

Empirical Research on Adoption Behavior of LBS Users of Mobile Management Information System

— SEM Multiple-Group Analysis Based on UTAUT Model

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Abstract: Mobile management information system has the function of LBS (Location Based Service) which may bring brand new functions and experience to users and improve the management efficiency of the organization. However, due to the potential threaten of privacy leakage that LBS may bring with, users of different types may have different levels of receptivity of LBS function. Based on UTAUT model, this paper will analyze different types of users, and empirically analyze the theoretical model and its hypotheses by SEM. Study found that performance expectancy, efforts expectancy, social influence, perceived risk and facilitating conditions have various influences on use behavior and use intention of government, enterprises, universities and research institutes. Therefore, while developing and selling the mobile management information system with LBS functions, the enterprises need to adopt different strategies based on the characteristics of different users in the stages of research and development, sales and after-sales.

Keywords: LBS, mobile MIS, UTAUT, SEM

I. INTRODUCTION

Currently, the overall access to 4G network in China and some south and southeast Asian countries surrounded it has prepared for the construction of 5G network. Wireless access is becoming the mainstream for the Internet access. At the same time, mobile phones have gradually replaced computers as one of the indispensable tools in our daily life. LBS (Location - Based Service) is a value-added service which gets position information of the mobile terminal with GPS (Global Positioning System), BDS (BeiDou Navigation Satellite System) and GIS (Geographic Information System) and is provided by the means of SMS, MMS, voice, web pages and client application etc.. Providing the Internet users with real-time location information, it is widely used in navigation, social communication and payment at the present. Integrating LBS with mobile cooperative work and management information system promises the improvement of management efficiency in the fields of international business,

business management, and public administration etc..

Although cooperative work and management information system with LBS function has a lot of advantages and development space, there exists uncertainty in users' acceptance to the system. This is because the LBS services may contribute to the reveal of personal location within the organization, and at the same time, LBS service takes more system resources and Internet data of mobile phone. Based on the uncertainty, the paper will analyse the adoption behavior of LBS users, which is of important meaning for the research and develop of Enterprise Management Information System with LBS.

II. THEORETICAL FOUNDATION AND RESEARCH MODEL

A. Literature review

At present, many scholars at home and abroad have studied the user adoption and usage intention of LBS application. Based on the fair value theory and acceptance model, Shi (2018) explored the influences of characteristics of LBS on the intention of users from the perspective of personal privacy information. The results indicates that the characteristics of personalization and interaction have positive implications to the user's perceived usefulness and perceived entertainment. And the interactive promotion will increase users' attention on privacy, which relief privacy concerns through the privacy policy. Lei (2016) explored the factors that affect the application of mobile LBS by the Elaboration Likelihood Model. The results show that when users have different motivations and different information processing capabilities, the path to persuade users to adopt the system is different. When the user is in the state of high fine processing, the central path is more effective, while when the user is in a low finesse state, edge path is more effective.

Guo et al. (2015) discussed the influence mechanism of perceived cost, situational value, security value, social value and cognitive value on users' willingness to accept LBS advertisement. Wu (2014) built a research model based on

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TAM, and empirically proved that social influence, system characteristics, relevant experience, personal difference, perceived usefulness and perceived ease-of-use significantly affected consumers' use of LBS services. Based on TAM theory, Li (2015) studied that perceived usefulness and perceived ease-of-use had positive effects on users' LBS group-buying acceptance intention, while product factors, personal factors, situational factors and website factors would affect users' perceived usefulness and perceived ease-of-use of LBS group-buying. Li (2016) believed that users' perceived usefulness and information incentive to LBS recommendation information negatively affected their compulsive feelings; Personality characteristics and time pressure have negative effects on compulsive feelings and manipulation intention inference; Perceived risk significantly positively affects compulsive perception and manipulation intention inference; and perceived ease of use has no significant impact on user manipulation intent inference.

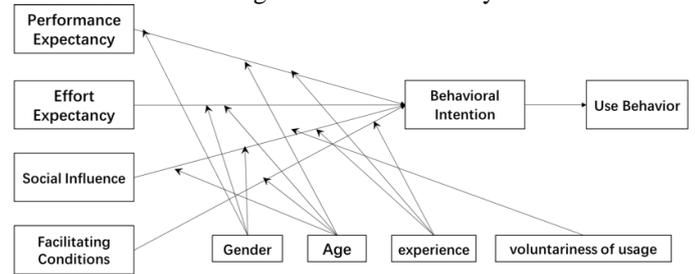
Through literature review, it can be found that because of the possible threatens of privacy brought by LBS, many scholars have conducted studies on user adoption and user acceptance of LBS users, and have laid a certain research foundation on the influencing factors and paths of LBS adoption. The main research method adopted is user acceptance model. However, the research objects of LBS adoption are mainly in the business application fields such as mobile social networking, advertising, group-buying, etc., and no scholars have conducted relevant researches on the user acceptance degree and user adoption factors of LBS in the management information system.

