that lack of knowledge and difficulties perceiving the benefits and value before implementation were the main reasons for not adopting m-commerce applications.

Even though some studies have been done on the mobile commerce adoption in firms, the literatures on the adoption mainly focus on either technological factors or organizational factors within the companies. Factors that influence mobile commerce adoption intentions from the external environmental perspective have been less explored in the context of China. Without an institutional view, IT research might focus only on technological, economic or psychological factors, thus missing important social, cultural and political aspects (Orlikowski & Barley, 2001).

Institutional Theory and Firm's IT adoption

Institutional theory emphasizes that institutional environments have strong influence on organizational behaviors, and organizational decisions or actions are driven less by efficiency but more by external environmental factors and the need for legitimacy (Scott and Christensen, 1995). Firms seek legitimization within an industry by adhering to specific business practices. Instead, organizations become legitimate when adopting similar strategies with other firms within an industry. This drive for legitimacy would gradually make firms more homologous due to institutional isomorphism including coercive, mimetic, and normative pressures (Di Maggio & Powell, 1983). Mimetic pressures are observed when organizations adopt innovation or strategies imitating others with the same industry such as competitors or leading companies in order to cope with uncertainty. Coercive pressures are a set of formal forces such as government laws and regulation or informal forces such as industry persuasion exerted on organizations by some other organizations upon which they are dependent. Normative pressures are composed of social pressures on organizations and its members to conform to certain norms. When considering the influence of external environments on organizational behavior, institutional theory is very suitable. Mimetic, coercive and normative institutional pressures existing in an institutional environment may influence firms' intention toward IT(Teo et al., 2003). Rather than making a purely internally driven decision to adopt IT, firms are more likely to use IT

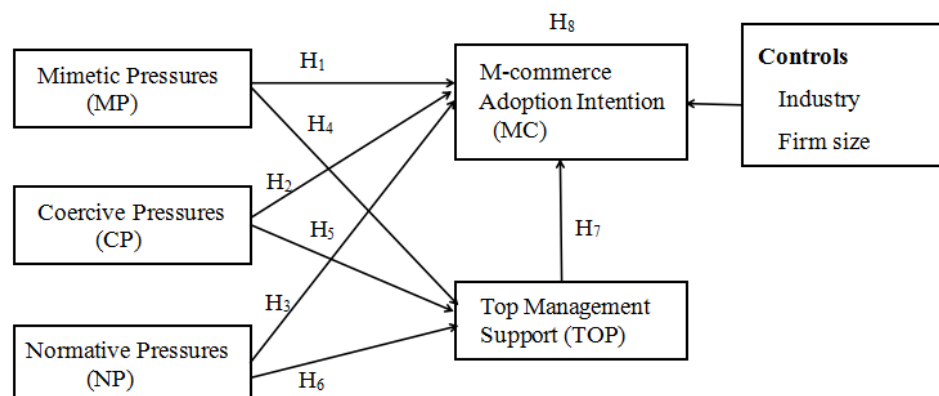
by external isomorphic pressures from competitors, trading partners, customers, and government. Many empirical studies have used institutional theory to explain firm's IT adoption and implementation behavior in different context (Mignerat & Rivard, 2009) such as EDI adoption (Teo et al., 2003b), e-commerce (Gibbs & Kraemer, 2004), ERP (Liang et al., 2007), eSCM (Liu et al., 2010), m-commerce (Swilley et al., 2012) and cloud computing solutions (Yigitbasioglu, 2015). Some studies integrated institutional theory into environmental dimensions of T-O-E framework as pressures from competitors or trading partners (Oliveira & Martins, 2011). Zhu et al. (2004) and Lin & Lin (2008) applied the TOE framework and institutional theory to explain determinants of e-business intent to adopt and found support for the importance of competitive pressures.

Some studies have confirmed that three dimensions of institutional pressures both have significant effect on firm's IT adoption. Teo et al. (2003) found these three types of institutional pressures had significant effect on firm's intention to adopt Interorganizational linkages, especially financial electronic data interchange. Some others concluded that the three types of institutional pressures had differential effects. Liu et al. (2010) found that normative and coercive pressures were positively associated with e-SCM adoption intention while mimetic pressures were not related to e-SCM adoption intention using the data of 131 Chinese firms. By collecting the data of 249 firms in USA, Swilley et al. (2012) reached similar conclusions in the context of m-commerce adoption in USA. Yigitbasioglu (2015) concluded that mimetic and coercive pressures influence top management team's beliefs in the benefits of cloud computing.

Due to the widely usage of internet, full legitimization of e-commerce has occurred while m-commerce is just now starting to become legitimized as it is still in the early phase of development (Swilley et al., 2012). Take China for example, the computer usage rate, internet usage rate and fixed broadband access rate of Chinese companies by the end of 2015 have reached 95.2%, 89.0% and 86.3% respectively, while mobile internet access rate of Chinese companies have just reached 23.9% (CNNIC, 2016). While there are many studies focusing on the impact of institutional pressures on IT adoption intention of companies, research on m-commerce adoption using institutional theory in Chinese firms is scant. Institutional analysis examines how broad social and historical force affect are affected by the actions of organizations (Orlikowski & Barley, 2001).

RESEARCH MODEL AND HYPOTHESES

Based on institutional theory, we developed a research model including 8 hypotheses as shown in figure 1 grounded in the m-commerce context.



Mimetic Pressures

Mimetic pressures in the context of m-commerce arise from a firm's perceived successes or benefits of competitors' adoption of m-commerce. According to a survey report conducted by Vanson Bourne in May-July 2013, more than 75% of 1300 firms surveyed globally that have adopted m-commerce technology have already seen external and internal benefits including both customer experience as well as employee productivity. For firms in China, however, most of them have not launched the mobile commerce strategies, and hold a wait-and see attitude towards m-commerce (Research Center of Mobile Information, 2014). When the firm learns how its competitors or leading companies in the industry benefit from m-commerce, it will be more likely to adopt same actions or technologies with the competitors. Besides, mobile commerce means new business models and processes (Clark III, 2001; Alvarez et al., 2009; Alfahl et al., 2012). In the early stage of m-commerce adoption, companies faced many uncertainties related to the adoption results. When in face of uncertainty, firms tend to imitate the successful competitors to reduce perceived risks. Therefore:

H₁: A firm's perceived mimetic pressures toward m-commerce positively affect its m-commerce adoption intention

Coercive Pressures and M-commerce Adoption

Coercive pressures mainly come from powerful suppliers and customers because of the nature of mobile technology as a tool linking everyone. When dominant firms in the supply chain have adopted m-commerce technologies, upstream and downstream members might be forced to adopt m-commerce due to their dependence on the dominant partners. One of the differences on IT implementation between Chinese companies and companies in developed countries lies in that Chinese firms are driven by rather external pressure than internal motive. Take ERP for example, many OEM firms in China only use ERP system to receive orders from upstream companies instead of optimizing the business process of internal management (CNNIC, 2016). Likewise, many small and medium-sized firms in China only use mobile technology on marketing and selling activities

instead of internal management and operation as more and more consumers spend much time on smart phones. Liu et al.(2009) found that coercive pressures were positively with the eSCM adoption intention. Therefore:

H₂: A firm's perceived coercive pressures toward m-commerce positively affect its m-commerce adoption intention

Normative Pressures and M-commerce Adoption

Normative pressures come from the need to be part of the professional member collective (Di Maggio & Powell, 1983). Through relational channels among members of a network, firm's decision to adopt m-commerce may arise from other firms' pressures including competitors, customers, suppliers, professional association members and government agencies. Normative pressures in the context of m-commerce refer to pressures that companies face when dealing with competitors, suppliers and customers through social networks (Swilley et al, 2012). If adopting m-commerce are thought to be superior or regarded to be a social trend, firms would be more likely to conform to these widely accepted norms and rules. These norms guide firms about the way and extent to adopt m-commerce. Therefore:

H₃: A firm's perceived normative pressures toward m-commerce positively affect its m-commerce adoption intention

Institutional Pressures and Top Management Support

Top management support refers to the extent to which top management actively supports in the adoption process of m-commerce. According to social cognitive theory (Bandura, 1986), human behavior is caused by personal, behavioral, and environmental influences. Top management's belief and attitude towards m-commerce would be affected by institutional environments. Institutional pressures would change the support extent of m-commerce by influencing top manager's cognition and belief on m-commerce.

Liang et al.(2007) found that institutional pressures positively affect top management beliefs in the ERP assimilation process. This logic can be extended to the context of top manager's attitude to m-commerce. When competitors within the industry have benefited from the m-commerce strategies or dominant firms in the supply chain have adopted m-commerce technologies or the usage of m-commerce have become a common expectation of the industry, top managers of firms might pay more attention on m-commerce and give more support to m-commerce strategies within firms and actively participate in the implementation of the m-commerce system. Therefore:

H₄: A higher levels of mimetic pressures lead to higher levels of top management support to m-commerce adoption

H₅: A higher levels of coercive pressures lead to higher levels of top management support to m-commerce adoption

H₆: A higher levels of normative pressures lead to higher levels of top management support to m-commerce adoption

Top Management Support and M-commerce Adoption

According to theory of planned behavior, theory of reasoned action and technology acceptance model (Davis, 1989), human's attitude and beliefs guide their behaviors. Firms' choices and decisions are reflected by top management's values (Hambrick & Mason, 1984), thus firm's decisions and behaviors are always guided by top management's attitude and beliefs, especially in SMEs. Many literatures suggested that top managers' support play an important role in the successful implementation of IT systems (Jarvenpaa et al., 1991; Chatterjee et al., 2002; Ngai et al., 2008; Balocco et al., 2009). Liang et al. (2007) confirmed the important role of top management in mediating the effect of institutional pressures on IT assimilation. Institutional forces may not only directly affect m-commerce adoption in firms but also influence the top management's beliefs and behaviors. The positive beliefs of top management about the values and necessity of m-commerce adoption may result in strong intention of m-commerce adoption. Therefore:

H₇: Top management support on m-commerce is positively associated with firm's intention to adopt m-commerce

H₈: Top management support mediates the relationship between mimetic (a), coercive (b) and normative (c) pressures and m-commerce adoption intention

Control Variables

To fully account for the differences among firms, firm size and industry are also included in the model as control variables. Many studies have shown that firm size have a positive effect on the adoption behavior(Rogers,1995;Zhu& Kraemer,2005;Zhu et al.,2006).The type of industry could have a significant effect on adoption intention. According to the survey report of Chinese Enterprises' Mobile Informatization in 2013, government and financial in China are the fast growing industries on mobile informatization.

METHOD

Measures

The questionnaire began with a definition of m-commerce, and followed by 17 survey items. We measured all the items on a five-point Likert-type scale ranging from "strongly disagree" to "strongly agree". Measurement items used in this research

were adapted from previously validated measures and modified to the m-commerce context in China. The three types of institutional pressures were largely measured with items adapted from Toe et al.(2003) and Swilley et al.(2012). The measurement of mimetic pressures focused on the perceived competitor adoption and perceived competitor success. The measurement of coercive pressures focused on perceived pressures from major customers and suppliers. The measurement of normative pressures focused on perceived pressures from industry or social trend. The measurement of top management was adapted from Chatterjee et al. (2002). The measurement of m-commerce adoption intention was adapted from Swilley et al. (2012).

Sample and Data Collection

We used a paid online survey platform (SoJump.com) to collect data and gathered 204 valid questionnaires from top managers (including CEO, CIO, COO and directors) of Chinese small and medium-sized firms during August to October in 2014. Most of the respondents are in Manufacturing (35.8%), Retailing (19.1%), IT (16.2%) and Financial (9.3%) industries, as shown in Table 1. The number of employees is shown in table 2. In China, the ministry of Industry and Information Technology defined micro, small and medium enterprises by employee number or turnover and the standard varies according to industries. For manufacturing industries, firms with employees fewer than 1000 or annual turnover less than 400 million Yuan RMB are defined as SMEs. For retailing industries, firms with employees fewer than 300 or annual turnover less than 300 million Yuan RMB are defined as SMEs. Firm sizes reported by respondents are shown in table 3.

We analyzed the main survey data by SPSS 20.0 and assessed the common method bias by the Harmon one-factor test (Podsakoff & Organ, 1986). Results show that 3 factors are present and that the most co-variance explained by one factor is approximately 21%, which indicates common method bias is not a likely contaminant of results. PLS method was used to structural equation modeling since the sample size was small. We evaluated the measurement and structural models by Smart PLS 2.0 and tested the mediating effect by bootstrapping method.

Table 1: Industry

Industry	Number	Percent (%)
Manufacturing	73	35.8
Retailing	39	19.1
IT	33	16.2
Financial	19	9.3
Logistics	9	4.4
Hotel and Food	7	3.4
Traveling	5	2.5
other	19	9.3
Total	204	100

Table 2: Number of Employees

Employee Number	Number	Percent (%)
0-9	2	1.0
10-49	28	13.7
50-299	91	44.6
300-999	68	33.3
Over 1000	15	7.4
Total	204	100

Table 3: Firm Size

Firm Size	Number	Percent (%)
Medium	153	75
Small	47	23
Micro	4	2
Total	204	100

DATA ANALYSIS AND RESULTS

The Measurement Model

We assessed the validity of constructs in terms of indicator reliability, internal consistency, convergent validity, and discriminant validity. Factor loadings of each construct are greater than 0.7, as can be seen in Table 4, which indicates that the instrument shows good indicator reliability. Cronbach's alpha and composite reliability (CR) were used to evaluate the internal consistency. The measurement model shows good internal consistency with Cronbach's alpha exceeding the recommended threshold value of 0.7 and CR exceeding the criterion levels of 0.7, as shown in Table 5. The AVE are greater than 0.5, as can be seen in table 5, which indicates that the measurement model has good convergent validity. Discriminant validity is achieved if the square root of the AVE is greater than all of the inter-construct correlations (Chin 1998). The results in Table 6 indicate that the measurement model shows good discriminant validity.

