

Extended Information Technology Initial Acceptance Model and Its Empirical Test

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Abstract: Based on the literature on the technology acceptance model (TAM) and related efforts in technology adoption research, this paper proposed an extended model for analyzing initial IT acceptance behavior of Chinese users. To empirically test the model, we conducted a survey regarding the recognition and adoption of an English e-learning system in the freshmen of a business school. Results from structural equation model (SEM) analyses illustrated that most of the factors in the proposed model have direct or indirect significant influence on both short-term and long-term intention of use. Therefore, it was demonstrated that the model possesses the ability to interpret the initial IT acceptance behavior of individual Chinese users. Grounded on the results, future work will be focused on longitudinal studies.

Key Words: information technology; technology adoption; technology acceptance model (TAM); structural equation model

1 Introduction

The dramatically rapid development of modern information technologies (IT) and information systems (IS) brings both opportunities and challenges to contemporary organizations. In the practice and research of IT/IS application and management, it is often questioned why some systems or software are well utilized, while others are not^[1]. While the power of information technology continues to improve dramatically, IT/IS practitioners and managers are still troubled by the long-existing problem that end-users are often unwilling to use available information systems that, if used, would generate significant performance gain^[2–3]. Consequently, IT/IS adoption has become one of the hottest topic in the IS research field^[2,4].

The past two decades have witnessed tremendous advances on IT adoption research not only from theoretical perspectives, but also from practical views^[5]. The achievements in this research area could essentially help IT/IS manufacturers and managers to better handle the development, implementation, and management of new products and systems. As the economy keeps growing rapidly, IT/IS application in China is developing even faster than in the western countries. Therefore, it is worthwhile to probe into the technology adoption characteristics of Chinese users in the light of investigations in the organizational contexts of China based on the accumulated findings in the area^[6].

In September and October of 2005, we conducted a survey study among the freshmen of undergraduate students in our school, aiming at analyzing their adoption behavior toward an English e-learning system. According to a general classification framework, the locus of adoption could be differentiated between “organization” and “individual”^[7]. Like

most empirical studies by far, our research is focused on the individual locus of adoption, grounding on the standpoint that individual behavior could be deemed as a basic element of organizational behavior. Furthermore, it has been stated that during different periods of acquaintance, there are different factors that impact the users’ acceptance^[2,8–9]. On the other hand, all through the whole process of technology adoption, the initial recognition and acceptance at the first stage, or the “first impression”, could be most important in determining the eventual acceptance and continuous use. A recent study disclosed that users tend to follow a repeated behavior pattern while using information systems^[10]. Therefore, we chose the freshmen, who had never touched the English e-learning system before, as our target population.

We developed our search model mainly on the base of the Technology Acceptance Model (TAM), which has by far been the most widely discussed among all the related models. By incorporating some factors from other theories, we proposed an extended IT/IS initial acceptance model. With the results of empirical tests, it was verified that most of the factors in the proposed model have direct or indirect significant influence on both near-term and long-term intentions of use, which indicates that the model possesses the ability to interpret the initial IT acceptance behavior of individual Chinese users.

2 Technology acceptance model (TAM)

Since late 1980s, IT/IS adoption, acceptance, and use have remained a central concern in the field of information systems research. The related efforts have produced a number of theoretical models, such as Technology Acceptance Model (TAM)^[2,11–12], Task-Technology Fit Model (TTF)^[13–14], and Unified Theory of Acceptance and Use of

Received date: June 27, 2006

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Foundation item: Supported by the National Natural Science Foundation of China (Nos.70231010 and 70621061)

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Technology (UTAUT)^[15], to interpret the psychological and social mechanisms that potentially determine the behavior of technology adoption. As well, influential theories in other areas, including Theory of Planned Behavior (TPB)^[16–17], Social Cognitive Theory (SCT)^[18], and Innovation Diffusion Theory (IDT)^[19–20], were borrowed into the studies of technology adoption. Meanwhile, large amounts of empirical and field studies were conducted in various regions of the world to validate the theories. Results from these studies illustrated that the models generally explain a substantial proportion (about 40% in average) of the variance in usage intention and behavior^[5].