B. Research model building

As the fastest developing technology in the past few decades, information technology has been undergoing non-stop development and change, and the receptivity of information technology is a controversial issue for the researchers all around the world. They have extensively studied the receptivity of information technology from different perspectives and thus a series of theoretical models have emerged, such as the TRA(theory of reasoned action) by Fishbein (1975) Ajzenl (1980) , the TAM (technology acceptance model) by Davis (1989) , the TAM2 (the extension of the technology acceptance model) by Venkatesh and Davis (2000) based on TAM , the TAM3 (Technology Acceptance Model 3) by Venkates and Bala (2008) , and the UTAUT (the unified theory of acceptance and use of technology) by Venkates (2003) .

Since the Mobile Internet and LBS technology are new technology, this paper will use the Information technology adoption model, which is adopted in the previous researches, to analyze the adoption behavior of LBS users of mobile management information system. The literature tells that UTAUT synthesizes many theoretical models of technical acceptance. After Venkates (2003) introduced bound variable, the UTAUT is better capable of explaining user behavior than other models with 70%. In addition, the model is able to integrate the different external variables when applied to

different fields, so as to better explain the user's individual perceptual. The UTAUT model has widely used in various industries by scholars from home and abroad, because it is more reliable and better at explaining and predicting compared with other models. Therefore, based on the improvement of UTAUT model, this paper will study LBS user adoption behavior of mobile management information system.



The relevant indicators of this study based on UTAUT model are explained as follows:

Performance Expectancy: users are more willing to use management information system with LBS function if it can improve work efficiency

Effort Expectancy: whether the management information system with LBS function is easy to use

Social Influence: the degree to which users are affected by surrounding colleagues, leaders and other organizations who are using management information system with LBS function

Perceived Risk: the user may not be able to predict the result of a certain behavior. The users may worry about their privacy, system resource of mobile phone, and mobile Internet data when they use the management information system with LBS function.

Facilitating Conditions: facilitating conditions refer to the convenience and completeness of various conditions required in the use of information technology. facilitating conditions in this paper mainly refer to the current external environment, such as mobile Internet, mobile devices and the level of support provided by employers or service providers.

Behavioral Intention: Users are willing to use the management information system with LBS function

Use Behavior: Whether users use management information system with LBS function

Based on the UTAUT model and the definition of related variables, this paper proposes the following hypotheses:

H1 : Performance Expectancy has positive effect on Behavioral Intention;

H2: Effort Expectancy has positive effect on Behavioral Intention;

H3: Social Influence has positive effect on Behavioral Intention;

H4 : Perceived Risk has negative effect on Behavioral Intention;

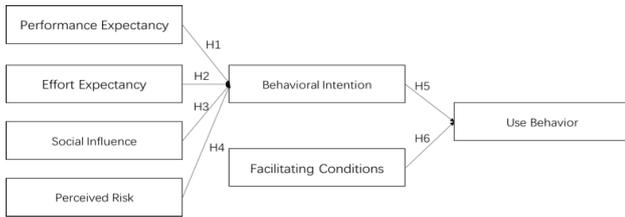
H5 : Facilitating Conditions has positive effect on Use Behavior;

H6 : Behavioral Intention has positive effect on Use Behavior.

Since there is no significant difference in the age and gender for smartphone users due to its high penetration, this

paper does not take the gender and age factors of the original UTAUT model into account. And given that management information system and collaborative work are usually compulsory at workplace duo to its core position in information management, there is no consideration for the voluntariness and experience of users.

The research model is as follow:



III. METHODOLOGY AND FINDINGS

A. Questionnaire design

In this paper, questionnaire was used to examine the hypothesis model. Referring to measurement index and indicators in the literature with some modification, all items in the questionnaire were rated by Likert scale, from 1 (strongly agree) to 5 (strongly disagree). To ensure the validity of the questionnaire, primary questionnaire was sent to enterprises, government, and related department in universities before the results and recommendations were collected for the final questionnaire in which 21 measurements were used for 7 latent variables: Performance Expectancy (PE1-PE3), Effort Expectancy (EE1-EE3), Social Influence (SI1-SI3), Perceived Risk (PR1-PR3), Behavioral Intention (BI1-BI3), Facilitating Conditions (FC1-FC3), and Use Behavior (UB1-UB3).