Table 4: Factor Loadings

Construct	Indicator	Factor Loadings
MC	MC ₁	0.826
	MC ₂	0.777
	MC ₃	0.803
	MC ₄	0.713
TOP	TOP ₁	0.777
	TOP ₂	0.741
	TOP ₃	0.779
	TOP ₄	0.822
MP	MP ₁	0.835
	MP ₂	0.852
	MP ₃	0.770
CP	CP ₁	0.831
	CP ₂	0.821
	CP ₃	0.767
NP	NP ₁	0.871
	NP ₂	0.817
	NP ₃	0.742

The Structural Model

We assessed the validity of the structural model by examining R^2 values and the significance of paths. The R^2 is 0.725 for the m-commerce adoption intention and 0.542 for the top management support. All R^2 are greater than 0.33, which indicates a good fit of the model. Table 7 presents the path coefficients and the total effect. H_1, H_2, H_3, H_4, H_6 and H_7 were supported while H_5 was rejected. The results reveal that mimetic pressures, coercive pressures, normative pressures and top management support have significant effect on firm's intention to adopt m-commerce while coercive pressures and normative pressures except for mimetic pressures have a positive impact on top management support. For the total effects, coercive pressures have the strongest effect on firm's intention to adopt m-commerce, followed by normative pressures, top management support and mimetic pressures.

Table 5: AVE, CR and Cronbach's alpha

Construct	AVE	CR	Cronbach's alpha
MC	0.6097	0.8617	0.7852
TOP	0.6087	0.8614	0.7851
MP	0.6722	0.8600	0.7588
CP	0.6507	0.8481	0.7311
NP	0.6587	0.8522	0.7387

Mediating Role Test

This paper followed Preacher and Hayes(2004,2008) and applied bootstrapping method to test the mediating effects of top management between institutional pressures and m-commerce adoption intention(Hair et al,2014). To begin the analysis, the PLS path model should be estimated without the mediator variable TOP. Table 8 shows that the three path coefficients are all significant, which results from the conducting bootstrapping procedure. In the next step, the mediator variable was included in the model. A bootstrapping procedure generating 5000 random samples of size of 204 was used to estimate the significance of indirect effects.

Table 9 shows the calculation results of empirical t value. The empirical t value of the indirect effect of MP on MC is 1.167, and we can conclude that this relationship via TOP is not significant. Thus, H_{8a} was rejected. The empirical t value of the indirect effect of CP on MC is 3.446, and we can conclude that this relationship via TOP is significant. Thus, H_{8b} was supported. The empirical t value of the indirect effect of MP on MC is 3.039, and we can conclude that this relationship via TOP is significant. Thus, H_{8c} was supported.

Table 6: AVE and Latent Variables Correlations

	MC	TOP	MP	CP	NP
MC	0.7808				
TOP	0.7531	0.7802			
MP	0.7406	0.6426	0.8199		
CP	0.7456	0.6888	0.681	0.8067	
NP	0.7228	0.6349	0.7341	0.6405	0.8116

Note: The diagonal(in bold) are the values of AVE squared root and the off-diagonal represents the correlations.

Table 7: Path Coefficients

Hypothesis	Path	Path Coefficients	t Value	Path Coefficients (Total Effect)	t Value
H ₁	MP \rightarrow MC	0.177*	2.4115	0.212**	2.786
H ₂	CP \rightarrow MC	0.235**	3.7164	0.371**	5.8706
H ₃	NP \rightarrow MC	0.237**	3.4057	0.323**	5.0664
H ₄	TOP \rightarrow MC	0.320**	4.3812	0.320**	4.4792
H ₅	MP \rightarrow TOP	0.109	1.2981	0.109	1.2625
H ₆	CP \rightarrow TOP	0.423**	5.2815	0.423**	5.2169
H ₇	NP \rightarrow TOP	0.284**	3.9578	0.284**	3.9313

Note: *p<0.05, **p<0.01, ***p<0.001. The same below.

Table 8: Significance of Path Coefficients without the Mediator

Path	Path Coefficient	t Value
MP \rightarrow MC	0.208**	2.8179
CP \rightarrow MC	0.364***	5.6724
NP \rightarrow MC	0.328***	5.0816

Table 9: Indirect Effect with the Mediator

Path	Path Coefficient (Indirect Effect)	t value
MP \rightarrow MC	0.035	1.167
CP \rightarrow MC	0.136***	3.446
NP \rightarrow MC	0.091**	3.039

To estimate the size of the indirect effect, the paper used the variance accounted for (VAF) value, which equals the ratio of the indirect effect to the total effect (Hair et al, 2014). As shown in table 6, the direct effect of CP on MC has a value of 0.235, while the indirect of effect via TOP has a value of 0.136 (equals 0.423*0.320). Thus, the VAF has a value of 0.136/0.371=0.367. Consequently, 36.7% of CP's effect on MC is explained via the TOP mediator. The direct effect of NP on MC has a value of 0.237, while the indirect of effect via TOP has a value of 0.091(equals 0.284*0.320). Thus, the VAF has a value of 0.091/0.323=0.282. Consequently, 28.2% of NP's effect on MC is explained via the TOP mediator. Since the value of VAF is between 20% and 80% (Hair et al, 2014), it means that the top management plays partial mediation between the two institutional pressures (i.e., coercive pressures and normative pressures) and m-commerce adoption intention.

CONCLUSIONS

Contributions

The paper provides both theoretical and practical contributions.

First, this paper contributes to the growing empirical literature on m-commerce adoption at organizational level instead of individual level in the context of China. In terms of the fast penetration of mobile technologies in China, it becomes very necessary for firms to implement m-commerce applications and technologies. Adoption of m-commerce means great opportunities for SMEs in China. Thus, it is very meaningful to study the m-commerce adoption at organizational level in the context of China.

Secondly, this paper adds to the growing evidence of institutional influence on organizational behaviors by confirming its applicability to m-commerce adoption. The role of institutional pressures in affecting firms' adoption of innovations has been broadly studied, but few research has been done within the context of the new m-commerce

technologies. Consistent with previous studies in the context of EDI (Teo et al., 2003), our results confirmed the effect of institutional pressures on m-commerce adoption intention.

Thirdly, this study integrates institutional pressures and the influence of top management on firms' m-commerce adoption intention into one model. Most studies adopted the institutional theory to explain the IT adoption behavior of organizations, not individuals (Mignerat and Rivard, 2009). Our study draws upon this limitation to develop and test an empirical model that emphasizes the effect of three institutional pressures on top managers and organizations. Our results indicate that two of the three institutional pressures have significant influence on firms' behavior through top management.

Finally, for practitioners, this study points out that the importance of top management and institutional pressures to m-commerce adoption in firms. By identifying the relationship among institutional pressures, top management and m-commerce usage, this study offers top managers a more systemic understanding for how m-commerce application of firms are embedded in complex interdependent social and economic networks. The findings of this study could offer practitioners guidelines for promoting the application of m-commerce. Top managers of firms should react actively to normative pressures and coercive pressures in the process of m-commerce adoption, and evaluate the real benefits before adopting m-commerce carefully. When persuading firms to adopt m-commerce applications, the practitioners and IT consultants should emphasize on the institution pressures especially normative pressures and coercive pressures in addition to the benefits and values of m-commerce.

Limitations

Limitations of our study are as followings. Firstly, this study collected data at one point in time. Although the Harmon one-factor test showed that the common method variance was acceptable, a longitudinal data collection would enrich the robustness of the model and offer more information on the relationship between institutional pressures and m-commerce adoption. Secondly, we collected data through online survey platform, which relied on the informants' understanding of the variables. Thirdly, this research took adoption intention of m-commerce as independent variable rather than actual adoption. Although adoption intention had been used widely in previous study as a proxy for the decision to adopt IT innovations, it might be more meaningful and necessary to examine the actual adoption of m-commerce in terms of the fast penetration of mobile phones in China.

Discussions

Drawing on institutional theory and the literature on IT adoption and diffusion, this study developed and tested an m-commerce adoption model in the context of SMEs of China. We find that institutional pressures affect m-commerce adoption in firms in different ways, and are partially mediated by top management. Mimetic pressures, coercive pressures, normative pressures might directly affect firm's intention to adopt m-commerce. Coercive pressures and normative pressures except for mimetic pressures have a positive impact on top management support. Top management support partly mediates the influence of two institutional pressures (coercive pressures and normative pressures) on the adoption intention of m-commerce. However, contrary to what we expected, findings suggest that mimetic pressure does not affect top management support on m-commerce. One possible reason is that m-commerce in China is still in the early stages. Although there are institutional pressures for firms to adopt m-commerce, the benefits of adopting m-commerce have not been fully perceived by top managers yet. In other words, there is a low level of perception of the real benefits brought by m-commerce applications. The results indicate that Chinese small and medium-sized firms' decisions on m-commerce adoption are driven less by efficiency but more by external environmental factors.

ACKNOWLEDGMENTS

This research was supported by the Major Program of the National Social Science Foundation of China (Grant No. 2015YZD03).

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E2.0 Post-Adoption: Extending the IS Continuance Model Based on the Technology-Organization-Environment Framework

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ABSTRACT

This paper extends the IS continuance model to improve our understanding of the determinants of E2.0 post-adoption. Our proposed research model incorporates four constructs into the IS continuance model: firm size, firm scope, subjective norms and competitive pressure based on the TOE framework. Results from a survey of customers of a leading E2.0 in China supported our model. We find that organizational and environmental context factors including subjective norms and competitive pressure significantly influence enterprises' intention to renew their E2.0 service. Perceived usefulness and satisfaction are no longer the strongest predictors of continuance usage in the context of enterprise system.

Keywords: Post-adoption intention; Enterprise 2.0; TOE; IS continuance; Subjective norms; PLSPM.

INSTRUCTIONS

In recent years, Web 2.0, one of the most significant information technology innovations in the Internet Age – spearheaded by such applications as Facebook, LinkedIn, and Twitter – has rapidly permeated people's lives [1][11][14][15][17][36][64]. A growing number of business companies have begun to apply various Web 2.0 applications to support regular business operations, such as internal communication, team collaboration, project management and information sharing. However, consumer-market, individual-based Web 2.0 applications are not well suited to the enterprise context, due to such problems: compatibility, security, scalability and functionality [20][46]. Correspondingly, Enterprise-level 2.0 applications (E2.0) have been designed and developed by adapting the technologies and philosophies of individual-level Web 2.0 applications to specific business requirements (e.g., Yammer, Jive, Socialcast of Chatter and Mingdao)[35]. In this research, Enterprise 2.0 applications are defined as a set of online applications, built on the cloud computing Web 2.0 infrastructure, to help firms to improve business performance. Examples of benefits of the applications of E2.0 include rapid and agile online collaborations [8], knowledge management [52][67] and emergency response capabilities [45][46].

Compared to Web 2.0 usage in consumer markets, companies usually bear the monetary cost of E2.0 use. To leverage fully the considerable role of E2.0 in improving competitive advantages, an organization should insist on long-term use. However, a large number of E2.0 platforms still face difficult challenges in survival, owing to a low free-to-paid conversion rate [43]. There is currently little understanding of the factors influencing E2.0 post-adoption. In this study, we focus on the research question of why some companies continue renewing E2.0 (i.e., E2.0 continuance usage) while others do not. While prior studies on Web 2.0 continuance usage (e.g. [11][66]) can contribute to understanding the continuance of E2.0 to some degree, there is still a need for a systematic investigation and theorizing of the salient factors that influence E2.0 continuance from an enterprise rather than individual context. Compared to the continued adoption of Web 2.0 that is mainly determined by factors related to individuals' cognitive beliefs (e.g., subjective norms) and experience-specific affect (e.g., satisfaction), we argue that the continuance adoption of E2.0 may be viewed as an enterprise-level economic decision and should be determined by enterprise-related (e.g., firm size) as well as individual-based factors. Moreover, the significance of these individual-based factors in determining enterprise system continuance usage (i.e. E2.0 in this case) may change due to the differences between enterprise system and consumer software. For instance, the continued adoption of Web 2.0 has no financial cost to individual users while firms that use E2.0 pay a monthly or yearly enterprise license fee based on the number of users. Moreover, the implementation of E2.0 is likely to significantly influence business performance and employees' working styles from different perspectives such as communication and project management. Thus, the adoption and implementation of an enterprise system is mainly determined by the management team of a firm, particularly in small-and-medium-sized enterprises (SMEs). Our study is arguably one of the first attempts to explore E2.0 post-adoption. With the development of cloud-based platform infrastructures, the utilization of E2.0 as a catalyst for strengthening businesses' competitive advantages has received notable attention from both academia and practitioners. According to TechNavio's analysts, the compound annual growth rate (CAGR) of E2.0 market reaches 31 percent over the period 2012-2016 and firms increase their business developmental activities through implementing E2.0 infrastructures [55].

However, existing E2.0 studies predominantly focus on describing the implementation strategy [5], E2.0 functions [52][67], functions of knowledge management[5][9], and challenges and risks [33][46]. Only a few studies have empirically examined initial adoption behavior toward E2.0 (e.g., [64][40]). Lin et al. [40] develop a value-based adoption model (VAM) and show that perceived benefits and perceived costs can significantly influence the value perceived by managers of adopting E2.0. However, the respondents for the study were 80 part-time MBA students rather than real E2.0 users. Wang et al. [64] apply UTAUT to propose a research model that incorporates context-specific variables for enhancing the prediction of individuals' adoption

intentions toward enterprise 2.0 applications. A professional E2.0 platform, Clearvale was used as the research context, and employees of seven companies that use the platform's trial version were invited to participate in a paper-based questionnaire. Their research findings suggest that some general information system (IS) adoption factors are still significant in the E2.0 initial adoption context including perceived usefulness and perceived ease to use.

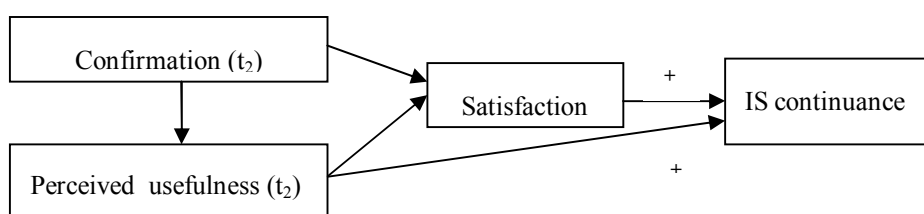
To fill this research gap, we develop a conceptual model by extending Bhattacharjee's [7] IS continuance model to the E2.0 post-adoption context based on the Technology–Organization–Environment (TOE) framework [61], which was originally developed for understanding enterprise-level information technology (IT) innovation adoption. This is in line with our research purpose. The TOE framework has been extensively used as a theoretical framework in prior studies of enterprise-level IS innovation, including material requirement planning (MRP) [16], electronic data interchange (EDI) [32], open systems [10] e-commerce adoption [27][29][59][68], e-procurement [58], enterprise resource planning (ERP) [50], knowledge management systems (KMS) [34][38] and software-as-a-service (SaaS)[65]. We believe that the TOE framework is an appropriate theoretical base for us to extend the IS continuance model through introducing specific context factors that are noteworthy for understanding E2.0 post-adoption.