In the past ten years, TAM has been prevailing in the area of IT/IS adoption research. The model was firstly proposed by Davis in 1989^[11–12]. The core concepts and structure of TAM are illustrated in Figure 1, where perceived usefulness (PU) is defined as the prospective user's subjective probability that using a specific application system will increase his or her job performance within an organizational context and perceived ease of use (PEOU) refers to the degree to which the prospective user expects the target system to be free of effort. TAM postulates that actual technology usage is determined by behavior intention to use, which in turn, is viewed as being jointly determined by the person's attitude toward using the technology and PU^[12].

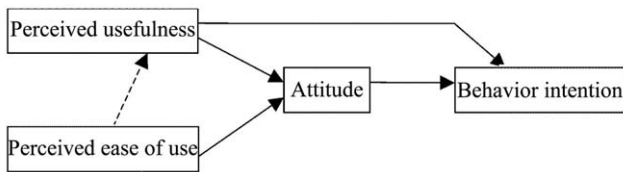


Figure 1. Technology acceptance model (TAM)

Since the establishment of the model, TAM has gained distinct reputation for its outstanding performance to explain the differences in user behavior^[2,11]. Some scholars, however, believe that TAM is too sketchy to provide in-depth insights on the details of IT/IS adoption behavior^[16]. Partly

due to this recognition, recent efforts regarding TAM are mostly focused on the two aspects: (1) to enriching and extend the model from theoretical perspectives^[2,4,21–23], and (2) to further validate the performance of the model with various innovations in various environments^[24–26], including the comparison of behavioral differences in different cultural context^[27]. In the recent years, IT/IS adoption research has also gained more and more attention in China^[6,28–29], although the empirical studies based on survey data collected in China are still scarce^[30].

3 Extended information technology initial acceptance model

Taking TAM as the kernel, the extended IT/IS initial acceptance model we proposed in this paper decomposes users' intention to use into near-term intention and long-term intention. To explain the mechanism that determines the initial recognition and acceptance, we introduced 8 external factors into the model, including compatibility, facilitating condition, perceived enjoyment, individual characteristics (including personal innovativeness of IT/IS, job relevance, substitutability), and training impression. Figure 2 illustrates the conceptual structure of our research model.

3.1 Long-term intention and near-term intention

Both long-term intention and near-term intention represent the prospective user's behavioral inclination to use the new technology or system. Although near-term and long-term intentions could be highly related, they are likely to be diversely affected by the determinant factors. Specifically, near-term intention could be more easily affected by perceived usefulness and facilitating conditions, especially at the initial stage. Most previous researches, however, have not distinguished the behavioral intention into "near-term" and "long-term". In order to better understand the change of user intention in IT/IS acceptance process, this research investigated the two types of intentions respectively and proposed the series of hypotheses based on TAM:

Hypothesis 1a. Initial perceived usefulness will have a positive effect on the attitude toward using.