B. Data collection

This study supported by science and technology major projects of Yunnan province -- Collaborative work and Command and Dispatch System Based on BeiDou Navigation Satellite System. In the process of its promotion, application and commercialization, we found that the receptivity of LBS varied greatly among users considering the nature of business and the scope of service. Therefore, in order to conduct multi-group analysis, respondents in the study were divided into three categories: government agencies, enterprises, as well as universities and scientific research institutions according to the nature of business. Among them, the government institutions entitled to enforce laws and regulations were selected, such as departments of quality supervision, industry and commerce and fire control. Enterprises which need to go out for business are also selected. As for the universities and scientific research institutions, their respondents do not have many outside businesses due to the limitation of research conditions, so LBS function is shown in the mobility of their attendance monitoring.

Questionnaires were distributed to the users and potential users of the project. The survey questionnaires were distributed 987 copies, of which the effective recovery of 524. Government institutions contributed to 148 copies (28.3%), while enterprises 210 copies (40%) and universities & science and research institutions 166 copies (31.7%).

C. Data analysis

In this paper, SPSS 19.0 and AMOS 22.0 are used to process the data collected from questionnaires, and the Structural Equation Modeling (SEM) is used to analyze the data. Firstly, the reliability and validity of the research object are analyzed, and then the path coefficient and explanatory power of the model are analyzed and tested by the method of multi-group analysis.

1) Reliability Analysis

This paper uses L. J. Cronbach's α , the most commonly used in Kuder-richdson, for the reliability analysis. This coefficient has been widely proved to be an effective indicator for the reliability of multidimensional scaling method. Cronbach's α is between 0 and 1. Generally, if the consistency coefficient of the variable to be measured is greater than 0.7, the results may meet the research requirements (Wu, 2010). In this survey, Cronbach's $\alpha > 0.7$ was used as the critical value to test the reliability of each variable. The Cronbach's α of each variable in this paper are shown in table 1:

Table 1: α of each variable

Variables	Cronbach's α	Number of the item
Performance Expectancy	0.797	3
Effort Expectancy	0.778	3
Social Influence	0.744	3
Perceived Risk	0.915	3
Facilitating Conditions	0.78	3
behavioral Intention	0.765	3
Use Behavior	0.768	3

The Cronbach's α of all the variables are greater than 0.7, which means the data of the questionnaire is reliable, and the measurement results of all variables are highly consistent and reliable.

2) Validity Analysis

The KMO (Kaiser-Meyer-Olkin) is used for the sample measure and Bartlett's Test is used to test the validity of the scale. The results are shown in table 2:

Table 2: KMO and Bartlett's Test

Variables	KMO	Bartlett	DF	Sig.
Performance Expectancy	0.705	486.394	3	.000
Effort Expectancy	0.700	431.799	3	.000
Social Influence	0.690	351.880	3	.000
Perceived Risk	0.755	1130.777	3	.000
Facilitating Conditions	0.703	433.963	3	.000
behavioral Intention	0.677	413.419	3	.000
Use Behavior	0.695	409.462	3	.000

According to the test, the KMO of all variables tested in this questionnaire are between 0.677 and 0.755, which means all variables in Bartlett's Test are significant. Therefore, the

questionnaire has a good structural validity, which allows further data analysis.

3) Method selection of SEM

According to the SEM, if the data conform to normal distribution, Maximum Likelihood Estimate (MLE) will be used for further analysis. The absolute values of each variable's skewness coefficient are between 0.362 and 1.149 and absolute values of kurtosis are between 0.079 and 1.839, which conform to normal distribution. Consequently, the MLE is used to test the hypothesis of SEM model.

D. Interpretation of result

Table3.

No.	Hypothesis	government	enterprise	university	government	enterprise	university
		Estimate			P		
H1	Performance Expectancy has positive correlation with Behavioral Intention of LBS users	0.509	0.752	0.005	***	***	0.956
H2	Effort Expectancy has positive correlation with Behavioral Intention of LBS users	0.537	0.306	0.473	***	***	***
H3	Social Influence has positive correlation with Behavioral Intention of LBS users	-0.276	0.429	0.007	0.025	***	0.380
H4	Perceived Risk has negative correlation with Behavioral Intention of LBS users	-0.406	-0.033	-0.477	***	0.008	***
H5	Facilitating Conditions has positive correlation with Use Behavior of LBS users	0.376	0.393	0.664	***	0.002	***
H6	Behavioral Intention has positive correlation with Use Behavior	0.297	0.709	0.304	***	***	***

By comparing the results of the government, enterprises, and universities & scientific research institutes (see table 4), we may find the differences in the consistency with hypotheses. And according to the comparison and analysis in the illustrations, the results are as follow:

1) Users in enterprises

For the users in enterprises, their Performance Expectancy has highest positive effect on Behavioral Intention when comparing with all the other variables. And according to the values of path coefficient, their Behavioral Intention has the highest correlation with the Performance Expectancy and Use Behavior when comparing with the users in government and universities & scientific research institutions. Meanwhile, there is a relatively weak positive correlation between Facilitating Conditions and Use Behavior. Thus it may infer that users in enterprises might be more willing to use collaborative work and management information system with LBS function if it could improve their working efficiency. Besides, the Behavioral Intention would determine whether LBS system will be used for a long run.