The paper is organized as follows. We first present the theoretical background to our study, including the conceptual model of E2.0 post-adoption, its theoretical foundation and hypotheses. The methodology is then discussed, followed by the results of testing the theoretical model. Finally, the paper rounds off with a discussion of major findings, limitations and practical implications.

THEORETICAL BACKGROUND

IS Continuance Model

Bhattacharjee[7] developed an IS continuance usage model adapted from the Expectation-confirmation theory (ECT) [48] that has been widely used in the marketing discipline to examine the influence of consumers' satisfaction on their intention to continue using an adopted technology [13][41]. In the IS continuance model, IS continuance behavior is determined by two post-consumption variables including perceived usefulness and satisfaction. In order to adapt ECT to the IS continuance, Bhattacharjee [7] makes several theoretical adaptations. First, two pre-consumption antecedents of confirmation including perceived performance and expectation are removed because Bhattacharjee [7] proposes that their effects are captured within the confirmation and satisfaction constructs. Second, Bhattacharjee [7] added an ex post expectation variable, perceived usefulness, because ex post expectation is especially important for IS products or services, where initial expectations often change with time. Following prior studies on IS initial adoption (e.g., [19][31]), Bhattacharjee [7] argued that it is plausible that perceived usefulness had a constant influence on subsequent IS continuance usage decisions and thus theorizes perceived usefulness as an additional determinant of satisfaction. Third, the IS continuance model proposes that the usefulness-intention relationship originally developed by the technology acceptance model (TAM) [19], in the initial adoption context is also likely to exist in the continuance context because human continuance intention can be viewed as a series of usage decisions that are independent of timing or behavioral stages [56]. Thus, perceived usefulness should directly influence IS continuance intention in addition to having an indirect effect on IS continuance intention via satisfaction.



Note: t_2 = post-consumption variable

Figure 1. An expectation-confirmation model of is continuance [7]

The Technology-Organization-Environment (TOE) Framework

The TOE framework proposes that factors determining enterprise system adoption behavior can be broadly divided into three contextual categories including technology, organizational and environment contexts although it provides no information on what these specific factors are. First, the impact of the technological context upon enterprise system adoption behavior refers to technology-related factors that influence a firm's adoption of an innovative IS [49]. Second, the organizational context emphasizes the impact of a firm's profile characteristics, resources, internal social network on its' IS adoption behavior, firm size and scope, formal and informal linking structures, internal communication, peer influence, organizational culture, the quality of human resource and so on. Third, the environmental context emphasizes that a firm's IS adoption is also significantly influenced by many external factors beyond a firm's control, such as government policies, competitors and trading partners [61]. Based on the TOE framework, we can effectively recognize key factors that could be neglected by prior studies on consumer software, such

as external circumstance-related factors [10]

THE EXTENSION OF IS CONTINUANCE: IDENTIFYING CONSTRUCTS TO INCORPORATE INTO THE IS CONTINUANCE MODEL

This section examines how we extend the IS continuance model to the organization-level IS post-adoption context for explaining E2.0 continuance usage behavior. Building on our discussion in the introduction, here, we present an overview of the four constructs we add to the IS continuance model and discuss the details of the four constructs. We adopt an approach that complements the current constructs in the IS continuance model. The IS continuance model focuses on individual continuance acceptance of technology, whereas this research focuses on IS continuance usage at the organizational level. An important difference between the organizational continuance usage setting and an individual continuance usage setting and, where the IS continuance model was developed, is that firms' innovation adoption decisions usually are not only influenced by technological factors related to individuals' beliefs (e.g., perceived usefulness) but also can be determined by organizational factors and external survival context factors (i.e., environmental factors), according to the TOE framework. Within the technological context, perceived usefulness has been frequently proposed to be the most salient technology-related factor influencing IS post-adoption behavior in the IS continuance model and subsequent studies using it as a baseline model (e.g., [60]). As a consequence, prominent factors in an organization-level continuance, usage context particularly from the perspective of organizational and environment settings should be supplemented.

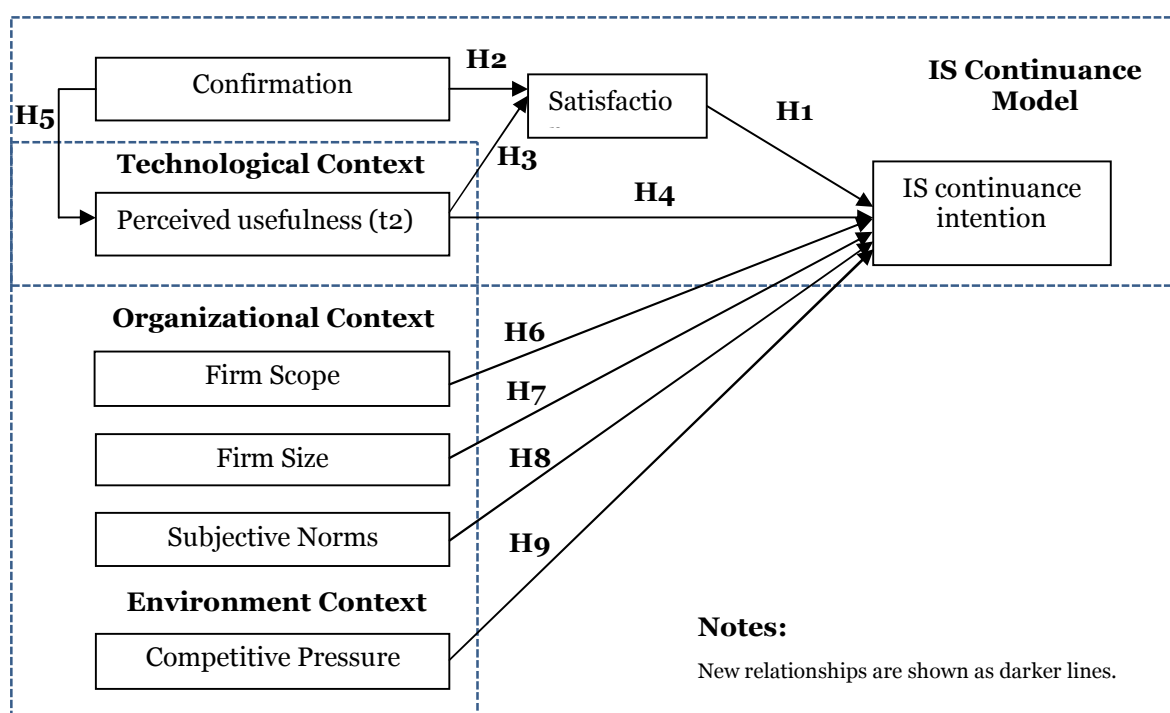


Figure 2. Research Model

With regard to organizational factors, organizational structure is one of the most commonly studied organizational aspects in the innovation or IS adoption literature (see [18] for a detailed meta-analysis) and it specifies how business activities, such as task allocation, coordination and supervision are directed toward the achievement of organizational business purposes. Moreover, how information flows between levels within an organization is also determined by organization structure. We therefore believe that a firm with a complicated organizational structure is likely to have a higher willingness to improve current business activities and information flows and thus to adopt E2.0. The complexity of an organizational structure usually involves two dimensions, firm scope (i.e., the breadth) and firm size (i.e., the depth). Thus we add firm scope and firm size as two predictors of firm intention to renew E2.0 to capture the influence of organization characteristic factors. In addition, subjective norms refer to the perceived expectation from an individual's key referents to perform the behavior of interest [3][4]. A large number of studies on individual-level behavior have found support for the significant impact of subjective norms on IS initial adoption [37][63]. An individual's behavior is considerably influenced by others' opinions on intended behavior, particularly when referents are important to the individual (e.g., family members and intimate friends). We propose that such a communication

influence resulting from key referents is still prevalent in the E2.0 post-adoption context. We note that key partners or collaborators are also important people to the focal firm and the construct, subjective norms, can be regarded as an environmental context factor sometimes. However, this paper focuses on E2.0 applications that are principally designed and developed for internal organizational communications and collaborations between teams and departments, which is little relevant to external communications, such as, business partners. As a result, we only consider subject norms as an organizational context factor in this research.

Second, environmental context relates to facilitating and inhibiting factors resulting from external circumstances and significant factors include competitive pressure, trading partners' readiness and government policies [68]. Consistent with these prior studies, competitive pressure is included into our conceptual model. With the rise of fierce market competition, firms actively look for effective approaches to increase sustainable competitive advantage, such as reducing business costs, improving customer service, and employing knowledge management. As a result, IT innovation (i.e., E2.0 continuance usage in this case) is viewed as an important channel to help firms to achieve the above purposes. As discussed above, E2.0 applications are lightweight and agile software and mainly work for team communication and collaboration within an organization and the implementation and usage of E2.0 don't involve trading partners and government departments. Therefore, trading partners' readiness and government policies seem to be unrelated to this research context and purpose. Based on the above gaps in the IS continuance model, and the associated theoretical explanation provided, we integrate firm size, firm scope, subjective norms, and competitive pressure, into the IS continuance model in order to tailor it to the E2.0 continuance use context, as shown in Figure 2.

HYPOTHESIS DEVELOPMENT

In this section, we present the hypotheses that we incorporate to extend the IS continuance model to the E2.0 continuance use context. Figure 2 shows the original Bhattacharjee's [7] model and our proposed extensions. Similar to the relationships between perceived usefulness and confirmation, satisfaction and continuance intention developed by Bhattacharjee [7] in the consumer system acceptance context, we propose that the relationships further apply to the context of enterprise system continuance usage. Hence, we posit:

H1: A firm's level of satisfaction with initial E2.0 use is positively associated with the firm's E2.0 continuance intention.

H2: A firm's extent of confirmation is positively associated with the firm's satisfaction with E2.0 use.

H3: A firm's perceived usefulness of E2.0 use is positively associated with the firm's satisfaction with E2.0 use.

H4: A firm's IS continuance intention is positively associated with the firm's perceived usefulness of E2.0 use.

H5: A firm's extent of confirmation is positively associated with the firm's perceived usefulness of E2.0 use.

Firm Scope and Firm Size

Firm scope emphasizes the horizontal extent of a firm in terms of business operations [68] and in this research it is defined as the degree of geographical dispersion of a firm's business activities. Owing to the high heterogeneity of market knowledge, many firms struggle to integrate and exchange market knowledge at a more abstract level, particularly those with multiple business operations departments [25]. The more branches a firm has, the more likely the firm is to confront complex difficulties in exchanging market knowledge and best practice between its branches. Prior studies have identified that one of the competitive advantages of using E2.0 is the significant improvement of the effectiveness and efficiency of team collaborations across different regions [46]. For instance, employees can effortlessly and safely exchange and share business data between multiple locations through a Web-based application programming interface (API) of E2.0. We believe that such perceptions of usefulness of E2.0 for increasing competitive advantages are more likely to achieve by a company that uses E2.0 applications in a wider scope of cross-department activities. Consequently, we posit:

H6: Firm scope is positively associated with a firm's intention to renew E2.0

In addition to firm scope, firm size (i.e., the number of employees) is another important aspect of an organizational structure that significantly determines an enterprise's business performance, such as innovation awareness, resource availability, communication costs, and flexibility [22]. Following the logic outlined above, we believe that the major functions of E2.0 (e.g., reducing internal communications, facilitating project management and motivating information sharing) will be more usefulness for a large-scale firm that has a complex hierarchical structure, owing to the high communication costs and poor efficiency of team collaboration across various departments. Zhu and Kraemer [69] argue that "size is often associated with inertia; that is, large firms tend to be less agile and less flexible than small firms. The possible structural inertia associated with large firms may slow down organizational usage [of e-business]" (p. 65). This leads to the following hypothesis: H7: Firm size is positively associated with a firm's intention to renew E2.0.

Subjective Norms

Enterprise 2.0 represents an important IT innovation in contemporary firms for improving information flow, which usually involves several aspects including business procedures, employees' work habits and horizontal organizational structures. Such radical improvements are usually accompanied by high failure rates [51]. An organization's decision-making on IT innovation essentially represents key organizational members' decisions as a whole (e.g., president and CEO). As a rule of thumb, it is a common strategy that members of the management team are likely to acquire important opinions from key referents regarding a significant organizational decision. Key referents may include both internal and external entities, such as shareholders, employees, customers, partners, suppliers, distributors, competitors, government, community, consultants, creditors and investors [57]. In this case, we believe that an organization's management team will typically reach an agreement on renewing their E2.0 service. In other words, each senior management member and related managers (e.g., IT managers) will cautiously consider others' opinions on renewing their E2.0 service before making a final decision on supporting or opposing the renewal of E2.0. Thus, we propose that subjective norms should influence an organization's behavioral intention to renew E2.0: H8: Subjective norms are positively associated with a firm's intention to renew E2.0.

Competitive Pressure

In the innovation context, competitive pressure mainly refers to peer pressure to use an innovative technology [26]. In this research, we use the construct of competitive pressure to refer to the pressure perceived by a firm's leaders that competitors have achieved substantial competitive advantage by using E2.0 (for example, in terms of communication effectiveness and product development processes) [39]. The more competitive pressure a firm has realized, the more likely the firm is to strengthen competitive advantage by continuing using E2.0. Thus, we posit: H9 Competitive pressure is positively associated with a firm's intention to renew E2.0.

STUDY DESIGN AND METHODOLOGY

Data Collection

Our target population is current users (i.e., companies) of Mingdao (www.Mingdao.com) --a leading enterprise 2.0 platform in China. The rationale for selecting Mingdao for the research is as follows. First, reports show that China has become the most promising market for the proliferation of E2.0 technologies [54][64]. More and more enterprises in China have high expectations to increase competitive advantage by improving team collaboration and knowledge sharing. Consequently, there are several emerging E2.0 platforms available in China, e.g., Mingdao, Kingdee (www.kdweibo.com) and Tita (www.tita.com). Second, Mingdao offers a 30-day trial period for new customers to access all E2.0 applications without any functional limitations, such as cloud computing-based customer relationship management system (CRM) and an e-procedure management system. As a startup company, Mingdao aggressively launches a series of marketing promotion campaigns to invite potential enterprises to use and assess its E2.0 applications. Through several years of development, Mingdao has become one of the most influential E2.0 platforms in China. Third, a 30-day trial account with all E2.0 applications enables senior managers to assess fully the benefits of E2.0 to their enterprises before deciding to pay license fees to continue using the E2.0 service after the trial accounts expire.