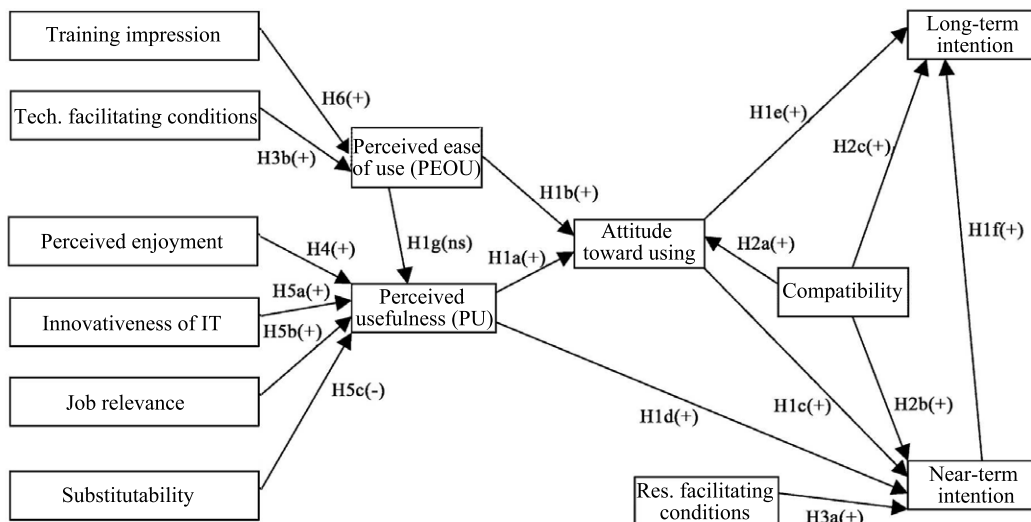


Figure 2. Extended IT/IS initial acceptance model (TAM), +: positive effect; -: negative effect; ns: no effect

Hypothesis 1b. Initial perceived ease of use will have a positive effect on the attitude toward using.

Hypothesis 1c. Attitude toward using will have a positive effect on near-term behavior intention to use.

Hypothesis 1d. Initial perceived usefulness will have a positive effect on near-term behavior intention to use.

Hypothesis 1e. Attitude toward using will have a positive effect on long-term intention to use.

Hypothesis 1f. Near-term behavior intention to use will have a positive effect on long-term behavior intention to use.

Although Davis stated that the influence from PEOU to PU is not significant at the beginning but would increase with in-depth utilizing^[12], some later empirical results conflict with this conclusion^[2,10,15,31]. In our study, we still follow Davis' original hypothesis, so as to provide a basis for future investigation on the change of this influence:

Hypothesis 1g. Initial perceived ease of use will not have any effect on initial perceived usefulness.

3.2 Compatibility

Compatibility was originally one of the factors determining the diffusion speed in the IDT. It refers to "the degree to which the use of the new technology is perceived by a user to be consistent with their practice style or preference"^[32]. Accumulated literature indicates that perceived compatibility is one of the important determinants of user behavioral intention^[17,19–20,33]. We suppose that this factor have impact on both the attitude toward using and the behavioral intentions including the near-term and the long term intention.

Hypothesis 2a. Compatibility will have a positive effect on attitude toward using.

Hypothesis 2b. Compatibility will have a positive effect on near-term behavior intention to use.

Hypothesis 2c. Compatibility will have a positive effect on long-term behavior intention to use.

3.3 Facilitating conditions

The concept of facilitating conditions was firstly proposed in a research of PC usage, representing "the objective environmental factors that help users use the technology more conveniently"^[34]. This concept was later divided into technology facilitating conditions (TFC) and resource facilitating conditions (RFC)^[17]. In our model, the following hypotheses were included:

Hypothesis 3a. Resource facilitating conditions will have a positive effect on near-term behavior intention to use.

Hypothesis 3b. Technology facilitating conditions will have a positive effect on perceived ease of use.

3.4 Perceived enjoyment

Perceived enjoyment (PE) was firstly introduced in a research of PC acceptance^[21]. With the rising of hedonic technologies such as online games, this factor is gaining more and more attention^[4,25,35]. We have the following hypotheses in our model:

Hypothesis 4. Perceived enjoyment will have a positive effect on perceived usefulness.