In addition, compared with other two groups of users, the Social Influence of users in enterprises shows the highest path coefficient. Therefore, given the fiercest competition they are encountering, enterprise users attach great importance to whether other organizations and colleagues are using LBS system.

In terms of the correlation between Effort Expectancy and Behavioral Intention, the lowest path coefficient appears among enterprise users, which indicates that enterprise users would spend more time to explore new technologies and functions in order to improve work efficiency.

However, the hypothesis that Perceived Risk has negative correlation with Behavioral Intention of LBS users is false according to the interpretation of the analysis result. It

means enterprise users do not care much about risk factors of individual level.

2) Users in government

For the government users, Performance Expectancy shares a similar path coefficient with Effort Expectancy, indicating the equal importance in the convenience of LBS systems and the work efficiency improvement that LBS may bring. Government users attach great importance to the rationality of software design and the ease of operation.

Use Behavior has the weakest correlation with Behavioral Intention but the very strong correlation with Facilitating Conditions. According to the analysis, the LBS system is part of government work and is forced to use so government users' Behavioral Intention is not as important as it is for the users in enterprises. For the government, they might be more concern about the service and support that producers and suppliers can provide in the long term.

Compared with enterprise users, government users place a high value on risk factors, for instance whether the system would divulge personal privacy, or whether there would be more cost in the daily usage. And that determines their Behavioral Intention.

Social Influence has no correlation with Behavioral Intention. In a government department, whether to use a software or not is not determine by individuals. As a result, users do not care which software other departments are using. And the absence of competition among government departments might be another reason for this.

3) Users in universities and scientific research institutions

For the users in universities and scientific research institutions, the hypothesis that Performance Expectancy has positive correlation with Behavioral Intention is false. This might be related to the nature of their work. Universities and scientific research institutions users have little need to go out for business, which leads to the slack demand for LBS function because it could not improve their working efficiency directly.

The Perceived Risk of users in universities and scientific research institutions has the largest path coefficient among all variables, even compared with that of the other two groups of LBS users. Therefore, it may infer that users in universities and research institutes value the potential risks the most, for example the personal privacy, cost or other risks.

In terms of the effects of Effort Expectancy and Social Influence on Behavioral Intention, and the effect of Facilitating Conditions and Behavioral Intention on Use Behavior, the data find similar correlations with government users.

IV. CONCLUSION AND RECOMMENDATION

Focusing on three groups of users, this paper uses UTAUT model to analyze the effects of Performance Expectancy, Effort Expectancy, Social Influence, Perceived Risk and Facilitating Conditions on Behavioral Intention and Use Behavior when they use collaborative work and management information system with LBS function. According to the data

analysis, the Behavioral Intention and Use Behavior of users are determined and influenced by different factors in different types of working institutions. This may have much value for the development and promotion of LBS system. In general, different strategies need to be adopted in the research and development of LBS products as well as their pre-sale and after-sale services when encountering various types of users.

For the government users who have a lot of outside businesses, the management information system with LBS function can improve their working efficiency, so it is very important to integrate LBS function into the management information system. However, due to the equal importance is attached to the Effort Expectancy and Perceived Risk, it is worthwhile to pay more attention on designing related functions in the development of software. If necessary, some functions of LBS can be decreased for the sake of ease of use, privacy protection, and cost to use. In addition, enterprises may attach great importance to after-sales service, in order to provide enough facilitating conditions to ensure the continuous support of users.

For the enterprise users who concern more about the impact of LBS function on working efficiency, the highlight of software design need to be put on how to improve the operating efficiency of enterprises with LBS function, and at the same time develop as many relevant functions as possible to improve enterprise efficiency. In addition, as Behavioral Intention is decisive for Use Behavior, software development companies should strengthen pre-sales service, and make users fully understand the advantages of LBS function in their improvement of performance and efficiency.

For the users in universities and research institutes who have little outside work and do not need to go out for business, software development companies need to seriously deliberate not to integrate LBS function into their products in the development and promotion stages, if the software cannot promise an obvious improvement in the working performance. This is because users in universities and research institutes stress the perceived risks very much, while the LBS function

might increase the risks to some extent, and add LBS in collaborative work and management information system function, to a certain extent can increase the risks related to using cost and personal privacy etc.

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