To obtain data for our research, an online survey was carried out through the integrated online survey platform of Mingdao. The URL of our questionnaire was authorized and then sent to all Mingdao's free enterprise customers. The respondents that we focus in the survey were limited to a firm's senior management team and IT managers, who are considered as decision makers for renewing enterprise 2.0 in the firm. Specifically, a firm's senior management team and IT managers received a private message from Mingdao's customer manager soliciting their participation in a survey of their intention to consider renewing Mingdao services after their trial accounts expire. The message described our research purpose, provided the URL of the questionnaire. Invalid or suspicious data were removed (e.g., duplicate IP addresses or unreasonable survey completion times). In all, 228 completed responses from 44 firms were received. After 22 invalid responses were deleted, 206 qualified responses were obtained for quantitative analysis. The gender of respondents was broadly even (54.6% male) and educated (75.9% with a degree) (see Table 1). Most of the respondents were 40 years of age or less. Moreover, 38.3% of respondents are from IT-related industries, with a large number from the wholesale and retail trade industries (16.7%). The median annual revenue of respondent organizations was \$787,000-\$1,570,000. More than 95% enterprises that the respondents work for are SMEs with fewer than 500 employees. To test for nonresponse bias, we compared the demographic characteristics of the respondents in early and late waves of data collection and found no significant differences. Different response formats were used in an effort to control common method bias including semantic differential scales, Likert scales, and reversed statements.

Table 1. Descriptive statistics of respondent and organizations

Gender		Age	
Male	54.6%	18-30	52.5%
Female	45.4%	31-40	40.3%

41-50	6.4%	Industry	
50+yrs	0.8%	Information transmission, software	38.3%
Positions		Wholesale and retail trade	16.7%
CEO, General manager	24.3%	Manufacturing	8.9%
CIO, CTO, VP of Information system	11.2%	Financial industry	6.5%
IS manager, IS planner	6.3%	Culture, sports and entertainment	6.4%
Other administrators in IS department	14.7%	Education	5.2%
COO	5.8%	Leasing and business services	4.3%
CFO	8.6%	Accommodation and catering	3.3%
Other administrators in an	29.1%	Building industry	2.3%
Education Level		Others	8.1%
High school (non-graduate) or below	1.7%	Firm Size (the number of employees)	
College diploma graduate or	22.4%	1-49	54.4%
Bachelor's degree or equivalent	58.3%	50-99	21.3%
Master's degree or equivalent	13.4%	100-199	12.2%
Doctoral degree or equivalent	4.2%	200-499	7.3%
Annual Revenue of Organizations (\$)		>=500	4.8%
<=31,500	23.2%	Firm Scope (the number of branches)	
31,500-78,700	9.4%	1-5	72.6%
78,700- 157,000	8.2%	6-10	16.4%
157,000 -787,000	18.7%	11-15	5.4%
787,000-1,570,000	17.4%	16-20	2.6%
>=1,570,000	23.1%	>20	3.0%

Measurement

In our research, multi-item scale measurement was employed. Most items in the research model were adapted from prior studies. The final version of the questionnaire contained 21 questions (2 general items and 19 scale items) (see Appendix A). Measurements for the original IS continuance constructs were adapted from Bhattacharjee [7] including a reverse-coded item. Following prior studies, firm size is measured based on the number of employees, while firm scope refers to the number of branches that a company has established [27][68][69]. Competitive pressure includes three items that were adapted from [70]. To measure subjective norms, three items were adopted from [64], but modified for our context. Satisfaction was measured using 7-point semantic differential items. All other scale items were scored on a 7-point Likert scale with a score of 7 indicating 'strongly agree' and a score of 1 indicating 'strongly disagree'. We conducted several tasks to address the potential threat of common method bias. First, we performed Harman's one-factor test by entering all of the principal constructs into a principal components factor analysis [53]. Four factors were produced, the first accounted for 38% of the variance. This suggests that there is unlikely to be significant common method bias. Next, following the recommendation of [53] we performed a single-method factor test in PLS by using indicators that measured both their theoretical constructs and a common method latent construct, and by re-running the structural model. The results did not change, again suggesting that common method bias was not an issue in our data.

DATA ANALYSIS AND RESULTS

Convergent Validity and Reliability

For multiple item scales, three metrics were used to test convergent validity and reliability: average variance extracted (AVE), Cronbach's alpha and composite reliability (CR). As shown in Table 2, all of the AVE and CR values for constructs were satisfactory, with composite reliabilities at 0.889 or more and AVE values at 0.727 and above [12]. Further, as suggested by [47], Cronbach's alpha values are higher than 0.70. Thus, the measurement items that we used converged on the same latent construct and demonstrated internal consistency.

Table 2. Convergent validity and reliability measurement

Construct	AVE	Composite reliability	Cronbach's alpha
Intention to renew E2.0 (IN)	0.858	0.948	0.917
Satisfaction (S)	0.874	0.965	0.952
Confirmation(C)	0.842	0.941	0.906
Perceived usefulness (PU)	0.908	0.967	0.949
Subjective norms (SN)	0.820	0.932	0.891
Competitive pressure (CP)	0.727	0.889	0.812

Discriminant Validity

To assess discriminant validity, we used the techniques of [24][12] and [30]. First, we developed a matrix of correlations between constructs with reflective measures. We replaced the diagonal with the square root of the AVE (see Table 3 below) and found that the square-root of AVE for each construct was higher than the elements off the diagonal. Second, we assessed discriminant validity by making a comparison between the loadings of items for an associated construct and their cross-loading on other constructs. For our model, all items loaded on their corresponding constructs more strongly than on other constructs (as seen in Table 4 below). Third, the heterotrait-monotrait ratio of correlations (HTMT), a new approach to assessing discriminant validity in variance-based SEM suggested by Henseler [30] was used. We found that all HTMT values were below the 0.90 threshold (see Table 5). To further test for multicollinearity, we computed variance inflation factors (VIFs). All VIFs were found to be less than the conservative threshold of 5, suggesting that multicollinearity is not a major issue in our data. Overall, there is strong empirical support for the discriminant validity of the constructs in our research model.

Table 3. Correlations between constructs (square root of AVE on diagonal)

	IN	S	C	PU	SN	CP
IN	0.926					
S	0.449	0.935				
C	0.211	0.486	0.917			
PU	0.481	0.484	0.463	0.953		
SN	0.424	0.243	0.160	0.276	0.906	
CP	0.375	0.183	0.059	0.243	0.192	0.853

Table 4. Loadings and cross-loadings

	IN	S	C	PU	SN	CP
IN1	0.942	0.436	0.201	0.458	0.362	0.330
IN2	0.936	0.407	0.203	0.465	0.355	0.354
IN3	0.899	0.403	0.183	0.414	0.460	0.358
S1	0.397	0.916	0.42	0.442	0.234	0.165
S2	0.396	0.946	0.495	0.463	0.209	0.162
S3	0.456	0.939	0.469	0.457	0.226	0.210
S4	0.426	0.938	0.427	0.446	0.241	0.146
C1	0.142	0.422	0.924	0.416	0.097	0.061
C2	0.183	0.456	0.917	0.409	0.163	0.050
C3	0.252	0.457	0.912	0.446	0.177	0.052
PU1	0.391	0.411	0.455	0.941	0.262	0.197
PU2	0.483	0.471	0.425	0.956	0.227	0.250
PU3	0.494	0.496	0.444	0.962	0.299	0.244
SN1	0.372	0.198	0.109	0.190	0.903	0.142
SN2	0.407	0.190	0.122	0.254	0.908	0.201
SN3	0.372	0.276	0.206	0.306	0.906	0.178
CP1	0.345	0.165	0.039	0.207	0.180	0.882
CP2	0.319	0.135	0.063	0.240	0.212	0.876
CP3	0.293	0.170	0.051	0.173	0.094	0.797

Table 5. Heterotrait-monotrait ratio (HTMT)						
	IN	S	C	PU	SN	CP
IN						
S	0.480					
C	0.230	0.521				
PU	0.514	0.507	0.499			
SN	0.468	0.266	0.178	0.300		
CP	0.434	0.209	0.07	0.275	0.222	

Hypotheses Testing

Our proposed model and the hypothesized relationships among constructs were evaluated by using SEM-PLS modeling in SmartPLS 3.0M because the goal of this paper is to identify key constructs that influence the continuance usage of E2.0 rather than to carry out theory testing, theory confirmation, or the comparison of alternative theories. Moreover, our sample did not fully follow a multivariate normal distribution, which is required by covariance-based SEM (CBSEM) methods, as exemplified by software such as LISREL, AMOS, and EQS [28].

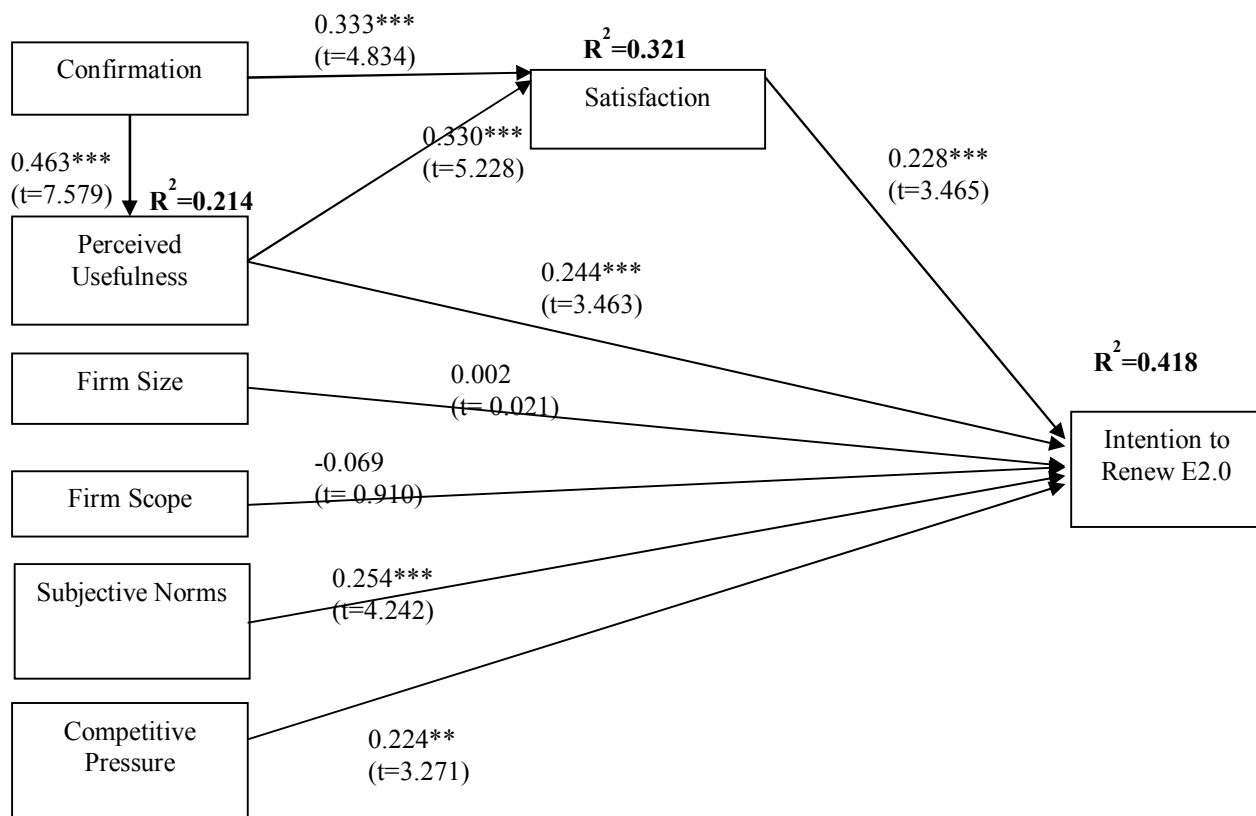


Figure 3. Research model with empirical results

Overall, the results support seven of the nine hypotheses posited. Figure 2 shows the standardized path coefficients and path significances as reported by SmartPLS. We computed t-statistics and path significance levels for each of the hypothesized relationships using the bootstrapping method. Path coefficients and R2 values were obtained by running the PLS algorithm to assess the predictive performance of the structural model. The construct for intention had an R2 value of 0.418, indicating that more than 41% of the intention to renew E2.0 services was explained by the respondents' perceptions of benefits, subjective norms, and leaders' support. Overall, the empirical results strongly supported the explanatory power of our research model for enterprises' intentions to renew E2.0. Let us consider the individual hypotheses in turn. Specifically, despite a slight decrease in path coefficients, the relationships of the IS continuance model are still significant at the 0.1% level (i.e., H1-H5). Two firm characteristics, firm size and firm scope, showed little impact on intention to renew E2.0 services (H6 and H7 were not supported), and the path between subjective norms and intention to renew E2.0 was strongly supported ($\beta = 0.254$, $t=4.242$), as proposed by H8. Furthermore, our data did support the path between competitive pressure and continuance intention (i.e., H9 is supported). It appears that an enterprise's intention to renew E2.0 services is significantly driven by external pressure, which is

consistent with prior studies on general IS adoption, including those on e-business adoption and assimilation [59]. An organization is more likely to continue using E2.0 in case the organization recognizes that more and more competitors in the same industry have increased competitive advantages and developed marketing dynamic capabilities through the continuance usage of E2.0 [21][58].

DISCUSSIONS AND CONCLUSIONS

The results of our analysis provide valuable findings for theory and practice. Our study is arguably one of the first attempts to develop a theoretical model of E2.0 continuance usage. We have found that more than 41% of the variance in an organization's intention to renew E2.0 services can be explained through our theoretical model. Overall, the statistical tests provided good support for our research model. Let us further examine the theoretical and practical contributions of the research, along with possible limitations.

Theoretical Contributions

Our first major theoretical contribution is in modifying the IS continuance for the enterprise-level technology continuance use context. By doing so, we extend the generalizability of prior studies on social network from an individual-level IS usage (e.g., Web 2.0) to an organization-level IS context (i.e., E2.0 in this case). Prior social network studies on initial [15] and continuance usage (e.g., [11]) have investigated the phenomenon in the personal usage context (e.g., Facebook, Blog and Twitter) where satisfaction and perceived usefulness are the main drivers of individuals' technology continuance use intention. In the case of firms' continuance adoption of technology, other drivers come to the fore. Two such drivers included in our research model are subjective norms and competitive pressure.