Personal innovativeness of IT/IS (PIIT), Job relevance (JR), and substitutability can be categorized into "Individual characteristics", which usually have impact with relative advantage on perceived usefulness^[22,36]. Accordingly, in

our model, these factors are considered as the determinants of perceived usefulness. Personal innovativeness of IT was originally adapted from IDT representing the willingness of an individual to try out any new information technology^[36]. Job relevance represents "the degree of consistence between system functions and the user's current job requirements". This factor was firstly proposed in the TTF^[13]. It is natural to expect that users with higher job relevance will more easily perceive the usefulness of the new technology or system. Substitutability stands for the individual judgment on whether the problem that new system was aimed to address can be solved by other existing methods. To some extent, this factor may be especially important in the context of China, where labor is still relatively inexpensive and many firms find it to their advantage to employ people more than IT^[3]. Summarily, we have the following hypotheses regarding these individual factors:

Hypothesis 5a. Personal innovativeness of IT will have a positive effect on perceived usefulness.

Hypothesis 5b. Job relevance will have a positive effect on perceived usefulness.

Hypothesis 5c. Substitutability will have a negative effect on perceived usefulness.

3.5 Training impression

Employee training regarding IT/IS has long been considered as a critical issue of IT management in China^[37]. Since the training in our research context mainly focuses on operational level, we hypothesized that Training impression (TI) will only influence perceived ease of use.

Hypothesis 6. Training impression will have a positive effect on perceived ease of use.

4 Methods

As mentioned, in order to empirically test the model, we conducted a survey regarding the recognition and adoption of an English e-learning system in the undergraduate freshmen (about 150 students) of our school in 2005. This computer-aided English e-learning system was installed in a laboratory of the school. With simulation practice, voice recording, human-computer conversation, and other interactive functions, the software was designed to help the students improve their listening and speaking ability in English.

4.1 Data collection

Questions utilized in the questionnaire to operationalize the constructs included in the research model were largely adapted from existing literature^[2,8–9,11–12,17,19,21–23,34,36,38–39]. All the questions were translated into Chinese and adjusted in wording in the light of the characteristics of the system for better understanding. For the two newly proposed constructs, namely training impression and substitutability, specific question items were designed and discussed among a group of researchers. Most of the items were measured using a five point Likert-type scale, ranging from "strongly disagree" (1) to "strongly agree" (5).

A one-hour training was arranged, including half hour of demonstration by a lab assistant and the other half for try-out. The questionnaires were handed out during the try-out period and collected right after the training finished. In total,

134 questionnaires were distributed and 121 valid responses were collected, with a responding rate of 90 percent. The students were divided into four groups for training. The results of a Mann-Whitney U test^[15] showed that there are no difference between the groups of trainees on any of the 13 constructs at a significance level of 0.01.

4.2 Reliability and validity

The internal consistency reliability was assessed by computing the Cronbach Alpha, of which value higher than 0.7, and the Fornell coefficient (composite reliability coefficient), of which value higher than 0.8 generally indicates acceptable reliability^[8,34–35,40–42]. In our study, the Fornell values range from 0.8 (for attitude toward using) to 0.947 (for near-term intention). With none of the values for all 13 constructs less than 0.8, the reliability of the scales could be accepted. The Cronbach Alphas and the Fornell coefficients for all constructs in the model are listed in Table 1.

Convergent validity was evaluated by the average variance extracted (AVE). According to related studies, AVE values higher than 0.5 are acceptable^[4,23,42]. For a satisfactory degree of discriminant validity, the square root of AVE of a construct should be higher than the variance shared between this construct and the other ones in the model^[23,35,41–42]. In our research, although some of the variables' inter-correlations were relatively high, convergent and discriminant validities of the model both attained a satisfying level, with all the AVE square root values above 0.7. The AVE square roots and inter-correlation values of all 13 constructs are listed in Table 2.

5 Results and discussions

The research model was tested using partial least squares (PLS), a structural equation modeling (SEM) technique suitable for highly complex predictive models. Since integrating two classical statistic method, factors analysis and path analysis^[43], the SEM has been called “the second-generation multivariate statistic method”^[44]. Whereas covariance-based SEM techniques such as LISREL and EQS use a maximum likelihood function to obtain the estimated values in the models, the component-based PLS uses a least-squares estimation procedure. By this means, PLS avoids many of the restrictive assumptions underlying covariance-based SEM techniques, such as multivariate normality and

large sample size^[3,4,8,15,20–23,35,38,42].

We used the PLS Graph software (version 3.0) for the analysis, utilizing the bootstrap resampling method (200 re-samples) to determine the significance of the paths within the structural model^[44]. Figure 3 shows the results of the test of the hypothesized structural model.

It can be concluded from the testing results that the model explains about 40 percent of the variance in all five endogenous variables, specifically 47% for near-term intention and 48% for long-term intention, which are higher than the average level of prior studies regarding intention of use^[5]. With most hypotheses in the model significantly supported by the statistical results, it is reasonable to accept that the extended initial technology acceptance model proposed in this paper could help us to better understand and predict IT adoption and use more accurately. Furthermore, the hypotheses from the original TAM model, namely H1a–H1g, have all been tested and reached the very identical results with most prior studies regarding TAM^[2,8,11–12,15], which implies that the core hypotheses of TAM could be consistent in the context of China. Therefore, a large number of valuable research results based on TAM regarding IT/IS implementation and training methodology would also hopefully be helpful Chinese companies and other organizations.

It is worth-noting that hypotheses about the three newly proposed factors are both supported. Particularly, the statistical results strongly support the impact of training impression on perceived ease of use. Training impression alone explains

Table 1. Internal consistency reliability

Constructs	Croobach α	Fornell
Perceived usefulness	0.847	0.897
Perceived ease of use	0.833	0.888
Attitude	0.888	0.947
Near-term behavior intention	0.788	0.904
Long-term behavior intention	0.517	0.800
Compatibility	0.664	0.819
Technology facilitating condition	0.743	0.881
Resource facilitating condition	0.725	0.856
Perceived enjoyment	0.650	0.805
Personal innovativeness of IT	0.834	0.913
Job relevance	0.575	0.816
Substitutability	0.739	0.884
Training impression	0.779	0.872

Table 2. AVE square roots and inter-correlations

	PU	PEOU	A	NTI	LTI	C	E	TFC	RFC	PIIT	TI	JR	SUB
PU	0.828												
PEOU	0.041	0.816											
A	0.513	0.304	0.948										
NTI	0.544	0.173	0.612	0.908									
LTI	0.508	0.302	0.556	0.584	0.817								
C	0.353	0.159	0.416	0.461	0.519	0.777							
E	0.507	0.223	0.506	0.494	0.581	0.450	0.770						
TFC	0.117	0.236	0.265	0.301	0.307	0.388	0.216	0.888					
RFC	0.160	0.067	0.065	0.077	0.113	0.211	0.100	0.223	0.867				
PIIT	0.056	−0.079	0.047	0.077	0.082	0.145	0.325	0.152	0.190	0.917			
TI	0.068	0.650	0.306	0.200	0.276	0.181	0.297	0.219	0.032	0.010	0.823		
JR	0.363	−0.096	0.330	0.222	0.302	0.192	0.177	0.053	−0.090	0.064	−0.091	0.834	
SUB	−0.317	0.067	−0.227	−0.312	−0.246	−0.039	−0.142	0.005	0.040	−0.007	0.156	−0.039	0.890