Subjective norms was found to be a more important driver than satisfaction and perceived usefulness in non-individual IS continuance usage contexts. Unlike personal decision-making on IS continuance usage (e.g., Facebook), a firm's decision-making on enterprise system continuance usage has a considerable impact on the firm performance and survival and thus represents the final decision of management team as a whole. Such a final decision is not only influenced by individuals' cognitive beliefs and affect (e.g., CEO's perception of usefulness and satisfaction), but also more importantly is determined by a majority opinion expressing the view shared by more than half of management team members. Our research findings suggest that if most senior managers of a firm are likely to continue using E2.0, CEO normally respect their opinions on renewing E2.0 service even though he or she doesn't fully realize the usefulness of E2.0 during a trial period. Thus, the significance of subjective norms in the enterprise system continuance usage context is highlighted.

We integrate competitive pressure into the IS continuance model to capture the influence of competitors that have used emerging IS in the enterprise system continuance usage context. While the extant literature has examined the role of competitive pressure in initial adoption of firm-level IS (e.g., [38][39][50]), we extend it to continued use. Future research may build on our study to further examine how different pricing strategies can influence firm intention to continue using the focal E2.0 software, such as decoy pricing vs. freemium. Another major theoretical contribution of this work is the empirical investigation of the role of leaders in determining firm-level IS continuance. 206 managers from 44 firms offer valuable opinions to our research. More and more contemporary companies are trying to build a "flat" organizational structure with few hierarchical levels and looser boundaries through E2.0 platforms. However, the free-to-paid user conversion rate of E2.0 platforms is still low. Even for the biggest Enterprise 2.0 platform, Yammer, the average conversion rate from free trials to paid users is only 15%. IS researchers should pay particular attention to examining factors that influence E2.0 continuance usage from the perspective of a company's management team. This hitherto under-researched form of leaders' support, peer influence and their subjective assessment of the benefits of paid E2.0 continuance usage could result in important research contributions. In sum, in contrast to prior social network studies that mainly focus on examining factors relating to a user's subjective evaluation of the expectation-performance discrepancy introduced from the ECT [48] and its derived theories (e.g., [7]), this study introduced three organizational context factors and one external environment factor to explain behavior. Our research findings show that subjective norms and competitive pressure have a significant impact on IS continuance behavior in the enterprise system context. Our study helps to enrich the IS post-adoption literature in an enterprise-level purchase setting, particularly from the perspective of enterprise leaders. Such a theoretical contribution is of great significance given the fact that most E2.0 platforms are facing a significant challenge in improving their free-to-paid user conversion rate. We provide a complementary perspective to current theoretical models of IS continuance to provide a better understanding of enterprise-level IS purchase behavior.

Practical Implications

Practitioners who develop E2.0 platforms for contemporary companies should be aware of the importance of management team as a whole in facilitating the implementation of E2.0, particularly in the SME context. Particularly, our study suggests that subjective norms over perceived usefulness of IT applications can influence E2.0 continuance use. As a consequence, E2.0 developers should actively demonstrate and promote successful E2.0 usage cases as a way to enhance enterprise leaders' recognition of the benefits of E2.0 services. In addition, a series of E2.0 training courses should be freely available, which will help company leaders to understand how to utilize effectively E2.0 applications for improving their business activities. The findings show that perceived usefulness is important for E2.0 continuance usage. Perceived usefulness are of course one of the

fundamental objectives of enterprises when they consider purchasing E2.0 services. We suggest that E2.0 developers should consider this in attempts to demonstrate explicitly the advantages of E2.0. For example, one idea is to develop some measurable indices of business performance, such as office automation efficiency or reduction in communication costs that help enterprises to compare their business performance between pre- and post-E2.0 implementation.

Limitations

Our study is not without its limitations. The first is about the generalizability of our findings. The target respondents in our investigation are users of Mingdao, which mainly comprises of SMEs. We believe that the results may be somewhat different if data is collected from an E2.0 platform where the majority of users are large companies. Second, leaders' opinions in this study are only collected from a single, leading, Chinese E2.0 platform – Mingdao. Generalizing our research findings to other E2.0 platforms should consider the different characteristics of such platforms. Third, related to the points mentioned previously and the nature of the customer base, an examination of the influence of firm characteristics may be considered limited, thus limiting the effect of an examination of firm size and scope. Finally, the study was conducted in China and our findings must be considered in that context: a “high-context” culture in which communicators are likely to carry out implicit communication in organizations, which may limit the formation of the habit of using E2.0. Our research findings may not apply to other countries with a different (“low-context”) culture. Future research should be encouraged to build on our study by examining the influence of habit on E2.0 continuance usage in different regions and countries.

ACKNOWLEDGEMENTS

This work was supported by Fundamental Research Funds for the Central Universities [grant numbers 2014B18914, 2014B01414]; Jiangsu Provincial Natural Science Foundation of China [grant number BK20150823], the youth project of National Social Science Fund (Project no. 14CGL020) and The Humanities and Social Sciences Foundation of the Ministry of Education in China (Project No. 16YJC630028)

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APPENDIX

Construct	Items	Sources
Intention to renew E2.0	(1=Strongly Disagree to 7=Strongly Agree) IN1: I intend to continue using Mingdao rather than discontinue its use after the trial account expires. IN2: My intention is to continue using Mingdao rather than use any alternative means. IN3: If I could, I would like to discontinue our use of Mingdao after the trial account expires (reverse coded) .	[7]
Firm Size	What is the number of employees in your organization?	[68]
Firm Scope	What is the number of establishments (branches) where your organization develops business activities?	[68]
Subjective Norms	(1=Strongly Disagree to 7=Strongly Agree) SN1: In our firm, people who are important to me think that I should support the continuance use of Mingdao. SN2: In our firm, people who influence me think that I should support the continuance use of Mingdao. SN3: In our firm, colleagues whose opinions I value think that I should support the continuance use of Mingdao.	[62]
Perceived Usefulness	(1=Strongly Disagree to 7=Strongly Agree) PU1: Through using Mingdao, I facilitate collaboration and communication. PU2: Through using Mingdao, I improve operational efficiency. PU3: Through using Mingdao, I improve organizational structures.	[7]
Satisfaction	How do you feel about your overall experience of Mingdao use to the present time: S1 Very dissatisfied (1) - Very satisfied (7) S2 Very displeased (1) - Very pleased (7) S3 Very frustrated (1) - Very contented (7) S4 Absolutely terrible (1) - Absolutely delighted (7).	[7]
Confirmation	(1=Strongly Disagree to 7=Strongly Agree) C1: My experience with using Mingdao was better than what I expected. C2: The benefits with using Mingdao were better than I expected. C3: Overall, most of my expectations from using Mingdao were confirmed.	[7]
Competitive Pressure	(1=Strongly Disagree to 7=Strongly Agree) CP1. More and more competitors in your industry have conducted team collaboration and communication through E2.0 CP2. More and more competitors in your industry have conducted knowledge management and sharing through E2.0 CP3. More and more competitors in your industry have conducted project management through E2.0	[70]

An Empirical Investigation of Smart Product Adoption

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ABSTRACT

The advance of information technologies and the Internet have been enabling the transformation of physical products into smart products by embedding information technologies into the products and thereby making them intelligent. The movement to the 'Internet of Things' is accelerating connection of the products to the net. While those changes could enhance value propositions of products, they might also cause consumer privacy concerns, which might hinder smart product adoption, because the smartness of the product mainly takes advantage of personal information about the users. This study aims to investigate consumers' intention to adopt smart products. Building on previous studies on smart products and privacy literature, we propose a research model that explains factors influencing consumers' intention to adopt smart products. The proposed research model is empirically tested using data from an online survey of consumers. The overall results validate the proposed research model of smart product adoption. Specifically, perceived personalization is found to positively affect consumers' intention to adopt smart products, whereas information privacy risk decreases the intention. We also find that the attributes of personal information are critical antecedents of consumers' risk-benefit assessment. The sensitivity of information increases information privacy risk while the congruency of information enhances perceived personalization. Based on the results, theoretical and managerial implications are discussed.

Keywords: Smart product adoption, perceived personalization, information privacy concern, personal information, attributes of information.

INTRODUCTION

Information technology has been changing physical products drastically, which is being accelerated by the movement to the 'Internet of Things.' The change in physical products includes two major types of transformation. One is digitization of physical products as can be seen in the transformation of books into e-books. The other is transformation into smart products, where the physical form of a product remains, however the product itself gets smart. Smart products are defined as "products with digital representations that enable adaptation to situations and consumers." [18, p. 212]. Smart products, containing information & communication technology, are able to collect, process, and produce information, and interact with users, other products, and environments [25].

Whereas digitization of physical products is usually confined to those products whose core values are the information they contain (i.e., information goods), transformation into smart products can be applicable to almost all physical products, offering firms with new opportunities for product innovation. In this regard, Porter and Heppelmann [23] view the transformation as a third transformation information technology has introduced to competition and strategy.

While the change of a product into a smart one could equip the product with enhanced consumer value, it may also cause consumer privacy concerns because the smartness of the product mainly takes advantage of personal information about the users such as their identities, usage behaviors, and/or usage contexts. Therefore, consumers' privacy concerns are a critical issue for firms to address to capitalize on smart products, and a major potential factor that works in consumers' decision to adopt smart products as well.

The main objective of this study is to investigate consumers' intention to adopt smart products. Building on previous studies on smart products and privacy literature, we propose a research model that explains factors influencing consumers' intention to adopt smart products. Specifically, we posit that consumers' adoption decision is guided by the evaluation of the tradeoff between the benefit and cost related to their use of smart products. We consider personalization and information privacy risk as key benefit and cost factors respectively. Further, we link two attributes of personal information with the two factors and propose that sensitivity of information can affect information privacy risk while congruency of information can influence perceived personalization. The proposed research model is empirically tested using data from an online survey of consumers.

The rest of this paper is organized as follows. Related literature is reviewed and research hypotheses are proposed in the following section. We then describe our research methods for online survey and data gathering. Afterward, we analyze the data and provide the analysis results. Finally, we conclude with a discussion about our findings.

THEORETICAL BACKGROUND AND HYPOTHESES

Smart Products

Porter and Heppelmann [23] suggest that smart products consist of three core elements: physical components, "smart" components, and connectivity components; Smart components enhance the capabilities and value of the physical components, while connectivity components amplify the capabilities and value of the smart components and enables some of them to exist outside the physical product itself. The combination of the components leads to enhanced value proposition. The authors categorize functions and capabilities of smart products into four areas: monitoring, control, optimization, and autonomy, each of which sets the stage for the next level [23].

In a similar vein, Rijdsdijk and Hultink [24] refer to smart products' abilities collectively that differentiate them from non-smart products as product smartness. Based on this concept, Rijdsdijk and Hultink [24][25] suggest seven dimensions of product smartness; autonomy, adaptability, reactivity, multifunctionality, ability to cooperate, humanlike interaction, and personality. The definition of each dimension is summarized in Table 1.

Table 1: Dimensions of Product Smartness [25]

Dimension	Definition
Autonomy	The extent to which a product is able to operate in an independent and goal-directed way without interference of the user
Adaptability	A product's ability to improve the match between its functioning and its environment
Reactivity	The ability of a product to react to changes in its environment
Multifunctionality	The phenomenon that a single product fulfills multiple functions
Ability to cooperate	The ability to cooperate with other devices to achieve a common goal
Humanlike interaction	The degree to which the product communicates and interacts with the user in a natural, human way
personality	A smart product's ability to show the properties of a credible character

At the heart of the above dimensions is the capability of adaptability, which implies that smart products are able to adapt to users and contexts. For example, independent operation of a smart product without the user's interference (autonomy) or reaction to changes in the environment (reactivity) would not be possible without the product's perception of and adaptation to its operating context. Three core components of adaptability include adaptation to situational contexts, adaptation to actors that interact with products, and adaptation to underlying business constraints [18].

Because adaptation is enabled by perceiving information about user activities and context [18, p.212], an indispensable prerequisite for adaptation is collection and use of information about the user and her usage of the product. As such, Porter and Heppelmann [23] argue that the information is fundamental to value creation and competitive edge in smart products. However, the collection and use of personal information cause consumer concerns for their privacy. Therefore, consumers' privacy concerns are not only a critical issue for firms to address to capitalize on smart products, but also a major potential factor that works in consumers' decision to adopt smart products.

Privacy Calculus and Smart Product Adoption

The privacy calculus framework is a well-established theoretical perspective to explain individuals' decisions regarding personal information disclosure [9]. The perspective conceptualizes the individual's privacy interests as an exchange where individuals provide their personal information in return for certain benefits [28]. As such, consumers' privacy decisions are accompanied by an assessment of the costs (risks) and benefits related to information disclosure [8] [10]. A positive net outcome implies that individuals are more likely to accept the loss of their privacy involving disclosure of personal information as long as the level of risk is acceptable [9]. Based on this logic, it is predicted that benefits related to information disclosure increase the likelihood of personal information disclosure while related risks decrease the likelihood.

Because collection and use of personal information is the fundamental source of enhance value proposition of smart products that differentiate them from non-smart products, refusal to personal information disclosure can be equated with refusal to smart product adoption. Therefore, risks related to information disclosure are expected to decrease consumers' intention to adopt smart products, whereas benefits are expected to positively affect the adoption intention.

In this study, we consider information privacy risk as a critical risk factor in consumers' decision. Information privacy risk is defined as potential loss of control over personal information [11]. Previous empirical studies have verified the negative impact of information privacy risk on willingness to disclose personal information [10] [19] [28] and on product/service adoption decisions [11]. Therefore, we suggest the following hypothesis.

H1: Information privacy risk is negatively related to intention to adopt smart products.

We consider perceived personalization as a critical benefit factor in consumers' privacy (therefore adoption) decision regarding smart products. Personalization refers to "the ability to provide content and services that are tailored to individuals based on knowledge about their preferences and behaviors [1, p. 84]." This definition implies that personalization is about people and personalization is adaptive [26]. Therefore, personalization reflects the smart products' key capability, adaptability. Because adaptability (and personalization) is enabled collection and use of personal information, there should be a tension between benefit of personalization and risk of information disclosure in consumer decisions regarding smart products, which is reflected in the concept of 'personalization-privacy paradox' in the privacy literature [3]. Therefore, perceived personalization, a consumer's perception of a smart product's personalization, is expected to increase adoption intention, leading to the following hypothesis.