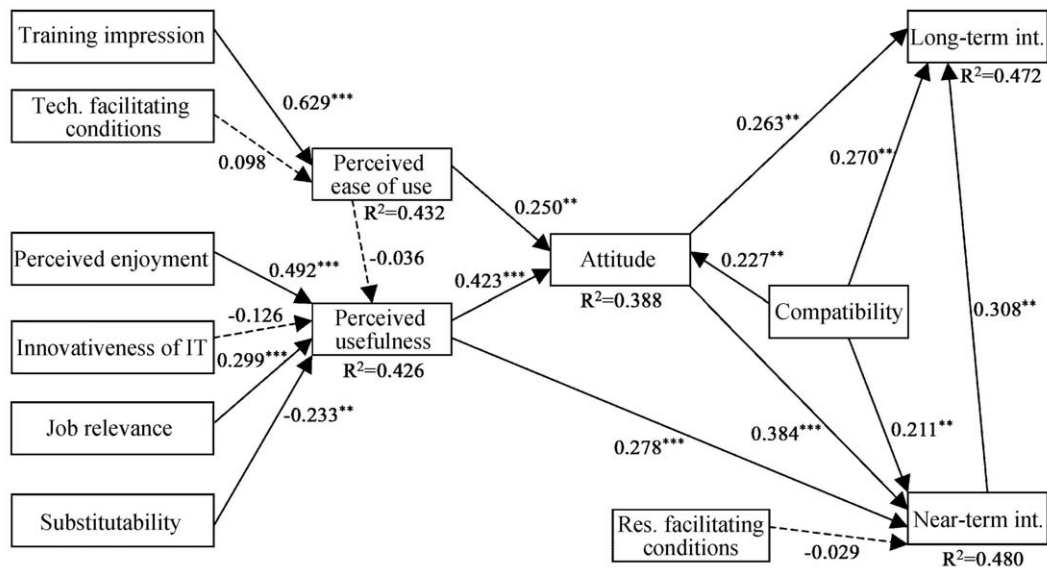


Figure 3. Testing results of structural equation model

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.0001$; Broken lines represent non-significant effect

almost 40 percent of the variance in perceived ease of use. However, because influence of perceived ease of use on intention to use is limited, the impact of training impression on behavior intention to use through perceived ease of use and attitude toward using is insignificant. Thus, it could be inferred that training is more likely to solve the problems happen on the operational level, rather than the conceptual level.

Although neither the hypothesis of facilitating conditions H3a nor H3b are supported, it cannot be simply concluded that facilitating conditions does not play a role in IT acceptance and use. The reason for this result may lie in that the respondents did not have enough time to try out the facilitating systems. In the training process, the trainer just use 1–2 minutes to introduced the online help system and integrated help system of the software. In the following 30 minutes for try-out, the trainees did not have much chance to use those functions. The researcher also found that when the trainees ran into a problem in operating, their first reaction was to seek help from the trainer instead of the help systems. Under such conditions, it is almost impossible for the respondents to have impressive cognition for the technology facilitating conditions of the technology in just one hour. The same problem exists in resource facilitating conditions. For the most trainees, it was the first time for them to enter the laboratory of the school, because they were all freshmen. They were not familiar with how to utilize the lab and the facilities. Furthermore, the trainees were new students at the early stage of the university life and consequently there were some uncertainties in their cognition of the resource facilitating conditions. This may be the reason why the effects of facilitating conditions have been weakened in the results. Possibly, along with further use, the effects of facilitating conditions on the acceptance intention and adoption behavior will show up slowly. Further investigation is needed in the flowing research to prove this prediction.

The hypothesis that personal innovativeness of IT positively affects perceived usefulness is not supported. There could be two possible reasons for this unexpected result: (1)

The questions about user innovativeness in the questionnaire we used in the survey was an self-evaluation report, which could lead to information distortion because it is hard for people to judge their personalities objectively; (2) those who had a high assessment on their own innovativeness might have more opportunities to use various system and tend to think lowly of the target technology.

6 Conclusions

In this paper, we proposed an extended information technology initial acceptance model based on TAM and related other studies which have been proved by empirical investigation. By empirically testing the model with a survey regarding a certain e-learning system, it has been demonstrated that most of the factors in the proposed model have direct or indirect significant influence on both near-term and long-term intentions of use. Therefore, it can be concluded that the model is potentially useful for interpreting the initial IT acceptance behavior of individual Chinese users.

Since IT/IS adoption is a complex and changeful process, the focus of this research area has gradually transfer from static adoption to dynamic adoption^[10,15,42]. Based on the findings of this paper, on-going research will focus on longitudinal studies, which will attempt to discover the dynamic patterns of technology cognition, acceptance, and use over time.

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