H2: Perceived personalization is positively related to intention to adopt smart products.

Information Attributes and Privacy Calculus

We consider two attributes of personal information that is collected in the usage of smart products, information sensitivity and information congruency. The attributes are linked with the privacy calculus as antecedents of the risk and benefit factors.

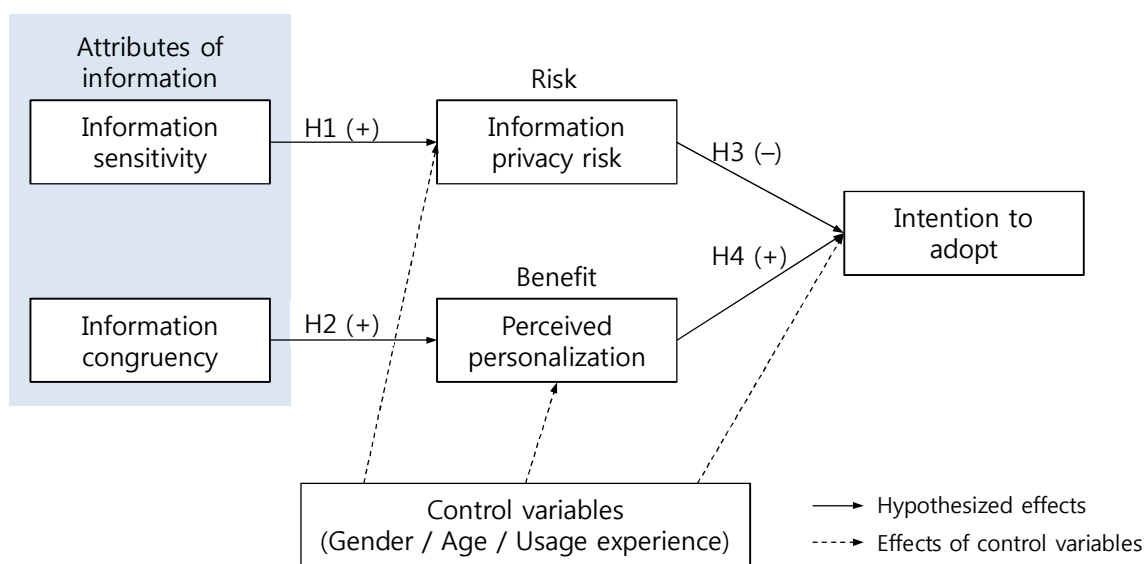
Following Angst and Agarwal [2] and Li et al. [17], information sensitivity is conceptualized as an attribute of personal information that indicates the level of discomfort an individual perceives when disclosing that specific personal information. Disclosure of personal information implies potential of loss of control over that information [28], and individuals' reactions to privacy threats depend on the type of information requested [19] [22]. Because releasing more sensitive information is more likely to instigate risk belief than releasing less sensitive information, information sensitivity is expected to increase information privacy risk. Thus, we suggest Hypothesis 3. Please note that given that information sensitivity is conceptualized as a perception concerning specific personal information, people may attach different levels of sensitivity to the same information, generating variation across people.

H3: Information sensitivity is positively related to information privacy risk.

Information congruency is conceptualized as the degree to which the information requested appears relevant to the purpose of transactions with the firm [27]. In the context of smart product usage, information congruency can be defined as the degree to which an individual perceives that specific personal information collected appears relevant to the purpose of smart product usage. Because personal information is a critical input to personalization, personalization is a function of the information. For congruent information, a consumer would perceive that she could effectively achieve her purpose of smart product usage and, more specifically, enjoy enhanced value in the form of personalization. Therefore, the congruency of information would have a positive effect on perceived personalization.

H4: Information congruency is positively related to perceived personalization.

Figure 1 shows the research model in this study



RESEARCH METHOD

We conducted an online survey of consumers to test the research model empirically. We chose a real smart product and asked survey participants to respond questions measuring their perceptions about the product. A market research company administrated the survey using its large-scale online panel of consumers.

The smart product we chose was a smart toothbrush by Oral-B. The product was launched in the U.S. and several European countries at the time of the survey. It is an electric toothbrush coupled with a smartphone application through Bluetooth communication. The product offers several smartness features. For example, it provides users with real-time feedback on their brushing by telling exactly which part of the mouth to brush now and displaying the time elapsed on the application screen. Equipped with a pressure sensor, it notifies the user if she toothbrushes too hard. Users can control the operation of the toothbrush by changing the application settings. The application saves the user's brushing history, which can be handed over to dentists to suggest customized dental care.

Electronic toothbrushes are, although the smart toothbrush is not, a popular product category most consumers are acquainted with. Further, a smart toothbrush is a personal appliance each consumer can consider purchasing. Therefore, it was judged

appropriate for the empirical context of our study.

Participants and Measurement Items

A total of two-hundred respondents participated in the survey. Among them, seven were screened out owing to insincere responses. We used the remaining data for the analysis (sample size = 193). The demography of the sample shows an equal representation of male (47%) and female (53%) and a well-balanced distribution in age (21% in 20s, 26% in 30s, 31% in 40s, and 22% in 50s or 60s) with an average age of 39.8.

When accessing to the survey site, the respondents were asked to acquaint themselves with the description of the smart toothbrush presented on the screen including its pictures and features. To ensure that the respondents read it carefully, the survey system was set in such a way that they could move to the next page only after they stay on the page during at least thirty seconds. Then, the survey items were presented on the following pages. The items intended to measure the five constructs included in the research model and demographics and control variables. A total of seventeen items were employed as presented in Table 2.

Sensitivity of information was measured with two items based on Hui et al. [13]. Congruency of information was measured using three items adapted from Li et al. [17], where information congruency is measured in the context of membership sign-up for a commercial website. Three indicators measuring information privacy risk were adapted from Xu et al. [28], which examines information privacy and personal information disclosure in the location-based service context. Perceived personalization was measured with three items adopted from Komiak and Benbasat [16] and Sheng et al. [26], which deal with online personalization services. Intention to adopt smart product consists of three items used in Pavlou and Fygenson [21] and Kim et al. [14] to measure adoption intention. All of the items were measured on seven-point Likert scales with 1 being “strongly disagree” and 7 being “strongly agree.”

We measured, as a control variable, electric toothbrush usage experience because there may exist systematic differences in perceived personalization and adoption intention of smart toothbrush between those who have experienced electric toothbrushes and those who have not. We also measured gender and age and used them as control variables.

Table 2: Measurement Items

Construct	Measurement Item	
Information sensitivity (SEN)	SEN1 SEN2	It seems that sensitive personal information is collected during the use of the product. I would feel sensitive about sharing my personal information during the use of the product.
Information congruency (CON)	CON1 CON2 CON3	Personal information gathered seems relevant for effective use of the smart product. Personal information gathered appears to have a bearing upon the purpose of using the product. It seems that personal information necessary for the use of the product is collected and shared appropriately.
Information privacy risk (PRI)	PRI1 PRI2 PRI3	If I use the product, ... providing my personal information during the use of the product would involve many unexpected problems it would be risky to disclose my personal information during the use of the product. there would be high potential for loss in disclosing my personal during the use of the product.
Perceived personalization (PER)	PER1 PER2 PER3	If I use the product, this product would ... understand my needs. know what I want based on my personal information provide me with personalized teeth care functions.
Intention to adopt (INT)	INT1 INT2 INT3	I intend to purchase this product. I am likely to purchase this product. I am willing to use this product for better teeth care.
Gender Age Electric toothbrush usage experience	GEN AGE EXP	What is your gender? What is your age? Have you ever used electric toothbrushes?

ANALYSIS RESULTS

To test the proposed research model, both the measurement model and structural model were analyzed. After examining the measurement model, we provide the results of the hypothesis tests based on the estimation of the structural model.

Evaluating the Measurement Model

We performed a confirmatory factor analysis using AMOS to evaluate the measurement model. A maximum likelihood estimation was employed for the analysis. First, the model fit was examined and fit measures indicated an acceptable fit. The relative (or normed) chi-square value (chi-square / degree of freedom) of 2.19 is lower than the threshold of 3.0 recommended by

Kline [15] and the threshold of 5.0 by Byrne [6]. Fit indices (CFI = 0.96, NFI = 0.92, TLI (NNFI) = 0.94) and RMSEA (= 0.08) also satisfies common criteria [5] [12]. Therefore, the results display a satisfactory level of fit between the measurement model and the data.

Next, construct validity and reliability were evaluated. To assess the convergent validity, we examined the factor loadings, composite reliability, and average variance extracted. As shown in Table 3, all of the factor loadings are greater than 0.6, a common criteria suggested by Bagozzi and Yi [4]. The composite reliability scores are greater than 0.79 for all constructs, exceeding a commonly recommended threshold of 0.7 [20]. Finally, the average variance extracted for each construct is greater than 0.65, exceeding the threshold of 0.5 recommended by Chin [7]. Overall, the convergent validity is considered satisfactory.

The discriminant validity was assessed by comparing the square root of the average variance extracted for each construct with the correlation coefficients between the construct and the other constructs. As shown in Table 4, the amount of the variance captured by each construct is greater than the shared variance with the other constructs. Therefore, it is concluded that the measurement items have a sufficient level of discriminant validity.

Finally, the reliability (internal consistency) was evaluated with Chronbach's α . The last column of Table 3 shows that every construct has a Chronbach's α score greater than 0.79, satisfying the threshold of 0.7 recommended by Nunnally and Bernstein [20]. Further, none of the scores exceeds 0.95, suggesting that concern about common method bias can be ignored.

Overall, the results from the above assessments indicate that the fitness of the measurement model and the validity and reliability of the measurement scales are satisfactory.

Table 3: Factor Loadings, Average Variance Extracted, Composite Reliability, and Chronbach's α

Construct and Item	Factor Loading*	Average Variance Extracted	Composite Reliability	Chronbach's α
Information sensitivity SEN1 SEN2	0.789 0.835	0.660	0.795	0.794
Information congruency CON1 CON2 CON3	0.859 0.899 0.658	0.660	0.851	0.844
Information privacy risk PRI1 PRI2 PRI3	0.796 0.832 0.797	0.654	0.850	0.846
Perceived personalization PER1 PER2 PER3	0.904 0.899 0.825	0.769	0.909	0.908
Intention to adopt INT1 INT2 INT3	0.897 0.892 0.889	0.797	0.922	0.921

Note: 1. * $p < 0.001$ for every factor loading

Table 4: Inter-construct Correlation Coefficients

Construct	Information sensitivity	Information congruency	Information privacy risk	Perceived personalization	Intention to adopt
Information sensitivity	0.812				
Information congruency	0.101	0.812			
Information privacy risk	0.804*	0.126	0.877		
Perceived personalization	0.096	0.513*	0.047	0.809	
Intention to adopt	-0.065	0.365*	-0.114	0.473*	0.893

Note: 1. Value on the diagonal is the square root of average variance extracted (AVE).

2. * $p < 0.01$; for the others, $p > 0.05$.

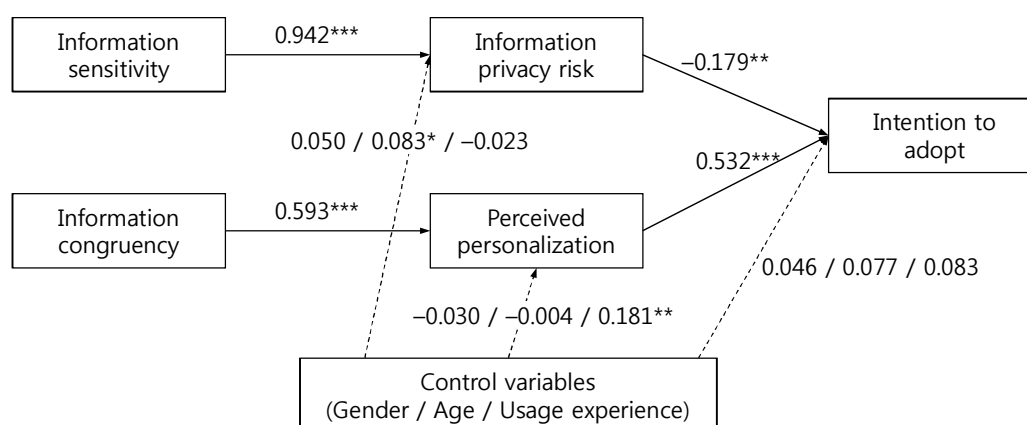
Structural Model Assessment

We conducted hypothesis tests by estimating the structural model and examining the results. First, the model fit was examined. The relative chi-square value (= 1.88) is sufficiently low, indicating an acceptable fit. Fit indices (CFI = 0.95, NFI = 0.90, TLI

(NNFI) = 0.94) and RMSEA (= 0.07) also satisfies common criteria. Therefore, the results establish a satisfactory level of fit between the model and the data.

Next, we provide the test results of the hypothesis based on the structural model estimation. Figure 2 and Table 5 show the results of estimation and hypothesis testing. Figure 2 and Table 5 include standardized path coefficients and unstandardized path coefficients, respectively. First, we consider the effects of the information attributes. The sensitivity of information is found to have a positive effect on information privacy risk with a standardized coefficient of 0.942 ($p < 0.001$), supporting Hypothesis 1. The congruency of information is found to increase perceived personalization with a standardized coefficient of 0.593 ($p < 0.001$). Thus, Hypothesis 2 is also supported.

The results reveal significant effects of the two determinants of the intention to adopt a smart product, information privacy risk and perceived personalization. Information privacy risk has a negative effect on the intention (standardized coefficient = -0.179, $p < 0.01$), validating Hypothesis 3. Perceived personalization is found to influence the intention positively (standardized coefficient = 0.532, $p < 0.001$), supporting Hypothesis 4. Therefore, all of the four hypotheses included in the research model are supported.



Note: * $p < 0.1$, ** $p < 0.01$, *** $p < 0.001$

Figure 2: Structural Model with Standardized Coefficients

Table 5: Path Model Results

Path	Unstandardized Coefficient	Standard Error	<i>t</i> -value	<i>p</i> -value	Hypothesis Test Result
Information sensitivity → Information privacy risk	1.014	0.093	10.871	< 0.001	H1 supported
Information congruency → Perceived personalization	0.501	0.069	7.313	< 0.001	H2 supported
Information privacy risk → Intention to adopt	-0.197	0.074	-2.655	0.008	H3 supported
Perceived personalization → Intention to adopt	0.719	0.106	6.749	< 0.001	H4 supported
Gender → Information privacy risk	0.106	0.093	1.138	0.255	Control variables
Age → Information privacy risk	0.007	0.004	1.873	0.061	
Usage experience → Information privacy risk	-0.034	0.066	0.511	0.609	
Gender → Perceived personalization	-0.052	0.113	-0.461	0.645	
Age → Perceived personalization	0.000	0.005	-0.068	0.946	
Usage experience → Perceived personalization	0.218	0.080	-2.713	0.007	
Gender → Intention to adopt	0.106	0.149	0.709	0.478	
Age → Intention to adopt	0.007	0.006	1.196	0.232	
Usage experience → Intention to adopt	0.136	0.107	-1.270	0.204	

Finally, we find some path coefficients involving the control variables are significant. The path between age and information privacy risk is weakly significant ($p < 0.1$), indicating that age increases information privacy risk. Further, electric toothbrush usage experience has a positive effect on perceived personalization ($p < 0.01$), suggesting that those consumers who have used electric toothbrushes evaluate personalization of the smart toothbrush more positively than those who have not. Lastly, we find no significant effect of gender.

DISCUSSIONS AND CONCLUSIONS

In this study, we investigated consumers' intention to adopt smart products. Drawing on previous studies on smart products and privacy literature, we proposed a research model that explains factors influencing consumers' intention to adopt smart products, and empirically tested the model using data from an online survey of consumers. Overall, the analysis results support the research hypotheses.

The current study has several implications. First, this study contributes to emerging research stream on smart products by exploring consumers' adoption decision of smart products. The results suggest that consumers' adoption decision is guided by the evaluation of the tradeoff between the benefit and cost related to their use of smart products. Specifically, the results show that personalization offered by smart products is a major benefit while information privacy risk is a critical cost factor in smart product usage.

The results also have important implications for firms that intend to capitalize on smart products. They need to communicate with consumers regarding enhanced value proposition of smart products, more specifically, personalization based on the capability of adaptability, to facilitate their adoption of the products. At the same time, they need to bear in mind that information privacy risk plays a critical role in consumers' adoption decisions, and thus should be addressed effectively. This may be a challenging task because the privacy issue has been rarely an business issue for the firms providing physical products. Relatedly, Porter and Heppelmann [23] suggest that firms should carefully decide which information to collect, secure, and analyze to maximize the value of their smart product offerings and how to manage ownership and access rights to the information.

Our results imply that the sensitivity and congruency of information should be important criteria in deciding which information to collect. We found that the attributes of personal information are determinants of consumers' risk-benefit assessment in their privacy calculus. The sensitivity of information increases information privacy risk while the congruency of information enhances perceived personalization. Further, because the sensitivity and congruency of information influence the risk-benefit assessment through perception about the attributes by consumers, it would be also important for firms to communicate with consumers effectively to mitigate their perception of the sensitivity of the information to be requested and to enhance their perception of the congruency of the information.

Although this study offers the above significant implications, there is a need for future research involving various smart products in terms of price and usage frequency, because the amount of benefit consumers expect from a smart product may be an increasing function of price and the amount of information collected is likely to be an increasing function of usage frequency. Further, regarding the impacts of the information attributes, our study measured the sensitivity and congruency for the aggregate information items collected in the course of the smart toothbrush usage. Therefore, overall sensitivity and congruency were considered in our empirical approach. However, each of the two attributes varies at the information item level. It would be an interesting venue for future research to study user perception on various, specific information items to be collected potentially could generate valuable implications to guide firms' decisions about which information to collect.

ACKNOWLEDGEMENT

This research was financially supported by Hansung University.

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A Research on Continuous Using Intention of the Q&A Community Platform: Evidence from “Zhihu.Com”

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ABSTRACT

We set “zhihu.com” as an example and integrate a new model to study the user's intention to continuously using the network Q & A community platform based on traditional S-O-R model, Information System (IS) success model, the unified theory of acceptance and use of technology (UTAUT) model and Error Correction Model (ECM). In the social dimension, technological dimension, service quality dimension, we carried out an empirical research on the important factors affecting the user's continually using the network Q & A community platform. Finally, we put forward suggestions and Countermeasures on how to manage the network innovation community and encourage users to participate it effectively.

Keywords: the network Q & A community; the intention to continue using; continuously use;

INTRODUCTION

Nowadays, the network Q & A community platform represented by “zhihu.com” is becoming more and more popular, proved to be one of the main fields of the Internet users access to information and online activities, called “the best Chinese Q & A community”. However, the research based on user participation or continuous to participate in online Q & A community behavior is still in the blank. This paper takes S-O-R model as the main theoretical framework, integrates IS success model, UTAUT model and ECM model, uses “zhihu.com” as example, and establishes the theoretical model of influencing factors of the user's intention to continuously using the network Q & A community platform.

This paper mainly discusses three questions. Firstly, what are the influencing factors of the user's intention to continuously using the network Q & A community platform? Secondly, which variables play the role of organic variable between stimulus and response variables? Thirdly, what kind of relationship is there between organic variables?

THEORETICAL RESEARCH

At present, a lot of research is based on the user's initial use, but some studies of users continuous use intention shows that the behavior after receiving information system is also the important factors that affect its success [1-2]. Even some studies have shown that information system's long-term success depends on the continuous use of the target information system [3].

Theory of Reasoned Action[4], Theory of Planned Behavior[5], Technology Acceptance Model[6], UTAUT[7] and especially ECM[3] have already been widely applied to explore the influencing factors of information system's continuous use. At the same time, Limayem et al. 's research confirmed that began to use and with the continuation of behavior are determined by the different purpose [8].

IS success model[9] integrates a large number of external variables or models to it, in order to find out the factors of information's continuous use, which also applied to mining the determinant of continuous use of “zhihu” platform. In addition, although the DeLone and McLean[10] shows that determinant influencing the success of information system has 3 points: information quality, system quality and service quality, Petter et al[11] hold that success factors can be divided into five categories: task characteristics, user characteristics, social characteristics, project characteristics and organizational characteristics. Additional studies are needed to confirm some of these features, especially the social characteristics. Therefore, these factors should be considered in the study of continuous use.

This article takes S-O-R model[12,13] as the basic theoretical framework, which firstly is applied to environmental psychology. Stimulus variable (S) is possible the driving force to affect the user's cognitive and emotional process; Organic variable (O) involves “between stimulus and final action, reaction between the individual internal process and structure”, which is made up of perceived, psychology, feeling and thinking; Response variable (R) is the final behavior to producing results or consumer reaction, including psychological reaction such as reaction of attitude and behavior. Some scholars extend this behavior model in the virtual community, studying outside stimulation from web page hint, interactive and social signals[14]. Based on S-O-R model, Bai et al[15] established a model contains information system success model to explore the effect of site quality on satisfaction and purchase intention. In addition, in the field of information system, S-O-R model was used to explore how online shopping environment affect consumer

behavior[16]. Therefore, it shows that S-O-R model is a right choice about confirming the factors that affect consumers' continuous use to zhihu platform.

THEORETICAL MODEL AND RESEARCH HYPOTHESES

Theoretical model

This paper based on the S-O-R model, IS success model, the UTAUT model, the TTF model and ECM model, build a portfolio model to explore the determinants of zhihu platform users continuous using intention. Figure 1 summarizes our research model.

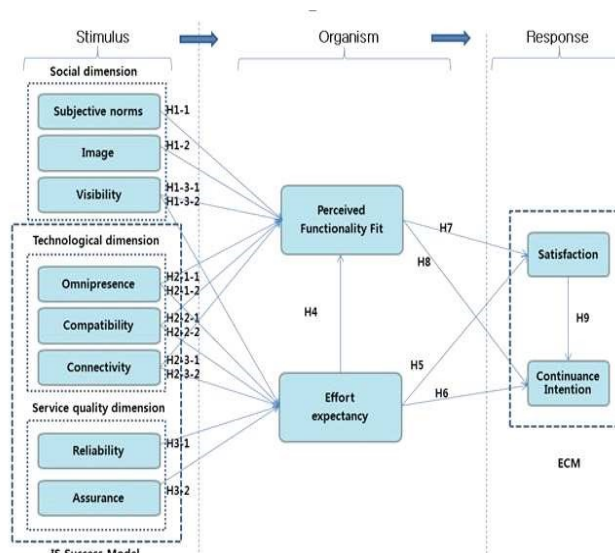


Figure 1: Research model.

In this model, stimulate stage includes three dimensions: social dimension (subjective norm, image and popularity), technical dimensions (universality, compatibility and connectivity) and dimension of service quality (reliability, ensure degrees), in the three dimensions, the service quality and technical structure adopted by the information system success model. From the social dimension, this paper adopted subjective norms, image and popularity as an determinant of information system's success[13]. Individual psychological characteristic stage includes two dimensions: pay expectations and cognitive function. These mediation variables are adopted respectively from UAUT and TTF model, as a process of user's response to stimulation of the cognitive [17]. Finally, on the "reaction stage", this paper studies the function relationship of the mediation variables with platform satisfaction and continuous intention.

Research hypotheses

Social dimension

According to the TRA and TAM2, the concept of subjective norm is defined as somebody hold that most people who are important to him think he or she should use the new system or technology[4]. Previous studies have confirmed that the subjective norms have significantly influence on perceived attitude[17,18]. On zhihu platform, support online collaboration is one of the most important features, for online collaboration and document sharing, users often consider the views or demand of the colleagues or peers. Therefore, the following hypotheses can be formulated:

H1-1 Subjective norms will have positive effects on cognitive function's accommodation.

Image refers to enhancing a person's perception of the image or status with innovation in the social system. It emerged from relative advantage and was regarded as a social approval. New technology has been considered as a symbol of social value, which can then be used to prompt the user to adopt it. Previous research has empirically demonstrated that the image is one of antecedents on behavior intention to continued usage of IT. In term of new technology, the Zhihu platform can be seen as a symbol of a new fashion (like the latest smart phone or application) and it can be used to improve his or her self-esteem in the social environment. This status will increase the communication and collaboration with other colleagues or friends, and improve working efficiency. Therefore, the following hypotheses can be formulated:

H1-2 Image will have a positive effect on cognitive function.

Visibility refers to the context in which the innovation is visible. It implies that if a person finds many benefits of a service before the subscription, he or she can establish a positive view and attitude on the technology. Some articles use this innovative feature to predict the continued use of behavior. Although visibility is often used to explain the behavioral beliefs in the field of IT, recent empirical evidence suggests that it also has a positive effect on behavioral attitudes. Active exploration of experience will help individuals to gain more efficient use of knowledge from the platform. Therefore, the following hypotheses can be formulated:

H1-3-1 Visibility will have a positive impact on perceived functionality fit.

H1-3-2 Visibility will have a positive effect on effort expectancy.

Technological dimension

Generally, refers to that as long as users access to the Internet, they can visit the website. It is defined as a unique property of the platform. Using the platform will help users overcome the limitations of location and time, and through the usage of different computing devices and applications. Universality can help users understand and use the platform more easily. It can also improve the efficiency of users by constantly using information and applications. Therefore, the following hypotheses can be formulated:

H2-1-1 Universality will have a positive impact on cognitive function.

H2-1-2 Universal will have a positive effect on effort expectancy.

Compatibility is the degree to which an IT innovation is perceived as being consistent with the existing values, needs, and past experiences of potential adopters. New system compatible with existing IT can lead to be understood and adopted more quickly. This is because users need not to change and learn new behaviors to fit new target system. If you know that the platform can be compatible with the current system, it will be more easily to learn and also more useful. Previous studies have indicated that compatibility also indirectly affects people's behavioral intentions through objective beliefs. Therefore, the following hypotheses can be formulated:

H2-2-1 Compatibility will have a positive impact on cognitive function adaptation.

H2-2-2 Compatibility will have a positive impact on pay expectations.

Connectivity is user's perception that to what extent a connection is speedy and stabile. It is regarded as an important factor of internet's service quality in the context of mobile game. In case of zhihu, stable connection will enhance collaboration thereby result in a higher completion of task, which means the more efficient connectivity it owes, the better assignments performance it will be aligned. And collaborating with friends or colleagues frequently lead to he or she can receive more assistance, by which the consumers will believe zhihu is ease to use. Therefore, the following hypotheses can be formulated:

H2-3-1 Connectivity will have a positive impact on cognitive functioning.

H2-3-2 Connectivity will have a positive impact on the expectations of the pay.

Service quality dimension

Reliability refers to the extent to which ability to perform and maintain the promised service timely, dependably and accurately. Van Gorder suggested that reliability is the most important factor in determining service quality. Customers may be especially concerned about the reliability of service delivery on the basis of a new technology, because they may consider some performance in that service may not work well. However, in the context of the zhihu services, providers perform software update and fix system vulnerabilities timely, and resolve questions accurately. Users may have perceptions of benefits from these conception, whereby users can learn instructions of zhihu with less effort and time, and accomplish task more efficiently on the zhihu's environment. Therefore, the following hypotheses can be formulated:

H3-1 Reliability will have a positive impact on cognitive function.

Assurance refers to the knowledge and courtesy of employees and their abilities to inspire trust and confidence. Although zhihu's environment differs from the traditional service, it still offers professional assistance to users for helping them accomplish tasks. For instance, even if a person is not familiar with Google Docs, he or she might handle the problems though accessing the "help center" to acquire help or send feedback to the company. This approach may precipitate consumer to understand and experience the zhihu service instead of face-to-face. At the same time, knowledge-based familiarity with zhihu vendors will positively affect perceptions of ease to use. Therefore, the following hypotheses can be formulated:

H4 Effort expectancy will have a positive effect on perceived functionality fit.

H5 Effort expectancy will have a positive effect on user satisfaction.

H6 Effort expectancy will have a positive effect on continuance intention to use the zhihu services.

Perceived functionality fit refers to the extent to which an individual believes that functionalities of the system will match his or her needs. This construct is adapted from task-technology Fit (TTF) model. Although previous research discovered that TTF can be combined into other models (e.g., TAM, UTAUT) for exploring the IT adoption in different context, they only tested its effects on perceived IT beliefs. Negahban and Chung conducted an empirical research and proposed that objective beliefs can also affect user's perception of device functionality fit. Based on the TTF, they developed a new construct, namely perceived functionality fit, and tested its validity as well. Owing to focusing on functionality perspective, this present study adopts this construct as a prominent mediating variable which influence on continuance intention directly. Perceived fit can be used to test the satisfaction in term of adopting technology to fulfill the needs of tasks. If the zhihu services match consumers' requirement, users will perceive satisfaction and continue towards using the services. Therefore, the following hypotheses can be formulated:

H7 Perceived functional compliance will have a positive impact on the user's satisfaction.

H8 The perception of functional compliance will have a positive impact on the willingness to continue to use the knowledge on the platform.

Satisfaction refers to the degree of individual's pleasure or disappointment of using target systems. According to ECM theory, IS continuance intention is primarily determined by users' satisfaction with prior IS use. Previous studies have proved this significant relationship in several contexts. For the zhihu services, this study posit users' satisfaction is linked with continuance intention. Therefore, the following hypotheses can be formulated:

H9 Satisfaction will have a positive impact on the intention of the service of the platform.

Finally, the relations between model variables are as shown in table 1.

Table 1: THEORETICAL MODEL AND RESEARCH HYPOTHESES

Construct	Definition	Sources
Subjective norm	The person's perception that most people who are important to him think he or she should use the new system or technology	Fishbein and Ajzen (1975) Taylor and Todd (1995)
Visibility	The degree to which the innovation is visible in the organization	Rogers (1983) Moore and Benbasat (1991)
Image	The degree to which use of an innovation is perceived to enhance one's image or status in one's social system	Rogers (1983) Moore and Benbasat (1991)
Omnipresence	The extent to which subjects expected anytime/anywhere access to the zhihu services, given their access to the Internet	Buttel (2010) Bhattacharjee(2013)
Compatibility	The degree to which an IT innovation is perceived as being consistent with the existing values, needs, and past experiences of potential adopters	Rogers (1983) Moore and Benbasat (1991) Kim et al. (2010)
Connectivity	The person's perception that to what extent a connection is speedy and stabile	Kim and Hwang (2012)
Reliability	The extent to which ability to perform and maintain the promised service timely, dependably and accurately	Parasuraman (1988) Van Gorder (1990) Xu et al. (2013)
Assurance	The knowledge and courtesy of employees and their ability to inspire trust and confidence	Parasuraman (1988) Xu et al. (2013)
Effort expectancy	The extent to which a person believes that using a system is free of effort.	Venkatesh et al. (2003, 2012)
Perceived functionality fit	The extent to which an individual believes that functionalities of the system will match his or her needs	Negahban and Chung(2014)
Satisfaction	The degree of individual's pleasure or disappointment of using target systems	Bhattacharjee (2001)

Continuance intention	Intention to continue using the technology	Bhattacharjee (2001)
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QUESTIONNAIRE DESIGN AND DATA COLLECTION

All measurement items were adapted from previous literature, with minor modifications in wording to make them relevant in the context of internet financial sales platforms. The measurement items were formulated by a seven-point Likert scale, ranging from 1 “strongly disagree” to 7 “strongly agree”. Before posting formal survey, the survey was examined by bachelor’s degree students (n=20) in a MIS program who have experience of internet financial sales platform to reduce possible ambiguity in the questions. Respondents were asked about any problems they may have encountered in the survey. Comments and suggestions on the items’ contents were solicited.

Most of the respondents are undergraduates at the age of 18 to 22 years old, coming from different positions. The survey results show that young people are keener on new technology. Zhihu is a relatively new technology, 78.8% of respondents use zhihu.

MODEL ANALYSIS

Measurement Model

The measurement model is evaluated based on its reliability and validity. We assessed the reliability with Cronbach’s α , composite reliability (CR) and the average variance extracted (AVE). For a construct with good reliability, Cronbach’s α should be at least 0.7, CR should exceed 0.5, and the AVE should be larger than 0.7 (Hair et al. 1998). As shown in Table 2, all values are larger than the generally accepted values, representing good reliability.

Table 2: CONSTRUCT RELIABILITY AND CONVERGENT VALIDITY.

	Item	factor loading	CR	AVE	Cronbach's α
Subjective norm	Those people who influence my behavior think that I should use the zhihu platform.	0.879	0.9129	0.7774	0.908
	Those people who are important to me think that I should use the zhihu platform.	0.875			
	Those people whose opinions that I value prefer that I use the zhihu platform.	0.891			
Image	People who use the zhihu platform have a high profile in my department .	0.850	0.8658	0.7636	0.928
	Using the zhihu platform is a status symbol in my department.	0.897			
Visibility	In my department one sees the zhihu platform a lot.	0.835	0.886	0.7215	0.890
	The zhihu platform is very visible in my department .	0.851			
	In my department one sees lots of people is using the zhihu platform.	0.862			
Omnipresence	I can use the zhihu platform anytime and anywhere, given that I have access to Internet.	0.881	0.8718	0.6952	0.874
	I find the zhihu platform easy to accessible, given that I have access to Internet.	0.872			
	I find the zhihu platform is available to use whenever I need it.	0.741			
Compatibility	I believe the zhihu platform is compatible with existing technology.	0.841	0.8863	0.7221	0.921
	I believe the zhihu platform is compatible with my previous experience.	0.870			
	I believe the zhihu platform is compatible with my daily routine tasks.	0.838			
Connectivity	The zhihu platform has a rapid initial connection speed	0.900	0.9335	0.8239	0.911
	The zhihu platform has a rapid synchronization speed	0.911			
	The zhihu platform has a stable connection.	0.912			
Reliability	The zhihu platform provider’s service is dependable	0.795	0.8116	0.5897	0.829
	When the zhihu platform provider promises to do something, it does so.	0.746			
	The provider performed services right during my task	0.762			

Assurance	The provider of the zhihu platform has a good reputation.	0.845	0.8952	0.7401	0.836
	My personal information feels secure on the zhihu platform.	0.893			
	I can trust the provider of the zhihu platform	0.842			
Effort expectancy	Skillfully using the zhihu platform is easy for me.	0.732	0.8217	0.538	0.845
	My interaction with the zhihu platform is clear and understandable.	0.765			
	I find the zhihu platform easy to use.	0.607			
	Learning the zhihu platform need not so much time	0.814			
Perceived functionality fit	The functionality of the zhihu platform meets my needs	0.868	0.8707	0.692	0.914
	The zhihu platform has all the functionality that I find necessary	0.832			
	I am satisfied with the functionality of the zhihu platform.	0.794			
Satisfaction	Technical things considered, I am very satisfied with the zhihu services.	0.743	0.8681	0.6225	0.931
	I am very pleased with using the interface of the zhihu platform.	0.835			
	I am very content with using the interface of the zhihu platform.	0.818			
	Overall, my interaction with the zhihu platform is very satisfying.	0.756			
Continuance intention	I intend to continue using the zhihu platform rather than discontinue its use.	0.746	0.8229	0.6079	0.896
	My intentions are to continue using the zhihu platform rather than use any alternative technology.	0.791			
	If I could, I would continue my use of the zhihu platform.	0.801			

Discriminant validity was examined using criteria suggested by Fornell and Larcker (1981): the square root of AVE from each construct should be greater than the correlations between the construct and the other constructs. Each construct in our research model has a higher loading on its corresponding construct than its cross-loadings on other constructs, thus providing evidence of discriminant validity (Table).

Table 3: DISCRIMINANT VALIDITY: THE SQUARE ROOT OF AVE AND CORRELATION

Items	SN	IM	Vis	Com	Om	Con	RE	AS	EE	PFF	Sat	SN
SN	0.881											
Im	0.483	0.874										
Vis	0.366	0.364	0.849									
Com	0.138	0.172	0.314	0.834								
Om	0.143	0.140	0.308	0.453	0.850							
Con	0.061	-0.188	-0.021	0.014	-0.004	0.908						
RE	0.266	0.266	0.311	0.355	0.431	0.051	0.768					
AS	0.029	0.043	0.129	0.053	0.155	0.106	0.089	0.860				
EE	0.270	0.225	0.210	0.373	0.292	0.182	0.426	0.149	0.733			
PFF	0.283	0.170	0.205	0.266	0.319	0.106	0.380	0.043	0.619	0.832		
Sat	0.232	0.258	0.355	0.378	0.497	0.048	0.588	0.128	0.449	0.467	0.789	
CI	0.215	0.273	0.396	0.394	0.444	-0.039	0.478	0.135	0.440	0.340	0.641	0.780

It shows that measurement model has already passed the validity test, so we can discuss the structural model.

Structural Model

To assess how well the model represents the data, this paper employed AMOS 6.0 to evaluate' Goodness-of-Fit Indexes. We found that most of the model fit indices ($\chi^2/df=1.932$, RMSEA=0.051, GFI=0.852, AGFI=0.810, CFI =0.941, NFI=0.887 and IFI=0.942) are within the commonly accepted thresholds suggested in the literature (Fornell & Larcker 1981; Hair et al. 1998). The fit indices indicate that the model provides a relatively good fit.

Table 4: MODEL FIT INDICES.

Fit index	Observed value	Recommended value	References
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$\chi^2/\text{d.f.}$	1.932	Good fit (should be less than 3)	Fornell and Larcker 1981
GFI	0.852	Good fit (should be greater than 0.80)	Hair <i>et al.</i> 1981
AGFI	0.810	Good fit (should be greater than 0.80)	Hair <i>et al.</i> 1981
NFI	0.887	Good fit (should be greater than 0.80)	Fornell and Larcker 1981
IFI	0.942	Good fit (should be greater than 0.90)	Hair <i>et al.</i> 1981
CFI	0.941	Good fit (should be greater than 0.90)	Fornell and Larcker 1981
RMSEA	0.051	Good fit (should be less than 0.80)	Hair <i>et al.</i> 1981

The structural model's test result of each hypothesis is shown in table 5.

Table 5: HYPOTHESIS TESTING RESULTS

假设路径			Estimate	S.E.	C.R.	P
Subjective norm	-->	Functionality fit	.130	.032	4.002	***
Image	-->	Functionality fit	.160	.047	3.416	***
Visibility	-->	Functionality fit	-.026	.030	-0.854	.393
Visibility	-->	Effort expectancy	.150	.034	4.455	***
Omnipresence	-->	Functionality fit	.049	.025	1.990	.047*
Omnipresence	-->	Effort expectancy	.083	.029	2.850	.004**
Compatibility	-->	Functionality fit	.069	.033	2.101	.036*
Compatibility	-->	Effort expectancy	.178	.040	4.428	***
Connectivity	-->	Functionality fit	.055	.022	2.537	.011*
Connectivity	-->	Effort expectancy	.029	.029	.983	.325
Reliability	-->	Effort expectancy	.186	.036	5.224	***
Assurance	-->	Effort expectancy	.059	.025	2.031	.042*
Effort expectancy	-->	Functionality fit	.406	.056	7.257	***
Effort expectancy	-->	Satisfaction	.837	.122	6.885	***
Effort expectancy	-->	Continuance Intention	.298	.069	4.310	***
Functionality fit	-->	Satisfaction	.614	.102	6.020	***
Functionality fit	-->	Continuance Intention	.393	.093	4.211	***
Satisfaction	-->	Continuance Intention	.187	.060	3.105	.002**

Notes: *** represents $p < 0.001$; ** represents $p < 0.005$; * represents $p < 0.01$

Results show that 16 of the 18 hypotheses are significant, which suggests that the pay expectations, cognitive function, and satisfaction have significant effects on continuous intention. Therefore, they all have a positive influence on the continuous use of zhihu. If zhihu's service disappoint users, many of them will give up using it. In addition, easy operation and better connectivity will promote users continue to use zhihu.

Both pay expectations and cognitive functions provide active user satisfaction, which shows that those two variables are determinant. Therefore, zhihu team can focus on simplifying the operating process, adding more appropriate function to increase satisfaction.

The hypothesis of positive influence is significant to pay expectations and cognitive function. This suggests that when users realize zhihu is easy to use, they will think zhihu can meet their needs, so more easy zhihu is, more frequently user use it.

Overall, the test results are as follows: H1-1, H1-2, H1-3-1, H1-3-2, H3-1, H4, H5, H6, H7 and H8 are significant ($p < 0.001$), H2-2-2 is positively associated with H9 ($p < 0.001$), H2-1-1, H2-2-1, H2-3-1 and H3-2 are supported ($p < 0.05$), H1-3-1 and H2-3-2 are not supported ($p < 0.05$).

CONCLUSIONS AND SUGGESTIONS

Conclusions and contributions

First of all, online Q & A community is a relatively new concept, related research is still in the early stage. This paper integrate a new model to do research on continuous use of Q & A community , compared with the traditional information system success model, in addition to technical dimensions and service quality dimensions, also pay attention to the social dimension.

Secondly, S-O-R framework has already been widely used in market research, but less in the field of information systems. Studies have confirmed that S-O-R can be used as theoretical framework about structural information technology adoption behavior, and its application in the field of information systems are appropriate.

Finally, the model defined a series of factors that have positive influence on behavior, and inspect the mediation effect and its influence on information systems continuous use intention, these variables can also be used in other places.

The results of the study has a certain practical significance, it can do good help for online Q & A community to maintain existing users.

From social dimension, Q & A community should pay more attention to those who have social status, easy operation can improve user satisfaction, for the user, using a Q & A community can also raise users' profile in the social system.

From technology dimensions, Q & A needs to consider how to improve connectivity performance brings more convenient network access service to users, considering compatibility at the same time, which will enhance the user satisfaction.

From service quality dimensions, Q & A community's Stability is very important. Regularity of product updates, prompt reply to the question and rapid leak repairment will help the user use the community more easily and efficiently.

Limitations and futural research direction

Firstly, this paper emphasizes three important dimensions of continuous use intention of the network Q & A community . At the same time, there are also some other factors need to be confirmed. For example, surveys show that most users prefer to use free Q & A community, therefore, we need to study the relationship between cost and adoption. Thus, other factors are recommended to study in the future.

Secondly, with the support of the research results, this paper highlights the intermediary variable cognitive function but ignored the exogenous variables' direct impact on the satisfaction and intention of continuous use. Therefore, we suggest explore the relationship between them.

Thirdly, this paper only constructs one model, therefore, in the future study, we can also build other suitable model.

ACKNOWLEDGMENT

This work has been supported by the National Social Science Foundation of China (Project No. 14BGL186).

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